THIS BOOK IS DUE ON THE DATE INDICATED BELOW AND IS SUBJECT TO AN OVERDUE FINE AS POSTED AT THE CIRCULATION DESK.
A TREATISE
ON THE
PARASITES AND PARASITIC DISEASES
OF THE
DOMESTICATED ANIMALS.

BY
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TRANSLATED AND EDITED
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WITH 365 ILLUSTRATIONS.

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Dedicated

to
PRINCIPAL AND PROFESSOR JAMES McCALL, F.R.C.V.S.,
GLASGOW VETERINARY COLLEGE,
AS A TOKEN OF SINCERE ESTEEM, AND IN RECOGNITION OF
GENIAL AND CONSTANT FRIENDSHIP DURING
MANY YEARS.
TRANSLATOR AND EDITOR'S PREFACE.

As long ago as 1876, I made an attempt to supply a want which had long been experienced in English-speaking countries, by undertaking a work on the parasites and parasitic diseases of the domesticated animals. The need for such a work had frequently been seriously brought before me, as there was no complete treatise in our language to which the student of human or veterinary medicine, the sanitarian, agriculturist, or breeder or rearer of animals, could refer for full information with regard to the external and internal parasites—vegetable and animal—which attack the various species of creatures man has domesticated. But soon after its commencement I was reluctantly compelled, from pressure of other duties and lack of opportunity, to relinquish the task until I could find more leisure. Subsequently there appeared in Germany Zürn's useful work, *Die Schmarotzer*, in two parts, and in France Mégnin's equally valuable book, *Les Parasites et les Maladies Parasitaires*; but in 1888 Neumann's treatise was issued, and as this was certainly the most complete and comprehensive of any which had yet appeared, and the arrangement was somewhat on the plan I had adopted, while the facts and authorities brought together in it were more numerous than I could have obtained, I resolved to venture on its translation, instead of proceeding with my own independent effort.

The value of such a work as this of Professor Neumann is amply testified to by the fact, that the first edition was exhausted in less than three years, while the author received the Vernois Prize from the Académie de Médecine in 1889, and the gold medal of the Société Nationale d'Agriculture de France; the War Minister of France has also authorized its issue to all the mounted corps and the military schools and establishments. No better evidence of its great merits could be adduced, nor can stronger proof be afforded of the recognition and encouragement such labours meet with in France. Professor Neumann, with the greatest courtesy and generosity, not only gave me permission to translate his admirable work, but furnished me with revise
sheets of the second edition as they passed through the press, thus enabling me to produce this English edition almost simultaneously with the new French one; he also provided me with corrections and additions which could not appear in the body of his book. For all this goodness and attention, I beg to tender my estimable friend warmest thanks; and I feel certain that those who have occasion to refer to this English edition, will also gratefully recognise the benefits he has conferred upon them.

There is no work in English to be at all compared with this, so far as veterinary medicine is concerned; and even in human medicine—English or foreign—there is none so comprehensive and complete. In his preface to the first edition, Neumann gives expression to the feeling which impelled me, in 1876, to make my abortive attempt; and I may be allowed to quote as much of what he says as will indicate this, and also give some idea of the scope of his treatise.

He writes: 'Those who have studied the subjects so numerous and varied, the substance of which is given in this book, will have had reason to be astonished at the multiplicity of the works in which they are treated, and the almost innumerable documents of which they are constituted. They will also have had cause to regret more than once that, in our country at least, no one has ventured to give a didactic tableau of the injury caused by parasites to the health of the domesticated animals. Having, as much as anyone, had to regret the existence of this void, we determined to fill it. Truly, this attempt is not altogether without precedent; but none of the French or foreign works to which we have referred—excellent though some of them are—could be accepted as a model; as some were limited to the "entozoa," others to the parasites of the skin, certain of them prematurely included microbic diseases in their list, or confined themselves to the parasites only—neglecting too much the host and the mischief they caused; while the majority, if not all of them, adapted their plan to the taxinomic requirements of zoology and botany.

'As we had in view more particularly the damage done to health—the parasitic diseases—we deemed it useful to establish the order to be followed according to the nature of the organs invaded; and this has been the predominant idea throughout the work—the rare deviations therefrom which had to be made being of no importance, as they will cause no trouble or hindrance to the attentive reader in determining the character of the parasites he may meet with.

'In dealing with the parasitic diseases of our domesticated animals, no notice has been taken of those very small and subtle parasites usually
designated "microbes," and which belong to the vast class of Schizomy-
cetes; for, notwithstanding the incontestable interest that invests them,
as a whole, in the parasitism of animals, it appeared advantageous to
omit the virulent diseases. One decisive reason, among others, justi-
tied this omission; for if among these maladies there are some the
parasitic origin of which is established, there are many others, unfor-
tunately, for which the same cannot be said, though they are better
known, and cannot be separated from them with regard to symptoms,
course, lesions, conditions of contagion, sanitary police, prophylactic
measures, etc. The diseases which we here treat of are nearly all due
to relatively large parasites, which might be designated macro-parasites.

'The domestic animals dealt with in this book—mammals and birds
—are almost exclusively species belonging to our country, as the obser-
vations regarding parasitism more especially belong to them; the species
special to Asia, Africa and America have, in this connection, an interest
too secondary to warrant us in further extending our already very ex-
tensive work. Therefore it is that they have only received rare and
brief notice.

'Although pathology has been more especially kept in view, we have
not confined ourselves to an enumeration of the troubles engendered in
the economy by the organisms that invade it. In order to facilitate
diagnosis, we have added to the study of the parasites—properly so
called—that of the commensals which are so frequently met with; and
we have been compelled to include all the living forms observed on the
surface or in the texture of organs, whether they be common or rare,
frequent or exceptional.

'As it is not always easy, in presence of an intrusive species, to allot
it to parasitism or commensalism, and as numbers are, in this matter,
a powerful element in distinguishing it, the determination of a parasite
is singularly aided by comparing it with species having the same habitat.
The mention which accompanies each of these gives the measure of its
importance.

'In order to render a nosographical account of the parasitic disorders
intelligible, it is absolutely necessary that zoological, and sometimes
botanical, information be had recourse to. Generally speaking, this
has been reduced to the strictest minimum, as the reader can find in
other treatises or special works any further information he may require.'

After alluding to the great assistance he had received from Professor
Railliet, of the Alfort Veterinary School, whose valuable work, *Les
Êléments de Zoologie Médicale et Agricole*, receives well-deserved praise,
and also to Professor Peuch of the same school, our confrère adds:
But the reader also owes much to the multitude of scientists and practitioners whose observations have constituted the science with which we are now occupied. In endeavouring to do justice to each, we have been desirous of furnishing the means whereby to complete the information contained in this work; and if we have multiplied the bibliographical references, the mode adopted will, we believe, avert the inconveniences they might otherwise have for the reader. And frequently this bibliography has been reduced to a small number of authorities, when these have already given a very extensive and complete list; while it has also often been suppressed when there was reference made to such masters of the subject as Dujardin, Diesing, Leuckart, Davaine, Zürn, etc., whose works had already been oftentimes quoted from.'

I have only to express the hope and desire that the subject of parasitism, which has been so closely and advantageously studied by members of the veterinary profession—more especially in France, Germany, and Italy—will now receive greater attention from those in English-speaking countries generally—countries which cover such a large surface of the globe, and therefore offer such excellent opportunities for extending our knowledge in this important section of biology and sanitary science.

I have ventured to supplement some of the author's statements, and to make some small additions in several portions of the work; these are placed in brackets. The metric system of measurement has been retained, as it is the most convenient, and is now generally adopted in scientific treatises. The introduction of the micromillimetre (\(\mu\)) is a great advantage in dealing with very minute objects. The title of the work I have also taken the liberty of slightly altering, in order the better to indicate its scope; as it treats not only of parasitic diseases and their treatment, but lucidly, if briefly, of the parasites themselves—an advantage which will be appreciated by those who wish to gain some knowledge of them, and learn to identify them.

GEORGE FLEMING.

St. John's, London,
March, 1892.
## LIST OF ILLUSTRATIONS

<table>
<thead>
<tr>
<th>FIG.</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td><em>Simulium reptans.</em> <em>(After Woodward)</em></td>
<td>25</td>
</tr>
<tr>
<td>2.</td>
<td>Autumn Breeze-Fly. <em>(Delafond)</em></td>
<td>29</td>
</tr>
<tr>
<td>3.</td>
<td>Autumnal Breeze-Fly. <em>(Railliet)</em></td>
<td>30</td>
</tr>
<tr>
<td>4.</td>
<td>Small Rain Breeze-Fly. <em>(Railliet)</em></td>
<td>31</td>
</tr>
<tr>
<td>5.</td>
<td>Small Blinding Breeze-Fly. <em>(Railliet)</em></td>
<td>31</td>
</tr>
<tr>
<td>6.</td>
<td>Head of the Stinging Stomoxys. <em>(Delafond)</em></td>
<td>33</td>
</tr>
<tr>
<td>7.</td>
<td>Stinging Stomoxys. <em>(Railliet)</em></td>
<td>33</td>
</tr>
<tr>
<td>8.</td>
<td>Tsé-tsé. <em>(Railliet)</em></td>
<td>35</td>
</tr>
<tr>
<td>9.</td>
<td>Hippoboscus of the Horse. <em>(Railliet)</em></td>
<td>37</td>
</tr>
<tr>
<td>10.</td>
<td>Head of the Blue or Flesh Fly. <em>(Delafond)</em></td>
<td>40</td>
</tr>
<tr>
<td>11.</td>
<td>Blue Flesh Fly. <em>(Railliet)</em></td>
<td>41</td>
</tr>
<tr>
<td>12.</td>
<td><em>Sarcophaga magnifica.</em> <em>(Laboulbène)</em></td>
<td>41</td>
</tr>
<tr>
<td>13.</td>
<td>Cayor Fly. <em>(Railliet)</em></td>
<td>44</td>
</tr>
<tr>
<td>14.</td>
<td>Wing of the Ox Hypoderma ...</td>
<td>46</td>
</tr>
<tr>
<td>15.</td>
<td>Hypoderma of the Ox. <em>(Réaumur)</em></td>
<td>49</td>
</tr>
<tr>
<td>16.</td>
<td>Hypoderma of the Ox. <em>(Joly)</em></td>
<td>49</td>
</tr>
<tr>
<td>17.</td>
<td>Hypoderma of the Ox ...</td>
<td>51</td>
</tr>
<tr>
<td>18.</td>
<td>Human Flea. <em>(Railliet)</em></td>
<td>58</td>
</tr>
<tr>
<td>19.</td>
<td>Head of the Human Flea. <em>(Railliet)</em></td>
<td>58</td>
</tr>
<tr>
<td>20.</td>
<td>Larva of the Flea of the Fowl. <em>(Railliet)</em></td>
<td>59</td>
</tr>
<tr>
<td>21.</td>
<td>Head of the Dog Flea. <em>(Railliet)</em></td>
<td>60</td>
</tr>
<tr>
<td>22.</td>
<td>Head of the Flea of the Leporidae. <em>(Railliet)</em></td>
<td>60</td>
</tr>
<tr>
<td>23.</td>
<td>Head of the Flea of the Fowl. <em>(Railliet)</em></td>
<td>61</td>
</tr>
<tr>
<td>24.</td>
<td>An Engorged Chigoe. <em>(Karsten)</em></td>
<td>63</td>
</tr>
<tr>
<td>25.</td>
<td>Posterior Extremity of the Haematopinus of the Pig. <em>(Delafond)</em></td>
<td>66</td>
</tr>
<tr>
<td>26.</td>
<td><em>Haematopinus macrocephalus</em> of the Horse. <em>(Railliet)</em></td>
<td>69</td>
</tr>
<tr>
<td>27.</td>
<td><em>Trichodectes pilosus</em> of the Horse. <em>(Railliet)</em></td>
<td>69</td>
</tr>
<tr>
<td>28.</td>
<td><em>Haematopinus erysater</em> of the Ox</td>
<td>70</td>
</tr>
<tr>
<td>29.</td>
<td><em>Haematopinus tentirostris</em> of the Ox</td>
<td>70</td>
</tr>
<tr>
<td>30.</td>
<td><em>Trichodectes scalaris</em> of the Ox. <em>(Railliet)</em></td>
<td>70</td>
</tr>
<tr>
<td>31.</td>
<td><em>Trichodectes spherocephalus</em> of the Sheep</td>
<td>71</td>
</tr>
<tr>
<td>32.</td>
<td>Melophagus of the Sheep ...</td>
<td>71</td>
</tr>
<tr>
<td>33.</td>
<td>Proboscis of the Melophagus. <em>(Dufour)</em></td>
<td>71</td>
</tr>
<tr>
<td>34.</td>
<td><em>Haematopinus stenopsis</em> of the Goat</td>
<td>72</td>
</tr>
<tr>
<td>35.</td>
<td><em>Trichodectes climax</em> of the Goat</td>
<td>72</td>
</tr>
<tr>
<td>36.</td>
<td><em>Haematopinus urix</em> of the Pig. <em>(Delafond)</em></td>
<td>72</td>
</tr>
<tr>
<td>37.</td>
<td><em>Haematopinus piliferus</em> of the Dog</td>
<td>73</td>
</tr>
<tr>
<td>38.</td>
<td><em>Trichodectes latus</em> of the Dog. <em>(Railliet)</em></td>
<td>73</td>
</tr>
<tr>
<td>39.</td>
<td><em>Trichodectes subrostratus</em> of the Cat</td>
<td>73</td>
</tr>
</tbody>
</table>

*Page numbers indicate page where each illustration is located.*
<table>
<thead>
<tr>
<th>FIG.</th>
<th>LIST OF ILLUSTRATIONS.</th>
</tr>
</thead>
<tbody>
<tr>
<td>40.</td>
<td><em>Hematopinus ventricosus</em> of the Rabbit</td>
</tr>
<tr>
<td>41.</td>
<td><em>Gyropus gracilis</em> of the Guinea-pig</td>
</tr>
<tr>
<td>42.</td>
<td><em>Gyropus oralis</em> of the Guinea-pig</td>
</tr>
<tr>
<td>43.</td>
<td><em>Goniodes dissimilis</em> of the Fowl. <em>Piajet</em></td>
</tr>
<tr>
<td>44.</td>
<td><em>Goniocotes holosterus</em> of the Fowl</td>
</tr>
<tr>
<td>45.</td>
<td><em>Goniocotes gigas</em> of the Fowl</td>
</tr>
<tr>
<td>46.</td>
<td><em>Lipeurus variabilis</em> of the Fowl</td>
</tr>
<tr>
<td>47.</td>
<td><em>Menopon pallidum</em> of the Fowl</td>
</tr>
<tr>
<td>48.</td>
<td><em>Docophonus iterodes</em> of the Duck</td>
</tr>
<tr>
<td>49.</td>
<td><em>Ornithobius bucephalus</em> of the Swan</td>
</tr>
<tr>
<td>50.</td>
<td>Pupa of the <em>Melophagus</em> of the Sheep</td>
</tr>
<tr>
<td>51.</td>
<td>Magnified Pupa of the Sheep <em>Melophagus</em></td>
</tr>
<tr>
<td>52.</td>
<td>Bug of the Fowl. <em>Railliet</em></td>
</tr>
<tr>
<td>53.</td>
<td>Rostrum of the <em>Ixodes ricinus</em>. <em>Delafond</em></td>
</tr>
<tr>
<td>54.</td>
<td>Transverse Section of the Egyptian <em>Ixode</em></td>
</tr>
<tr>
<td>57.</td>
<td>Harvest Bug or Larva of the Trombidium <em>holosericeum</em>. <em>Railliet</em></td>
</tr>
<tr>
<td>58.</td>
<td><em>Cheyletus parasitivorax</em></td>
</tr>
<tr>
<td>59.</td>
<td><em>Tyroglyphus longior</em></td>
</tr>
<tr>
<td>60.</td>
<td><em>Listrophorus gibbus</em>, male, of the Rabbit</td>
</tr>
<tr>
<td>61.</td>
<td><em>Listrophorus gibbus</em>, female, of the Rabbit</td>
</tr>
<tr>
<td>62.</td>
<td>Rostrum and leg of the first pair of the <em>Sarcoptes scabiei</em>, var. <em>equi</em>.</td>
</tr>
<tr>
<td>64.</td>
<td><em>Symbiotes auricularium</em>. <em>Railliet</em></td>
</tr>
<tr>
<td>65.</td>
<td><em>Sarcoptes scabiei</em>, var. <em>equi</em></td>
</tr>
<tr>
<td>66.</td>
<td><em>Sarcoptes scabiei</em>, var. <em>equi</em></td>
</tr>
<tr>
<td>67.</td>
<td><em>Sarcoptes scabiei</em>, var. <em>equi</em>; hexapodal larva</td>
</tr>
<tr>
<td>68.</td>
<td><em>Sarcoptes scabiei</em>, var. <em>equi</em>; octopod nympha</td>
</tr>
<tr>
<td>69.</td>
<td><em>Sarcoptes scabiei</em>, var. <em>equi</em></td>
</tr>
<tr>
<td>70.</td>
<td><em>Sarcoptes minor</em>, var. <em>cati</em></td>
</tr>
<tr>
<td>71.</td>
<td><em>Sarcoptes minor</em>, var. <em>cati</em></td>
</tr>
<tr>
<td>72.</td>
<td><em>Sarcoptes minor</em>, var. <em>cati</em></td>
</tr>
<tr>
<td>73.</td>
<td><em>Psoroptes communis</em>, var. <em>equi</em></td>
</tr>
<tr>
<td>74.</td>
<td><em>Psoroptes communis</em>, var. <em>equi</em></td>
</tr>
<tr>
<td>75.</td>
<td><em>Psoroptes communis</em>, var. <em>equi</em></td>
</tr>
<tr>
<td>76.</td>
<td><em>Psoroptes communis</em>, var. <em>equi</em></td>
</tr>
<tr>
<td>77.</td>
<td><em>Symbiotes communis</em>, var. <em>equi</em></td>
</tr>
<tr>
<td>78.</td>
<td><em>Symbiotes communis</em>, var. <em>equi</em></td>
</tr>
<tr>
<td>79.</td>
<td><em>Symbiotes communis</em>, var. <em>equi</em></td>
</tr>
<tr>
<td>82.</td>
<td>Sarcopt of Man</td>
</tr>
<tr>
<td>83.</td>
<td>Egg of the <em>Sarcoptes scabiei</em>, in various stages of development</td>
</tr>
<tr>
<td>84.</td>
<td>Anterior extremity of the <em>Demodex folliculorum</em> of the Dog</td>
</tr>
<tr>
<td>87.</td>
<td>Dog affected with advanced <em>Demodic Scabies</em></td>
</tr>
<tr>
<td>88.</td>
<td>Section of the Skin of a Dog affected with Follicular Scabies. <em>(Landani)</em></td>
</tr>
<tr>
<td>89.</td>
<td><em>Demodex of the Pig</em>. <em>(Csokor)</em></td>
</tr>
<tr>
<td>90.</td>
<td>Rostrum of the <em>Argas marginatus</em>. <em>Railliet</em></td>
</tr>
<tr>
<td>91.</td>
<td><em>Argas marginatus</em>. <em>Railliet</em></td>
</tr>
<tr>
<td>FIG.</td>
<td>Illustration</td>
</tr>
<tr>
<td>------</td>
<td>-------------</td>
</tr>
<tr>
<td>92.</td>
<td>Dermanyssus gallinae. (Delafond)</td>
</tr>
<tr>
<td>93.</td>
<td>Dermanyssus gallinae. (Delafond)</td>
</tr>
<tr>
<td>94.</td>
<td>Picrobia bicipitata of the Fowl</td>
</tr>
<tr>
<td>95.</td>
<td>Megninia sternalis of the Pigeon</td>
</tr>
<tr>
<td>96.</td>
<td>Falciger rostratus of the Pigeon. (Railliet)</td>
</tr>
<tr>
<td>97.</td>
<td>Epidermoptes bilobatus of the Fowl</td>
</tr>
<tr>
<td>98.</td>
<td>Epidermoptes bilobatus of the Fowl</td>
</tr>
<tr>
<td>99.</td>
<td>Cytodites nudus of the Fowl. (Railliet)</td>
</tr>
<tr>
<td>100.</td>
<td>Cytodites nudus of the Fowl. (Railliet)</td>
</tr>
<tr>
<td>101.</td>
<td>Symplectoptes cysticola of the Fowl. (Railliet)</td>
</tr>
<tr>
<td>102.</td>
<td>Symplectoptes cysticola of the Fowl. (Railliet)</td>
</tr>
<tr>
<td>103.</td>
<td>Narcoptes mutans of the Fowl</td>
</tr>
<tr>
<td>104.</td>
<td>Narcoptes mutans of the Fowl. (Railliet)</td>
</tr>
<tr>
<td>105.</td>
<td>The foot of a Fowl affected with Scabies</td>
</tr>
<tr>
<td>106.</td>
<td>Narcoptes heenis, var. gallinae. (Railliet)</td>
</tr>
<tr>
<td>107.</td>
<td>Narcoptes heenis, var. gallinae. (Railliet)</td>
</tr>
<tr>
<td>108.</td>
<td>Narcoptes heenis, var. gallinae; larva. (Railliet)</td>
</tr>
<tr>
<td>109.</td>
<td>Filaria of hemorrhagic tumours. (Condamine)</td>
</tr>
<tr>
<td>110.</td>
<td>Granular Dermitis in the Horse. (Railliet)</td>
</tr>
<tr>
<td>111.</td>
<td>Diagram of vegetation of Dermatophytes. (Balzer)</td>
</tr>
<tr>
<td>112.</td>
<td>Trichophyton tonsurans of the Horse</td>
</tr>
<tr>
<td>113.</td>
<td>Horse's tail invaded by the Trichophyton tonsurans</td>
</tr>
<tr>
<td>114.</td>
<td>Head and neck of a Fowl affected with generalized Favus</td>
</tr>
<tr>
<td>115.</td>
<td>Achorion Schoneleinii of the Favus of Poultry</td>
</tr>
<tr>
<td>116.</td>
<td>Diagram of the organization of a Trematode. (Van Beneden)</td>
</tr>
<tr>
<td>117.</td>
<td>Anatomy of the Ascaride of the Pig. (Delafond)</td>
</tr>
<tr>
<td>118.</td>
<td>Digestive tube of a female of the Scherostoma equinum. (Delafond)</td>
</tr>
<tr>
<td>119.</td>
<td>Sexual apparatus of the female Megalocephalus Ascaride. (Delafond)</td>
</tr>
<tr>
<td>120.</td>
<td>Caudal extremity of the male of the Ascaride of the Pig. (Delafond)</td>
</tr>
<tr>
<td>121.</td>
<td>Spicule of Megalocephalus Ascaride. (Delafond)</td>
</tr>
<tr>
<td>122.</td>
<td>Oral sucker and denticles of the Leech. (Carlet)</td>
</tr>
<tr>
<td>123.</td>
<td>Genital apparatus of the Leech. (Carlet)</td>
</tr>
<tr>
<td>124.</td>
<td>Hemopis sanguisuga. (Railliet)</td>
</tr>
<tr>
<td>125.</td>
<td>Medicinal Leech</td>
</tr>
<tr>
<td>126.</td>
<td>Spiroptera megastoma. (Railliet)</td>
</tr>
<tr>
<td>127.</td>
<td>Spiropteres and larve of the Estrus in the Stomach of a Horse. (Railliet)</td>
</tr>
<tr>
<td>128.</td>
<td>Spiroptera microstoma. (Neumann and Railliet)</td>
</tr>
<tr>
<td>129.</td>
<td>Wing of the Gastrophilus equi. (Railliet)</td>
</tr>
<tr>
<td>130.</td>
<td>Gastrophilus equi</td>
</tr>
<tr>
<td>131.</td>
<td>Eggs of the Gastrophilus equi fixed on hairs</td>
</tr>
<tr>
<td>132.</td>
<td>Larva and pupa of the Gastrophilus equi. (Delafond)</td>
</tr>
<tr>
<td>133.</td>
<td>Gastrophilus hemorrhoidalis; female</td>
</tr>
<tr>
<td>134.</td>
<td>Ovum of ditto</td>
</tr>
<tr>
<td>135.</td>
<td>Larva of ditto in third stage</td>
</tr>
<tr>
<td>136.</td>
<td>Pupa of ditto, with its operculum</td>
</tr>
<tr>
<td>137.</td>
<td>Larva of the Gastrophilus nasalii. (Railliet)</td>
</tr>
<tr>
<td>138.</td>
<td>Isotricha intestinalis. (Colin)</td>
</tr>
<tr>
<td>139.</td>
<td>Ophryoscolex of the paunch of Ruminants. (Colin)</td>
</tr>
<tr>
<td>140.</td>
<td>Fragment of rumen of Cow, showing Conical Amphistoma. (Railliet)</td>
</tr>
<tr>
<td>141.</td>
<td>Simoudsia paradoxa. (Colbod)</td>
</tr>
<tr>
<td>142.</td>
<td>Spiroptera sanguinolenta. (Railliet)</td>
</tr>
<tr>
<td>143.</td>
<td>Tumours of the Spiroptera sanguinolenta in stomach of Dog. (Railliet)</td>
</tr>
<tr>
<td>144.</td>
<td>Strongylius strigosus. (Railliet)</td>
</tr>
</tbody>
</table>
145. Diagram of the structure of a Cestode segment. (Van Beneden) ... 379
146. Tænia solium. (Railliet) ... 380
147. Head of the Tænia solium seen in front. (Leuckart) ... 380
148. Diagrammatic section of a Cysticerus ... 382
149. Diagrammatic section of the Cœnurus. (Railliet) ... 383
150. Bothriocephalus latus, showing the bothridia of head ... 384
151. Vertical section through head of B. latus. (Moniez) ... 384
152. Three ripe segments of B. latus. (Eschricht) ... 384
153. Anterior extremity of the Ascaris lumbricoides of Man ... 385
154. Lumbrioid Ascaride; male. (Railliet) ... 386
155. Lumbrioid Ascaride; female. (Railliet) ... 386
156. Cephalic extremity of a duodenal Uncinaria. (Peronat) ... 387
157. Caudal pouch of the duodenal Uncinaria ... 387
158. Trichocephalus of Man ... 387
159. Intestinal Anquillula. (Grassi and Parona) ... 388
160. Faecal Anquillula. (Peronat) ... 388
161. Infusoria of the Horse’s intestine. (Collin) ... 393
162. Tænia perfoliata. (Railliet) ... 394
163. Cephalic extremity of the Tænia perfoliata. (Railliet) ... 394
164. Tænia mamillana. (Railliet) ... 395
165. Cephalic extremity of Tænia mamillana. (Railliet) ... 395
166. Cephalic extremity of Tænia plicata. (Railliet) ... 395
167. Tænia plicata. (Railliet) ... 395
168. Gastrodiceus Soninii. (Railliet) ... 397
169. Oxyuris of the Horse ... 401
170. Oxyuris of the Horse; female ... 401
171. Oxyuris of the Horse; female. (Delafond) ... 402
172. Oxyuris of the Horse; male. (Railliet) ... 402
173. Caudal extremity of male Oxyuris of the Horse. (Railliet) ... 403
174. Oxyles of the Horse. (Railliet) ... 404
175. Oxyles of the Horse. (Railliet) ... 404
176. Anterior extremity of the Sclerostoma equinum. (Delafond) ... 405
177. Portion of buccal capsule of the Sclerostoma equinum. (Delafond) ... 405
178. Sclerostoma equinum. (Delafond) ... 405
179. Caudal extremity of the male Sclerostoma equinum. (Railliet) ... 406
180. Sclerostomes in cæcum of Horse. (Railliet) ... 407
181. Anterior extremity of Sclerostoma tetracanthum. (Schneider) ... 410
182. Ovum of the Tænia expansa. (Moniez) ... 412
183. Cephalic extremity of the Tænia denticulata ... 412
184. Tænia expansa. (Railliet) ... 413
185. Cephalic extremity of the Tænia expansa ... 413
186. Lateral third of a segment of the Tænia expansa ... 413
187. Cephalic extremity of the Tænia alba ... 414
188. Anterior extremity of the Ascaride of the Calf ... 415
189. Caudal extremity of the male Strongylus ventricosus. (Railliet) ... 415
190. Esophagostoma inflatum. (Railliet) ... 416
191. Trichocephalus affinis. (Delafond) ... 417
192. Cephalic extremity of the Tænia Benedeni ... 419
193. Segments of the Tænia fimbriata. (Railliet) ... 420
194. Lateral portion of segment of the Tænia fimbriata. (Railliet) ... 420
195. Two segments of the Tænia ovilla. (Perronat) ... 420
196. Transverse section of segment of the Tænia ovilla ... 420
197. Cephalic extremity of the Tænia centripunctata... ... 422
LIST OF ILLUSTRATIONS.

198. Anterior extremity of the Ascaride of the Sheep... 142
199. Caudal extremity of the Male Strongylus filicolis 142
200. Cephalic extremity of the Strongylus contortus. (Railliet) 142
201. Caudal extremity of the Male Esophagostoma venulosum. (Railliet) 142
202. Scedostoma hypostomum. (Railliet) ... 142
203. Anterior extremity of the Dochnius or Uncinaria cernea. (Railliet) 142
204. Anterior extremity of the Dochnius or Uncinaria cernea. (Railliet) 142
205. Balantidium coli. (Stein) ... 142
206. Cephalic extremity of the Giant Echinorhynchus. (Railliet) 132
207. Giant Echinorhynchus. (Railliet) ... 132
208. Echinorhynchus gigas. (Railliet) ... 132
209. Caudal pouch of the Esophagostoma dentatum. (Schneider) 135
210. Coccidium bigeminum of the Dog's intestine. (Railliet)... 147
211. Head of the Tenia serrata. (Railliet) ... 149
212. Hooks of the Tenia serrata. (Railliet) ... 149
213. Tenia serrata ... ... ... ... ... ... ... ... 149
214. Mature segment or joint of the Tenia serrata. (Railliet) ... 140
215. Ova of Tenia serrata. (Railliet) ... 140
216. Tenia marginata ... ... ... ... ... ... ... ... 141
217. Hooks of the Tenia marginata ... ... ... ... ... ... ... ... 141
218. Tenia caenurus ... ... ... ... ... ... ... ... ... ... 143
219. Hooks of the Tenia caenurus... ... ... ... ... ... ... ... ... 143
220. Hooks of the Tenia serialis ... ... ... ... ... ... ... ... 144
221. Tenia echinococcus. (Perroncito) ... ... ... ... ... ... ... ... 144
222. Hooks of the Tenia echinococcus ... ... ... ... ... ... ... ... 144
223. Tenia canina of the Dog. (Railliet) ... ... ... ... ... ... ... ... 145
224. Tenia canina. (Railliet) ... ... ... ... ... ... ... ... ... ... 145
225. Completely developed ovum of the Tenia canina. (Moniez) ... ... 146
226. Cysticercoide (Cryptocestus trichoodectis) of the Tenia canina. (Leuckart) ... 146
227. Cephalic extremity and segments of the Tenia litterata. (Krabbe) ... 147
228. Cephalic extremity of the Tenia litterata ... ... ... ... ... ... ... ... 147
229. Tenia litterata. (Railliet) ... ... ... ... ... ... ... ... ... ... 147
230. Portion of a Bothriocephalus latum. (Leuckart)... ... ... ... ... 155
231. Diagram of segment of the Bothriocephalus latum ... ... ... ... ... ... 156
232. Ova of the Bothriocephalus latum. (Laboulbène) ... ... ... ... ... ... 156
233. Ciliated embryo of the Bothriocephalus latum. (Leuckart) ... ... ... ... 156
234. Head of the Bothriocephalus cordatus. (Leuckart) ... ... ... ... ... ... 158
235. Hemistoma alatum. (Gard) ... ... ... ... ... ... ... ... ... ... 158
236. Phases of evolution of the Distoma echinatum of the Duck. (Ercolani) ... ... 159
237. Ascaris mystax of the Cat. (Railliet)... ... ... ... ... ... ... ... ... ... 160
238. Uncinaria or Dochnius trigonocephalus ... ... ... ... ... ... ... ... 162
239. Cephalic extremity of the Dochnius trigonocephalus. (Railliet) ... ... ... 162
240. Caudal pouch of the Dochnius trigonocephalus ... ... ... ... ... ... 162
241. Cephalic extremity of the Uncinaria or Dochnius stenocephalus. (Railliet) 165
242. Caudal pouch of the Uncinaria or Dochnius stenocephalus. (Railliet) 165
243. Trichocephalus depressivusculus in cecum of Dog. (Railliet) ... ... ... ... 166
244. Head of the Tenia crassicolis ... ... ... ... ... ... ... ... ... ... 168
245. Hooks of the Tenia crassicolis ... ... ... ... ... ... ... ... ... ... 168
246. Cysticercoide fasciolariis. (Leuckart) ... ... ... ... ... ... ... ... ... 168
247. Recently-hatched larva of the Strongylus striagouna. (Railliet) ... ... ... 171
248. Caudal extremity of the male Strongylus retortiformis. (Railliet) ... ... ... 171
249. Coccidium perforans of the Fowl's intestine. (Perroncito) ... ... ... ... 177
250. Monostoma verrucosum. (Dujardin) ... ... ... ... ... ... ... ... ... ... 180
LIST OF ILLUSTRATIONS.

304. Larvae of Oestrus in frontal sinuses of Sheep. (July) ... ... 571
305. Strongylus filaria ... ... ... ... ... ... ... ... ... ... 581
306. Strongylus filaria. (Delafond) ... ... ... ... ... ... ... 581
307. Strongylus rufescens. (Railliet) ... ... ... ... ... ... ... 583
308. Strongylus rufescens. (Railliet) ... ... ... ... ... ... ... 583
309. Ova and embryos of Strongylus rufescens. (Railliet) ... ... ... 585
310. Strongylus micrurus. (Railliet) ... ... ... ... ... ... ... ... 593
311. Caudal extremity of male Strongylus Arsfeldi. (Railliet) ... ... 595
312. Cephalic and caudal extremities of female Strongylus Arsfeldi. (Railliet) ... ... ... 596
313. Evolution of Strongylus Arsfeldi. (Railliet) ... ... ... ... ... 596
314. Strongylus paradoxus. (Railliet) ... ... ... ... ... ... ... ... 597
315. Pseudo-follicle undergoing formation. (Laulanié) ... ... ... ... 601
316. Pseudo-follicle in pulmonary Strongylosis. (Laulanié) ... ... ... 601
317. Ova and embryos of Strongylus pusillus. (Railliet) ... ... ... ... 604
318. Syngamus trachealis. (Railliet) ... ... ... ... ... ... ... ... ... 607
319. Abdominal Aorta of a Horse ... ... ... ... ... ... ... ... ... 624
320. Vermiuous Anemia of the great Mesenteric Artery. (Railliet) ... 625
321. Bilharzia hamatobia, male and female. (Bilharz) ... ... ... ... ... 632
322. Male and female Filaria immitis. (Railliet) ... ... ... ... ... ... 640
323. Caudal extremity of male Filaria immitis. (Railliet) ... ... ... ... 640
324. Embryos of Filaria immitis. (Railliet) ... ... ... ... ... ... ... ... 640
325. Strongylus raimum. (Railliet) ... ... ... ... ... ... ... ... ... 645
326. Ceoccus serialis. (Railliet) ... ... ... ... ... ... ... ... ... ... 651
327. Distome of the muscles of the Pig. (Leuckart) ... ... ... ... ... 654
328. Spioptera reticulata; male. (Railliet) ... ... ... ... ... ... ... ... 656
329. Spioptera reticulata; female. (Railliet) ... ... ... ... ... ... ... ... 656
330. Spioptera reticulata; portion of female. (Railliet) ... ... ... ... 657
331. Ova of the Spioptera reticulata. (Railliet) ... ... ... ... ... ... ... 657
332. Embryos of the Spioptera reticulata. (Railliet) ... ... ... ... ... 657
333. Psorospermic Utricles in muscular fibres. (Railliet) ... ... ... ... 660
334. Psorospermic Utricles. (Railliet) ... ... ... ... ... ... ... ... ... 660
335. Transverse section of muscle of Pig. (Laulanié) ... ... ... ... ... 661
336. Psorospermic granule of muscle of Pig. (Laulanié) ... ... ... ... 661
337. Completely developed psorospermic granule. (Laulanié) ... ... 662
338. Transverse section of a Balbiania gigantea. (Railliet) ... ... ... 665
339. Falciform corpuscles of Balbiania gigantea. (Railliet) ... ... ... 665
340. (Esophagus of Sheep with Balbiania gigantea. (Railliet) ... ... ... 665
341. Cysticercus cellulose. (Robin) ... ... ... ... ... ... ... ... ... 669
342. Head of the Cysticercus cellulose. (Railliet) ... ... ... ... ... ... 669
343. Hooks of the Taenia solium. (Railliet) ... ... ... ... ... ... ... ... 669
344. Fragment of measly muscle from the Pig. (Railliet) ... ... ... ... 671
345. Ovum of the Taenia solium. (Laboulbène) ... ... ... ... ... ... ... 678
346. Head of the Taenia solium. (Laboulbène) ... ... ... ... ... ... ... ... 680
347. Head of the Taenia solium. (Laboulbène) ... ... ... ... ... ... ... ... 680
348. Head of the Taenia saginiata. (Laboulbène) ... ... ... ... ... ... ... 690
349. Head of the Taenia saginiata. (Laboulbène) ... ... ... ... ... ... ... ... 690
350. Fragment of muscle with Cysticercus boris. (Railliet) ... ... ... ... 690
351. Ova of the Taenia saginiata. (Laboulbène) ... ... ... ... ... ... ... ... 693
352. Male intestinal Trichina. (Colin) ... ... ... ... ... ... ... ... ... ... 700
353. Female intestinal Trichina. (Colin) ... ... ... ... ... ... ... ... ... ... 700
354. Digestive and sexual apparatus of the male Trichina. (Colin) ... ... 701
355. Digestive and sexual apparatus of the female Trichina. (Colin) ... ... 701
356. Trichinas encysted in muscular tissue. (Colin) ... ... ... ... ... ... 705
<table>
<thead>
<tr>
<th>FIG.</th>
<th>Description</th>
<th>Author(s)</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>357</td>
<td>Free larval Trichina. (Colin)</td>
<td></td>
<td>706</td>
</tr>
<tr>
<td>358</td>
<td>Very old trichinos cyst. (Colin)</td>
<td></td>
<td>707</td>
</tr>
<tr>
<td>359</td>
<td>Cœnurus cerebralis.</td>
<td></td>
<td>728</td>
</tr>
<tr>
<td>360</td>
<td>Psoroptes communis, var. equi. (Delafond)</td>
<td></td>
<td>746</td>
</tr>
<tr>
<td>361</td>
<td>Symbiotes auricularum of the Dog. (Railliet)</td>
<td></td>
<td>749</td>
</tr>
<tr>
<td>361A</td>
<td>Symbiotes auricularis canis. (Sewell)</td>
<td></td>
<td>751</td>
</tr>
<tr>
<td>362</td>
<td>Giant Eustrongle</td>
<td></td>
<td>763</td>
</tr>
<tr>
<td>363</td>
<td>Ova and embryo of a Giant Eustrongle. (Balbiani)</td>
<td></td>
<td>763</td>
</tr>
<tr>
<td>364</td>
<td>Giant Eustrongle in the kidney of a Dog. (Railliet)</td>
<td></td>
<td>767</td>
</tr>
</tbody>
</table>
# CONTENTS

<table>
<thead>
<tr>
<th>TRANSLATOR AND EDITOR'S PREFACE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIST OF ILLUSTRATIONS</td>
<td>vii</td>
</tr>
<tr>
<td>INTRODUCTION.—The Parasitic Diseases in General</td>
<td>xi</td>
</tr>
<tr>
<td>Vegetable Parasites</td>
<td>1</td>
</tr>
<tr>
<td>Animal Parasites</td>
<td>2</td>
</tr>
<tr>
<td>Habitat of the Parasites</td>
<td>3</td>
</tr>
<tr>
<td>Degrees and Mode of Parasitism</td>
<td>6</td>
</tr>
<tr>
<td>Etiology of Parasitic Diseases</td>
<td>6</td>
</tr>
<tr>
<td>Symptoms and Lesions</td>
<td>9</td>
</tr>
<tr>
<td>Diagnosis</td>
<td>13</td>
</tr>
<tr>
<td>Nomenclature of Parasitic Diseases</td>
<td>16</td>
</tr>
<tr>
<td>Prognosis</td>
<td>17</td>
</tr>
<tr>
<td>Prophylaxis</td>
<td>18</td>
</tr>
<tr>
<td>Treatment</td>
<td>20</td>
</tr>
</tbody>
</table>

## BOOK I.

### PARASITES OF THE SKIN.

<table>
<thead>
<tr>
<th>GENERAL CONSIDERATIONS</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHAPTER I.—Dipterous Parasites in the Perfect Insect State</td>
<td>21</td>
</tr>
<tr>
<td>CHAPTER II.—Dipterous Parasites of the Skin in the Larval State</td>
<td>24</td>
</tr>
<tr>
<td>CHAPTER III.—The Fleas</td>
<td>40</td>
</tr>
<tr>
<td>CHAPTER IV.—Phthiriases</td>
<td>58</td>
</tr>
<tr>
<td>CHAPTER V.—Acariaises</td>
<td>65</td>
</tr>
</tbody>
</table>

#### A.—ACARIASES OF THE DOMESTICATED ANIMALS

<table>
<thead>
<tr>
<th>ARTICLE I.—Non-psoric Acariases</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARTICL II.—Psoric Acariases</td>
<td>95</td>
</tr>
</tbody>
</table>

#### 1. Sarcoplastic Scabies

<table>
<thead>
<tr>
<th>A. Scabies of the Equidae</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Sarcoptic Scabies</td>
<td>136</td>
</tr>
<tr>
<td>2. Psoroptic Scabies</td>
<td>136</td>
</tr>
<tr>
<td>3. Symbiotic Scabies</td>
<td>151</td>
</tr>
</tbody>
</table>

#### B. Scabies of Bovine Animals

| 1. Sarcoptic Scabies            | 155  |
| 2. Psoroptic Scabies            | 155  |
| 3. Symbiotic Scabies            | 155  |

#### C. Scabies of the Sheep

| 1. Sarcoptic Scabies            | 157  |
| 2. Psoroptic Scabies            | 157  |
| 3. Symbiotic Scabies            | 157  |
CONTKNTS.

BOOK I. (continued).

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>D. Scabies of the Goat</td>
<td>192</td>
</tr>
<tr>
<td>1. Sarcoptic Scabies</td>
<td>192</td>
</tr>
<tr>
<td>2. Symbiotic Scabies</td>
<td>194</td>
</tr>
<tr>
<td>E. Scabies of the Pig</td>
<td>195</td>
</tr>
<tr>
<td>F. Sarcoptic Scabies of the Rabbit</td>
<td>198</td>
</tr>
<tr>
<td>G. Scabies of the Dromedary and Camel</td>
<td>199</td>
</tr>
<tr>
<td>H. Sarcoptic Scabies of the Dog</td>
<td>203</td>
</tr>
<tr>
<td>I. Sarcoptic Scabies of the Cat</td>
<td>208</td>
</tr>
<tr>
<td>J. Sarcoptic Scabies of the Ferret</td>
<td>211</td>
</tr>
<tr>
<td>2. Demodecic Scabies</td>
<td>212</td>
</tr>
<tr>
<td>A. Demodecic Scabies of the Dog</td>
<td>215</td>
</tr>
<tr>
<td>B. Demodecic Scabies of the Pig</td>
<td>221</td>
</tr>
<tr>
<td>C. Demodecic Scabies of the Goat</td>
<td>225</td>
</tr>
<tr>
<td>D. Demodecic Scabies of the Ox</td>
<td>226</td>
</tr>
<tr>
<td>B. ACARIASES OF DOMESTICATED BIRDS</td>
<td></td>
</tr>
<tr>
<td>Article I. — Non-psoric Acariases</td>
<td>226</td>
</tr>
<tr>
<td>Article II. — Psorid Acariases</td>
<td>227</td>
</tr>
<tr>
<td>1. Scabies of the legs</td>
<td>246</td>
</tr>
<tr>
<td>2. Scabies of the Body, Depilating Scabies</td>
<td>247</td>
</tr>
<tr>
<td>CHAPTER VI. — Cutaneous Helminthiases</td>
<td>253</td>
</tr>
<tr>
<td>Article I. — Parasitic Dermatorrhage</td>
<td>253</td>
</tr>
<tr>
<td>Article II. — Summer Sores of Horses</td>
<td>257</td>
</tr>
<tr>
<td>Article III. — Dracontiasis (Filaria of Medina)</td>
<td>262</td>
</tr>
<tr>
<td>Article IV. — Indigenous Cutaneous Filarias of the Dog</td>
<td>266</td>
</tr>
<tr>
<td>Article V. — Verminous Foot-rot of Sheep</td>
<td>267</td>
</tr>
<tr>
<td>CHAPTER VII. — Cutaneous Psorospermiosis</td>
<td>268</td>
</tr>
<tr>
<td>CHAPTER VIII. — Dermatomycoses</td>
<td>271</td>
</tr>
<tr>
<td>Article I. — Tinea Tonsurans</td>
<td>274</td>
</tr>
<tr>
<td>Article II. — Favus</td>
<td>299</td>
</tr>
<tr>
<td>Article III. — Onychomycosis of the Equida</td>
<td>315</td>
</tr>
</tbody>
</table>

BOOK II.

PARASITES OF THE DIGESTIVE APPARATUS.

GENERAL CONSIDERATIONS                                             | 317  |

CHAPTER I. — Parasites of the Mouth and Pharynx                     | 327  |
| Article I. — Hemopis                                               | 328  |
| Article II. — Thrush                                                | 335  |
| Article III. — Gutturomycosis of Equida                            | 340  |
| Article IV. — Diphtheria of Fowls                                   | 341  |

CHAPTER II. — Parasites of the Esophagus and Stomach                | 345  |
| Article I. — Parasites of the Esophagus and Stomach of Equide      | 346  |
| Article II. — Parasites of the Esophagus and Stomach of Reminants  | 360  |
| Article III. — Parasites of the Stomach of the Pig                 | 367  |
| Article IV. — Parasites of the Esophagus and Stomach of the Dog    | 368  |
| Article V. — Parasites of the Stomach of the Cat                    | 372  |
| Article VI. — Parasites of the Stomach of the Rabbit                | 373  |
| Article VII. — Parasites of the Esophagus and Stomach of Birds      | 374  |
BOOK II. (continued).

CHAPTER III.—Parasites of the Intestines

A.—DOMESTICATED MAMMALLIA

Article I.—Parasites of the Intestines of the Equidae

Article II.—Parasites of the Intestines of the Ox

Article III.—Parasites of the Intestines of the Sheep

Article IV.—Parasites of the Intestines of the Goat

Article V.—Parasites of the Intestines of the Pig

Article VI.—Parasites of the Intestines of the Dog

Article VII.—Parasites of the Intestines of the Cat

Article VIII.—Parasites of the Intestines of the Rabbit

Article IX.—Parasites of the Intestines of the Guinea-Pig

Article X.—Parasites of the Stomach and Intestines of the Elephant

B.—DOMESTICATED BIRDS

Article I.—Parasites of the Intestines of Poultry

Article II.—Parasites of the Intestines of the Turkey, Guinea-Fowl, Peacock, and Pheasant

Article III.—Parasites of the Intestines of the Pigeon

Article IV.—Parasites of the Intestines of the Duck

Article V.—Parasites of the Intestines of the Goose

Article VI.—Parasites of the Intestines of the Swan

CHAPTER IV.—Parasites of the Liver

Article I.—Coccidiosis of the Liver

Article II.—Echinococcosis of the Liver

Article III.—Dystomatosis of the Liver

1. Dystomatosis of Herbivora

2. Dystomatosis of Carnivora

CHAPTER V.—Parasites of the Pancreas and Spleen

BOOK III.

PARASITES OF THE SEROUS MEMBRANES.

Equidae

Ruminants

Pig

Rabbit

Dog and Cat

547

550

551

553

558

559

567

575

576

579

580

583

591

BOOK IV.

PARASITES OF THE RESPIRATORY APPARATUS.

General Considerations

A.—DOMESTICATED MAMMALIA

CHAPTER I.—Parasites of the Nasal Cavities and Larynx

Article I.—Linguatula

Article II.—Larva of the Centrus

CHAPTER II.—Parasites of the Trachea, Bronchi and Lungs

Article I.—Pulmonary Echinococcosis

Article II.—Pulmonary Dystomatosis

Article III.—Bronchial and Pulmonary Strongyloses

1. Verminous Broncho-pneumonia of the Sheep and Goat

2. Verminous Bronchitis of Bovines
CONTENTS.

BOOK IV. (continued).

3. Verminous Bronchitis of the Camel ... 594
4. Verminous Bronchitis of Equines ... 595
5. Verminous Bronchitis of the Pig ... 596
6. Verminous Bronchitis of the Domesticated Rabbit ... 598

ARTICLE IV.—Helminthiases of the Trachea, Bronchi and Lungs of the Dog ... 598

ARTICLE V.—Helminthiases of the Trachea, Bronchi and Lungs of the Cat... 602

B.—DOMESTICATED BIRDS ... 605

CHAPTER I.—Verminous Tracheo-Bronchitis (Syngamosis) ... 606

CHAPTER II.—Mycosis of the Air-Passages ... 612

BOOK V.

PARASITES OF THE CIRCULATORY APPARATUS.

GENERAL CONSIDERATIONS ... 618

CHAPTER I.—Hæmatozoa of the Horse ... 619
   ARTICLE I.—Infusoria ... 619
   ARTICLE II.—Nematodes ... 622

CHAPTER II.—Hæmatozoa of Ruminants ... 632

CHAPTER III.—Hæmatozoa of Rodents ... 635

CHAPTER IV.—Hæmatozoa of the Dog ... 636
   ARTICLE I.—Hæmatozoa of Lewis ... 636
   ARTICLE II.—Hæmatic Filariosis ... 639
   ARTICLE III.—Strongyllosis of Blood-vessels ... 644
   ARTICLE IV.—Spiroptera Sanguinolenta ... 646

CHAPTER V.—Hæmatozoa of Birds ... 648

BOOK VI.

PARASITES OF THE MUSCLES, CONNECTIVE TISSUE AND BONES.

GENERAL CONSIDERATIONS ... 650

Cœnurus Cerebralis ... 650
Cœnurus Serialis ... 651
Echinococel ... 652
Distoma Hepaticum ... 654
Distoma of the Muscles of the Pig ... 654
Nematodes ... 655
Spiroptera Reticulata ... 656

CHAPTER I.—Psorospermosis of the Muscles and Connective Tissue ... 659
   ARTICLE I.—Muscular Psorospermosis ... 660
   ARTICLE II.—Connective-Tissue Psorospermosis ... 665

CHAPTER II.—Measles ... 667
   ARTICLE I.—Measles of the Pig ... 668
   ARTICLE II.—Measles of the Dog ... 667
   ARTICLE III.—Measles of the Ox ... 668
   ARTICLE IV.—Various Measles ... 697

CHAPTER III.—Trichinosis ... 699

CHAPTER IV.—Parasites of the Bones (Echinococci) ... 724
BOOK VII.

PARASITES OF THE NERVE CENTRES AND ORGANS OF SENSE.

CHAPTER I.—Parasites of the Nerve Centres ........................................... 726
   Article I.—Wandering Helminths .................................................. 726
   Article II.—Hydatidocephalus or ‘Gid’ ........................................... 727
   Article III.—Larve of the Oestrile ............................................... 741

CHAPTER II.—Parasites of the Organs of Sense ........................................ 743
   Article I.—Parasites of the Ear .................................................. 743
       1. Psoroptic Otacariasis ......................................................... 745
           A.—Psoroptic Otacariasis of the Rabbit ................................ 745
           B.—Psoroptic Otacariasis of the Goat ................................... 748
       2. Symbiotic Otacariasis ....................................................... 748
           A.—Symbiotic Otacariasis of the Dog ................................... 748
           B.—Symbiotic Otacariasis of the Cat ................................... 753
           C.—Symbiotic Otacariasis of the Ferret ................................ 754
   Article II.—Parasites of the Eye ................................................. 754
       1. Ocular Cysticercosis and Echinococcosis ................................ 756
       2. Intra-ocular Filariosis ..................................................... 756
       3. Extra-ocular Filariosis ..................................................... 759

BOOK VIII.

PARASITES OF THE GENITO-URINARY ORGANS.

CHAPTER I.—Parasites of the Urinary Organs ........................................ 761
   A.—Fungi ................................................................................. 761
   B.—Coccidia ............................................................................. 761
   C.—Cestodes ............................................................................. 762
   D.—Trematodes .......................................................................... 763
   E.—Nematodes ........................................................................... 764
   F.—Acari ................................................................................. 770
   G.—Larve of the Oestrile ......................................................... 770

CHAPTER II.—Parasites of the Genital Organs ........................................ 771
   Mammalia ................................................................................. 771
   Birds ......................................................................................... 772

Alphabetical Index of the Authorities Quoted ........................................ 774
Alphabetical Index of Contents ......................................................... 782
Errata et Addenda ............................................................................. 798
A TREATISE
ON THE
NON-MICROBIC PARASITIC DISEASES OF THE
DOMESTICATED ANIMALS.

INTRODUCTION TO THE PARASITIC DISEASES IN GENERAL.

Among the diseases which are engendered in the external media surrounding animals, a large number are due to inferior organisms contained in these media—organisms in various stages of development, from the egg to the perfect individual. The recent and uninterrupted progress of science daily increases the domain of this section of pathology, and incessantly tends to include disorders which, until lately, were ascribed to purely physical causes. Hence has arisen a kind of special science, Parasitology, which has a distinct object and methods, and possesses a particularly suggestive interest.

In the immense laboratory of living matter representing the organic world, the conditions of nutrition are so framed for animals, and also for non-chlorophyllous plants, that their aliment is exclusively composed of organic substances. The majority of these organisms subsist on lifeless matter; but there are many which prefer deriving their nourishment from living beings, and so obtain it during a part, or even the whole period of their existence. When the relations between size and strength are such that the consumer is inferior to its victim, the former becomes the parasite of the latter.

Parasitism is, therefore, only a particular instance of Symbiosis (De Bary); and the various forms of life in common of different organisms are so named, there being distinguished mutualism, commensalism, and parasitism (P. J. Van Beneden).

In mutualism, or mutualistic symbiosis, the two beings in contact form a real association or union. In commensalism one of the two alone profits by this union, in which it finds a refuge, and also, without
injuring its co-symbiot, more favourable, if only contingent, conditions for existence. In parasitism, or antagonistic symbiosis, only one of the organisms, again, gains by the union, which affords it an assured shelter and subsistence—sometimes only the latter—most frequently at the expense of its co-symbiot, which in this case becomes its host (or bearer). It is in this sense that we adopt the word 'parasite,' and so give it an extension which will be at least justified by the aim of this work.

The Parasites (παράσιτος, eating beside or with another, from παρά, beside, and σίτος, food) which live on the domesticated animals (Mammals and Birds) belong to the vegetable or animal kingdoms. All the vegetable parasites (Phytoparasites) are fungi; all the animal parasites (Zooparasites) belong to the Invertebrata.

Vegetable Parasites.—The majority of the parasitic Fungi of the domesticated animals are included in the group—order or family—of Schizomycetes, Bacteria or Bacteriaceae. They are formed of a single cell destitute of nucleus, the homogeneous protoplasm of which is generally colourless, and is enveloped in a thin membrane. Their essential mode of multiplication is by division, nearly always transversal, and rarely in two, or even three directions. Among them are found the most minute organisms. If, indeed, some of them (Leptothrix, Spirochète, Spirillum Volułans, etc.) may measure two to ten millimetres in length (200 μ), there are many that reach the limit of the highest magnifying powers of the best microscopes. All the inferior organisms which are now popularly designated Microbes, belong to the Schizomycetes. The considerable part they play in the general economy of Nature is every day rendered more evident by the progress of science, and there is a particular tendency to give them a more and more preponderating influence in the etiology of infectious and contagious maladies—such as Bacteridian Anthrax, Symptomatic Anthrax, Fowl cholera, Swine-plague, Tuberculosis, Typhoid Fever, etc. These pathogenic microbes, as they are called, are now considered the virulent agents proper to each of these affections; and their multiplication by cellular division in the body of an animal, affords an explanation of all the characteristic processes noted in these diseases.

Their rôle in pathology, the special nature of the disorders they occasion, their biological physiognomy, the special and delicate methods their study demand, and the different points of view from which they may be considered, separate them distinctly from the other parasites. It is for this reason that they are not comprised in this work, which is devoted only to parasites relatively gigantic for the most part, localized in one or more organs or tissues, never intimately mixed up in the fluids, and the pathogenic action of which rarely implies the intervention or knowledge pertaining to sanitary police. But it must
be stated that there are between these two large groups of parasites some intermediate ones: Schizomyctes, such as the Sarcinæ; the Micrococcus of the funinculus; the Actinomyces bovis, etc., which very closely localize themselves; and macroparasites which, at certain phases of their development, invade the circulating fluid—as the embryos of the haematozoa. Notwithstanding these few exceptions, there are rather advantages than inconveniences in separating these two groups of parasites, in order to study them. Only a small number of parasitic fungi will, consequently, be referred to in this work. These are:

1. The Dermatophytes (Tricophyton tonsurans and Achorion Schaeleini), which live on the skin, and may be likened to the Mucorinae; they will be studied when dealing with the parasitic dermatoses.

2. The Saccharomycetes, such as the Saccharomyces (Oidium) albicans, which infest the upper digestive passages and produce 'thrush'; and the Saccharomyces guttulatus, found in the stomach and intestines of various herbivorous animals.

3. The Haplococcus reticulatus, a muscle parasite of the Pig, and which resembles the Vampyrellæ.

4. Lastly, several kinds of Aspergillus, 'moulds' belonging to the family of Perisporiaceæ, which may develop in the respiratory apparatus of Birds and some Mammals.

These groups of fungi are distinctively separated from each other by the seat of the alterations they produce, and it is therefore preferable to refer what has to be said about them to each of the chapters devoted to the organs or tissues they invade.

Animal Parasites.—Three sections only of the animal kingdom contain the parasites of the domesticated animals; these are the Protozoa, Worms, and Arthropodes.

A. The Protozoa are very small, often microscopic creatures, formed of a single and more or less complex cell, and possessing neither differential organs nor tissues. Their reproduction never requires the intervention of male or female sexual elements (spermatozoïds and ova), but takes place by fission, budding, and sporulation; at most, it may sometimes be preceded by the definitive or transient fusion of two or more individuals (conjugation).

They are divided into five classes: Monera, Amœba, Rhizopoda, Sporozoa, and Infusoria; only three of these classes (Amœba, Sporozoa, Infusoria) contain parasites of the domesticated animals.

a. The Amœba are nucleated Protozoa, destitute of cilia and flagellum in the adult state, and only showing pseudopodes, i.e., variable prolongations which may be withdrawn into the body, and are here ordinarily broad, obtuse, and well defined. The only parasite certainly belonging to this class is the Amœba parasitica, discovered by R. von Lendenfeld in ulcers of the lips and feet of Sheep.
b. The *Sporozoa* are parasitic Protozoa provided with a nucleus, and generally limited to the adult age by a hairless cuticle which has no flagellum or suckers. They are reproduced by spores, resulting from segmentation of their protoplasm or sarcode. They are often designated *Psorospermie*. Balbiani has arranged them in five orders: *Gregarines*, *Coccidia* (*Psorospermia ovoides*), *Sarcosporidiae* (*Psorospermiae utriculiformes*), *Myxosporidiae* (*Psorospermie of Fish*), and *Microsporidic* (*Psorospermiae of the Arthropodes*). The *Psorospermie* which concern us are the *Coccidia* and *Sarcosporidiae*. The first chiefly inhabit the digestive apparatus, the second are found exclusively in the muscles.

c. The *Infusoria* are Protozoa provided with a nucleus, and, generally, a cuticle bearing cilia, flagella, or suckers. They are divided into three sub-classes according to the nature of their appendages: 1. The *Flagellata*, which never have cilia, but are always furnished with one or more flagellata, and sometimes with an undulating membrane; 2. The *Ciliata*, covered at all ages with vibratile cilia over the whole surface or only partially; 3. The *Tentaculifera*, which, in the adult state, have only suckers in the form of tentacula. *Infusoria* are more particularly found in the digestive apparatus, or its dependencies, of the domesticated animals: they belong to the *Flagellata* or *Ciliata*.

B. The *Worms* are Invertebrate, with a soft contractile body, which is symmetrically bilateral and non-articulated, or is markedly divided into a linear series of similar (homonymous) rings, is always destitute of articulated limbs, and is provided with a system of excretory organs in pairs (aquiferous vessels) opening externally.

This section contains a vast collection—the *Helminths* (*hêlmînths*, worm)—which do not form a very natural zoological class; but from our point of view it is useful to bring them into one group, because of the analogies in their habitat, and their customs and actions. These are the Worms which are generally parasitic; they are cylindrical or flattened, are always destitute of a ventral chain of nerve-ganglia, and have no rotatory apparatus for locomotion. All those we treat of belong to this group, with the exception of a small number which pertain to the *Annelidae*.

The *Annelida* have the body cylindrical or flattened, are distinctly ringed, and have always a ventral chain of nerve-ganglia, an oesophageal collar, a cerebroid ganglion, and a blood-vascular system. The *Hemopis*—parasites of the mouth and pharynx—are the only Annelides that enter into our study.

The *Helminths* demand a more detailed description. Simple in their organization, they are—especially as parasites—unprovided with sensory organs, and their feeble respiration is always carried on through the integuments. Designated in many works as *Entozoa, intestinal Worms*, etc., although they may be found in various organs, they are
INTRODUCTION.

divided into two classes: the *Platelmhnts*, with bodies generally flat; and *Nemathelmhnts*, whose bodies are nearly cylindrical.

The *Platelmhnts* or *Platodes* (πλατύς, wide, flat) comprise three orders: *Cestodes*, *Trematodes*, and *Turbellaries*. The first two only are limited to a parasitic existence. Nearly all the species are hermaphrodites.

a. The *Cestodes* or *Cestoïdes* (κερτός, band, and κυδός, form) are Plathelmhnts whose bodies are nude in the adult condition, ribbon-shaped, nearly always segmented, and provided at one extremity with organs of fixation—suckers or hooks; they have no digestive apparatus. In the adult state, they live in the intestines of the higher animals; but before that period they undergo a certain number of metamorphoses and migrations, which are often effected in the most diverse organs of different hosts.

b. The *Trematodes* (τριματόδως, perforated) are Plathelmhnts, the bodies of which are nude, soft, and non-segmented, generally foliaceous, and furnished with one or more suckers; they have a digestive canal having a single opening and no anus. Those which concern us live as parasites in the interior of the body of their host (endoparasites), and belong to the sub-order of *Distomata*, which is characterized by the presence of two suckers at most, of which the anterior is oral.

The *Nemathelmhnts* (νῆμα, thread) or round *Worms*, in which the sexes are nearly always separate, comprise two orders: *Acanthocephali* and *Nematodes*.

c. The *Acanthocephali* have no digestive canal, and have a protractile proboscis armed with hooks. They include only the *Echinorhynchus*, which, in the adult state, lives in the digestive canal of Vertebrates.

d. The *Nematodes* or *Nematoides* have a digestive canal, generally complete, with two openings. They are elongated, frequently slender, and even filiform. Their number is considerable, and they are found in all the organs of the domesticated animals, with the exception of the bones and the nervous system.

C. The *Arthropodes* are Invertebrates, symmetrically bilateral, formed of dissimilar rings (heteronomous), and always provided with articulated limbs. There are four classes: *Crustacea*, *Arachnidæ*, *Myriapodes*, and *Insects*. The Arachnidæ and Insects alone contain species which are parasitic in the domesticated animals.

a. The *Arachnidæ* are air-breathing Arthropodes, respiration being effected by a trachea and lungs, or by the cutaneous surface; the head is usually fixed to the thorax (cephalothorax); there are two pairs of masticatory appendages (gnathites), four pairs of feet, no wings, and an apodous abdomen. Of the ten orders into which they are divided, two alone include parasites of warm-blooded Vertebrates: these are the *Linguatulae* and the *Acari*. The first live, when adults, in the air-passages, but in the larval state they infest the internal organs. The
parasitic Acari almost exclusively inhabit the surface or the substance of the skin.

b. The Insects are air-breathing Arthropodes, with a trachea, having their bodies divided into three distinct parts (head, thorax, and abdomen), the head carrying a pair of antennæ, the thorax three pairs of feet, and most frequently two pairs of wings. There are seven or eight orders, only two of which—the Diptera and Hemiptera—contain parasitic species, nearly all of which live—at least in the adult state—on the surface or in the substance of the skin.

More extensive zoological details on the various groups of parasites (orders, families, tribes, etc.) will be given when studying the affections to which they give rise.

Habitat of the Parasites.—Parasites live on the surface of the skin or in organs. The first are named ectoparasites, and the second endoparasites.

The ectoparasites are vegetable or animal. The first are called dermatophytes, and the others epizoæ or entozoa. The two last names are generally, however, more particularly applied to the apterous Insects known as Pediculidae, and which include Lice and Ricinidae. The other animal ectoparasites are the Acari and Insects.

The vegetable endoparasites comprise all the phytoparasites other than the dermatophytes. The animal endoparasites are the Sporozoa, the Infusoria, and the Worms; there are also a certain number of larvae of Insects, and notably those of several Œstridæ. The term Entozoa, which is quite suitable, is also applied almost exclusively to Helminths.

Degrees and Mode of Parasitism.—Parasitism occurs in various degrees. It may be facultative or obligatory. Facultative or occasional parasitism (Leuckart) is rarely met with beyond the Fungi, and particularly the Schizomycetes, a large number of which may develop indifferently in lifeless media, in organic matter undergoing decomposition, or in living bodies. Nearly all the parasites embraced in our study present obligatory or constant parasitism (Leuckart); their development necessarily admits of it, at least during a portion of their existence.

From this point of view, parasitism is transitory or permanent. It is transitory for the creatures which, during a portion of their lives, may be nourished external to an animal organism; and sometimes it may take place only during early age—as in the case of the Œstridæ, only the larvae of which are parasites; at other times, it is only at adult age—such are the Ankylostomes, the Ixodes, and the Chigoe (or Chigre). Permanent parasitism extends from the hatching of the egg and liberation of the embryo, to reproduction in the adult. The majority of the Entozoa undergo permanent parasitism.
Parasites may also be fixed or erratic, according as they have a narrowly defined habitat and cannot pass from one host to another (Helminths, Linguatulæ, larvæ of the Æstridæ), or enjoy a more extensive domain (Lice, Ticks, psoric Acari, Fleas, Bugs, Gnats, Leeches, etc.).

For the latter—obligatory and erratic parasites—parasitic life may be essentially intermittent, that is, when they only visit their host to obtain nourishment, leaving immediately afterwards. Such are the adult Diptera (Stomoxes, Hæmatobia, Tabanidæ, Simulidæ, Gnats, etc.), which, when they are gorged with blood, forsake their entertainer and fly to other occupations. Parasitism is continuous for those which remain permanently on the surface of their host for generations: Lice, Ticks, and psoric Acari. Remittent parasitism is an intermediate form between intermittence and continuity, and examples are furnished by the erratic parasites which breed away from their hosts, and are not so closely attached to them—such are the Lice, Hippoboscidæ, Hæmopis.

The mode of reproduction is, in fact, one of the principal factors that determines the conditions in which parasitism shall take place; and in proof of this, there is the profusion with which the germs are produced—this tending to compensate for the multitudinous causes of destruction to which they are exposed.

With regard to intermittent and remittent parasites, reproduction is independent of the host, copulation usually occurring far from the latter, and ovulation always.

Transient parasitism often commences at ovulation and terminates at adult age (larvæ of the Æstridæ).

Independently of the cases mentioned above (continuous parasitism), in which generations succeed each other indefinitely in the same host, there are others in which eggs, deposited in the body of the entertainer, are soon expelled, and must remain external until they reach the maturity indispensable for their hatching. The latter may take place either in an external medium, or in a new host into which the eggs may have penetrated by various channels. The Helminths offer in this respect extremely varied types, of which we shall only notice those relating to the parasites of the domesticated animals, or to neighbouring and better known species.

Sometimes complete evolution of the species only requires one host, sometimes it demands two, successive and, in general, specifically different hosts. Parasites may therefore be termed monoxenous (μῦνος, single, and ἕνος, host) or heteroxenous (ἕνος, different, ἕνος, host).

I. Monoxenous Parasites.—a. The ovum having been evacuated by the host, the embryo is developed within the shell, and while it is

1 These expressions are borrowed from Mycology.
there it passes into a new and definitive host. Examples: *Oxyuris vermicularis*, *Trichocephalus affinis*.

b. The embryos, having left their shell, live in water or moist soil, and are nourished and grow there; but they are not complete—that is to say, sexualized—until after they reach the body of their host. Example: *Uncinaria trigonocephala*.

II. *Heteroxenous Parasites.*—These pass by an intermediate or transitory host, in which they cannot attain their complete development; consequently, this first host must become the prey of a second or definitive host. The choice of the latter is subordinate to its habits. This passing of the heteroxenous parasites from one host to another is named transmigration.

a. Some of the embryos pass to the intermediate host; others may become developed in the host in which they are hatched. Example: *Ollulanus tricuspis*. This type serves as a transition between the monoxenous and heteroxenous parasites.

b. The embryos are hatched in the body of the host which shelters their mother, and invades its tissues; they attain the adult state in a second host. Example: *Trichina spiralis*.

c. The eggs are expelled from the body of the definitive host, and the embryos—free or yet in the shell—pass to the intermediate host; or, after a first development, they give rise, by a sexual generation, to individuals different from their parents. It is incumbent that these individuals make one or more migrations, in order to realize the definitive form which terminates the cycle of their development. These parasites, therefore, represent what has been termed *alternate* or *heterogeneous digenesis*. By their faculty of multiplication in the intermediate host, they realize more exactly than the others the heteroxeny of the Fungi. Example: *Taenia cœnurus*, which has the Sheep for a transitory host, in the brain of which it is developed as an agamous form of the cœnurus—and for definitive host the Dog, whose intestine it inhabits in acquiring the adult state.

Lastly, there are a large number of parasites the metamorphoses and migrations of which we are ignorant.

In general, each kind of domestic animal has its parasites, which are only found in it, or, at least, do not thrive on a different species, and soon leave it. There is between the inferior organism and its host an intimate correlation, an exact subordination, which may be recognised without our being able, in many instances, to determine the conditions of these. Parasites which escape them are precisely those for which parasitism is not imperative, and which only appear in the domesticated animals intermittently; such are the majority of the Diptera, which, in the perfect state, attack the Horse, Ox, and Sheep indifferently; and certain kinds of Fleas that pass readily from Man to the domesticated animals, or inversely, or from one Bird to a
different Bird. The Entozoa are more strictly limited to a certain species, and the exceptions to this rule are rare. One of the most remarkable is furnished by the Trichina, which, in the larval state, finds in the muscles of very diverse species a favourable habitat. Many of the cystic forms of Tænia are equally indifferent to the specific nature of their host, but it is not the same in the sexual state.

The subordination of the parasite is not confined to the host, but usually extends to the habitat. In general, the skin has its parasites, which are not those of the intestines, and those of the latter differ from the ones of the air-passages. Nevertheless, the forms which invade the parenchymatous organs often appear indifferently in one or the other (liver, spleen, lungs, kidney, etc.); such is the cystic form of Tænia echinoccucus. Certain nematode Worms—Spiroptera sanguinolenta, Filaria papillosa, etc.—may also be met with in various organs.

It may happen that, at an early age, a parasite attacks a host which is not suitable for its development; this, according to Davaine, is a foreign or accidental host; or, the host being normal, the parasite has penetrated organs improper to its evolution or growth. In both cases it is a stray parasite. It is called erratic when it is found in the adult state in an organ different from that which constitutes its usual haunt.

Etiology of Parasitic Diseases.—General ignorance at one time prevailed with regard to the origin of parasites. Certain of them, because of their small size, escaped observation, and the maladies they occasioned were relegated to those sections of pathology into which the character of their lesions seemed to warrant their being placed; such were the microbial diseases, the dermamyces, scabies, etc.

The others were considered as the products of a spontaneous generation in the midst of organic matters, under the influence of heat, fermentation, putrefaction, etc. These views were discredited towards the end of the last and the commencement of this century, when precise notions began to be entertained as to the complex structure and reproductive organs of a large number of parasites. But until the early years of the nineteenth century, the most distinguished helminthologists of those days, such as Rudolphi and Bremser, clung to the old doctrines, and Burdach even professed them in 1830, in his Traité de Physiologie.

It was more especially in the mysterious origin of the Cestoda and Trematoda that they found their most solid foundation. But when, in 1842, Steenstrup made known his theory of alternate generation, and a few years afterwards Von Siebold, Van Beneden, Küchenmeister, and others published their significant researches on the generation of flat Worms, the early theories were overthrown, and the necessity for an anterior germ for parasites, as for other creatures, was univer-
sally admitted. The ingenious experiments of Pasteur prevailed against all refractory opposition, and peremptorily established the fact that spontaneous generation could not be invoked, even for the infinitely small parasites or microbes.

Our knowledge of vegetable parasites was later in being perfected, for they were not rendered evident without the assistance of the microscope. The demonstrative labours of Tulasne in 1847, and of De Bary, having proved the nature of the parasitic Fungi of plants, the doctrine of parasitic mycoses in animals obtained a solid basis. A great share of this important acquisition is due to Ch. Robin, who has shown in a classical work¹ on the subject, the considerable part played by these inferior organisms.

Another theory invoked by the ancients to explain the origin of parasites—the intestinal Worms, at least—was their hereditary character; and it is to be noted that, ignorant of the nature of these creatures, they only knew of three kinds of Worms in Man, and, it may be said, none in the other animals. When the researches of naturalists had established the great number of parasites that a single individual may harbour, it became incumbent to renounce an explanation that could not satisfy sensible minds. All that can be admitted is that the foetus may be invaded—as is the maternal organism, and for the same reason—by embryonic worms, which the circulation carries to every part of the body.

The propagation of parasitic diseases is subordinate to the conditions of existence of the parasites.

The eggs deposited by Worms in the intestinal canal, or biliary or urinary passages, are expelled with the excremental contents of these. The parasites of the air-passages are carried outwards by the vibratile cilia of the epithelium (Davaine), and more especially by coughing and husking. Frequently fragments of, or even entire Worms are so expelled, and these, by a process of natural disintegration, yield the ova they contain to external agents.

These ova have various destinations. The majority are lost by exposure to unnatural dryness or humidity. Those which are more fortunate may have to wait a long time—months, and sometimes even years—before they can reach the body of a new host; and sometimes it is the ovum itself, at other times the hatched embryo, that finds a new home; often it is as an intermediate larva between the embryo and the adult; but sometimes they are individuals of a new generation, and which remain independent for a longer time.

In this way the ova of the lumbricoid Ascarides and the Trichocephalus of Man may wait four years for the chance that will bring

them into their natural host. The embryos formed in their interior maintain a latent existence, which terminates when they arrive in the digestive canal, where they pierce the shell enclosing them, and which has become softened by the intestinal juices.

The duration of the period of confinement of the embryo in the egg varies with the species. With the ovoviparous parasites, hatching takes place with the laying—as with the Trichina, and the majority of the Strongles inhabiting the air-passages. This more or less protracted duration of intra-ovular life corresponds to the more or less easy migration of the future Entozoon.

The conditions which the ovum expelled from the organs of its host encounter, are generally related to the mode of life of this host; for in a great number of cases the ovum ought to develop, or to complete its development, when free. If the host lives in water or on a more or less arid soil, it is in one or other of these conditions that the ovum produces its embryo. The ova of certain Entozoa perish without developing, if they are in a humid medium; but others, on the contrary, die if they are placed in a dry medium.1

Besides, in certain species the ova have only a very thin shell, while in others it is thick and resisting; and these differences are related to the durability of the ova after they are laid. In general, the first are hatched in the surrounding media, and infection takes place by the embryos. Example: Sclerostomata; and the thick-shelled ova pass intact, on the contrary, into the digestive canal of the host. Examples: the Ascaridae and Trichocephalus.

The embryo, set at liberty in the digestive canal, thence finds its way to the compartment suitable to its specific nature; or it passes through the intestinal wall, and, either by reptation or by means of the circulation, it attacks those organs which alone favour its ulterior development. In this way are the proscolices of the Tænia, and the embryos of the Trichinæ and several others, eventually localized. If this first sojourn does not constitute more than a stage in the process of evolution, it is necessary that the primary host shall become the prey of a second; so it is that the cysts which reach the intestine become Tænia, the cercariae Flukes (Distomidae), the future Trichinæ adults, the Linguatulae of the Dog full grown, etc.

The transmission of parasites may also take place from an infected to a healthy animal, and it is in this way that scabies and phthiriasis are propagated by direct or mediate contact.

Lastly, in certain cases the instincts of the parasite count for nothing in its installation, as happens with the majority of those which live at liberty till they are of adult age. With these it is the female which is charged to deposit her eggs in the conditions

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required to ensure the indispensable refuge, until the larval stage is reached. The Oestridae furnish a well-known example.

The circumstances that preside over the propagation of parasites are so varied, that they cannot all be passed in review here, but will find their place in the following chapters. In general, parasites are singularly favoured by their prodigious fecundity, and the great vital resistance with which a large number of them are endowed. Leuvenhoek calculated that the female Louse may become in eight weeks the grandmother of 10,000 lice; according to other authorities, the second generation of a single individual may furnish 2,500 progeny, and the third 125,000. Gerlach asserted that a couple of the Sarcoptes of Man might yield six generations in three months, the last generation comprising 1,500,000 individuals. The female Chigoe, when completely developed, is scarcely more than a bladder full of eggs. In a female Ascaris, the oviduct occupies nearly the whole of the body. Each mature segment of a Tænia is gorged with ova, and it has been computed that the Tænia armata of Man may throw off in a year, by the successive detachment of its rings (scolices), as many as 150 millions of eggs. These few startling examples would give cause for great alarm, did we not know how numerous, varied, and powerful, are the causes of destruction surrounding these vermin.

But independently of their prolific capabilities, many parasites possess an altogether remarkable vital resistance. The Ixodidae can endure a very prolonged abstinence. Ralliet has kept the Argas reflexus alive for fourteen months in a glass bottle, and Laboulbène has seen the Argas persicus remain active during four to five years, without receiving the least nourishment. There are Nematodes which complete dessication only renders torpid, and which regain their activity under the influence of moisture. The muscle Trichinae can withstand a cold of 15° (Cent.). Other Worms continue to exist in the midst of putrefying substances, and the ova and embryos of a large number of species are endowed with the same powers of resistance.

The propagation of parasites is facilitated by certain predisposing conditions.

The zoological species of the host plays an important part. As has been said above, few parasites are common to several species. There are, nevertheless, some which are more or less cosmopolitan in this respect, such is the Cysticerus of the pig-measle, the hepatic Fluke, the Trichina, and the larva of the Linguatulus tænoides.

Age has a manifest influence. Young animals are often invaded by Entozoa, and readily so by those which have to immigrate in the tissues, which are more delicate and offer less resistance. Old animals are also the favourite hosts of parasites, internal or external; they are less able to defend themselves from attacks, and the contractions and secretions of the digestive organs are less capable of eliminating these vermin.
After these observations it will be understood that the constitution of the host plays an analogous part, and that weakly subjects are more liable to parasitism than those in the opposite condition. But this is not due to a verminous diathesis, as was at one time believed, but very probably to defective reaction. This explains the fact given by Delafond, that the Psoroptes deposited on the skin of Sheep in good condition did not multiply, and soon perished, while in debilitated sheep they bred rapidly.

The state of the surroundings in which the domestic animals are placed, may favour or hinder the multiplication of parasites. Those whose skins receive but little attention are liable to phthiriases and acariases, which are never witnessed in well-kept animals; and those which are clipped have more chance of escaping them. Crowding and dirty habitations aid in the propagation of parasites. The Herbivora, which live at pasture, alone harbour the larvæ of the Æstrídæ; butchers' dogs, and those of shepherds, are the favourite hosts of certain Tæniae, whose cystic life is passed in the tissues of Herbivora; and there are also Dogs which harbour the Linguatulae in their nasal cavities, the larvæ of these parasites offering analogous facts. Flocks kept in dry pastures are exempt from distomatosis, and other examples might easily be given.

The influence of Seasons is related to the preceding. It is only in summer that are seen the adult Diptera, which torment our animals by living on their juices, or depositing their larvæ in their skin; in summer, also, the Ixodes appear, and the Fleas breed; and we have the Ticks in autumn and the Pediculi in winter. Many of the parasitic diseases—as Scabies—undergo very remarkable seasonable variations. It is in the autumn that Sheep receive the germs of distomatosis, etc.

Countries operate according to their climate, and also by the management and the kind of feeding the animals receive in them. Many Ixodes and Argas are peculiar to certain hot countries; the Bilharzia crassa has only been found in Egypt; the Gastrodiscus in Egypt, Guadeloupe, and Senegal. The Tænia of the Horse are frequent in Germany, but rare in France. In Iceland, the Tænia echinococcus is found in one-third of the Dogs, and the Cystic echinococcus in the majority of the Sheep and Cattle. The Trichina spiralis is particularly common in Germany and the United States. On the other hand, there are parasites which are found everywhere—such are the majority of the Tænia of the Dog, the Ascarides of the Horse, and the Cysticercus of the Pig.

Symptoms and Lesions.—The influence of parasites on the health of their host has been at all times the subject of contradictory opinions. Some authorities—as Andry, Nylander, Leuwenhoeck, etc.—have attributed to imaginary worms or inoffensive parasites the most diverse
diseases, and chiefly epizoötic or enzoötic affections. Later, there was a tendency to consider the majority of the parasites as indifferent to their host, and even favourable to health. So it was that Abildgaard and Goeze admitted that Lice are the natural emunctories, and remove the bad humours secreted by the skin, while the intestinal Helminths stimulate digestion, and consume the superfluous juices in the viscera. Bracy Clark expressed a similar opinion with regard to the larvae of the Gastrophilus found in the stomach of the Horse; even in our own times, the Abyssinians consider that harbouring one or more Tænia is a sign of good health, and there are physicians to be found—though they are rare—who entertain such a doctrine.

It is no doubt true that at the autopsies of animals which showed every sign of health, the intestines may be discovered to contain a considerable quantity of Worms; this is often the case with the Ascarides of the Horse, and the Tæniae of the Dog and Birds. The larvae of the Gastrophilus may cover nearly all the mucous membrane of the left sac of a healthy Horse’s stomach; an Ox may, without any apparent inconvenience, have all the upper part of its body studded by the tumours of the Hypodermata; but we cannot therefore conclude from such facts that these are of any benefit to the hosts infested by them. At most, we might admit the indifference of the latter, or, better, the production of a reaction by which there is compensation for the inconveniences of this invasion. For these parasites are nourished on the tissues of their host, or on the chymous matters in the digestive organs, and they more or less obstruct those passages, the freedom of which is favourable to health. They often finish by being a source of trouble, especially if they bring about disadvantageous modifications in the constitution, these becoming manifest as parasitic diseases. The instances are numerous in which the tolerance of the organism is rapidly exceeded, either by the nature of the weapons of the parasite, its mode of attack, its propagation, or its habitat.

The innocuousness of the latter is, in its way, for the most part, due to its habitat, to the organ it invades, and to the function of the organ. Sometimes—as with the majority of the intermittent or remittent parasites—the damage is not so much owing to the blood abstracted from the host, as to the torture the bites or stings produce; and at other times—as with the psoric Acari—their breeding brings about in the skin disorders in nutrition, which have a bad effect on the general health; while certain of them which invade the ear, give rise to serious nervous disturbance.

In general, the intestinal parasites act by crowding, so as to cause mechanical obstruction, and digestion may become impaired; though rarely, in consequence of some defect in local resistance, there may be perforation or rupture of the organ. Sometimes the injury is limited to the abstraction of a certain quantity of blood, which the worm
INTRODUCTION.

sucks from the mucous membrane. The Uncinaria act in this manner.

When the liver is very much infested, beside the lesions and symptoms of hepatitis or cirrhosis, there is icterus and anaemia. The respiratory organs, and especially the bronchi and lungs, with difficulty support the presence of parasites. Verminous bronchitis and pneumonia owe their gravity to the unceasing and increasing effects of a cause always acting more and more energetically. The parasites disseminated in the organ occasion around them an inflammatory process of variable intensity, according to the vitality of the agent, and which, as Laulainé has demonstrated, may descend to the slow, insidious, and silent form of tuberculosis.

The parasites of the blood-circulation may not, for a long time, attract attention; but when they manifest their presence, it is by alarming symptoms resulting from alterations in the walls of the vessels.

The natural susceptibility of the nerve-centres scarcely permits them to withstand the presence of parasites. As the bony covering of these centres fits closely upon them, a parasite that penetrates it can only develop by causing compression and atrophy, which are nearly always fatal. In the same way the organs of vision betray, by disturbance of their functions, the invasion they have undergone.

The muscles are, of all the organs, the most tolerant. Pig-measles, trichinosis, actinomycosis, etc., most frequently occur without arousing any suspicion; the histological alterations the muscular tissue undergoes are not betrayed by marked signs.

Of the genito-urinary organs, the kidneys almost alone exhibit any susceptibility, particularly with regard to the Eustrongylus; this susceptibility being accounted for by the enormous volume of the parasite.

Otherwise, it is evident that, independently of habitat, the pathological phenomena due to parasitism are subordinate to the number, dimensions, and mode of life of the parasites.

If there be only one, or if they are in small number, they are only obnoxious when a delicate organ is attacked—as is witnessed in 'Gid,' or in verminous ophthalmia; or if their volume causes a great destruction of tissue (giant Strongle). It is usually by their accumulation that parasites become dangerous.

It is only among those of the intestines that the dimensions are great, the volume and nature of the habitat admitting them without inconvenience. Nevertheless, the Echinococci of the liver and lungs are capable of attaining a considerable size.

A large number of parasites of the stomach and intestines are nourished by the more or less modified alimentary matters contained in these organs. All the others derive their sustenance from the substance of their host. The Ricinidæ, the Sarcoptidæ plumicolæ, and the Gliricolæ feed on the epidermic cells, or the débris of worn-out
feathers or hairs; they might, therefore, be considered as mere mutualists, relieving the skin of useless materials, if we did not know that the first—at least, when breeding—are a veritable torment to their host, and that certain plumicole Sarcoptes, when they penetrate the shafts of the feathers, may, by causing atrophy of the papille, bring about the shedding of these cutaneous appendages, and, consequently, a real dermatosis.

The parasites which live on the blood (haematophagi) are, from this fact, rarely dangerous to their host. Some—such as Fleas, Gnats, and other Diptera—puncture the skin, and leave it when their appetite is satisfied; others plunge into the fluid upon which they subsist (Haematozoa); and certain others, as the Hæmopis, may, nevertheless, extract such a large quantity of blood that anaemia results—a circumstance which is also remarked when the Ucincaria of the intestines are in considerable number.

The majority of the parasites derive the materials for their development and maintenance from the morbid products they excite the secretion of. Those which are provided with a digestive apparatus ingest these materials; while others imbibe them by cutaneous osmoses. Among the Worms, the Nematodes and Trematodes are in the first category, and the Cestodes are in the second. This spoliation, aiding the compression, may induce atrophy of organs.

The anatomical situation occupied by the parasite in the tissues of organs, is subordinate to its size. The smallest may be lodged in the elements of the tissues: the Coccidium oviforme in the epithelial cells of the Rabbit’s biliary ducts; the Sarcosporidia in the ultimate fibres of the muscles, as well as the Trichinae and the Actinomyces musculorum; and the ova of the Strongylus vasorum in the giant cells. Others are contained in the natural cavities of organs: example, the majority of the parasites in the digestive canal. Certain are found in cysts formed at the expense of the tissues of the host—such are the cystic Worms, the Cysticeri, Cœnuri, and Echinococci; such are also the Trichinae. Or they may be lodged in real unilocular or multilocular abscesses—such as the larvae of the Hypodermata and the Spiroptera of the stomach; or in fibrous tumours, as the Spiroptera reticulata; or in aneurisms, as the Sclerostoma armata. Lastly, the Worm is in direct contact with the tissues it invades, and burrows in them to effect a lodgment—such are the giant Strongle and the Filaria of verminous ophthalmia.

Diagnosis.—The diagnosis of parasitic diseases rests principally on the investigation and determination of the parasites which cause them. There are many which do not give rise to any precise sign or symptom, and their presence can only be ascertained by an autopsy; often, even the name of the malady cannot be justly applied to them.
Sometimes the ejection of some parasites is the only symptom, and this frequently happens in cases of intestinal helminthiasis, especially in the Dog, and also for the gastricular Cestridae. When suspicion alone exists, certainty can only be ensured by a microscopical examination of the matters discharged, or of the excrements; in default of a parasite, ova or embryos may be found—as in distomatisis, and in verminous bronchitis and pneumonia; or, by a kind of partial ante-mortem autopsy, fragments of tissue may be extracted from the animal, and their examination will remove all uncertainty—as by using the harpoon in trichinosis, or in the ablation of tumours due to the Spiroptera reticulata.

The dermatoses, and the parasitic otites and ophthalmias, show more or less manifestly their original cause.

The symptoms proper, due to the functional disturbances in the host, may also be sufficiently significative to permit a true diagnosis being established, and this will be confirmed at a later period—during the life or after the death of the patient—by the discovery of the parasite; this is usually the case in scabies, the Hypodermes, distomatisis, verminous bronchitis, 'gid,' etc.

A somewhat frequent cause of error occurs in considering as parasitic, the affections that coincide with the presence of minute organisms—animal or vegetable—which have absolutely no pathogenic influence. There are often found on the skin the germs of Cryptogams which are brought there with the dust from forage, or stray Acari or small insects also derived from forage, litter, or grooming utensils; larvae and various foreign bodies have also sometimes been mistaken for parasites, and in the intestines of Carnivora may be found Helminths belonging to the host which they have eaten, and which have resisted the gastric juice. These are so many examples of what is termed pseudo-parasites.

Nomenclature of Parasitic Diseases.—The maladies caused by parasites have received various appellations, according to the state of science at the periods when they have been so named. When their nature was not known, the names given to them were based on some important symptom—such are the terms scab or mange, red mange, ringworm, herpes, favus, osteo-sarcoma, rot, measles, gid (hoose), etc. Later, some more precise terms indicated the progress made in knowledge, and thus we find in the mange or scab of the domesticated animals sarcoptic, psoroptic, and symbiotic scabies; and in verminous bronchitis, verminous pneumonia, and verminous ophthalmia, affections characterized according to their seat, and, with varying precision, their cause.

At present the general tendency is to designate each parasitic disease by a word, the radicle of which is derived from the generic name of
the parasite, this radicle being followed by the suffixes asis or osis. Examples: Phthiriasis, Acariasis, Helminthiasis, Strongylosis, Filariosis, Trichinosis. Parasitic diseases having always an immediate and known etiology, residing in the parasites producing them, this division of pathology has thus the advantage of possessing a rational nomenclature.

**Prognosis.**—The gravity of the disturbances due to parasites is subordinate to the alterations they determine. Inappreciable with some parasites, the symptoms exhibited may appear in every degree—from that of mere inconvenience to the extent of deadly disease—a fatal result ensuing more or less rapidly, according to the organ attacked.

The seriousness of many parasitic disorders depends upon their often appearing in an epizootic form in the whole of a herd or flock, over a wide district, or throughout an entire country. This may depend upon whether the majority of the animals have been submitted to conditions which permit the invasion of the parasites—distomatosis, for instance; or whether their agglomeration has extended the contagion—as in scabies. There is multiplication of the losses by deaths, by depreciation of the flesh or the wool (or skins), by the difficulty in fattening, by the inability of working animals to perform their labour, and by the time required (and expense incurred) in attending to (and curing) them.

On other occasions, a disease which may be benignant in one animal may acquire an extremely serious character if due to certain heteroxenous parasites, which become dangerous in their second form. The helminthiasis of the Dog, insignificant in itself, is of much gravity for numbers of the Herbivora, in which—according to their species and the kind of Taenia—it may be the source of 'gid,' echinococcosis, and several cysticercoses.

But what gives this study much of its interest, is the fact that the danger from these heteroxenous parasites is often threatened to Man. Without reckoning scabies and ringworm, which he may derive from contact with animals, he finds in what he eats the germs of trichinosis, and those of the armed and unarmed Taenia; while the Dog may also transmit to him the Echinococci. The enumeration of these affections might be made more extensive, particularly if the microbic maladies were included.

**Prophylaxis.**—If we do not yet know the precise mode of introduction of a great number of parasites, we are yet not altogether at the mercy of their invasion. For them as for the others, their germs are certainly derived from without; and it is evident that our animals can be rendered absolutely safe from them, if we can ensure the rigorous cleanliness of the various hygienic agencies—the air they breathe, water they drink, food, harness, etc. It is on this point
that attention should be fixed at first; but as it requires continual, fastidious, and patient care, it is generally neglected in practice, and only comes into notice when circumstances have demonstrated the imminence of an invasion. This is a consequence of the exigencies of rearing animals.

If dealing with ectoparasites, the animals attacked should be isolated, and the place they occupied—and, by preference, all the locality—scrupulously disinfected. In this respect, boiling water is the best agent.

For the endoparasites, the preservative measures should be subordinate to what is known of their mode of introduction. Water having in this instance the greatest share, its purity should be attended to. Abstention from such watering-places as ponds, streams, cisterns, etc., into which rain-water passes, is necessary, if these receive and retain various dejections containing germs of parasites. In taking precautions against some heteroxenous parasite, we should keep away the definitive host; for instance, we ought not to allow Dogs to eat the heads of Sheep which have died of ‘gid’; flocks of Sheep should be kept from Dogs which have Tape-worms; Sheep should not be allowed to graze in damp pastures, where they may find Snails infested with the Cercaria of the Distomata, etc. But for each malady to be hereafter studied, more precise information will be given on these various points.

All the parasites met with—those ejected by the natural passages, or collected by cleaning instruments—and all the organs which, after examination, are found to be infested, should be carefully destroyed by fire or boiling water. Above all, they ought not be thrown on to dungheaps, where rain may carry the germs they contain into watering-places. At most, Dogs should only be permitted to consume parasitic viscera when it is ascertained that the infection cannot be transmitted by these animals—such are verminous lungs; but it is really better to abstain from this use, for it is not certain if the ova of the Strongles may not pass with impunity through the digestive canal, to be disseminated everywhere by the excrements of the Dog. (Boiling these viscera, of course, renders them safe as food.)

These various precautions should be rigorously observed if the animals to be protected are, because of their age, their state of health, the season, locality, climate, etc., placed in predisposing conditions for invasion. The state of health may be advantageously modified. In this way Sheep are often preserved from distomatosis, in preventing anemia by giving good food and appropriate remedies.

Finally, there are cases in which administrative intervention efficaciously contributes to diminish the inroads of parasitic affections. In slaughter-houses and markets, special inspectors seize flesh and other articles affected with these, and in disinfecting or destroying them, so get rid of the germs which would otherwise develop in the human organism, and continue their evolution. The laws and regulations of
sanitary police concur in the same object, and through such measures, for instance, as those which restrict the extension of Sheep scabies.

Treatment.—In the therapeutics of the parasitic maladies, it is sometimes advantageous to modify the general health by tonics and alteratives. Nevertheless, a definite result cannot be obtained if the efforts have not for their principal, and most often exclusive, object the destruction of animal or vegetable organisms which, inhabiting some part of the body, live at its expense. The name of parasiticides (parasitus, parasite; cadere, to kill) is given to agents which possess that property. They are naturally divided into two groups: the octo-parasiticides, which destroy external animal or vegetable parasites; and the endoparasiticides, or anthelmintics, employed against helminths or entozoa, which live in the interior of the body of man or animals.

These medicaments are extremely varied. There are some which, like the fatty substances, occlude the respiratory stigmata of the Epizoa, and so asphyxiate these; but nearly all act as toxicants on the parasites to which they are applied, and a certain number being irritants also for the host, require the observance of certain precautions in their employment.

Parasites situated in the tissues, or in cavities not in communication with the exterior, cannot be reached directly by medicaments, and we do not know of any substances which can be administered without danger, in sufficiently large quantity to be distributed throughout the organism by diffusion or the circulation.

Nevertheless, these inaccessible parasitic diseases have not necessarily a fatal issue. In general, the deep-seated parasites cannot reproduce, and their number is therefore limited to those which formed the first invasion. If this is not mortal, then time diminishes the vitality of the parasite: its volume becomes reduced; it undergoes calcification, and is then only a foreign body, inoffensive because of its small dimensions.

In some instances surgery extends the resources of antiparasitic therapeutics. It is by hydrotherapy and trephining that we combat the Cœnurus cerebralis, by the extirpation of tumours the Spiroptera reticulata, by injections or fumigations the Linguatulus of the Dog and the larvæ of the Sheep Oëstrus, and by puncture those of the Hypoderma.

Lastly, there are parasitic affections which disappear of themselves, by virtue of the laws which control the evolution of parasites. Such are those which are allied with the seasons: the dermatoses due to the Ixodes, Ticks, the larvæ of Oëstridæ of the Horse’s stomach, the skin of the Ox, and the nasal cavities of the Sheep.

In the following chapters, in which, for greater facility in their study, the parasites will be examined as to their pathological influence according to their habitat, the treatment appropriate to each particular case will be indicated.
BOOK I.

PARASITES OF THE SKIN.

By its peripheral situation and its relations with the external world, the skin is, more than any other apparatus, exposed to the invasion of animal or vegetable parasites. These arrive directly at its surface, fix themselves there, and are propagated readily from the affected to the healthy animal. The maladies they occasion vary in seriousness, according to the mode of parasitism they affect—their habits, requirements, and their superficial or deep habitat. In general, the diagnosis of these affections is easy, the determination of the cause being at the immediate observation of the investigator; and so, for the same reason, is the treatment. Some of these diseases disappear spontaneously, as a consequence of the conditions which preside over their development—tumours of the Hypodermæ, and stings of the Diptera. Nevertheless, the majority have a tendency to perpetuate themselves and become aggravated, by direct reason of the fecundity of the parasites, and—owing to the absence of appropriate treatment—the grave disturbance in the functions of the skin bringing about loss of condition in the individual.

There is a small number of parasitic dermatoses which are markedly distinguished from the others in every respect. They are due to some Nematode which leaves the interior of the body and is attracted to the skin by accidental or instinctive selection. The diagnosis of such is easy, but not so the treatment which—not being capable of reaching the parasite at its source—has no influence on the progress of the malady, otherwise in itself of little gravity.

The parasitic dermatoses naturally divide themselves into dermatozoonoses and dermatomycoses, according as the parasites are animal or vegetable. The latter are few, and form quite a distinct group, as much by their physiognomy as by their nature. The dermatozoonoses, on the contrary, are extremely varied, according to the host affected, and especially owing to the numerous kinds of parasites which may produce them. The majority belong to the Insect class and to that of the Arachnidae; some are Nematode worms or Psorosperms.
All the parasitic insects belong to the order Diptera, or that of the Homoptera.

The Diptera are suctorial Insects, provided with only two wings, and undergoing complete metamorphoses. The two existing wings are the anterior ones; they are nude and membranous. The posterior wings are replaced by two balancers — small organs, each composed of a slender stalk terminated by a round knob, and furnished at its base with a small scale, concave below, convex above — the spoon or tegula. The buccal apparatus is a proboscis or sucker, adapted for the suction of fluids, and frequently for puncturing: the lower lip, in fact, is transformed into a canal and the other pieces into setiform stylets, six at most, lodged in a canal. To the mouth are annexed salivary glands, the secretion of which is often poisonous, and causes irritation consecutive to the puncture. By the fact of their complete metamorphoses, on their issue from the egg the Diptera are in the form of apodal larvae; then they become pupae or nymphae, and finally acquire the perfect state. They are divided into three sub-orders: Nemocera, Brachyceurus, and Aphaniptera. The latter is constituted by the Fleas, which, by reason of their mode of existence, are distinct from the Diptera — properly so called — from a parasitical point of view.

The Homoptera are also suctorial Insects, generally provided with two pairs of wings, the anterior of which are of variable consistence, while the posterior are membranous; their metamorphoses are null or incomplete. They are likewise divided into three sub-orders: Homoptera, Heteroptera, and Aptera. The latter is essentially parasitic, and composed of insects which will be studied under the name of Lice. Of the other two sub-orders, the Heteroptera is alone referred to, as it contains the Bugs, the noxious action of which will be considered after that of the Lice.

The Arachnida parasites of the skin all belong to the order of Acari, the study of which will form a special chapter.

The various parasites of the skin contract with their host relations more or less intimate, more or less continuous, and more or less necessary, which are in this respect subordinate to the state of perfection of their organism. Some — such as the Simulium and the Breeze, Ox, and Horse Flies — only come into contact with the domesticated animals at long intervals, in order to puncture them and suck their blood. Others — like the Hippoboscidæ — are independent, and live for a long time in contact with the Horse’s skin. Others, again, which are agile, but have no wings, only exceptionally live — and then only for a very short time — away from their natural host: such are the Epizoæ — Fleas and Lice. Those which live deeper in the skin — the Dermatozoæ — comprise the Acari of seabies, lodged in the epidermis; the Demodex, not so well endowed, sheltered in the hair follicles and sebaceous glands; the larvae of the Hypoderma, which penetrate beneath the skin itself; the Nematodes, which are met with in the substance of the derma, and in the products the formation of which they have excited. This sketch will show the intimate relation that usually exists between the
organization of the parasite and its localization, more or less deep and permanent, in the skin of its host.

The disturbances generally due to parasites are of an inflammatory character—hyperæmia, exudation, pustules, efflorescences, crusts, hæmorrhage, abscesses, tubercles, etc. They are due to the presence of the parasites only, or to their migrations or punctures. These organisms act also in causing pruritis, which impels the animal they infest to scratch itself; whence arise secondary alterations of variable intensity—such as depilations, excoriations, pustules, erythema, and ulcerations.

The symptoms of such dermatoses consist of these pathological processes, and especially in the presence of these parasites, their zoological characters, and their mode of existence. The gravity of the symptoms is subordinate to the facility with which medicinal agents may reach the parasites. But that which is most deserving of attention is the contagion, which is sometimes exercised with provoking facility, and outstrips by its rapidity all endeavours made to localize the disorder. Finally, when the dermatozoonoses prevail among animals in feeble health or badly attended to, they may bring about general troubles, and a physiological misery which is sometimes fatal.

In the following description, the parasites of the skin will be examined as closely as possible in their zoological order, subordinating this in part to the seat of the maladies and to the gravity of these. This will embrace successively:

1. The study of the parasitic Diptera in the perfect Insect or imago state;
2. That of the larvæ of the Muscidae and Æstridae;
3. That of the Fleas;
4. That of the Lice (phthiriasis);
5. That of the Acari (acariases);
6. That of the cutaneous Nematodes (cutaneous helminthiases);
7. That of the Sporozoa (cutaneous psorospermosis);
8. That of the Dermatophytes (dermatomycoses).
CHAPTER I.

DIPTEROUS PARASITES IN THE PERFECT INSECT STATE.

These are free and intermittent parasites, for they only visit animals at more or less long intervals, in order to prick them and suck their blood, or merely to feed on their perspiration. They are commonly called Flies, although only a very small number belong to the same family as the Flies, properly so called. They are comprised in the two sub-orders of Nemocera and Brachyceræ, thus named because of the form of their antennæ.

The antennæ of the Nemocera (νυμα, thread; κέφας, antenna) are filiform—sometimes plumose in the males—and formed of at least six articles or pieces. In the Brachyceræ (βραχίς, short; κέφας, antenna) they are short, and composed of only three articles, the last of which, stronger and often segmented, usually carries a fine stylet.

Nemocera.—In this sub-order, which is much less numerous than the other, the Culicidae (Gnats) and Simulidæ only come within our study. Both pass their larval phase in water, in damp ground, or in shady places. It is in the latter also that they abound in the adult state, although winds may carry them far from their place of origin. They subsist on vegetable juices, but the females often attack animals, to prick them and suck their blood.

The Gnats (Culex Linnaeus) form the type of the family of Culicidæ. They are recognised by their long body, their antennæ composed of fourteen articles, which are filiform and very plumose, especially in the males; by their bulging prothorax, narrow, cylindrical abdomen, their long thin legs, elongated narrow wings lying flat on the body during rest, and their humming during flight. The rostrum comprises six bristles or points, and carries laterally the two maxillary palpi, longer than the rostrum in the males and very short in the females.

The best known species is the Common Gnat (Culex pipiens L.).

It is five to six millimètres long, thorax brownish-yellow, with two dark lines on the dorsal surface, the abdomen pale gray, with ash-coloured rings (or segments); the legs are elongated and brown. It is found everywhere, and abounds particularly in the neighbourhood of
damp places and stagnant water, which are necessary for the opportune laying of its eggs and its metamorphoses.

It torments Man, particularly during the night, and in some countries constitutes a veritable scourge. Its sting, due to the penetration of the stylets of its rostrum into the skin, is not perceived at first, but it soon becomes the seat of intense itching and slight swelling, without doubt owing to the poisonous saliva the insect ejects.

To the genus Culex belong the Mosquitoes of America, abundant especially in the West Indies, Mexico, and South America, where they are, for mankind, a source of incessant torment. Certain travellers even affirm that they are obnoxious to the multiplication of Cattle in the llanos or prairies of Venezuela, persecuting them to such a degree as to prevent their thriving on the richest pastures.

It is not very probable that, in our country, the Gnats attack animals; in any case, they are far from being as aggressive and tormenting as with Man. Cobbold, however, mentions a Culex equinus which more particularly attacks Horses.

The scourge which takes the place of the Gnats with regard to the domesticated animals, though not sparing Man, is found in the genus Simulium.

The Simulium (Simulium Latreille), typical of the family of Simuliidae of Schiner, has a thick body, bulging thorax, somewhat short, cylindrical antennae formed of eleven articles, the two first being separated from the others; the abdomen is relatively short and broad; the legs are strong, with wide tarsi; the wings are very wide, short, and lying flat. The rostrum only comprises two resisting bristles designed to puncture, and is provided on its sides with two maxillary palpi having four articles, the last of which is long and slender. These Insects do not pipe when flying. They are invested in a fine downy covering; the males, much fewer than the females, are darker and more velvety, have the wings variegated, and the legs broader and more hairy.

The Simulium usually keeps to watering-places, shaded by trees, and flies in swarms towards sunset. The family subsist on the juices of vegetables, but the females often attack animals and Man, sucking their blood with avidity, and producing painful stings. They are encountered in all climates.

In Lapland, they are sometimes extremely abundant in May and July, and by night and day prey upon Man. According to Guillard,¹ "it is not rare to see Calves and Sheep succumb to their bites. The Reindeer only escape the torture by taking refuge beside glaciers and on the summit of mountains." (The Lapps preserve themselves and their

² (The line to the right of this and other figures indicates the natural length of the creature represented.)
Reindeer from these pests by living in the smoke of large fires.) The principal species are *S. boreale*, *S. reptans* (Fig. 1), etc.

Various parts of the New World are often infested with them. In Brazil and South America they are known as *Mosquitoes*; in North America they are called *Black Flies* and *Brâlots*.

Like that of the Gnats, the punctures of the Simulium are followed by a somewhat smart local irritation, probably due to the venomous saliva shed therein. These Insects have been accused of propagating anthracoid and septic diseases, it being supposed that, after having sucked the blood of an animal attacked with one of these affections, their proboscis, charged with this virulent fluid, may inoculate any healthy animal which they chance to fasten upon.

The Simuliidæ of Europe, though only numbering a few species, are, according to Laboulbène, somewhat difficult to distinguish from each other.

The commonest appears to be the *Simulium reptans* (Linn.) (Fig. 1). The male is dark and velvety, with the margins of the thorax grayish; the female gray. The legs have white rings; the base of the wings and the balancers are yellow. Length, 2 to 3 millimètres (Laboulbène). It is somewhat common in the Paris basin.

Spinola mentions that certain Diptera in Brandenburg, which he identified as *Simulium reptans*, and that, again, as the *S. Columbaschense*, attack Horses at pasture, and prick their ears more especially. Where these punctures have been made there appear white spots, which render the skin as if fly-bitten.

The Gray *Simulium* (*S. cineram* Mac.) is of a dark-gray tint, with the antennæ black, the thorax marked by three black, rather indistinct, longitudinal lines, and the abdomen by three black longitudinal lines. Legs black. Length, 3 mm. to 3·5 mm.

Mégnin has made similar remarks on this species to those of Spinola on the *S. reptans*. According to him, it is common more especially in the large forests in the centre and north-east of France. It chiefly attacks Horses on those parts where the skin is fine and destitute of hair, as on the inner surface of the thighs, and the interior of the auricular concha. The punctures—which are usually very numerous on a small space—give rise to a somewhat severe inflammation, the subsidence of which is accompanied by an abundant epidermic exfoliation and shedding of the hair. Some Horses, for several days after these attacks, have their ears so sensitive that it is difficult to bridle them. In others of good breeding and nervous temperament, the pricks of the Simulium inside the ears have been followed by a veritable *psoriasis guttata*, characterized by small lenticular patches, isolated or confluent, covered by a white, nacreous, epidermic stratification, beneath

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which the integument has disappeared, as in vitiligो.  ’ (This insect is also to be found in England, as I had evidence of during the Cannock Chase manœuvres in Staffordshire, in 1872. The horses of the Royal Engineers—to which corps I then belonged—were picketed in a narrow valley near the river Soar, where they were greatly annoyed by myriads of this Simulium; which congregated inside the ears, and gorged themselves with blood. Subsequently, the white patches mentioned by Spinola and Mégnin appeared on the skin lining the ears.)

Another species, the multiplication of which is sometimes very troublesome, is the Spotted Simulium (S. maculatum Meig.).

The male is of a velvety black, with the sides of the thorax in front of a silky yellow, and the base of the abdomen also yellow on each side. The female is bluish-gray, with three black longitudinal bands on the thorax. The abdomen has three black contiguous spots above. Length, 2 mm. to 2·5 mm.

The spotted Simulium is abundant in summer in woody and marshy places, and often attacks animals, particularly in warm and stormy weather. In April, 1863, the canton of Condrieu (Rhône) was particularly troubled, in consequence of the extraordinary multiplication of these flies. Professor Tisserant\(^1\), of the Lyons Veterinary School, observed that they chiefly attacked Equines and Cattle, annoying Sheep and Goats less, and not even sparing Man. They sought those parts of the body where the skin was thinnest and had least hair. When the Insects were numerous these parts became red, even bloody, and denuded; then followed a hard and painful tumefaction, with fever, and sometimes symptoms of dyspnœa and intoxication, which might result in death in from twelve to fourteen hours after the invasion of these swarms of Simulium. In fact, eight or ten cattle did die. ‘For some time,’ Railliet justly remarks,\(^2\) ‘it was sought to attribute these accidents to an epizooty of anthrax, in which the insects acted only as carriers of the virus. But this was an entirely gratuitous supposition.’ Conviction as to the fact of these Insects being the cause followed the study of the event, and especially when it was remembered that a similar, if not identical, species gave rise to serious consequences in certain parts of Central Europe, where it is famous as the Kolumbatz Fly.

The Simulium of Kolumbatz (S. Columbaschense Fabr.), female—the male is very rare—measures 3·37 mm. to about 4 mm. It is black, entirely covered with a whitish dust and yellowish hairs; the antennæ are yellow; the legs are white in the living specimen, but become yellow after death; the wings are hyaline.

This species derives its name from an old castle in Servia—district


of Posharavatz—on the right bank of the Danube, where it abounds in
low-lying, damp, and woody situations in that neighbourhood. It was
there that its damaging effects were first observed and described by
Schönbauer. It was subsequently found here and there throughout
nearly the whole of Germany; but it is only abundant in Southern
Hungary, Servia, Austria and Moravia, and is most numerous after
inundations from the Danube. Damp shady places are its favourite
haunts, as it passes the first phases of its development in water. Near
the castle of Kolumbatz are vast limestone quarries, where the Insects
doubtless find shelter during unfavourable weather, and this may
explain the tradition ascribing the abundance of these little Flies to this
locality.

From the early days in May, they appear in such numbers that, from
a distance, the swarms seem like dark clouds; it is impossible to breathe
without getting them into one's mouth, and white animals upon which
they settle appear quite black. They alight upon Man, but prefer the
domesticated animals, which they chiefly attack around the natural
openings, penetrating even into the air-passages. 'Each puncture this
Insect makes,' says Schönbauer, 'causes a burning itching, and a very
hard and painful tumefaction which rapidly forms, and does not dis-
appear until after eight or ten days. When the punctures are numerous
and close to each other, they occasion a violent fever, and, in irritable
individuals, cramps and convulsions. It will be understood, after this,
how these small Insects can kill large animals in a few hours, when
they inflict at one time thousands of punctures on the most sensitive
and thinnest parts of the skin, and when from these punctures arise
thousands of small, very painful swellings which merge into a large
tumour, and develop a violent inflammation. . . . The animals succumb
to the inflammatory fever and asphyxia, the Insects filling and obstruct-
ing the larynx, trachea, and bronchi. Some of the animals even suc-
cumb during the course of the invasion of the Simuliidæ, others a few
hours afterwards, and others, again, during the following night. The
more tender the skin is, so the more the punctured part is sensitive,
the consecutive irritation more intense, the swelling greater, and the
consequences more serious. This is why women, children, and young
animals suffer much more from the punctures than men and aged
animals. There are instances recorded of children being killed by these
Insects—these occurrences taking place more especially when the
mothers, occupied in the fields, have left their progeny lying on the
ground.'

According to Tömösváry, death is due to the multitude of punctures,
to the pain they cause, the small hemorrhages, and the poisoning of the
blood by which they are followed. The female Insect is alone capable
of pricking, and it acts with such vigour that it buries its entire head
in the skin, and, having gorged itself, falls helpless to the ground.²

In 1783, in the neighbourhood of Kolumbatz, the losses due to these
Simuliidæ were not less than 52 Horses, 131 Cattle, 316 Sheep, and
about 100 Pigs. In 1813 and in 1830, in this locality many hundreds of
Horses, Cattle and Sheep perished from this cause. In 1878, several
localities of Central and Southern Hungary were severely visited by

¹ A. Schönbauer. Geschichte der Columbazer Mücken. Wien, 1795. Cited by
Zürn.
DIPTEROUS PARASITES IN THE PERFECT INSECT STATE. 29

these pests, and in certain parts from 20 to 30 cattle died daily; the herds were so plagued that they could only be sent to graze at night. ¹

Brachyceres.—This sub-order, which is very extensive, has been divided into a great number of families; but the only ones which belong to the subject of this chapter are those of the Tabanidae, Asilidae, Muscidae, and the Hippoboscidæ or Pupipara.

The Tabanidae have a broad and slightly flattened body, the wings often apart, the head large and depressed from before to behind; the eyes are contiguous in the males; the last article of the antennæ is annulated, but has no stylet; the proboscis, usually salient, comprises six stylets in the female, four in the male; the tarsi are furnished with three cushions. (The proboscis is exserted, enclosing lancets and ending in two fleshy lobes; their wings are extended horizontally, are moved by powerful muscles, and provided with a greater number of nervures than any other of the order.)

These Insects, and particularly the Breeze-flies, 'are,' says Macquart,² 'spread over the world; each climate has its own proper species; and with regard to instinct, it is everywhere the same. The Lion in the deserts of the torrid zone and the Reindeer of Lapland have them for enemies, as have our Oxen and Horses. At the moment when the Insect fixes itself, the proboscis pierces the thickest skin, and blood flows immediately. The females alone attack, the males living on the sap of flowers, though the former have also been found on the corollas; it even appears that the Pangonia have no other food. The Tabanidae more particularly frequent woods and pastures; and it is during summer, and the warmest hours of the day, that they are most redoubtable. Their flight is rapid, and accompanied by a buzzing sound.' This revealing noise is for the threatened animal a cause of alarm; but it is in vain that, by movements of limbs or tail, it can repel the enemy,

¹ Oesterr. Monatschrift für Thierheilkunde, 1878, p. 54. See also Jahresber. ü. d. Veterinarwesen in Ungarn, 1889, p. 98.
which suddenly descends on it, choosing the parts where the skin is
finest, and burying therein the powerful sharp proboscis, which is not with-
drawn until the creature is satiated with blood. And
after its departure there flows a last drop of blood;
then appears a slight swelling, which generally dis-
appears in a short time. The Breeze-flies usually only
attack the larger domesticated animals—the Ox and
Horse, and, in Algeria, the Camel. It is believed that
they may eventually be agents for the transmission of
virulent diseases, when they quit an animal affected
with one of these maladies and introduce their soiled
proboscis into the skin of a healthy one.

The Tabanidæ comprise several hundreds of species. The most
common among the indigenous species are the following:

The Breeze-flies, properly called, belong to the genus Tabanus (Linn.);
they are characterized by a short, thick, slightly salient proboscis, and
the last article of the antennæ is notched in crescent form.

The Ox Breeze-flies (T. bovinus Linn.), the largest of the indigenous
species, measures 27 mm. in length. It is of a dark brown colour; the
thorax, covered with yellow hairs, is marked by black longitudinal
bands; the abdominal rings are fawn-coloured at their posterior border,
and on the middle of the dorsal face of each is a white triangular spot.
By its strength and size, this very common species is most formidable.
In Burgundy, it is known as the Great Breeze-fly (gros Tavins), to
distinguish it from the others, which are merely named Breeze-flies
(Tavins).

The Black Breeze-fly (T. morio Lat.), 18 mm. long, is of a shining
black colour. It has fuliginous wings, and the third article of the
antennæ is sickle-shaped.

The Autumnal Breeze-fly (T. autumnalis Linn.) is 18 to 20 mm. long,
is dark-coloured, with the thorax gray and velvety, and marked by four
brown, longitudinal bands, three rows of white spots on the abdomen,
the wings non-fuliginous, and the legs yellowish-white, the extremity
being black.

The Noisy Breeze-fly (T. bromius Linn.) is from 14 mm. to 16 mm.
long, and differs from the preceding, besides its size, more particularly
by its brighter thorax, by three rows of yellow spots on the abdomen,
and by its more hyaline wings.

The Rustic Breeze-fly (T. rusticus Fab.) has the same length as the
preceding, but is of a dark-gray colour, has thick yellowish hairs, and
is yellow or rust-tinted at several points.

The Tawny Breeze-fly (T. fulvus Meig.) is 16 mm. long, and is more
tawny than the preceding, principally from the thick down covering it;
it has, like the Ox Breeze-fly, only one line of white spots along the
abdomen.

The White-footed Breeze-fly (T. albipes Fab.), from 23 mm. to 25 mm.
long, is black, with yellowish hairs, and tufted on the thorax and two first rings of the abdomen; its legs are yellow.

All these species, which are the most important of the genus, have the same habits and same avidity, but they are not all equally common; the order in which they have been mentioned is that of their frequency.

In North Africa, and especially in Egypt and Algeria, there is a widespread species, which appears to be the *Tabanus albifacies*, and which the Arabs—bedouins or fellahs—name *El Debab* or *Debane* (Fly). They wrongly blame it for a mortality that often occurs among their Horses and Camels in the marshy regions they frequent. Piot has shown that these losses are independent of the stings of this Insect, and should be attributed to other parasitic affections, and especially to a pernicious anaemia due to the presence of numerous hydatid cysts in the lungs.\(^1\)

The genus *Hematopota* (Meig.), which differs from the Breeze-flies more especially by the absence of the crescentic notch in the third article of its antenna, and by its overlapping wings, has for its principal species the *Hematopota pluvialis* (Meig.), or small Rain Breeze-fly. This species is readily distinguished from the other Breeze-flies by its size (1 centimètre), its elongated and somewhat narrow abdomen, its very fuliginous wings marked by hyaline spots, its greenish eyes with reddish sinuous streaks, and the abdomen with a white middle dorsal line and a row of small white spots.

Very common in summer, the *Hematopota pluvialis* harasses animals more especially in stormy weather; Man is also liable to its attacks. It is said to be met with in Lapland, where the Reindeer suffer from its visitations.

The *Chrysops* (Meig.) is distinguished from the preceding genera by the presence of three accessory eyes or *ocelli*, which are very visible on the top of the head, and derives its name from its golden-yellow eyes, with purple lines and spots. The most interesting species is the *Blinding Chrysops*, or *Small Blinding Breeze-fly* (*C. excutiens* Meig.). This is an Insect 9 mm. long, with wings very wide apart, and the abdomen of which, flattened and square-shaped almost to its extremity, is yellow at the base, and gray for the remainder of its extent; the wings are brown, with a large hyaline spot near the base, and another triangular one near the extremity.

\(^1\) J. B. Piot. *El Debab ou Maladie de la Mouche*, a communication made to the Egyptian Institute. Cairo, 1890.
Common in summer, the blinding Chrysops is so named because it prefers to puncture the larger domesticated animals around the eyes. It also attacks Man.

The genus Pangonia (Latr.), which belongs to the same family, only merits special mention here because Mégnin attaches it to the Dipteron females brought from New Caledonia, where, according to Germain, they attack the Cattle like the Tabanidae, and thus concurred in the propagation of an epizoöty of anthrax that prevailed in Pine Island. Mégnin, who describes them, names them P. Neo-Caledonica.

The family of Asilidae offers little interest. The Asiles (Asilus Linn.), which are specially destructive of Insects, have the reputation—perhaps badly founded—of being tormentors of animals, like the Breeze-flies. It is the Hornet Asilus (A. crabroniformis Linn.) which is particularly inculpated in these misdeeds. It is recognised among all the Diptera by the resemblance it has, at the first glance, to a Wasp. It is from 23 mm. to 27 mm. long; its thorax is brownish yellow; the abdomen, narrow and elongated, is black in its three first rings, and bright yellow in the others; the feet are fawn-coloured, the wings dull yellow and spotted black at the inner border.

The family of Muscidae, which includes all the Flies properly so called, is extremely rich in genera and species.

With these Insects, the antennæ—usually inflected in front of the head—have their last article enlarged in the form of a palette, and provided at its base with a bristle which is most frequently dorsal. The proboscis, inflected, is essentially formed by the lower lip, and generally terminates by a soft enlargement; it contains only two stylets. The tarsi are provided with two hooks and two cushions.

Allusion will be made here only to those Muscidae which attack animals, in order to feed on their blood or cutaneous secretions. Hereafter, those will be described which are only parasitic in the larval state.

The first belong to the genera Musca, Stomoxys, Haematobia, Aricia, Hydrophoria, Hydrothea, and Glossina.

The Flies (Musca Linn.) have the stylet of the antennæ plumose to the end, and a soft proboscis adapted for suction, but incapable of penetrating the skin; so that if these insects trouble Man and animals, it is only to imbibe their perspiration. They cause annoyance by their importunity, and irritate by the tickling and itching they induce by their pads and proboscis. They are found in our houses, in stables, cow-sheds, sheep-folds, etc., and in paddocks and pastures. Of an ash-gray or grayish aspect, they resemble the Common Fly (M. domestica Linn.), so well known, and are distinguished from each other by such minute differences that there can be no practical interest in reproducing these; as all the species, beside their general likeness, have almost identical habits, and to an equal degree torment the domesticated animals during warm weather. Such are: the bovine Fly (M. bovina Davaine), the crow Fly (M. corvina Fab.), the cow Fly (M. vaccina Dav.), the vagabond Fly (M. vagatoria Dav.), the vitripene Fly
(M. vitripennis Meig.), the executioner Fly (M. carnifex Dav.), the importunate Fly (M. stimulans Dav.), the garden Fly (M. hortorum Meig.), etc.

The Stomoxes (Stomoxys Geoff.), often called Stinging Flies, have a solid, elongated proboscis, bent near its base, horizontal, and extending beyond the head in front. This feature serves to distinguish it immediately from the Flies, which it otherwise closely resembles.

A very common species is the Stinging Stomoxys or Obstinate Stomoxys (S. calcitrans Geoff.). It appears at the end of summer and commencement of autumn, and enters our houses, stables, and cowsheds. It attaches itself by preference to the legs of Horses, which causes them to stamp in order to get rid of it—hence the name calcitrans given to this species. With fine-skinned, sensitive animals, the puncture of the Stomoxys may be followed by a large papule, on which the hairs are erect. Its larvae live in the fresh dung of the Horse. When at rest, the Stomoxys and domestic Fly are distinguished from each other in that the first carries its head upward, while the second has it in the opposite position. It has been supposed that the Stomoxes may be agents in spreading anthracoid maladies, by stinging in succession a diseased and a healthy animal, but no proof of this has been given.

The Hæmatobia (Dav.) also resemble the Flies, though they are smaller. They have a proboscis like that of the Stomoxes, and are particularly distinguished for the length of their palpi, which equals that of the proboscis; while in the Stomoxes the palpi do not exceed the anterior border of the buccal fossette.

Thus, as their name indicates, the Hæmatobia are no less greedy of blood than the Stomoxes, but they do not enter stables; they only frequent pastures, where they are very troublesome to Horses and Cattle. Linnaeus was of opinion that they were favourable to the health of these animals; for in collecting in large numbers on their bodies, they compelled them to keep moving, and so prevented them

![Fig. 6.—Head of the Stinging Stomoxys, highly magnified and seen in profile.—Delafond.](image)

![Fig. 7.—Stinging Stomoxys, natural size.—Railliet.](image)
from eating too much, which would be hurtful to them. The exciting 
Hæmatobium (H. stimulans Meig.), the fierce Hæmatobium (H. ferox 
Dav.), the irritating Hæmatobium (H. irritans Meig.), and the saw 
Hæmatobium (H. serrata Dav.), are the principal French species.

The saw Hæmatobium, which is chiefly characterized by the shape 
of the posterior tarsi in the male, and which have the form of a saw, 
belongs especially to Southern France. It appears to be widely dis-
tributed in the United States of America, into which it has been pro-
ably imported from Europe. Of late years, by reason of its multipli-
cation, it has created much alarm by the way in which it has caused 
cattle to suffer, and so prevented their thriving. When these insects 
are in large numbers, they gather to rest at the base of the horns, 
which they cover for some inches. During heavy rain, they collect on 
the under side of the animal's abdomen. They attack, by preference, 
the back, flanks, and upper parts of the limbs. According to the in-
vestigations of Howard, the H. serrata deposits its eggs in fresh dung, 
where the larvae are hatched in about twenty-four hours, and there 
they develop. Nymphosis occurs in the superficial layers of the soil 
covered by the dung. The perfect insect appears in about fifteen days 
after the egg has been laid. To prevent the multiplication of this 
species, it suffices to throw lime over the dung lying on the pastures.¹

The Arices (Aricia Macq.), the Hydrophores (Hydrophoria Macq.), 
the Hydrotes (Hydrotae Dav.), possessing the same habits and causing 
the same discomforts as the Flies, are distinguished from the preceding 
genera by their balancers, which remain exposed; while in Flies, the 
Stomoxes, and the Hæmatobia, they are concealed by the elytra.

They live by preference in damp situations, and their ordinary 
nourishment consists of the sap of flowers; but the females attack 
animals, and although their soft proboscis cannot pierce the skin, and 
only allows them to suck up the humours thrown out on its surface, 
they harass and torment them most stubbornly. They are found in the 
company of the Flies—which they much resemble externally—around the 
eyes, nostrils, etc.—sometimes in veritable swarms. The best-known 
species is the meteoric Hydrotes (H. meteorica Dav.). Linneus 
termed it the meteoric Fly, because at the approach of rain it formed 
a kind of cloud towards the lower extremity of Horses' heads.

It remains to speak of a species in the family of Muscidæ, which does 
not belong to our country, but which cannot be passed over in silence, 
because of the universal evil reputation it enjoys. This is the Tsé-tsé, 
or Glossina Morsitans (Westwood), which, by the organization of its 
proboscis, comes near the Stomoxes and Hæmatobia. It is nearly as 
large as the domestic Fly; its slender proboscis is nearly twice as long 
as its head; its thorax, chestnut in colour, is marked by four black 
longitudinal lines; the abdomen is yellowish-white, and has only five

¹ C. V. Riley and L. O. Howard. *The Horn-fly (Hæmatobia serrata).* Insect Life, 
II., 1889, p. 93.
Dipterous Parasites in the Perfect Insect State.

rings (or segments), the last four of which have large black spots interrupted on the middle line; the wings are slightly smoky.\(^1\)

There are otherwise known by the common names of Tse-tse, Tzé-tzé, or Zimb, several Flies of tropical Africa, forming part of the genus Glossina (Wiedemann), and remarkable for their elongated proboscis, which allows them to puncture with force. The most celebrated is the Gl. morsitans, also named the Tsalsaya. It constitutes one of the most serious obstacles to civilization in Africa, for in the regions it frequents it renders the employment of the majority of beasts of burden impossible.

We will borrow from Railliet an excellent résumé of the history of this insect:

\[\text{The Fly to which the negroes give the name of Tse-tse} \]

\[\text{is met with throughout nearly the whole of Central Africa.} \]

\[\text{It appears to prefer hanging about the borders of marshes and} \]

\[\text{watering-places, and in beds of reeds. It makes a} \]

\[\text{loud buzzing noise, which is easily recognised again when} \]

\[\text{it has once been heard. If Bruce is to be believed, the buzzing of the} \]

\[\text{Tse-tse is "a mixture of dull and sharp sound, which is somewhat dis-} \]

\[\text{cordant. This buzzing causes more terror and disorder among men and} \]

\[\text{animals than the monsters of the countries they inhabit could produce,} \]

\[\text{if they were twice as numerous."} \]

\[\text{Many travellers—among others, Livingstone and Oswald—have} \]

\[\text{stated that this Fly is one of the most redoubtable scourges of the} \]

\[\text{African torrid zone; nevertheless, the descriptions published with} \]

\[\text{regard to it have, it appears to us, something of a legendary character.} \]

\[\text{Like the Stomoxes, the Tse-tse attacks Man and animals. It darts on} \]

\[\text{the latter, say the travellers, with the rapidity of an arrow, and} \]

\[\text{prefers biting them inside the thighs or beneath the belly, and a} \]

\[\text{tumour soon forms at the part attacked.} \]

\[\text{It has been said that this insect prefers the uncovered parts of the} \]

\[\text{body; that the action of its bite on Man is no more dangerous than} \]

\[\text{that of the Gnat; that the domesticated animals, on the contrary—} \]

\[\text{with the exception of the Ass, the Elephant, and the Goat—begin to} \]

\[\text{waste away immediately, and soon succumb; that Dogs resist the} \]

\[\text{bites when they are fed on venison, but perish when they receive milk;} \]

\[\text{that Calves nourished on milk, on the contrary, are exempt from} \]

\[\text{injury, etc. On autopsy, the heart, lungs, and liver are found more or} \]

\[\text{less affected.} \]

\[\text{The majority of these descriptions of the older travellers have been} \]

\[\text{contradicted by more recent observations. Thus, a Belgian expedition} \]

\[\text{has lost several Elephants; P. Baur has witnessed several of his} \]

\[\text{Asses perish as a result of the stings of this Fly, and he asserts that, instead of} \]

\[\text{preferring uncovered parts, the Tse-tse usually gets underneath the} \]

\[\text{clothing and up the sleeves of men, and below the tail of animals.} \]

\[\text{Others have observed that those bitten generally succumb as a conse-} \]

\[\text{quence of the gradually-increasing weakness, which may continue for} \]

\[\text{several weeks, and even months. Finally, the most careful autopsies} \]

\[\text{have not revealed any lesion of the spleen, liver, lungs, or brain.} \]

\[\text{All these contradictory statements show that the action of the Tse-} \]

\[\text{tse punctures is extremely variable, and that, consequently, they ought} \]

\[\text{not to be venomous. Besides, Nocard and myself have introduced,} \]

\[\text{A. Laboulléne. Sur une Mouche Tse-tse de l'Afrique australe. Bull. Acad. de} \]

\[\text{Méd., 3rd series, XIX., 1888, p. 721.} \]

3—2
without any result, beneath the skin of the thigh of a Sheep, the head and proboscis of a Tse-tse, brought from Zanzibar a short time before by Paul Leroy.

'TheirKL, the Tse-tse can merely be regarded as a carrier of virus, and its bite is only dangerous when its proboscis has been previously infected. With regard to the virus that it habitually inoculates, it is difficult, in the present state of our knowledge, to say what it actually is; but contrary to what Mégnin has advanced, it is impossible to say it is that of anthrax—at least, in the majority of instances. We have already given the opinion that it might well be the virus of various maladies, and, perhaps, even of affections peculiar to Central Africa. This manner of looking at it appears the only way by which to explain the diversity of statements given by travellers.'

Kay Lees has attributed to the Tse-tse, but without sufficient proof, the mortality occurring among Horses and Mules of the English army in Northern India.1

The small family of Pupipara, or Hippoboscidae, naturally concludes this list, for the Insects composing it live exclusively as parasites, either on Mammals or on Birds. The name has been given to it by Latreille, as the family does not lay eggs, but pupae or nymphæ. In reality, according to Leuckart, the eggs developed in the ovaries undergo, in a dilatation of the vagina, the evolution which leads to the formation of larvæ; the latter remain in this organ, where they are nourished on the secretions of the glandular appendages of the uterus, undergoing several moulttings, and acquiring their development before expulsion. Immediately after this hatching, they are transformed into pupæ. Therefore, the term 'Pupipara' is not quite exact. (In the pupa state, the insect is in the form of an egg, nearly as large as the abdomen of the mother, this region being covered by a continuous membrane, without distinct rings, and capable of great dilatation—a structure necessary in the female, from the peculiar manner in which she brings forth her progeny. When the pupa case is expelled it quickly becomes hard, and suddenly enlarges to a greater size than the abdomen itself in which it was contained. The larger end has a sort of hood, which the insect scales off as soon as it is ready to make its escape.)

These Insects have a flat wide body of a leathery consistency. The rostrum comprises only a sucker, formed of an extensive tube contained in a setiform, horny sheath, which is in its turn protected by two velvety valves. The antennæ are rudimentary, and usually reduced to scarcely apparent knobs. The legs are strong, and terminate in dentated hooks. The wings may be absent, and the insect is then a permanent parasite, like the Lice.

Only two species of Pupipara interest us. One is the Melophagus of the Sheep, and is apterous—consequently a permanent parasite, and does not enter the group now under consideration. The other is the

1 Kay Lees. Glossina Morsitans, or Tse-tse Fly. The Veterinary Journal, XXVI., 1888, p. 79.
**Hippoboscus of the Horse** (*Hippobosca equina* Linn.), which lives in intimate relation with the domesticated animals, but being provided with wings, easily quits its host, and therefore belongs to the group of remittent parasites.

The Hippoboscus of the Horse, *Spider Fly* (Réaumur), or *Flat Fly*, is about 8 mm. in length. The head is yellow, has a brown spot at the summit, and is salient and distinct from the thorax; the eyes are dark. The thorax is brown, with three yellow spots, one at each anterior angle, the other median, posterior and triangular; the scutellum is white, margined with brown. The abdomen is yellowish-brown. The legs are deep yellow, with some brown bands, and the tarsal hooks are bifid. The wings are oblong, rounded, fuliginous, and have nervules only in their antero-external third. The body is covered with short stiff hairs at intervals. According to Leuckart, the transformation from the pupa into the perfect insect requires about a month.

This Insect is very common in summer, and sometimes attacks Cattle and Dogs, but it more particularly selects Horses, fixing itself on their flanks, and especially on smooth parts—as around the anus and vulva, and on the perium and inner aspect of the thighs. It runs with rapidity on the body of its host, and certain animals which are particularly sensitive to its presence, kick furiously at the contact of a single Hippoboscus. Habit, in the course of time, overcomes this irritability, and Horses learn to endure swarms of these insects without disturbance. They are very difficult to drive away, always obstinately returning, and their coriaceous integument resists a moderate degree of pressure intended to crush them. When animals are badly groomed, the Hippobosces only leaves them at long intervals.

Rondani has separated into three species the different forms which the *Hippobosca equina* may present. Thus he distinguishes: *H. canina*, which attacks various Mammals, but more particularly the Dog; *H. equina*, which torments Horses, Cattle, Dogs, and other animals; and *H. taurina*, found on the Ox.¹

**Preventive and Curative Measures against the Action of the Diptera.**—The various Diptera, generally designated by the name of Flies, cause different degrees of injury to the health of animals. At least, they prevent them resting in their habitations, and they increase their fatigue during work by the superfluous movements and inconvenient attitudes they compel them to assume. It is, therefore, useful to endeavour to prevent their approach.

What is most necessary is to keep them away from the interior of habitations, or, at any rate, to destroy them there. The first object to

be attained is keeping these in comparative darkness; but curtains, blinds, and shutters interfere more or less with the ventilation. A procedure indicated by Spence as resorted to in Italy, and which avoids this inconvenience, 'consists in providing the windows externally with a simple net, the meshes of which may be wide enough to allow several Flies to pass through at a time. If the light enters at only one side of the building, the Insects will not venture to traverse the net; but if, on the contrary, there is a window in the opposite wall which admits the light, they will not hesitate to enter' (Railliet).

When Flies have entered the dwellings, it is somewhat inconvenient to endeavour to expel them by means of certain odorous substances, and it is preferable to impregnate certain parts of the bodies of the animals themselves with a solution of bitter, nauseous materials, such as those mentioned below. In some countries, while the animals are out of doors, it is customary to burn the dry leaves of the punkin, the acrid smoke of which immediately drives out or kills the Flies. In other countries, small bundles of heather, broom, willow, or ferns, are suspended from the ceiling or walls, and in these the Flies take refuge during the night, and while they are asleep the wisps are shaken over a fire and the Insects in this way destroyed.

During work or while at pasture, animals can be protected by means of covers and linen sheets. The garniture most employed with this object, is the net that is spread over the bodies of Horses and working Oxen, and which is bordered by a fringe of twine, the continual movement of which keep away Insects. Sometimes this fringe, fastened to the reins on each side, constitutes all the caparison; and only too frequently the protection for the Ox is reduced to merely a bit of cloth covering the face, and which defends the eyes and muffs. The abdomen is sometimes protected by a kind of linen apron. The bonnet or hood which envelops the ears, neck and face, prevents the entrance of Flies to the ears. Much employed in the east of France and in Germany, this is made of net or, better, of linen. These contrivances are often replaced by twigs and branches of trees, which, tied to the saddlery, by their continual movement drive away the Insects.

Finally, the bodies of animals may be dressed with odorous, bitter, or nauseous substances. In many countries, use is frequently made of a decoction of walnut-tree leaves, or of a maceration of them in vinegar. This need only be applied to the skin once a week. Sometimes it is sufficient to merely rub the animals with the walnut-tree leaves. There have also been recommended weak decoctions of tobacco (3 oz. to the quart of water), aloes (3 drams to the quart), and asafoetida (2 oz. in 5 oz. of vinegar and 8 oz. of water). Substances should be avoided—such as empyreumatic oils—which soil the harness and the coats of the animals, and are not superior in their effects to those just mentioned. The lotions and frictions need rarely be generally applied, but
should rather be localized on the regions of the body which are most sensitive, or which the Insects prefer.

There are no particular indications to offer with regard to the accidents that may sometimes be occasioned by the dipterous parasites; and attention has only to be directed to the local or general phenomena which present themselves. Usually cold affusions, douches, and local or general bathing, cause the disappearance of the tumefaction and pruritis that are manifested, and it is only these that appear to demand therapeutic intervention.
CHAPTER II.

DIPTEROUS PARASITES OF THE SKIN IN THE LARVAL STATE.

A certain number of Diptera pass their larval phase either in wounds on the surface of the body, or in the substance of the skin itself. Sometimes this sojourn is only accidental for them, and at other times it is absolutely necessary. Parasitism is, therefore, less complete for the former than it is for the latter, which only comprise the larvae of the ÓEstridae, and which are, for this reason, named cuticoles.

All these larvae are acephalous; the anterior extremity is destitute of eyes and antennae, and has, at most, two horny hooks; food is introduced into the mouth by suction. On transformation into nymphæ, the skin becomes hardened and assumes the form of a small barrel (barrelled pupa), in the interior of which is the real pupa. The perfect Insect makes its escape by raising a more or less rounded valve.

The term Myiasis (Hope) (πυa, fly) designating every disturbance due to the larvae of Diptera, it is naturally only a question here of Cutaneous Myiasis. This is caused by the larvae of the Muscidea or ÓEstridæ—sub-order of Brachycera. ·

Larvae of the Muscidae.—The latter belong to the genera Sarcophagus, Lucilia, and Ochromyia; for it is not proved that the blue flesh-fly (Calliphora vomitaria Dav.), which contributes so largely to changes in meat, nor the Carnivorous Sarcophagus (Sarcophaga carnaria Meig.), or gray carnivorous fly, really deposit, even accidentally, their eggs and their larvae on wounds. On the contrary, it is now known—thanks to Portchinsky—that the majority of larvae which are found in Europe

Fig. 10.—Head of the Blue or Flesh Fly, highly magnified.—Delafond.

a, antennae; p, maxillary palps; t, proboscis.

on the wounds of Man or animals, are those of the magnificent Sarco-
phagus (S. magnifica Schiner, Sarcophila Wohlfarti Portch.), which,
according to Laboulbène, has the following description:

Length 10 mm. to 33 mm. General colour ash-gray; face and sides of
head white; antennae and palpi black; thorax ash-gray, with three
black longitudinal lines; abdomen light-gray, with three black spots
on each segment. Wings hyaline, base yellow. Legs black.

Like all the Sarcophagi, this one is viviparous; the females deposit
their larvae in wounds on Man and animals.

These larvae are fusiform, with very distinct segments, and destitute
of spines; the buccal extremity is furnished with two hooks; the
posterior extremity shows two stigmata (or spiracles)—openings of the
respiratory apparatus.

This Diptera,' says Portchinsky, 'is entirely rural, and is never
seen in houses. In the perfect state, it is difficult to find, and it can
only be procured by hatching the nymphæ obtained from the larvae
gathered on animals' wounds. It is one of the finest of the Sarcophila,
and it is not only very annoying to Man, but also to animals, in the
Government of Mohilew. In fact, I have obtained the Sarcophila
Wohlfarti exclusively from different larvae derived from Cattle, Horses,
Pigs, Sheep, Dogs, and even domestic Birds—chiefly Geese. In certain
years, the infection of Cattle by the larvae of Flies extends to two-
thirds, or to at least one-half of a herd. An insignificant wound is
suddenly invaded by these larvae, and it soon becomes considerable.
This species prefers the mucous membranes, but more particularly the
inguinal region of Cows, where the larvae cause extremely serious
sores; this occurrence is frequent here. With Dogs, the same larvae
are often met with in the ears, and it is not rare to see them at the
same time punctured by legions of Stomoxys calcitrans and covered
with blood.'

Mégnin mentioned having found the larvae of this Fly not only in
wounds of the domesticated animals, but also in the depressions or
folds of skin where the sebaceous secretion is always in a state of
more or less ammoniacal fermentation—such as the lacuna of the frog
of the Horse's foot, the cavity of the prepuce, or hollow of the pastern
of that animal. In these places the larvae finish by inducing ulceration of the skin, and they may even sometimes penetrate beneath it, causing more or less considerable disturbance.

After their transformation into nymphae, Mégnin has, by hatching them, always obtained the same Fly—the *Sarcophaga magnifica*. He is of opinion that it is these larvae which are most frequently found in wounds in Man, and that if they are mistaken for those of the Calliphora vomitaria, Sarcophaga carnaria, and Lucilia Cæsar, it is only because they all resemble each other so much that they cannot be distinguished from each other, except by hatching the perfect Insect—which is rarely successful.

The genus *Lucilia* (Macq.) contains Flies with a soft proboscis; the epistoma—the superior border of the buccal cavity—is not salient; the antennæ to the third article are quadruple the size of the second, and the stylet is very plumose; abdomen short and round, wings wide apart. These characters, joined to the bright metallic colours, constitute a *facies* which distinguishes this genus from all the others.

The **Lucilia Cæsar** (Linn.) is the type; it is of a fine golden-green colour, is widely extended, and deposits its eggs on decomposing organic matter. It lays them also on the wounds of Man or animals.

The **Lucilia sericata** (Meig.) much resembles it.

It is smaller and of a greenish-blue tint. The epistoma and face are white, while the first is of a pale red in the *Lucilia Cæsar*. The first ring of the abdomen alone is black, while in the other species the second ring, in addition, has a black dorsal line.

In Holland, the Lucilia sericata often causes an affection of a certain gravity in Sheep, which the breeders designate the 'worm sickness' (*Worm-ziekte*). It was first studied by Bouman and by Gerlach, then by Jennes and Van Laer.¹

The larvae are found chiefly in young Sheep, and especially those suffering from diarrhœa; adult Sheep being seldom troubled by them unless they are badly kept. Attracted by the faecal matters about the hind-quarters of the animals, the flies there deposit their eggs, and from these issue small cream-coloured larvae, formed of ten to twelve rings, with points on their borders. The head has two hooks, and the posterior extremity, more voluminous, shows three stigmata. These larvae attack the skin and cause itching, which compels the animal to keep its tail continually in motion, and to bite and rub itself against surrounding objects. The wool is then very closely matted and in hard

patches, beneath which the skin is perforated by small openings or is largely abraded, and a thick viscid fluid of an unpleasant odour is discharged from it. When exposed, the larvæ are greatly disturbed, run away in every direction, and try to conceal themselves beneath the derma. They are sometimes found towards the croup. If the disease persists, it complicates the diarrhœa, and contributes to bring about marasmus in the young animals.\(^1\) (This condition is observed among lambs in the United Kingdom, which are said by the shepherds to be affected with the 'fly' or 'maggot'.)

Another better-known species is the Lucilia macellaria (Fabr.), more frequently designated the L. hominivorax (Coquerel) and L. anthropophaga (Conil.). It measures 9 mm. to 10 mm., and is recognised by its blue thorax streaked with three darker blue bands of a purple tint; the pads are black, and the wings brown at the base. The larva measures 14 mm. to 15 mm. This fly is met with over a great portion of America, from the north of the United States to the Argentine Republic; but more particularly in the warm regions. It is redoubtable because of its larvæ.\(^2\)

It deposits its eggs in the wounds of the domesticated animals and Man, and even introduces them into the natural cavities. By means of their two buccal hooks, the larvæ attack the tissues and rapidly produce serious disorder, with loss of substance and mutilation. The facts published with regard to this too interesting insect are chiefly concerning Man. Liguistin\(^3\) has, nevertheless, observed extremely grave complications caused by the larvæ of this Lucilia in wounds, and more particularly in the ulcerations (crevasses, cracks or fissures) from which the Horses and Mules suffered during the (French) expedition to Mexico.

The last species of this group of parasites is the Ochromyia anthropophaga (Blanchard). Railliet,\(^4\) who has particularly studied it, thus describes it: 'A fly of a grayish-yellow tint, measuring 8 mm. to 19 mm. long. The head is testaceous and covered with small black hairs; the style of the antennæ is plumose. The thorax has, in front, two black longitudinal bands; the wings are slightly smoky. The abdomen is covered with somewhat large black spots, particularly behind.

'It is a Senegal Fly, met with principally in the Province of Cayor—hence the designation of Cayor Fly by which it is generally known. It has been seen sometimes to hover over animals (Notaris); nevertheless, it appears to deposit its eggs in the sand. In any case, it is observed that the larvæ, known by the improper name of Cayor worms,

\(^1\) We do not know if an analogous affection to the Worm-ziekte, which has been observed in Sheep by Austruy, veterinary surgeon at Cayarc (Lot), should be attributed to the L. sericata. It differs from it so far, that the animals attacked were previously in perfect health, and that the larvæ are scattered over different parts of the body—particularly the loins, sides, and shoulders. Emaciation was rapid, and death soon ensued.

\(^2\) (In Paraguay, foals are said to die in large numbers from the effects of larvæ which hatch out of eggs deposited on the navel before it has dried up.)

\(^3\) Liguistin. *Journal de Méd. Vétérinaire Militaire,*** III., 1865, p. 663.

develop beneath the skin in Man and various animals—Dog, Cat and Goat. With the Dog, which is more particularly affected, a small inflammatory tumour is seen, which increases rapidly, and is covered by a brown crust. In about six or seven days the larva has completed its evolution, and leaves this tumour in order to be transformed into a pupa, cicatrization of the wound being spontaneously effected.

When the parasites are few in number, they occupy the tail by preference, as well as the paws and ears—parts in contact with the ground. But if, on the contrary, they are numerous, they are found on all parts of the body. Young animals are oftenest attacked, but adults may be so seriously invaded as to succumb. What is remarkable is that this parasite abounds at Mount Pal, twenty miles from St. Louis, while it has never been seen at the latter place; and what is more, Dogs which enter St. Louis covered with larvæ are free from them in about two days.'

R. Blanchard considers the Cayor Fly as belonging to the family of Cestridæ, and allied to the Hypodermae and Dermatobia (see p. 46).

Prophylaxis and Therapeutics.—The prophylactic measure to be opposed to myiasis, consists in preventing the approach of the flies, and has been sufficiently indicated in the preceding chapter. In the case of wounds, and in view of their usually small dimensions, it is advantageous to apply some empyreumatic oil—such as paraffin—around them: its strong and persistent odour allows of its employment in very small quantities.

It is evident that dressings carefully performed, and sufficiently frequent, will prevent the invasion of wounds by larvæ; and thorough cleansing will expel them from the parts (prepuce, frog, pasterns) where they have taken up their abode. Keeping the wool of the Sheep clean will prevent the visits of the Lucilia sericata; and as for the Cayor Fly, the prophylactic measure, says Lenoir, is preventing dogs from lying on the sand, or, better still, keeping them away altogether from the usual haunts of that insect.

The curative treatment is very simple, for the larvæ are very sensitive to an infinity of agents that cause but little irritation to the wounds that harbour these pests, which otherwise are easily killed or expelled. So that they may either be removed immediately, or the parts may be dressed with ether, chloroform, benzine, petroleum, tincture of camphor, etc.

**Larve of the Cestridæ.**—Although the larvæ of the Cestridæ

cuticoles infest the subcutaneous connective tissue, their study naturally comes in here, for their presence is associated with perforations of the skin.

An essential characteristic of the Cestrīdae, is the necessary parasitism of their larvæ. Guided by a special instinct, the female lays her eggs on the bodies of Mammalia, choosing the species to which their future development is subordinate. In order to be hatched, the larva employs various means to reach the organ or region most suitable. Sometimes it is the subcutaneous connective tissue, as for that which is about to be described; and in other instances it is the frontal sinuses or pharynx, the stomach or intestines. It remains in its special habitat for a variable period, generally from the summer until the following spring; when it contrives to leave it by a mode of procedure appropriate to each type, and buries itself in the ground, conceals itself beneath a stone, or seeks the shelter of some place which is a little damp, where it may become transformed into a nympha or pupa, before appearing in its perfect state. The latter is generally somewhat rare to find.

The Cestrīdae are recognised by the following zoological characters:

Body usually hairy; head somewhat voluminous and hemispherical; two facetted eyes, usually separated by a wide forehead which bears three ocelli; antennæ very short, fixed near the forehead, and folding into two corresponding cavities which are completely or incompletely separated. Of their three articles, the last, which is almost globular, has a dorsal bristle or stylet, inserted near the base, and usually single. Proboscis generally very small, or scarcely visible; two palpi sometimes distinct, sometimes rudimentary; thorax large, elevated, and prothorax very marked; wings large; abdomen formed of six apparent rings, the extremity being rounded in the males, and terminated by a very extensible oviscapt in the females.

Certain species are viviparous, bringing forth the larvæ already hatched; others are oviparous, laying eggs of different shapes, with a resisting shell sometimes operculated, which always present at its posterior pole an appendage that serves to attach the egg to the skin or to the hair of the host. The number of larvæ or eggs which each female deposits is always considerable.

The bodies of the larvæ are composed of twelve segments, the first two of which—cephalic segments—are not always very distinct from each other. Between these two first segments are two very small respiratory stigmata—anterior stigmata—in the form of points, nodules, or minute slits; these are sometimes concealed in a depression in the integument. The last segment has also two stigmata—the posterior—consisting of openings into which the tracheæ may project, or in large peritremes pierced with a variable number of openings. At their birth the larvæ have external buccal organs, formed chiefly of two hooks, which are sometimes persistent, or disappear as development progresses. Above these buccal organs are seen two small horny or cutaneous projections, which represent the antennæ. The anus is very small, and is situated below the
stigmatic plates of the last ring. During their parasitic existence, the larvæ undergo two moultings, which divide this period into three stages.

When the larva has quitted its host and reached a place favourable to its nymphosis, its skin becomes hardened, and is detached from the body of the nympha, the covering of which is supple, and to which it sometimes remains united by four tracheæ. The shell, more voluminous than the insect which has to leave it, is distended at its posterior part by fluid that afterwards escapes. The nymphal state continues from three to eight weeks, and even longer if the weather is cold. When hatched, the Insect, by means of a vesicle which is developed on its forehead, makes such pressure on the inner surface of the shell as to cause this to rupture at the cephalic extremity, and in the direction of the sutures of its arches. The wings of the newly-hatched creature are extended in ten to fifteen minutes.

In this perfect state, with their mouth atrophied, the Estridæ appear to be no longer able to take food; they may live, nevertheless, for several weeks on the fat accumulated in their bodies. Quiescent until their reproductive organs have attained their maturity, they then exhibit an extreme vivacity, particularly if atmospherical conditions are favourable. They fly chiefly during the warmest and finest days of summer, and during the middle of the day, and they generally frequent pastures in the vicinity of woods.

According to the particular habitat of the larvæ, the latter and the species to which they belong are distinguished, since the time of Bracy Clark, as gastricoles or chylivorous—gastric or intestinal; cavicoles or lymphivorous—those frequenting the cavities of the face; and cuticoles or purivores—those which are subcutaneous.

Brauer, whose works on the Estridæ constitute him an authority, has arranged all the species into thirteen genera, only four of which—Hypoderma, Dermatobia, Cuterebra, and Estromyia—are cuticole larvæ. Of these four genera, the first two alone develop their larvæ beneath the skin of the domesticated animals, in Europe or other parts of the world, and are consequently only those which will be noticed here. From a zoological point of view, they belong to the group whose wings have a terminal transverse nervure (Fig. 14).

Hypoderma.—The European cuticole Estridæ belong to the genus Hypoderma (Latr.).

In the perfect state, the body of these Insects is hairy; the head is generally larger than the anterior part of the thorax; the antennæ are very short, and the stylet nude and deeply buried in two separate depressions. The proboscis is quite rudimentary; the thorax is almost spherical, and generally larger than the abdomen. In the female, the
ovipositor (Fig. 16) is long, consists of four articles, and is continuous with the fifth segment; the segments composing it pass within each other in a telescopic fashion. When it is extended it projects backwards and slightly upwards, and at the end of the last article are three horny appendages, a little curved inwards toward each other like pincers, between which the eggs pass out. The wings, most frequently fuliginous, are small, divergent, and inclined outwards.

In the first stage, the larvæ are free in the subcutaneous connective tissue, in the panniculous carnosus, and in the superficial muscles. The skin covering them does not show any perforation, this being obliterated after giving passage to the young larvæ. The duration of this period appears to be several months.

At the end of this time the larva is about 13 mm. long; it is nearly cylindrical in shape, and only about 2:2 mm. thick. The mouth, which is altogether anterior, has, above, a salient stylet, completed on each by a hook curved almost at a right angle. These hooks can be brought together so as to become parallel to the median stylet, and thus form a point well adapted to bore through the tissues, while by their separation they are opposed to withdrawal and facilitate progression. It is doubtless by this mechanism that the newly-hatched larva can penetrate beneath the skin. This larva is formed of eleven rings; it is white except at the mouth, pharynx, and posterior stigmata, where it is brown. The stigmata consist of thin, porous plates of chitin, which do not yet perfectly fulfil their rôle of respiratory openings. This function must be accomplished partly by the skin—which is thin, almost transparent, and nude—if it is not carried out in the infundibuliform depression of the mouth and on the border of the lower lip, where there are two microscopical spines.

In the second stage, which occupies about two months, the larva increases in dimensions in every direction, but preserves its white colour except at the inferior surface, where there are three black spots formed by agglomerations of microscopical spines. The upper surface is nude, with the exception of the first two or three rings. The mouth is V-shaped and circumscribed by plates of chitin; the stylet and hooks have disappeared. The plates of the posterior stigmata are reniform and have large alveoli. The posterior extremity is thin, the anterior expanded and vesicular.

The third stage lasts two to three months. The larva becomes thick, pyriform, and almost spherical in a state of contraction; it has the shape of a boat when elongated, being convex below and plane above. Soft, flexible, and very contractile, it becomes yellow, then brown, and finally black. The buccal fossette is infundibuliform, with the rudimentary antennæ above it. At the upper surface of the cephalic extremity, is a slight horseshoe-shaped furrow that extends to the fourth ring. This furrow encloses the part which, at the termination of nymphosis, is detached by the Insect in the form of an operculum. Each ring, from the second to the ninth, carries three pairs of lateral ridges ranged beside each other and garnished with spines, the disposition of which varies according to the species; the last ring is hemispherical or cylindrical.

Three kinds of Hypodermæ whose larvæ are parasitic in the
domesticated animals, are actually known: the Striped Hypoderma, the Reindeer Hypoderma, and the Bovine Hypoderma. The latter belongs more particularly to this country, and has been the longest recognised.

The Striped Hypoderma (H. lineata Villers) is black, very hairy, 12 mm. or 13 mm. long, and derives its name from the gray, longitudinal bands on the upper surface of the thorax. It has been found in England, Norway, Germany, Italy, Southern Russia, and in Kentucky, America. Brauer supposes that its larva lives beneath the skin of the Ox, and that it must be included among the larvæ of the Oestridæ which have been several times observed in Germany beneath the skin of Sheep recently clipped.

The Reindeer Hypoderma forms the sub-genus Edemagena (Latr.), which is only distinguished from the Hypodermae by the latter having no palpi, and the spines on the surface of the larvæ being fewer on the lower than on the upper surface; while in the Edemagena the palpi—small and globular—are present, and the two surfaces of the larvæ are equally spinous.

The Hypoderma of the Reindeer (H. (Ed.) Tarandi Linn.) is black and very hairy. The female—larger than the male—is 16 mm. long. The thorax is covered with yellow hair, and has a wide, black, transverse band. The first segment of the abdomen is covered with pale-yellow hairs, the other segments with short hairs. The thighs are black: legs and tarsi grayish-yellow.

The larva is in every way larger than that of the Ox Hypoderma, which it much resembles in other respects.

This species is found in Lapland and North America.

Linnaeus states that it inspires so much fear in the Reindeer, that ten of the Insects will alarm a herd of more than five hundred. As soon as they appear, the Reindeer tremble, run about, snort, bellow, and stamp their feet. He also mentions that the female—as with the other Hypoderme—only deposits its eggs on the skin of these animals. Once hatched, the larva penetrates beneath the skin of its victim, and is there nourished after the manner of the Hypoderme.

The Insect deposits its eggs early in July, when the Reindeer has shed its coat. It prefers to attack young animals, though it does not spare the old; it pursues them in the valleys, among precipices, and even on the icy mountain-tops. In their agitation, the Reindeer can scarcely settle down to feed, and it is not uncommon to see them lying down all the day before the hut of their owner, without attempting to eat, in order that the thick smoke issuing from the habitation may preserve them from the attacks of the Edemagena. The larvæ are, however, not numerous on the same animal, being six to eight on young deer; but their presence causes much emaciation, and sometimes they are blamed for destroying as many as one-third of these (N. Joly).

The Ox Hypoderma (H. bovis Degeer) is by far the most interesting of the cuticole species, for it is abundant in this country, and extends from Scandinavia and North America to the south of Europe, and to Asia and Africa. It has the following characters (Fig. 15):

Black, very hairy. Face gray, with white or yellow hairs. Similar hairs on anterior half of the upper surface of the thorax, black on the
posterior half, and marked by wide longitudinal bands of shining black, close together. Abdomen black, covered with white or yellow hairs at

![Image of Hypoderma of the Ox](image)

**Fig. 15.**—Hypoderma of the Ox.
A, Female, natural size. B, Larva making its exit from a tumour.—Réaumur.

its base, black in the middle, reddish-orange in its posterior third. Legs black at the base, yellow in their terminal moiety; wings somewhat brown. Length, exclusive of the ovipositor, 13 mm. to 15 mm.

In its perfect state, this insect lives during the months of July and August, and may even be met with in the first days of September. It is particularly well known, from the fact that it can be artificially hatched when the larva is extracted from the Ox’s skin and kept in favourable conditions. The female is provided with a soft, short, black,
cylindrical oviscapt, which is folded beneath when the Insect is resting, and which serves to deposit its eggs on the skin of bovines while they are out of doors. It prefers the upper parts of the body—the shoulders, back, loins, croup, sides and flanks. Its flight is rapid and accompanied by a buzzing sound. When it is about to lay its eggs, it flutters above the back of the Ox for a minute or two, then suddenly drops, deposits an egg on the skin, rises in the air, again flutters, descends with the like rapidity as before, and drops another egg. This manœuvre is repeated ten or twelve times in a quarter or half hour.

It is a widespread belief—which the majority of authorities have subscribed to—that the approach of the female Hypoderma causes great terror among cattle: they are restless, become more and more agitated, and finally start off in a frantic manner, with tail horizontal, until beyond the sound of their enemy. Sometimes they plunge into water to shelter themselves from the dreaded pursuit; and in this way accidents may occur. This fear is contagious, and one Hypoderma will put to flight a whole herd; it is even sufficient, it is said, to closely imitate the buzzing of the Insect to realize the same moral effect, and to this trick is often attributed the panics among Cattle which occur at fairs.

Virgil is considered the first writer who has described the fear that the Oestrus inspires in herds ('Georgicorum,' lib. iii.); but it is more than doubtful that the Insect which he mentions belonged to the family of Oestridae; and, on the other hand, doubt has been thrown upon the correctness of the popular belief which, from the time of Virgil, has been transmitted to our own day. It is really founded on the dread the Ox may experience, of the puncture the female Oestrus makes on implanting each egg in the skin. But it is well established that the oviscapt (ovipositor) of the Oestrus is not adapted in any way for boring, and is merely a depositing apparatus; consequently, egg-laying does not cause any pain to the host. Bracy Clark first, and Hertwig afterwards, remarked on this fact; and, besides, Goudot, who has personally experienced the effects of the larvae of the Dermatobia, asserts that he never heard or saw the Flies, much less felt them deposit their eggs on the uncovered parts of his body, and is inclined to attribute the fear of animals on the approach of the Dermatobia, to an instinctive prevision of the future trouble that awaits them. On the other hand, it may be asked if the share the Hypoderma have in causing fear among Cattle is well founded, or if it is not rather due to their not being able to discriminate between the buzzing made by the Insect and that of the Gadflies, Breeze-flies, Wasps, and other Diptera which torment animals under the same circumstances—that is, in hot and stormy weather. Although Brauer, who is responsible for the statement, says that two females of the Hypoderma Actaeon have been seen depositing their eggs on the backs of Deer without these appearing
to notice them, yet he is careful not to draw an inference from one species to another. On the contrary, he brings forward a document to prove that here, also, popular observation cannot be relied upon without an imposing array of facts to support it. It is a letter from Schleicher, an intelligent farmer of Gresten, Austria, who had seen the perturbation caused by the Hypoderma, and was able to capture the Insect in the act of laying, forwarding it to Brauer, who recognised it as the female of the *Hypoderma bovis*, with an egg still between the pincers of its oviscapt.

It is probable that the ova are deposited on the skin itself, or at the hair-roots; but no one has seen them there. Those who have described the eggs have obtained them directly from the female, by slight pressure on the abdomen.

These eggs (Fig. 17, B, C) are white, elongated, spindle-shaped and a little flattened; they have a posterior pole, with a brownish appendage, which appears to be used to make the eggs adhere to the hairs; they are 1.25 mm. long. The duration of incubation is not known, neither is the form of the larva in the first stage. However, C. Curtice considers—and in this he is supported by C. V. Riley—as belonging to this first stage of the *H. bovis*, larvae of from 10 mm. to 15 mm. long and 1.5 mm. broad, similar to those of *H. Diana* figured by Brauer, and which he found in the wall of the oesophagus, beneath the costal pleura, and in subcutaneous tumours on the back of Oxen in the United States.¹

In the second stage—which usually corresponds to the month of May and lasts about thirty days—the larva is club-shaped, and measures 13 mm. long and 4 mm. broad at the fourth segment. The lateral

¹ C. Curtice. *Insect Life, II.*, p. 207.
prominences are very salient; the microscopical spines of the integument are in small groups on the sides of the two first segments, at the anterior border and upper surface of the second and third segments, at the two borders and inferior surface of the second and ninth, and over the entire surface of the last.

At the third stage the larva is thick and pyriform, and the lateral prominences are still more salient. On the upper surface is remarked, at the anterior borders of the second to the fifth segments, small spines more numerous anteriorly than posteriorly; the same is seen at the posterior borders of the second to the seventh or eighth; and the same also at the superior and middle prominences of the second to the fifth segments. On the inferior surface, the spines running along the two borders of the second to the ninth segments are larger on the anterior than the posterior border; and it is the same on the anterior border of the inferior lateral prominences from the second to the eighth segment. The two last segments are completely unarmed. The skin is rugged and furrowed, and is at first white, except where the spines and stigmatic plates are; there it is of a dark brown. As age advances, the larva assumes a grayish-yellow tint, then it becomes speckled with brown, and finally becomes yellowish-brown when mature, which occurs in June or July, exceptionally in August. It then measures 22 mm. to 28 mm. long, and 11 mm. to 15 mm. broad, at the eighth segment.

Larval existence is passed beneath the skin of the host, in the subcutaneous connective-tissue, in the panniculus carnosus muscle, or underneath aponeuroses. In the earlier period, no irritation is remarked around the parasites; but when the spring arrives the presence of the larvae is made manifest externally by tumours, the size of which increases with the development of these creatures. The number of the tumours is variable; there are rarely fewer than four or five, and usually there are ten to twenty, sometimes as many as fifty, and even one hundred and twenty have been counted. They are of unequal volume, but seldom exceed the size of a nut; they have the characters of a cold abscess, and are not abnormal in temperature, nor markedly painful. At their summit, or towards their base, they are pierced by an opening which is at first little apparent, but which measures from 4 mm. to 7 mm. in diameter in those tumours from which the larva is about to escape. From this opening flows pus, which dries and agglutinates the adjacent hairs; this comes from a subcutaneous abscess in which the larva is lodged. It is in the second stage of larval life that the tumour appears, and it is due to the presence of the parasite, which acts as a foreign body, irritating the tissues by the spines with which it is covered, and producing a moderate degree of inflammation that results in the formation of embryonic tissue in concentric layers, which are of a fibrous consistency in those that are deepest, and softer towards the surface. The skin is infiltrated and speckled with ecchymoses and blood-stains. The opening results from a process of ulceration; there is no hole at first, although Stricker has admitted that the larva penetrates by the orifice of a hair follicle or sebaceous gland, and that the
tumour of the Gasterus commences in one or other of these elementary organs. The larva almost exactly fills the sac, the shape of which is reproduced externally; and the creature is so placed in it as to present to the opening its oval anal extremity, furnished with the stigmated plates, while the cephalic end is turned towards the bottom of the sac. It is nourished not only by the pus which it has caused the production of, but also by the blood of its host, as an abundance of that fluid is found in its digestive apparatus.

When the development of the tumour is somewhat advanced, methodical pressure at its base will readily cause the expulsion of the larva. A few days before leaving its abode, the creature enlarges the opening in the tumour by pushing at intervals the last segments of its body into it, until, finally, it emerges in a state of complete maturity—usually in the morning between six and seven o'clock, as Réaumur had long ago remarked. Those larvæ which do not perish by being trodden upon by their host or devoured by birds, creep along by means of the hooklets on their inferior surface and the energetic contractions of their bodies, until they find a convenient place for their transformation into nymphæ; they then penetrate the ground to a depth of two or three inches, or conceal themselves in hay, among leaves, etc. The nymphæ is about three-fourths of an inch long externally; in shape it is pyriform and expanded, its anterior extremity showing a plane, oblique surface turned upwards, and infringing on the superior surface. The condition of nymphæ lasts for twenty-five to thirty days.

After the larva has left its cyst, the formation of pus gradually ceases and the wound cicatrizes; though for a long time it bears traces of the alteration it has undergone, so that the skin is seriously depreciated in value, especially if the larvæ have been numerous. And this is not the only damage the parasite inflicts, for it evidently acts as an exutory, and in this way brings about the loss of nutritive material, to the prejudice of the milk secretion and fattening. But it rarely happens that the animals themselves suffer in health, though it is doubtful if these larvæ exercise a salutary effect on the economy—preventing disease by acting as derivatives, according to Bracy Clark's belief. Lafore\(^1\) asserts that country people consider the presence of the larvæ as a proof that their animals are of good quality and that they fatten well; and they explain this belief by the instinct that impels the Hypoderma to deposit its eggs on animals with a fine supple skin. However this may be, it is certain that if aged animals are spared its visitations, calves are equally exempt.

(Th: pecuniary loss occasioned in this country by the 'Warble Fly,' as the Hypoderma bovis is popularly, designated in England, has been represented as very great, being estimated at as much as one pound per head on every animal unsheltered from its attacks, which would

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probably amount to seven or eight millions of pounds a year for the United Kingdom. Among dairy cattle, the loss has even been put so high as three pounds per head.

The loss by damage to the hides is also extremely heavy, and has been given as averaging one penny per pound weight, or five shillings and tenpence for each hide. One extensive hide-importing firm reports: 'Parcels of ox and cow hides and goat and sheep skins, coming from all parts of the world, all contain a varying proportion of warbled hides and skins, the damage being greatest, as a rule, on those from the hottest climates, and generally affecting goat-skins to the greatest extent. Those hides and skins from Mogador, and other northern parts of Africa, suffer most in this respect, an average of about one-fourth of them being damaged to the extent of 60 or 70 per cent. of their value. Those from Kurrachee, India, also suffer damage to almost the same extent; while those from Calcutta, Madras, and Bombay are depreciated perhaps to the extent of 50 per cent. on 10 per cent. of the skins. From the Cape Colony the skins are comparatively slightly damaged, and still less are the hides and skins from Australia and South America.'

Treatment.—To preserve animals from the ravages of the Hypoderma, it is only necessary to employ one of the many measures indicated when dealing with the Flies (see p. 37). Brauer relates that, in certain localities where the Oestriderae abound, the inhabitants have succeeded in diminishing the number of these, by not allowing their cattle to pasture after ten o'clock in the morning from April to August. As the mature larva usually quit their host before that hour, they fall on the cowshed floor, and not finding a suitable quarter in which to pass their nymphosis, they die; consequently, the species is much diminished. It has been remarked that such cattle are very much less visited by the Hypoderma than those of the Alps, in which the larvæ are exceedingly numerous, because the animals live out of doors night and day.

In order to free the skin from the larvæ which have invaded it, they may be extruded by pressure of the fingers, or they may be killed on place by introducing a lancet, or a bistoury, or a red-hot stylet into the orifice of the tumour. The same result can be obtained by the use of benzine, oil of turpentine, tar, or salt water. But these have the disadvantage of causing a long suppuration, in order to bring about the gradual elimination of the dead body of the parasite. It is, therefore, preferable in every respect to remove it at once, if necessary, by its exit orifice, in enlarging this and seizing the creature with forceps. Nothing more is then required than attention to keeping the wound clean and healthy.

(In England, much attention has been paid to this subject of prevention and treatment, and many suggestions have been made and carried into practice. One experienced veterinary writer, H. Thompson, says: 'Respecting the application of anything to prevent the Warble Fly depositing the eggs, there are a number of matters of a tarry nature that might be applied, but nothing better than Stockholm or green tar. This should be rubbed along the back of the cows before turning them out, and the dressing would last all the summer season, or applied in May and June between the top of the shoulder-blade and loins. This is the only part the Cow cannot lick, rub, or lash with the tail; hence the only peaceable place where the Fly can leave its eggs. Or sheep-salve—bad butter and tar mixed with sulphur. About two applications would last a full season. Or the application of brine is useful. It is a common practice to wash the Cows' backs with pickling brine, the application being made two or three times during the season. In this part—Cumberland—larger farmers keep what is called the "pickling-tub," wherein they put beef and mutton. The brine is made with salt and water, salt being added until an egg will float in it. This is an old remedy, and I think a good one, as I believe the ova would be destroyed immediately the mixture was placed on the skin. I have used, and also recommend, the following mixture as a preventive: flour of sulphur, four ounces; spirits of tar, one gill; train or whale-oil, one quart. Mix well together, and apply it to all the spine of the Cow once a week with a small brush. The smell drives off the flies, and prevents them depositing their eggs, the cattle are left at peace to graze, and warbles thus prevented. Paraffin, kerosine, carbolic acid, phenyle, etc., are all too transient to be of much service, and would have to be frequently applied."

The Hypoderma of the Horse.—Horses which are allowed to pasture during the summer season, are sometimes found to be, in the following spring, more or less invaded by the larvae of the Hypoderma. Wallisnieri, Huzard, sen., and Bracy Clark had already observed this. Roulin, cited by Joly, relates that, in the llanos of South America, the Horses which live there in a semi-savage condition, are gathered together at certain times, in order that the larvae of the CEstrus may be removed from them. Loiset, in particular, has given a good description of this cutaneous malady of the Horse, from which it appears that, so far as external appearances go, the tumours produced by the Hypoderma resemble in every way those of the Ox. 'The CEstrus cuticole of the Horse is common,' he says, 'not only in the North of France, but also throughout Belgium, Holland, and the whole extent of the littoral of the Baltic and North Sea; for I have very often found it in young

animals from these regions.' (I have also observed the larvae in the cutaneous tumours of army remount horses in England.)

The larva is vesiculous, fusiform, expanded in front, and terminating in a blunt point behind. Much smaller than that of the Ox, it is only about 9 mm. or 10 mm. in length; its skin is thin and diaphanous, and destitute of spines; its segments are very marked. The mouth is altogether unarmed (Loiset).

Joly,\(^1\) by reason of these particular characters, looks upon it as a distinct species, which he designates Hypoderma equi. Brauer, however, is inclined to think it is identical with the \(H. Silenus\). But the question is still undecided, as it has not yet been possible to ascertain the nymphosis of these larvae, nor yet has the perfect insect been found.

The tumours caused by the Hypoderma give rise, in the Horse, to the same inconveniences as in the Ox; in addition, they prevent the use of harness on the invaded parts of the body.

The preventive and curative treatment is similar to that for the Ox.

The larvae of the Hypoderma have also been found beneath the skin of the Ass; but Brauer considers that they belong to his Hypoderma Silenus.

Dermatobia.—The Dermatobia (Dermatobia Brauer) are distinguished by the proboscis, which is bent at its base, concealed in the buccal cavity, beneath the inferior surface of the head, and by the stylus of the antennæ, which is plumose at its superior border. They are interesting, for the reason that Man is sometimes the host of the larvae of one species—the noxious Dermatobia (\(D. noxialis\) Goudot), which lives in America, from Mexico to Brazil. For it would certainly appear that it is to this Dermatobia that must be allotted not only the larva which, according to Goudot, is known in New Grenada as the Nuche or Gusano, but also that which in Cayenne is named the Macau Fly; in Brazil, \(Ura\); at Costa Rica, Torcel; and in Mexico, Moyoquil Worm. It lives chiefly beneath the skin of the Ox and Dog.

It is elongated, terminates in a point, has spines on the borders of the segments in its anterior half only, carries two strong buccal hooklets, and measures about 3 cm. The perfect insect is about 17 mm. long, has the face and forehead yellow, with short, silky brown hairs; thorax brown, striped with gray; abdomen flat, blue, and covered with small black hairs, their base being of a dirty white.

According to Goudot,\(^2\) the Dermatobia noxialis is found in very great numbers on the borders of large woods and lands covered with underwood, so that such localities are regarded as unsuitable for herds of cattle. When they do chance to frequent them, it is observed that they pass the greater part of the day in sterile, sandy places, rather than venture to graze in the shade, where their enemies are so abundant. In certain years the larvae of this fly are counted by hundreds on one animal. They occupy a large portion of the shoulders of Cattle, form-

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\(^1\) Joly. Note sur une Larve d'Estrise qui vit sous la peau du Cheval. Com. Ren. de l'Acad. des Sciences, XXIX., 1889.

ing, by their agglomeration beneath the skin, a great collection of tumours, from which purulent matter is continually flowing through a multitude of openings. These orifices are frequented by other Diptera, which deposit their eggs in them, and in this way wounds are produced which are sometimes dangerous, and are always difficult to cure. The larvae of the same Dermatobia are also located on the head, flanks, tail, and along the dorsal region; but their principal haunt is always on the shoulders, as this is the part where the animal can least defend itself by its horns or tail.

In the countries in which the Dermatobia are abundant, the skins of the slaughtered cattle are frequently so perforated by holes as to be of little value.

Dogs are also very much attacked by these redoubtable Diptera, and often harbour a great number of larvæ; but Mules and Horses are exempt from their annoyance.

It is probable that the Dermatobia deposit their eggs in the same manner as the Hypoderma—that is, clandestinely and without pricking the skin. The agitation and dread the Cattle manifest, and which Goudot has remarked upon, ought therefore to be ascribed to a special instinct or acquired experience of the effects of these Insects.

In America, in order to free Cattle from the larvæ of the Dermatobia, measures are adopted similar to those employed in Europe against the Hypoderma. By methodical pressure, the larvæ can be expelled from the tumours, which are then dressed with salt water, removing at the same time all the eggs which the Muscidæ never cease depositing. Not infrequently an animal which has been carefully attended to in the morning, has in the openings made by the Dermatobia a perfect swarm of small larvæ, by the arrival of evening; these are destroyed by filling the places with an extract of tobacco or some other powerful insecticide.

It is not known to what species the Estride belong which deposit their larvæ on the Oxen, Buffaloes and Gazelles of South and Central Africa.

According to P. Dutrieux,¹ the natives of Unyamouezi, Central Africa, designate by the name of founza ia ngombe—that is, the 'Cattle-worm'—a larva which is developed beneath the skin of the Ox and Man, and which produces a kind of furunculous eruption; this larva is deposited in the egg stage by a large Fly that usually accompanies the Cattle. It appears to be unknown between the central plateau, or the Ugogo, and the east coast.

With regard to these subcutaneous larvæ of Africa, there is an interesting peculiarity. Certain birds of the order Passeres, allied to the starling tribe, and belonging for this reason to a family named the Buphaga, or Beef-eaters (βοῦς, an Ox; ἰδίως, to eat), constantly accompany herds of ruminants, and when they see the tumours of the Estridi on their skins, they fix themselves upon the backs of these animals, and with their bill (which is fashioned like a pair of scissors) they dig and squeeze out the larvæ that lie beneath the tough skin, finally extracting them. The Cattle and Buffaloes willingly endure this operation, as if they appreciated its utility. (There are two species of this bird described: B. africana and B. erythrorhyncha. Not only do they mix with the larger domesticated animals—Oxen, Camels and Buffaloes—but they are seen following herds of wild Buffaloes and Antelopes, and with the same object.)

CHAPTER III.

THE FLEAS.¹

Under this well-known name are comprised the Insects designated in zoology as Suctorials, or, better, Aphaniptera. As has been already mentioned, the majority of naturalists are agreed to consider them as a sub-order of the Dipterae.

These are jumping Insects, whose metamorphoses are complete, and whose buccal apparatus is arranged, in the larvæ, for mastication, and for suction in the adults.

![Fig. 18.—The Human Flea, male.](image)

![Fig. 19.—Head of the Human Flea, magnified thirty diameters.](image)

* md, mandible; mx, jaws; pmu, maxillary palp; l, single stylet; pl, labial palp.—Railliet.

The latter have the body flattened laterally. The head is small, and round or angular, being widely joined to the prothorax. The rostrum—adapted for piercing the skin and sucking the blood—comprises (Fig. 19): (1) two mandibles transformed into setiform prickers, and serrated; (2) two jaws or triangular maxillæ, sharp, and each carrying at its base a long and thin palp of four articles; (3) a single and rigid tongue; (4) a lower lip, terminating in two palpi of several articles, and which serves as a sheath or support to the other parts; there is no upper lip. The facetted eyes are replaced by two ocelli, which are sometimes rudimentary or are absent, behind which are concealed in a depression the antennæ, made up of from three to six articles. The three segments of the thorax are distinct; the two last have small appendages in the form of plates, which represent the

four wings. The abdomen comprises nine segments, overlapping at the sides. The legs are long, and adapted for jumping, principally the third pair; the thighs and tibiae are voluminous; the tarsi are composed of five pieces, and terminate in two hooklets. The general colour is brown, and the length of the body—which is greater in the female than the male—varies from 1 mm. to 4 mm.

The Fleas live as parasites on the Mammalia and on Birds, obtaining nourishment from their blood.

Very agile, and capable of jumping extensively, these creatures pass readily from one animal to another, and all the more so as they often quit their host—voluntarily or accidentally—and wander on the floors of habitations. The female lays about twenty eggs in dusty, damp, and dirty corners, in chinks of floors, filth, sawdust, etc. According to Fürstenberg, the female Flea of the Dog ascends to the summit of the hairs, and turning its posterior extremity outwards, drops on the ground white, elliptical, elongated eggs, measuring 0·8 mm. long. Austin has observed that sometimes the Flea undergoes all the phases of its development on its host.

The hatching of the eggs occupies about six days in warm weather, and from nine to twelve days when the temperature is lower. From the egg comes a white, cylindrical larva, complete, and formed of thirteen segments (Fig. 20).

It is absolutely destitute of legs, and moves somewhat rapidly by crawling, which is favoured by two hooked points situated at the caudal extremity, and by long hairs directed backwards, which garnish the inferior and posterior border of the first twelve segments. The head, which is distinct from the body, independently of the buccal pieces has two antennae, each composed of three short articles; and at the base of the lower lip are two small rounded elevations, each of which is provided with four points curved backwards, and which may also serve in progression.

Towards the eleventh day, the larva spins a little cocoon, gets rid of its old skin, and is transformed into a nymph that already shows three pairs of legs, and carries two small caudal pincer-like points if it is to be a male, only one point if a female. The nymph is at first white, but it gradually becomes darker, and towards the eleventh to the twentieth day—depending upon the warmth of the season—it appears as the perfect insect, and immediately goes in quest of a host to torment.

Of the domesticated animals, the Dog, Cat, Rabbit, and Pigeons and Fowls, only have Fleas. It is more especially young, weakly, or confined Dogs—such as those which are chained up or suckling—that are invaded by Fleas, as they live in a condition favourable to the breeding of these insects—from egg-laying to their full development—and which is more particularly favoured by litter and floors. Fleas can exist for a long time away from their habitual host; for they are sometimes found swarming in uninhabited places, in unoccupied Dog-kennels, and in abandoned Fox-holes. A remarkable maternal instinct
has been attributed to them, as it is stated that they feed their larvae on dried blood-corpuscles, which they carry to them. But attentive observation has proved that, in this respect, Fleas are absolutely indifferent to their progeny.

The species that lives on Man and the domesticated animals belongs to the genus *Pulex* (Linn.), which corresponds to the description given above. The best known is that of Man, the *Pulex irritans* (Linn.) (Figs. 18, 19).

The body is oval, of a maroon-brown colour, and shining; the head, rounded above and in front, is destitute of spinules at its anterior border; it is the same with the posterior border of the prothorax. The length of the female is 3 mm. to 4 mm.; that of the male 2 mm. to 2·5 mm.

It can be conveyed to Dogs and Cats which live in contact with Man. Two species live on the domesticated Mammals. One is the Dog *Flea* (*Pulex serraticeps* Gervais), which abounds on Dogs, is much less frequent on Cats, and may be transported to Man, though it rarely pricks him.

It is readily recognised, under a low magnifying power, by its blunt, black spines ranged like the teeth of a comb, and which—seven to nine in number—garnish the inferior border of each side of the head, that is rounded in front. The posterior border of the prothorax has also, laterally, seven to nine similar spines. The male is 2 mm. long, and the hinder part of the body is raised; the female is 3 mm. long, and the body is more rounded.

The other species is the *Flea of the Leporidae* (*P. goniocephalus* Tg.).

It is characterized by its head, the anterior summit of which is angular, and by the spines on the head and prothorax, which are only five or six on each side. The dimensions are sensibly the same.

It lives on Hares and Rabbits. On the Rabbit is also found the *Pulex serraticeps*, and sometimes also the *Pulex irritans*.

The Fleas which infest Fowls, Pigeons, and many other birds, are
relegated by Taschenberg to a single species, the Bird Flea (P. avium Tg.).

It has a somewhat elongated brown body; the head is rounded, and has no spinules at its posterior border, but the prothorax shows twelve or thirteen on each side of its posterior border. The male is 3 mm. long, the female 3·5 mm.

Fleas are often very troublesome, tormenting and harming animals by disturbing their rest and quietude. They are more frequently found on Dogs than on Cats, and they are common on Pigeons, rarer on Poultry.

The Pulex serraticeps infests more particularly sedentary Dogs and Cats—those which are nursing, and their young while sucklings; for laying the eggs and the development of the insect can then proceed under the most favourable conditions. ‘The complete evolution of the parasite may even be accomplished on the body of its host. Austin mentions the case of a Dog which suffered for six months from a cutaneous irritation, accompanied by intense pruritis, but without eruption. In the midst of the scurf and epidermic scales he found eggs, empty shells, larvæ at different stages of growth, the remains of larvæ, nymphae, and perfect insects. Leuckart has also found, in crusts from the eczematous skin of a Dog, numerous larvæ of Fleas, to which, in all likelihood, the eruption could not be attributed, but which had doubtless profited by this abundant source of nourishment.’—Railliet.

A particular interest attaches to the Fleas, from the part they play as intermediate hosts for certain parasites in the course of transmigration. It will be shown hereafter that the T. canina or T. cucumerina of the Dog lives in a cysterercoid state in the abdominal cavity of the Flea of that animal, and that certain embryos of Nematode worms, which are often found in the blood of the Dog are ingested with blood by the Fleas, and develop in the intestine and abdominal cavity of these parasites.—See Parasites of the Intestines, and Parasites of the Circulatory Apparatus.

Destruction of Fleas.—There is no need to allude here to the Flea of Rabbits, nor yet to that of Cats, as these parasites are rare. To destroy those of Dogs, insecticide powders, which have for their basis the flowers of pyrethrum, stavesacre, or wormwood, are sprinkled over the animal so as to fall between the hairs; or the skin may be rubbed with common or laurel oil, with which a little powdered

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tobacco has been mixed, and a soap-bath given twelve hours afterwards. Some people are content to use sulphurated, benzinated, or creolized water, or powdered parsley or wormwood. Cleanliness, baths, washing with potash, carbolic, or cresylated soaps, prevent the multiplication of Fleas. Kennels, or other places invaded by these creatures, should be treated with boiling water or limewash. Pine-shavings have been recommended as bedding for Dogs, with a view to keep away Fleas. It has also been recommended to have the floors of kennels made of the staves of old tar-barrels, laid edge-ways between the stones. The persistent odour of the tar does not hurt the Dogs, and it drives away the Fleas. The same result is arrived at in sprinkling on the floor creoline powder or creolized water, 5 or 10 per cent.

For Poultry the same measures may be adopted, or those prescribed for Lice.

The Chigoe. - In Brazil, Guinea, Mexico (West Indies), in all the equatorial republics, and generally throughout the whole of tropical America, from the 29th degree of north latitude to the 20th degree of south latitude, is found a kind of Flea which is extremely redoubtable by the accidents that its presence determines, principally in Man. Some years ago (1872) it was introduced into Africa (Congo, Gaboon) by ships arriving from Brazil, which disembarked it along with their merchandise, and it has already become a serious plague there.

It belongs to the genus Sarcoopsylla (Westwood), which is characterized by peculiarities in the rostrum and its angular forehead, which has a number of small points resembling the teeth of a saw. It is known by the common names of Jigger, Chigoe, Chiggre, Sand Flea, Penetrating Flea (Sarcoopsylla penetrans Wd., Pulex penetrans Linn.). It is much smaller than the ordinary Flea, the female—which is smaller than the male—measuring no more than 1.3 mm. long. Its colour is about the same as that of the Fleas of this country.

This insect lives in woods, on plants, dry herbage, and in sand, from which it passes to Man and the domesticated or wild animals, attaching itself principally to the limbs. It attacks Sheep, Goats, Cattle, Horses, Mules, Asses, Cats, and especially Dogs, and, even more so, Pigs. The latter have been considered as greatly contributing to the propagation of the insect. This Flea differs, then, from the other Aphaniptera by its indifference to the host it invades.

The male and virgin female act only as the other species of the genus Pulex. But the fecundated female penetrates the skin of Man or animal, lodging itself between the epidermis and derma, and remaining there for six or seven days. After the second day, the second and third abdominal segment of the Chigoe increases in size, enlarging in every direction, and pushing the thorax forward, the other abdominal segments backward, and assuming the appearance of a vesicle, the size of a pea. This sac is filled with eggs, which may be more than a hundred in number. These are ovoid in shape, white, and 0.4 mm. long. When

1 Journal d’Agriculture Pratique, 1889.
they are mature, the female is often expelled by the pressure of the tissue which it irritates, and lays its eggs external to the host.

The presence of the Chigoe entails local disorders of an inflammatory nature at first, then ulcerative. The wounds have a tendency to extend and become gangrenous, and in Man—whose feet are oftenest attacked—arthritis, necroses of bones and tendons, fistulae, and loss of phalanges and toes, are frequently witnessed. Animals have the same lesions, and it is not rare to see those which have lost toes, or even an entire limb; others have the ears deformed by irregular cicatrices.

Another species—the Chigoe or Sarcopsylla of Fowl (Sarcopsylla gallinacea Westwood)—a neighbour of the American Chigoe, lives on the domesticated Fowl, fixing itself principally around the eyes and the neck. It has as yet only been found in Ceylon by Moseley, during the voyage of the Challenger, and by Green at Colombo; it has been described by Westwood.

Treatment.—The measure to adopt against the Chigoe is its immediate extraction. This is accomplished by means of a needle, and demands all the more expertise if the parasite has been long embedded; for there is danger in perforating the oviscrous sac, which would allow the eggs to escape into the wound, and thus give rise to grave complications. In such unsuccessful cases, the wound is washed with pure or carbonized water, or even cauterized with nitrate of silver or dressed with tincture of iodine. Even in successful operations, cicatrization of the wound is relatively slow. When the Chigoes are very numerous, frictions with mercurial ointment, sulphur baths, applications of benzine, etc., have been beneficially employed.

With regard to prophylaxis, the American Indians rub themselves with acrid and very odorous tinctures, and infusions of the leaves of tobacco or arnatto. The negroes employ inunctions of almond-oil of the Carapa guianensis; these inunctions are very useful for protecting the paws and ears of the domesticated animals.

The Alakurt.—Schimkewitsch has described a kind of Flea which is allied to the Chigoe, and, like it, belongs to the Sarcopsyllidæ family, but which should be placed in a separate genera—the Helminthopsylla. It is found in Turkestan, and is known to the Kirghiz by the name of Alakurt—that is, a versi-coloured Worm or Insect, because it is at first nearly black, but on becoming distended it is white, with stripes of various colours. Schimkewitsch has given it the specific name of Helminthopsylla Alakurt.

The female alone is known. It measures 6 mm. in length when completely developed. The head is large, rounded behind and narrow in front; the fosette for the antenna is situated nearly in the middle of the head; the eyes are somewhat large; the maxillæ are triangular, and in the form of acute-pointed lancets, not curved backwards. The fecundated females have the abdomen vermiform and articulated like

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the Chigoe. The thorax is dark-brown, as are the abdominal segments; but the latter, in a state of distension, are wide apart, and united by a milky-white membrane.

The Alakurt is met with in certain valleys and on particular mountains in Turkestan. 'It appears in the autumn, when the mountains begin to be covered with snow, and it abounds more particularly during the intense cold. It lives as a parasite on Horses, Sheep, Camels, and Oxen, and brings about considerable debility, which, in foals, may terminate in death.'
CHAPTER IV.

PHTHIRIASES.¹

The general name of Phthiriasis (πῆπ, a louse) has been given to the cutaneous affection due to the presence of Lice on the surface of the skin. It is also named the Pedicular disease and Lousiness.

In its ordinary sense, the term Louse comprises all the apterous parasites which do not jump like Fleas, and only by accident quit their host.

With the exception of the Melophagus of the Sheep and some doubtful species, all belong to the sub-order of Hemipterus parasites, Rynchotes parasites, and the Pediculinae of Piaget.

These are small-sized—only a few millimètres in length—apterous insects, of a dull-white colour, and the mouths of which are adapted either for pricking or masticating. The head bears two simple eyes, or ocelli, often but little distinct; and two antennae, composed of three, four, or five articles. The three thoracic segments are more or less confounded with each other. The abdomen is usually composed of nine segments. The legs are ordinarily short and strong; the tarsi are formed of two articles, the last of which has two nails, or hooklets, by which the insect can creep. The eggs, called nits, are pyriform, have an operculum at one end, and are fixed very solidly to the hairs or feathers by a glutinous substance. The young—which leave the eggs by the operculum—have quite the shape of the adults, and do not undergo any metamorphoses, though they only acquire their definitive colour and consistency after several moltings.

The male and female differ from each other, in the former being a little smaller than the latter, frequently by peculiarities in the antennae, by the last abdominal segment being often divided in the female and rounded in the male, which has also, on the middle line, a copulating apparatus of a brownish colour, and digitform or lancet-shaped.

The males are usually much less numerous than the females.

The Hemipterus parasites are divided into two families—the Pediculidae and the Ricinidae.

The *Pediculidae*, or *Lice properly called*, have the mouth arranged as a sucker at the anterior border of the head; the tarsi always terminate in a single claw, with the exception of the *Haematomyzus*, which has two. The *Riciinidae, Ricini, or Mallophages*, have the buccal apparatus formed for mastication; they are *pellivorous*—that is, they live on epidermic productions, hairs (*pilevorous*), or feathers (*pennivorous*); the pieces constituting the mouth are placed at the inferior surface of the head, and the tarsi terminate in one or two claws.

**Pediculidæ.**—These have a movable proboscis, formed of the upper and lower lips, and armed in front with one or two verticilli of small spines. In this canal are four channels, arranged two and two, the juxtaposition of which form an internal tube, or sucker, narrower and longer than the canal. The insect projects this sucker beyond the sheath to bury it in the skin, and uses it to aspirate the blood. The hooklets, or spines of the sheath, fix the aspiratory apparatus, and so prevent access of air. The thorax is small, but usually larger and shorter than the head, and shows scarcely any traces of its division into three segments. The abdomen is generally elliptical in outline, and has its last segment rounded in the male, with an opening which the penis can pass through; in the female this segment is notched or bilobate, with two small terminal appendages.

All the known species live on the Mammalia. The Lice infesting Man—the head Louse (*Pediculus capitis*), body Louse (*Pediculus corporis*), and pubic Louse or Morpion (*Pediculus pubis*)—belong to this family: genera *Pediculus* and *Phthirius*. The species which are found on the domesticated animals are all included in the genus *Haematopinus* (Leach).

**Haematopinus.**—The Insects in this genus are not very distinct from the genus *Pediculus*, the species of which are comparatively few, and live, two on Man and a third on a Monkey. The *Haematopinus* are characterized by their head being inserted directly on the thorax, without any constriction like a neck; by their antennæ of five articles, their abdomen of eight or nine segments, their tarsi with a single claw, and their legs without a distinct appendage at the internal angle of their tarsal extremity (Figs. 25, 26, 28, 29, 34, 36, 37, 40).

The *Haematopinus* are found on all the domesticated Mammalia, with the exception of the Sheep, Cat, and Guinea-pig.
RICINIDÆ.—These Insects are often distinguished at first sight from the Pediculidae by their head, which is always larger than their thorax, and the shape of which is determined by a system of dark horny bands, to which particular names are given. The most important are: 1. The antennal bands, which are marginal, and border the head in front, from the insertion of the antennæ, joining or not joining each other in the middle line; 2. The occipital bands, which extend—one on each side—from the occiput, or posterior border, to the base of the mandibles or orbit. The mouthpieces are situated on the inferior surface, and are principally constituted by the mandibles, in the form of short hooks, and by the jaws. The thorax generally has its prothorax distinct, but its other two segments are usually joined as one, which receives the name of meta-thorax. The first seven abdominal segments have their borders strengthened by a lateral band, and most frequently have transverse spots.

The masticatory apparatus of the Ricines allows them to subsist on epidermic productions, and fragments of hairs or feathers. They do not suck the blood of their hosts like the Pediculidae; so that they might be considered not as true parasites, but as commensuals which free the skin from its scurf. But it must not be concluded that they are really advantageous to the animal infested by them. Not only do they soil the skin by their dejections, their 'nits,' their exuviae, and their dead bodies, but it is certain that their contact is felt by the creatures on which they live, and on which they produce disagreeable itching, accompanied by sharp bitings. Birds invaded by these vermin are often in bad health.

The Ricines are divided into two sub-families: 1. The Philopterinae, which have the antennæ composed of three or five articles, and have no maxillary palpi; 2. The Liotheinae, whose antennæ have four articles, and which are provided with quadri-articulated maxillary palpi projecting beyond the anterior border of the head.

Philopterinae.—Independently of the above characters, it is necessary to note in these Insects the frequently important development of the anterior part of the head, which is named the clypeus, and is sometimes distinctly separated from the posterior part by a suture. The antennal sinus is a more or less deep notch on each side of the middle line of the head, and at the bottom of it is a small protuberance which carries the antenna.

The Philopterinae are divided into eleven genera, only six of which are of interest to us. These are: the Trichodectes, which live exclusively on Mammalia; the Ornithobia, Lipeures, Gonoides, Goniocotes, and the Docophores, which are parasitic on Birds.

The Trichodectes (Nitzsch) are characterized by their three-articled antennæ, these having five in all the other genera. They are limited to Mammalia, the other genera being special to Birds (Figs. 27, 30, 31, 35, 38, 39).

The Ornithobia (Ornithobius Denny—Fig. 49) and the Lipeures (Lipeurus Nitzsch—Fig. 46) have a narrow, elongated body, the sides
being nearly parallel. The antennæ are different in the two sexes; besides, in the *Lipeurus* the third article in the male has an appendage which is absent in the *Ornithobius*. The latter has the abdomen bordered on each side by two parallel bands, while there is only one on the *Lipeurus*. The *Ornithobia* are special to the Swan.

The *Goniodes* (Nitzsch—Fig. 43) and *Goniocotes* (Nitzsch—Figs. 44, 45) have the body flattened, sides rounded, or an elongated oval, and the antennæ different in the two sexes, the first article in the male being larger than the others. In the male *Goniodes* the third article, and sometimes the first, has an appendage which is absent in the *Goniocotes*; and the latter always has the abdomen rounded at the end, while in the male *Goniodes* it sometimes has two points.

The *Docophores* (*Docophorus* Nitzsch—Fig. 48) have the antennæ the same in both sexes. They are inserted in the sinuses or excavations at the sides of the head, which has two strong movable trabeculae at its anterior angle.

The *Liotheinae* are distinguished from the Philopterineæ by their four-articled antennæ and distinct maxillary palpi. The head is very broad at the temples, and appears to be triangular or trilobate. In front of the temple there is often a notch, called the *orbital sinus*, in which is found the eye, though this is usually not very distinct.

The *Liotheinae* comprise ten genera, four of which have their representatives on the domesticated animals. These are *Gyropus*, *Trinoton*, *Colpocephalum*, and *Menopon*.

The *Gyropes* (*Gyropus* Nitzsch—Figs. 41, 42) have only a single claw at the tarsi, while there are two in the other nine genera. The head presents, posteriorly, two notches, limiting the very salient temples. They are only met with on the Mammalia, and principally Rodents.

The *Trinontons* (*Trinoton* Nitzsch) have the head very round in front, the temples salient and projected backwards; a wide orbital sinus, having at the bottom a bilobate eye; and the antennæ short and concealed. The thorax is divided into three distinct segments, and the tarsi have two claws. This Insect lives exclusively on Palmiped.s.

The *Colpocephales* (*Colpocephalum* Nitzsch) have the head wider than long—somewhat like that of the Trinontons; but they are distinguished from them by their rarely bilobate eyes, and antennæ projected beyond the head. The tarsi have two claws. They live on all kinds of birds except the Coursers (*Charadriidae*). The *Menopons* (*Menopon* Nitzsch—Fig. 47) generally have the head like that of the two preceding genera, but the orbital sinus is absent or very shallow at the part occupied by the eye, and often also that where the antennæ are fixed; the latter are always short and indistinct. Living on Birds of all kinds except the Coursers, Piaget has on two occasions found them on Mammals—one of them, the *Menopon extraneum*, on the Guinea-pig.

This summary zoological description being considered sufficient to enable anyone to recognise the genus to which a parasite belongs, it will be easy to determine its species by the following information.
Horse.—The horse harbours the Haematopinus macrocephalus, the Trichodectes pilosus, and the Trichodectes pubescens—the latter less frequently than the other two.¹

Haematopinus macrocephalus (Burm.—Fig. 26).—Head elongated and narrow; antennæ implanted on a kind of lateral protuberance, behind which is a deep notch, lodging the eye at the bottom. At this part the temples are wide and curve forwards; then the head contracts, and assumes a triangular form in its posterior moiety. The thorax is much shorter than the head; the abdomen is oval, with continuous and slightly sinuous borders; the two stigmates on the margin of each ring are placed in the middle of a lateral protuberance. The head and abdomen are of a grayish-yellow colour, and the thorax a brown maroon. The length of the female is 3·6 mm.; that of the male 2·6 mm.

Trichodectes pilosus (Giebel—Fig. 27).—The head is wider than it is long, and is rounded in front—a little widened at the temples; the antennal band makes a turn around the forehead. The first seven segments of the abdomen have middle quadrangular spots. The head, thorax, legs, and abdomen are covered with hair on both surfaces, and, in addition, the last abdominal segment on the male has two hairy cushions. The general colour is yellow; spots and head ferruginous; band brown maroon. The length of the female is 1·9 mm.; that of the male 1·6 mm.

Trichodectes pubescens (T. parumpilosus Piaget).—This Insect is much rarer than the preceding; it is 2 mm. less in length, and differs chiefly in the head, which is hairy only along the borders.

Ass.—The Haematopinus of the Ass belong to the same species as that of the Horse, but Piaget makes it a different variety—Colorata—a little larger than the type, head less hairy, tint darker, and with a quadri-

lateral spot on the sternum. The *Trichodectes pilosus* is also a parasite of the Ass.

Ox.—On the Ox there are found the *Haematopinus eurysternus*, the *H. tenuirostris*, and the *Trichodectes scalaris*.

**Haematopinus eurysternus** (Nitzsch — Fig. 28). — The head is rounded in front, slightly elongated—more in the male than the female. It is, besides, chiefly distinguished from the *H. macrocephalus* by its oval and very large abdomen, having on each segment a slightly-coloured lateral tubercle. The head and thorax are fawn-coloured, the latter being darkest; the abdomen is yellow or grayish; the genital spot is dark. The female is 3 mm. long, and the male 2·5 mm.

**Haematopinus tenuirostris** (Burm.—Fig. 29). — Rarer than the preceding, the head is elongated and somewhat buried in the thorax; the latter is as broad as it is long, and the abdomen is narrow—scarcely wider at the sixth segment—the largest—than at the first. The general tint is a deep chestnut, brighter on the forehead, legs, and the lateral band of the abdomen. The female is 3 mm., and the male 2·5 mm. long. It is probably this species that Linnaeus found on sucking calves, and named *Pediculus vituli*. It also infests adults, perhaps as much as calves.

**Trichodectes scalaris** (Nitzsch—Fig. 30).—The head is scarcely so wide as it is long, is almost parabolic in shape, and is very hairy.

It resembles *Tr. pilosus*, but it has not the hairy cushions on the last abdominal segment, and the median spots are larger. The general colour is white, the spots ferruginous, the bands being darker. The length of the female is 1·5 mm.
PHTHIASES.

Sheep.—The Pediculinae are only represented on the Sheep by the Trichodectes sphærocephalus (Nitzsch—Fig. 31).

It has the head as broad as long, rounded in front, the antenneal band turning round the forehead, which has long hairs at the sides. The antennæ are hairy and slightly longer in the male than in the female; the median spots on the abdomen are sub-quadrangular. The general colour is white, spots and head ferruginous. The length of the female is 1·7 mm., and of the male 1·4 mm.

The phthiriasis of the Sheep is usually due to the Melophagus ovinus (Lat.), which belongs to the Pupiparous Diptera (see p. 36), but which, being apterous, does not quit its host, and multiplies in its fleece; it is nourished on the grease (yolk) of the wool, the débris of hair, and the blood that it causes to flow by its bites; consequently, it lives like the Pediculinae. Macquart formulates its characteristics as follows:

'Head disengaged from the thorax. Palpi elongated, fluffy, and inclined downwards. Antennæ nude and in the form of tubercles. Eyes very small and close; no ocelli. Thorax somewhat narrow; abdomen oval. Feet downy; tarsal claws bi-dentated. Wings null.' The general colour is ferruginous; abdomen grayish-brown, and irregularly spotted. Length of body, 3 mm. to 5 mm.

Goat.—The Hæmatopinus of the Goat is the Hæmatopinus stenops (H. stenopsis Burm.—Fig. 34).

The head is elongated, narrow, conical, round in front, notched laterally, and widened at the temples, in the form of a gourd, acuminated in the thorax, which is scarcely concave on the abdomen; the latter is an elongated oval in shape, bearing two terminal appendages; stigmates nearly
marginal. Colour straw-yellow, gray for the abdomen. Length of female 2 mm., male 1.5 mm.

Several species of *Trichodectes* have been described as living on the Goat, but only one, the *Scaly Trichodectes* (*Tr. climax* Nitzsch—Fig. 35), is well established.

The head is scarcely as wide as it is long, and is quadrilateral, having in front a broad but shallow notch, at which the two antennal bands stop; the antennae are longer in the male than in the female, the first article being thicker and shorter than the others, and the second longer than the third. The abdomen has median spots, which diminish in breadth as the length increases; the last segment in the male has two hairy cushions. The head and thorax are reddish-brown in colour, and the bands dark. The female is 1.8 mm., and the male 1.3 mm. long.

This species lives on the common as well as the Angora Goat. The

Insect that Gervais figures and describes as the *Tr. limbatus* is evidently the *Tr. climax*, though Piaget appears to identify it with his *Tr. climax* var. *major*, found also on the Angora Goat, and the female only of which differs slightly from the type, scarcely in dimensions. With regard to the form vaguely described and figured by Gervais as *Tr. climax*, it appears to us to correspond to none of the known species. According to Taschenberg, *Tr. caprae* (Gurlt) and *Tr. solidus* (Rudow) of the Guinea Goat, and probably *Tr. mambricus* (Rudow) of the Levant Goat, are identical with *Tr. climax*. Taschenberg has also recognised that *Tr. crassipes* (Rudow) of the Angora Goat is none other than *Tr. penicillatus* (Piag.), found by Piaget on a Kangaroo (*Macropus penicillatus*). But this might be a case of wandering parasites on an abnormal host.

**Camel.**—The *Haematopinus of the Camel* (*H. cameii* Redi), which has only been seen by Redi, much resembles that of the Pig.
PHTHIRIASIS.

The Pig nourishes only the Hæmatopinus urius (Nitzsch, H. suis Linn.—Fig. 36).

This species is the largest known amongst the Pediculine. The head is very long and narrow, rounded and conical in front, with five hairs on each side, and towards the sucker three other long hairs. The temple has a very salient sharp horn on the first article of the antennæ, and it gradually contracts to the occiput, which is rounded to its thoracic suture. The abdomen is an elongated oval, very developed, with continuous borders; the stigmates are on a prominent lateral protuberance. The head and abdomen are yellowish-gray in colour, the stigmatic spots and thorax a maroon-brown, and legs fawn-tinted. The female is 5 mm., and male 4 mm. long.

Dog.—The Dog has one Hæmatopinus and one Trichodect.

Hæmatopinus piliferus (Burm.—Fig. 37). The head is short and almost as wide as long; it is salient in the thorax to which it is exactly applied; the third and fourth articles of the antennæ are alike. The abdomen is very developed in the female, and is a long oval in shape; it has nine rounded segments, which are often salient at the sides; stigmates distinct and marginal; the first seven segments have two rows of short bristles. The general tint is yellowish-white, the head and thorax being a little darker. The female is 2 mm. long, and the male 1·5 mm.

Trichodectes latus (Nitzsch — Fig. 38).—The head is sub-quad-rangular and much wider than it is long, being truncated in front; the antennæ are hairy, and different in the two sexes, the first article in the male being much thicker, and occupying a moiety of the length of the organ. The abdomen is broad and more rounded in the female, with lateral, but no median spots. The colour is bright yellow, spots darker; the bands on the head are blackish-brown. Length of the female 1·5 mm., of the male 1·4 mm.

Ferret.—There is sometimes met with on the Ferret, and in great numbers, the Hæmatopinus piliferus, which lives on the Dog.
RABBIT.—The only Louse found on the Rabbit is the *Hæmatopinus ventricosus* (Denny.—Fig. 40). It is rare.

The head is subuliform, broader than long, constricted behind the antennæ, widened at the temples, where it is rounded. The thorax is wider than the head, and is concave on the abdomen; the latter is ovate, as broad as long, bulging, rough, and hairy. The head, thorax, and legs are of a bright chestnut colour; the abdomen is of a dirty-white. The length of the female is 1·3 mm., and of the male 1·2 mm.

GUINEA-PIG.—The Lice of the Guinea-pig belong to two species of *Gyropes* (Figs. 41, 42).

*Gyropus gracilis* (Nitzsch).—This is recognised by its long, narrow abdomen, especially in the male; by its head, made, as it were, trilobate (Fig. 40). *Hæmatopimis ventricosus*, male, of the Rabbit; magnified twenty-five diameters.

*Gyropus gracilis*, female, of the Guinea-pig; magnified twenty-five diameters.

*Gyropus ovalis*, male, of the Guinea-pig; magnified twenty-five diameters.

in front of the antennæ; by the notch at the temples; and by its antennæ, the fourth article of which is globular, and rests on the third as an elongated peduncle. The general colour varies from dirty-white to ochre-yellow. The length of the female is 1·2 mm., and of the male 1 mm.

**Oval Gyropus** (*G. ovalis* Giebel).—This differs by its large, oval abdomen, crenulated on the borders, and garnished with two rows of hairs on each segment. The head is shorter and wider. The general colour is white; the spots, tarsal bands, and claws are dark. It is of the same length as the *Gyropus gracilis*.

To these must be added the *Menopon extraneum* (Piag.), found once by Piaget, and of which mention has been already made (p. 68).

Birds maintain a larger number of Pediculi than the Mammalia, and these parasites all belong to the family of *Ricinidae* (see p. 67). Each species of Ricinus is not strictly localized on a particular host, but many are common to several kinds of Birds. On the other hand, the promiscuousness of the poultry-yards, and, above all, of the markets, may lead to erratic parasites passing to a Fowl from a specifically different host.

**Fowls.**—The parasites found on Fowls belong to the four genera of *Goniodes*, *Goniocotes*, *Lipeurus*, and *Menopon*.
Goniodes dissimilis (Nitzsch—Fig. 43).—The head is wider than it is long, and rounded in front; it is smaller in the male. The antennae of the male—double those of the female—has the first article most developed, and has a long hair at the inner side. The temporal angles are salient, especially in the female, but do not form horns. The antennal band is very strong, and wide in front, with a series of distinct fissures for the implantation of hairs. There are five bristles at the posterior border of the metathorax. There are also two median bristles, and three or four at the angles of each abdominal segment, with an arched marginal spot; at the ventral surface of the abdomen of the female, there are two little bands in the form of a T laid sideways. The general colour is a dirty-white, the spots darker, and the bands fawn-tinted. The length of the female is 2·5 mm., and of the male 2 mm. This is one of the most frequent parasites.
Packard has observed on the Fowl a Goniode of Burnett (Gd. Burnetti Pk.), which is probably allied to Goniodes dissimilis.

**Goniocotes hologaster** (Nitzsch—Fig. 44).—The head is as wide as it is long, the anterior border rounded and slightly convex, the antennal band being wider in front. The abdomen has unicoloured quadrangular lateral bands, curved and broader towards the suture, and wider on the ventral than the dorsal surface; the transverse patches are faint, but distinct; the sutures are only visible between the first three segments. The general tint is a dirty-yellow, deeper at the thorax; the bands are brownish. The female is 1-3 mm., and the male 8 to 9 mm. long. Taschenberg has noticed a variety (var. maculata).

**Goniocotes gigas** (Tasch.—Fig. 45).—This is recognisable by its round and very large abdomen, marked on each segment by long, transverse, tongue-shaped spots, coloured only on their border. It has, besides, proportions which are quite exceptional in this genus. The general colour is yellow; the abdomen and metathorax are brighter coloured, and the bands and outline of the spots are dark. The female is 4 mm., and the male 3 mm. long.

**Lipeurus variabilis** (Nitzsch—Fig. 46).—The head is round in front, and in the male is wider in its anterior portion, at the temples in the female; it is margined in front by the uninterrupted antennal band. The first article of the male antennae is longer than the other four put together, and has a strong obtuse excescence. There is a middle spot beneath the thorax; the female has a genital, lance-shaped spot, and the last ring of the abdomen is bilobate. The general colour is a pale yellow, the spots being a deep fawn-tint and the bands black. The female is 2-2 mm., and the male 1-9 mm. long.

**Lipeurus heterographus** (Nitzsch).—The head is parabolic in front, very wide behind the eye, and limited anteriorly by the uninterrupted antennal band. The metathorax is as long as the prothorax. The abdomen is an elongated oval, slightly larger in the female, with six short bristles implanted in tubercles on each segment in the male, and median spots on each ring and bristles on their borders. The general tint is pale yellow, spots fawn-coloured, bands black. The female is 2 mm. long, the male being 1-8 mm.

**Menopon pallidum** (Nitzsch—Fig. 47).—The head is slightly angular in front and somewhat crescent-shaped, the temples being bent downwards; the latter are short and rounded, with four bristles and some hairs; there is no appendage to the second article of the antennae. The thorax is longer than the head in the female; they are equal in size in the male. The pads are strong and hairy. The abdomen is an elongated oval in the female, narrower and longer in the male, with a single series of bristles on each segment. The general tint is a dirty-yellow, the spots on the abdomen being a bright fawn-colour. The female is 1-7 mm. long, and the male 1-8 mm.

**Menopon biseriatum** (Piaget).—This is rendered distinct from the other by its head, which is markedly parabolic in front, by the presence of two series of bristles on each ring of the abdomen, and by the eighth segment, which is, in the male, elongated and narrow. It has the same tints as the preceding. The female is 2-7 mm. in length, the male 2-9 mm. This Insect lives also on the Turkey, Pheasant, and Pigeon.

**Turkey.**—The parasites of the Turkey belong to the genera Goniodes, Lipeurus, and Menopon.
Goniodes stylifer (Nitzsch).—The head is as wide as it is long; it is quadrangular, especially in the male; the temporal angle forms a long horn, acuminated behind and terminated by a bristle. The metathorax has divergent sides, acuminated on the abdomen, and bearing five bristles on the posterior border. The seven first segments of the abdomen show linguiform spots on the sides, and which cover the transverse third of the segment; in the middle of each there is a bright spot occupied by the stigmate; there are numerous hairs on both surfaces. The general colour is dirty-white, the spots are fawn-coloured, and the bands brown and black. The length of the female is 3 mm., that of the male 3·2 mm.

Lipeurus polytrapezius (Nitzsch).—The head is relatively short—it is strongest in the female—scarcely so wide at the temples, and very rounded in front, where it is bordered by the uninterrupted antennal band. The first article of the male antennæ is thick, fusiform, a little longer than the other four collectively, and is provided with a strong excrescence at its base. Beneath the thorax there are two median spots, the second of which extends for a short distance on the abdomen. The female has an acuminated genital spot posteriorly, and the last abdominal segment is deeply notched. The general colour is yellow, spots fawn-tinted, and bands black. The length of the female is 3 mm. to 3·7 mm., and of the male 2·8 mm. to 3·7 mm.

The Menopon of the Turkey is the M. bisertiatum, which lives also on the Fowl. It is probably the same as the M. stramineum (Nitzsch).

Guinea-Fowl.—A Goniode, a Goniocote, and a Menopon live on the Guinea-fowl.

Guinea-fowl Goniodes (Gd. numidianus Denny).—The head is longer than it is wide; the antennæ of the male are somewhat long, and have the third article curved and acute, carrying the succeeding two beyond its axis; the eye is salient, and occiput a little suppressed. The metathorax is wider than the head and acuminated on the abdomen, with a black band at the posterior border; the legs are strong. The abdomen is oval, with the spots twice interrupted. Its length is 1·7 mm. It has been found by Denny on the Guinea-fowl.

There has also been found on this Bird the Goniodes stylifer.

Goniocotes rectangulatus (Nitzsch).—This differs from Gonioc. hologaster of the Fowl chiefly in the lateral bands of the abdomen, which are wide on the ventral surface in this Insect. The segmental sutures are only distinct between the three first. The length of the female is 1 mm., and of the male 8 mm. This insect was found on a Guinea-fowl by Taschenberg, but it is rather a parasite of the Peacock.

Lipeurus of the Guinea-fowl (L. numida Denny).—The head is large, subpanduriform, rounded in front where it is bordered by the antennal band, and wide behind the eye; the female antennæ have the second article very long. The metathorax is nearly as wide as the prothorax. The abdomen is oval, the first seven segments showing a double series of spots, which form two interrupted dorsal bands. The colour is livid yellow, and the bands and spots black. The length is 2·1 mm.

This insect was found on the Guinea-fowl by Denny, who considered it a Nirmus (Nirmus numidae)—he probably had not seen the female. (Railliet.)
Menopon of the Guinea-fowl (*M. numidae* Gieb.)—The head is semilunär, and the orbital sinuses distinct. The prothorax is large, with three sharp points at each angle; the metathorax is large and trapeziform. The abdomen is also large, with festooned borders garnished with bristles and dark spots. The general colour is red. Length 1 mm.

Peacock.—The parasites of the Peacock, like those of the Guinea-fowl, belong to the genera Goniodes, Goniocotes, and Menopon.

*Goniodes falcicornis* (Nitzsch).—The head is nearly square, and curved somewhat downwards in front, especially in the male; the antennal band is narrow anteriorly and has parallel borders; the temples are angular, and do not form a horn behind; the occiput is scarcely depressed; the first article of the male antennae is very thick, is nearly as long as the other four, and has a strong appendage on the inner side; the third article has a long curved appendage; the other two are thin, and rest on a protuberance from the third. The metathorax is not so large as the head in the female, but in the male it is as large, or larger, than the prothorax. The abdomen is very large, and on the sides has very dark-coloured languiform spots. The genital apparatus of the male is very large, and ascends to the third segment. The general colour is yellowish-white, the spots being a deep-fawn hue. The female is 3·3 mm., and the male 3 mm. long. This is a common parasite.

Small-headed Goniodes (*Gd. parviceps* Piaget).—This differs from the preceding principally in the head, which is more regularly quadrangular; in its metathorax, which is larger than the head; in its abdomen, which is scarcely so large as the metathorax; and in the dimensions of the male and female, which are 2 mm. long.

*Goniocotes rectangulatus* (Nitzsch).—This is the same as those which are found on the Guinea-fowl.

Black-mouthed Menopon (*M. pheostomum* Nitzsch).—The head is elongated, contracted, and rounded in front, very wide at its posterior border, and the temples narrowed and bent downwards. There is no appendage to the second article of the antenna. The thorax is longer than the head, and the metathorax a little rounded on the abdomen; the latter is a long oval in the female and larger than in the male, with a single series of bristles on each ring. The general tint is yellow, brightest in the male; the spots are fawn-coloured. The female is 1·6 mm., and the male 1·3 mm. long.

Pheasant.—The common parasites of the Pheasant are the Goniodes, Goniocotes, Lipeures, and the Menopons.

*Goniodes of the Pheasant* (*Gd. colchicus* Denny).—This differs from the *G. dissimilis* of the Fowl chiefly in the presence of a small tooth at the inner side of the antenna of the male, of only two bristles at the posterior border of the metathorax, and in numerous median bristles on each segment. The dimensions are about the same.

*Goniodes truncatus* (Giebel).—The head is large and parabolically rounded in front; the temples are not excavated, nor prolonged posteriorly as horns; the occiput is convex, and the occipital angles acute. The abdomen is an elongated oval, that of the male is truncated behind;
the lateral bands are arched, and because of this a short appendage on them is pushed into the preceding segment. The colour is white, with dark bands. The female is 3 mm., and the male 2·4 mm. long.

Gonicotes chrysocephalus (Giebel).—This differs chiefly from Gc. rectangulatus of the Guinea-fowl and Pheasant, in having the sutures between the eight first segments of the abdomen visible. The colour is yellow, particularly at the head and thorax. The female is 1·2 mm., and the male 8·3 mm. long.

Lipeurus variabilis.—This parasite of the Fowl has also been found on the common Pheasant by Taschenberg and Railliet.

Long Menopon (M. productum Piaget).—This differs from M. pallidum of the Fowl principally in having the temples less excavated, and the body being elliptical and constricted to the sixth segment in the female, and nearly as short as broad in the male, with the ninth segment short and like a reversed ogive. The general tint is ochre-yellow, fawn-coloured on the sides of the abdomen. The female is 1·8 mm., and the male 1·5 mm. long.

Biseriated Menopon.—This is the same as that found on the Fowl and Turkey.

Among the parasites found on the Silver Pheasant, are placed the Gonicotes chrysocephalus of the common Pheasant, and a variety of the Menopon phe zostomum, the type of which lives on the Peacock.

The Golden Pheasant offers, amongst others, the Lipeurus heterographus—described for the Fowl, and the Menopon productum of the common Pheasant.

Pigeon.—On the domestic Pigeon there have been found: a Goniode, Goniocote, Lipeurus, Colpocephalus, and two Menopons.

Dwarf Goniode (Gd. minor Piaget).—All the species have the abdomen oval and broad, but this is distinguished by the antennæ of the male, the last two articles of which are very reduced and scarcely visible; and by its metathorax, which is rounded on the abdomen. The colour is yellow, and the female is 1·7 mm. long, the male being 1·4 mm.

Companion Gonicote (Gc. compar Nitzsch).—The length of the head is a little less than its width at the posterior border; the anterior border is convex, and the antennal band linear. The abdomen is oval and rounded in the female, truncated posteriorly in the male, and has coloured spots only on the border of each segment; each margin of the abdomen has two parallel bands. Colour a dirty-yellow. The female is 1·4 mm., and the male 1 mm. long.

Rod-shaped Lipeurus (L. baculus Nitzsch).—The head is elongated and very narrow, the anterior part—clypeus—being round and separated from the other portion by a constriction; it is not bordered in front by the antennal band, and is garnished by six fine hairs and two claviform appendages. The first article of the male antenna is much thicker than the others, and has an enlargement at its base, but has no appendage; the third article has a strong lateral appendage. The prothorax is quadrangular, and one-third shorter than the metathorax. The colour is dirty-white, with bright yellow spots and brown bands. The female is 2·1 mm. to 2·3 mm., and the male 1·8 mm. to 2·3 mm. long.

Long-tailed Colpocephalus (C. longicaudatus Nitzsch).—The occi-
pital bands are not distinct. The abdomen of the female is conical, and bordered by narrow dark bands; the first segments are the longest, and the ninth is elongated and constricted at its posterior moiety, as well as fringed with long and fine hairs; in the male the abdomen is an elongated oval, and the last segment is rounded and garnished with numerous long bristles. The insect is white, with fawn-coloured spots. The female is 1·6 mm., and the male 1·3 mm. long.

**Broad Menopon** (*M. latum* Piaget).—The head is parabolic, and nearly angular in front. There is an appendage to the second article of the antennae in the two sexes. The thorax is longer than the head in the female, shorter in the male; the metathorax is not so broad as the head, and is rounded on the abdomen. The latter is large, oval, and rounded in the female, and oval and elongated in the male, with salient angles. The colour is yellow, with bright, fawn-coloured spots. The female is 8 mm., and the male 1·5 mm. long.

**Goose**.—The parasites of the domestic Goose belong to the genera *Docophorus*, *Lipeurus*, and *Trinoton*.

**Bilious Docophorus** (*D. icterodes* Nitzsch).—The head is as wide as it is long; the clypeus is semicircular, with a triangle on each side, and at the lower surface a constricted elongated spot. The prothorax is not so wide as the metathorax. The abdomen is bordered on each side by a uniformly white band; the first segment has an interrupted transverse band on the median line; the others have a wide lateral band, leaving free the middle third; the last is simply notched in the female. The colour is brown. Length of female 1·8 mm., and male 1·3 mm. It is frequent on Ducks and relatively rare on Geese, on which it constitutes, according to Piaget, a mere variety that Nitzsch has named *Docophorus adustus*.

**Lipeurus jejunus** (Nitzsch).—The head is elongated, and the clypeus is colourless, rounded, separated by a constriction and a suture, not bordered in front by an antennal band, and garnished by six fine and two spreading hairs at the suture. The prothorax is subtrapezoidal, and has a spot at the posterior angle, which projects laterally; the metathorax is twice as long, with a large tubercle at the posterior angle, on which are implanted four short bristles. The colour is dirty-white, spots dark fawn, and bands black. The female is 3 mm., and the male 2·5 mm. long.

**Lipeurus anseris** (Gurli).—The head is elongated and conical, rounded in front, with the clypeus analogous to that of the preceding species. The metathorax is double the size of the prothorax, and is constricted at the sides. The colour is white, with dark spots. The dimensions are the same.

**Trinoton conspurcatum** (Nitzsch).—This is a very large species. The head is as long as it is wide, and is exceeded in front by the last two articles of the palpi, showing on each side two enlargements, the posterior of which—the temple—has five bristles. The thorax is longer than the head, and rounded on the abdomen. The legs

![Fig. 48. *Docophorus icterodes*, male, of the Duck; magnified twenty-five diameters.](image-url)
long, and garnished with hairs and bristles. The abdomen is oval, not so wide at the base as the metathorax, and the angles are salient; the first eight segments have a series of bristles fixed in colourless tubercles. The colour is white, the spots brown maroon, bands black, thorax dark, head bright-fawn tint. The female is 6-3 mm., and the male 5-8 mm. long. This parasite was found by Denny on the Goose, but it is more frequent on the Swan.

**Trinoton continuum** (Piaget).—This insect has four bristles at the temples, the abdomen has slightly salient angles, and is more downy on its two surfaces, while there are fewer hairs on the legs. The dimensions are also less, being for the female 6 mm., and for the male 5-6 mm. long. It is, probably, only a variety of the preceding species, and is more common.

**Duck.**—A Docophorus, Lipeurus, Trinoton, and a Menopon have been found upon the domestic Duck.

The **Docophorus icterodes**, described as infesting the Goose, is very common on the Duck.

**Lipeurus squalidus** (Nitzsch).—The head is narrow, elongated in front of the antennæ, and suddenly constricted at the suture of the clypeus; the latter has a spot—signature—parallel to the border, and rounded posteriorly. There are six hairs on the forehead, two of which are on the clypeus, the second being very flat; in front of the mandibles there is a round and small fossa; the temple is round, and has one bristle and a spine; the antennal bands stop at the suture of the clypeus, and do not go beyond it in front. The metathorax is not so wide at the head, is slightly longer than it is broad, and is a little concave on the abdomen.

The latter has a narrow, uniformly wide, black band on each side; the transverse fawn-coloured spots are more or less apparent. The general colour is fawn yellow. The female is 2-8 mm., and the male 2-5 mm. long.

This parasite is very common, and Taschenberg has found it on the Barbary Duck.

**Pale Trinoton** (*T. luridum* Nitzsch).—This more especially differs from the *T. conspurcatum* of the Goose, by the presence of only four bristles at the temples; the metathorax is concave on the abdomen, the latter having segments rounded at the sides; narrow transverse spots, interrupted in the middle on the first two segments, and surrounding a colourless circle on the side; and the bristles not having a wide base. The colour is white, with maroon spots and black bands. The length of the female is 5-4 mm., and of the male 4-7 mm.

**Dark Menopon** (*M. obscurum* Piaget).—The head is crescent-shaped and strong, with the temples broad and turned downwards, and the lateral borders nearly as long as the thorax. The abdomen has dark, narrow, lateral bands without appendages. The colour is dark fawn. The length is 1-4 mm. to 1-5 mm.¹

**Swan.**—Independently of the *Trinoton conspurcatum*, which lives on the Goose, the domestic Swan—*Cygnus olor*—has an Ornithobius.

**Ornithobius bucephalus** (Giebel).—The head is massive, nearly as

¹ Piaget only gives one host for this species, the *Anas radjah*, but we have found it in abundance on a domestic Duck.
broad as it is long, irregularly quadrangular, and shaped anteriorly like a pair of closed forceps; the antennæ are strong and carried forward; the posterior part of the head is divided into three portions by the two occipital bands, which, at first parallel, converge forwards towards the root of the mandibles. The thorax is narrower, and a little shorter than the head. The abdomen is oval, and nude except at the angles; the lateral bands are very narrow. The colour is white, with pearly transparent bands. The length of the two sexes is 3·5 mm. to 4·5 mm.

**Symptoms.**—Phthiriasis is manifested in all animals by signs of itching, the intensity of which is subordinate to the number of parasites, and the group to which these belong. The Hæmatopinus, the rostrum of which is formed for pricking, and which attacks the substance of the skin to feast on the blood and humours exuded as a result of this pricking, causes a much more intense pruritis than that occasioned by the Ricinus. The locality of the pruritis naturally indicates that of the parasites, which are also betrayed by their eggs—these being less deeply situated among the hair or feathers—and likewise by the débris the insects leave after moulting.

**Horse and Ass.**—The hæmatopinic phthiriasis of the Horse and Ass has its principal seat at the mane and forelock, but more especially at the root of the tail, or in the neighbourhood of these parts. The animal seeks to rub itself against everything within its reach, gently bites its neighbours, and allows itself to be bitten and rubbed by them. On entering a stable, it is easy to recognise animals so affected, by the erectness and matting of the hairs, especially at the root of the tail; and a careful examination will readily reveal the presence of the Hæmatopinus and its eggs, along with numerous epidermic pellicles—constituting true pityriasis. When grooming has not been carried out for some days, the dead dried bodies of parasites, and the exuviae of their moultings, increase the general aspect of uncleanness. The papules which some authors have described are rarely observed, but only various excoriations due to rubbing. Ralllet has seen an old mare 'which showed on the back little tumours caused by elevation of the epidermis, beneath which were numerous masses of Hæmatopinus.'

Trichodectic phthiriasis is less common, and not so pruriginous; but with this exception, it resembles the preceding, from which it is distinguished by examining the parasite. The Trichodectes are not often found on the upper parts of the body, but the two phthiriases may, though rarely they do, co-exist on the same Horse.

Ox.—The same symptomatic differences are remarked between the Hæmatopinin and trichodectic phthiriases of the Ox; but, contrary to what is observed in the Horse, the latter appears to be the most frequent. The Trichodectes are spread over the whole body, while the Hæmatopinin prefers the ears, back of the head, upper border of the neck, and middle of the back and loins. The pruritis impels the animal to rub itself against trees, posts, or salient parts of its dwelling, and with its rough tongue it scratches the skin; consequently, there are large hairless patches, and often an abundant epidermic secretion with—though very exceptionally—thickening of the skin, which may mislead as to the true nature of the malady.

Sheep.—The Sheep Lice are concealed at the bottom of the fleece. The presence of the Melophages is indicated by the pupæ, which are attached to the individual fibres, and appear as shining oval bodies, not unlike the small pip of an apple in colour and shape. In separating the wool, the parasites are found close to the skin, and when they are numerous the fleece is entangled, and sometimes absent in places. These insects attract the attention of Starlings and Wagtails, which hover about flocks of sheep, and perch familiarly on their backs in order to feed on the parasites.

The Melophages often emigrate from suckling ewes to the lambs, which they sometimes torment so much as to cause serious emaciation. If the fleece is short, in order to avoid the teeth of their victims, the parasites take refuge in front of the shoulders, on the neck, and particularly about the ears and horns. By their biting they produce great itching which makes the sheep gnaw themselves, scratch their bodies with their hind-feet, and rub against anything within reach. At the places where the Insects have been biting, on separating the wool, a red patch the size of a lentil is seen, in the centre of which is a darker spot.

The Trichodectes are less frequently observed than the Melophages, perhaps because of their smaller size. They may in certain cases seriously alter the wool; for its shedding appears to be due to the
cutting they effect by their mandibles at the root of the fibres, accord-
ing to the observations of Railliet.\(^1\)

The Trichodectes induce severe itching, and the wool is more or less altered, broken, and matted in places. There also are seen bright red spots from 8 mm. to 10 mm. in diameter, covered by thin furfuraceous scales, formed of epidermic débris and dried serosity. The Tricho-
dectes are easily found, hanging on by means of their claws and jaws to the wool fibres on and around these places. According to Delafond,\(^2\) these parasites are much more common on lean, debilitated, or badly nourished Sheep than on vigorous and well-fed ones.

**Pig.**—This animal is greatly incommoded when invaded by the Hæmatopininus. The species infesting it is the largest of all the family, and causes a pruritis proportionate to its size. The skin is marked by red papules of various dimensions, and is often excoriated. The itching is most severe at night, and the animal rubs itself eagerly against its sty or trough, rolls in the litter, or even demolishes its habitation. Sequens\(^3\) relates that of 140 porcelets, 40—aged from one to two weeks—suffered to an intense phthiriasis affecting all the pigs. The disease lasted four or five days. At the autopsies, besides signs of anaemia, there were found numerous excoriations and ulcerations on various parts of the body, the knees and hocks were inflamed, and even the capsular ligaments were involved—all the result of the pruritis which had killed these young pigs. The disease ceased when parasiticide and disinfecting agents were had recourse to. Viborg was a witness to similar occurrences, which led him to declare that the Hæmatopinus may pass to beneath the skin, and make its exit by the nose, mouth, and eyes. This, so manifest an exaggeration, shows to what an extent these parasites may crowd on the same animal.

**Dog.**—Lousy Dogs do not appear to be much inconvenienced by their numerous parasites. The Hæmatopinus torments them more than the Trichodectes, and sometimes to a high degree. Both kinds of parasites are encountered on all parts of the body, but the Hæma-
topinus is more particularly seen about the throat.

**Goat.**—According to Delafond,\(^4\) Lice may live in very great numbers on the Goat, especially in winter. The skin becomes irritated, and the hair falls off, leaving bare places covered with flaky, sometimes thick crusts, beneath which the integument is red and frequently ulcerated. The Hæmatopinus produces these troubles; but with Angora Goats the Trichodectes cause great depreciation in the value of the hair.

**Camel, Cat, Ferret, Rabbit, and Guinea-pig.**—The phthiriases of these animals have scarcely received any attention up to the present time,

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and their trifling importance or rarity justifies the silence maintained with regard to them. The Trichoectes of the Cat are seen most frequently on young animals debilitated by scabies. The majority of the Guinea-pigs affected have numerous Gyropes concealed in their fur; their presence is revealed by a yellowish dust at the ends of the hairs twenty-four hours after the death of their host. The oval Gyrops is much less abundant than the small Gyrops, and prefers to localize itself on the head.

**Birds.**—Phthiriasis has a much greater importance for Poultry than for the domesticated Mammalia; as the first are nearly always attacked in a variable degree, and the multiplication of their parasites becomes a real nuisance, causing them to lose their rest, become emaciated, and frequently compromises the rearing of their offspring. Their parasites are found all over the body, though less on the thighs, neck, and head than on the trunk, and especially beneath the wings. It is sometimes the reverse, however; for it at times happens that the head, and chiefly the neck—which cannot be reached by the beak—are particularly frequented by the Lice. Each species of Fowl being capable of nourishing several kinds of parasites, these may be found collectively on the same individual. And as several of the Ricinidae attack very different species, it may be remarked that, by the cohabitation of Fowls, Turkeys, Guinea-fowls, etc., one kind of parasite may be accidentally met with on an illegitimate host. So that here is an affair of erratic parasites, which signifies that they are not multiplicable, as they are not accompanied by their 'nits.'

**Diagnosis.**—The diagnosis of the disease is easy, if the size of the parasites is known. It is well, nevertheless, so far as the Mammalia—and especially the Horse and Sheep—are concerned, to be careful not to attribute to Lice affections of the skin which are sometimes coincident with phthiriasis, but are of quite another nature. Such is scabies, the gravity of which is otherwise serious, and which has been occasionally overlooked for some time, because the pruritis—of psoric origin—was ascribed to the Lice.

**Prognosis.**—This is rarely serious, considering the efficaciousness of the numerous remedies we possess. Nevertheless, in certain cases the malady induced is particularly obstinate to cure, especially when aggregations of young or debilitated animals have to be dealt with. Budelot relates the history of one enzooûty of hämatopinic phthiriasis, affecting 119 Horses of a regiment of Artillery, and which prevailed for nearly five months, notwithstanding the parasiticide treatment employed. It is true that, in reading this account, and in estimating the gravity of the cutaneous troubles he observed, one is inclined to question whether it was not one of those coincidences of scabies and phthiriasis the possibility of which has already been referred to.

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The troublesomeness of phthiriasis is dependent upon the pruritus which accompanies it. It may happen—at least with cattle—that the loss of hair will temporarily depreciate the value of the animals. Such depilation is damaging to Sheep; the disease has been known to persist for six years in one flock, and the wool to fall off to such an extent that the animals looked as if just clipped.

Birds, and especially Pigeons, sometimes suffer much from the invasion of parasites. There are poultry-yards and dovecots where these insects are perpetuated, in spite of all the efforts made to destroy them. Young creatures, particularly young Pigeons, at times succumb to phthiriasis, and breeding is then rendered somewhat risky. When the nests are infested with insects, the Pigeons neglect hatching, and even abandon their young.

Etiology.—It is clear that contagion is the primary cause of phthiriasis, and that the multiplication of Lice is due to a succession of prosperous generations, whose origin was due to a contagious host of the same species as that now dealt with.

It is always possible that two domesticated animals of different species may infect each other—as when the same kind of parasite may live on one or the other, as is the case with the Trichodectes pelosus of the Horse and Ass, with the Menopon biserialatum of the Fowl, Turkey, and Pheasant, with the Goniocotes rectangulatus of the Guinea-fowl and Peacock, with the Docephorus icterodes of the Goose and Duck, and with the Trinoton conspurcatum of the Goose and Swan. Beyond these exceptions, the parasites which accidentally venture upon a different species to that of their natural host do not become acclimatized or multiply there, but soon emigrate. Kemmerer\(^1\) has, however, published an observation in which a woman was seized with violent neuralgia of the hairy scalp, and was immediately cured by the extraction of an insect fixed in a wound on the head, and which the author recognised as a Trichodect. On another occasion a horse-dealer suffered from erysipelas from inflammation of the arm, and the author found in a small wound a Trichodect, the head of which was buried in the derma (!), the remainder of the body projecting from it. But the symptoms observed were altogether out of proportion to the ascribed cause, and the details furnished do not permit the zoological diagnosis to be accepted. These suspected cases cannot, therefore, be considered of any moment here.

Certain conditions favour the extension of the malady, and give to the contagion an unusual activity.

Want of cleanliness plays the chief part in this extension. The length of the hair, the abundance of the fleece, is one of the predisposing circumstances. In addition, debility in the animals gives a

\(^1\) Kemmerer. Journ. des Connaissances Médico-Chirurgicales, 1853.
more favourable soil for the parasites, whether this weakness be due to age, breed, temperament, work, food, etc.

For example, the Trichodectes appear somewhat more frequently on young Horses, while the Hæmatopinus rather favours old ones. Calves are more exposed to Lice than adult cattle, and these insects are rarely found on short-haired dogs, while they are frequent on those which have long frizzly hair. Though two species may live together, the Hæmatopinus piliferus is more particularly met with on long-haired sporting Dogs, as Spaniels, etc., and the Trichodectes latus on little Lap-dogs with long or frizzly coats, as small Spaniels, King Charles Spaniels, long-haired Terriers, Havana Dogs, etc.

It is the anæmic Sheep which are most frequently lousy, and in the instance cited by Railliet the nursing ewes were more especially attacked. According to Villeroy,1 ewes suffer most from the Trichodectes, etc., during the winter, and particularly if it be wet. It is stated, so Stephens asserts, that if lean Sheep are bought to feed on turnips, it is when they commence to fatten that the Melophagus multiplies on them in an astonishing manner. Otherwise it appears to prefer lambs, and on shearing they are sometimes found to be literally covered with the parasite in places at the anterior part of the neck.

The Melophages are at times so abundant that they constitute a veritable scourge; this happens in North America and in Iceland. And yet these parasites are not prolific, for the female only lays one larva at a time, and there are but four or five in the course of the year. These larvæ are sacciform, non-segmented, have four lateral surfaces, and measure 3·7 mm. long, 1·9 mm. wide, and 1·6 mm. high. Their buccal parts are alone movable. They become transformed very rapidly into nymphæ, even on the body of their host.

When the conditions are favourable Lice multiply, on the contrary, at a wonderful rate, the females being very prolific, and growth being rapid. It has been already stated (p. 12) that it has been calculated that the third generation of a Louse of the human head amounts in about twelve weeks to 125,000 individuals, and these calculations do not take into account the numerous causes of destruction which restrain this multiplication; they are, nevertheless, instructive in enabling us to understand the cases of excessive phthiriasis.

When phthiriasis occurs among Poultry, it is ascribed to feeble nutrition, due to bad or too uniform food, to the influence of damp, dirty, close, dark, and badly-ventilated localities. There are years which are favourable to this disease, and seasons appear to have an influence on its progress, while temperament and breed are not to be ignored. Bechstein, cited by Rivolta and Delprato, states that of two Capuchine Monkeys living in the same conditions, one was invaded by Lice, while they were rare on the other. We have observed the same

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occurrence in a Bantam Fowl, which was really lousy, while two Gascony Fowls living with it were quite free from parasites.

**Treatment.**—The attention required to be given to animals in cases of phthiriasis, will vary according to whether they are Mammals or Birds.

**Mammals.**—Perfect cleanliness keeps animals clear of phthiriasis. Such cleanliness is easy to realize with short-haired animals, and will rapidly get rid of the few parasites which contagion may convey to them. When phthiriasis is present, a cure will be singularly favoured by removing the hair of the Horse or Ox, as well as of the long-haired Dog, and the wool off the Sheep. With regard to the latter, clipping usually suffices to get rid of the Melophages; many of these are cut by the shears of the shearer, and those remaining on the skin are soon knocked off by the animal rubbing itself, so that in about two days none are to be seen. Sometimes, however, for them as for other parasites, it is necessary to have recourse to insecticide agents, the number of which is considerable.

A. One of the most efficacious and most employed is the decoction of tobacco (2 or 3 ounces to the quart of water). When near a manufacture of tobacco, the expense is much reduced by obtaining the refuse powder, or the juice, to which ten times the weight of oil is to be added; though this juice, being rich in amoniacal matters, has the inconvenience of decomposing rapidly. This treatment answers for all animals. Nevertheless, precautions must be taken; for the whole body should not be dressed at once, as poisoning may ensue from absorption of the alkaloids of the tobacco. For Sheep the preparation is kept in a bottle, the cork in which is perforated by a quill. As soon as the shepherd observes a Sheep commencing to scratch itself, he gets hold of it, and seizing its head between his legs, he opens out the wool and pours the fluid on to those places he judges requires it.

B. Frictions with *fatty bodies*, linseed-oil in particular, kill the Lice by asphyxia. Cooking-oil, in which fish have been fried, has been recommended as especially efficacious. This treatment is more particularly applicable to the Pig.

C. Mercurial ointment is a certain cure, but its employment is dangerous; therefore only a small surface should be dressed with it at a time, and it ought not to be used for Dogs, even when they are muzzled, and still less for cattle, which are so sensitive to mercury. Numerous cases of poisoning of animals by means of mercury are recorded.

D. Frictions with a decoction of stavesacre seeds, 2 ounces to the quart of water, and colchicum bulbs in the same proportion.

E. Insecticide powder. It is well, beforehand, to damp the skin with soapy water. Then the powder is dusted or blown over the skin *ad hoc*. The powders of pyrethrum flowers and stavesacre seeds are most generally in use.
F. Frictions with a mixture of 1 part benzine, 6 parts of soft soap, and 20 parts water; or, better, petroleum 1 part, common oil 10 parts. Employed alone, the benzine, and especially the petroleum, is too active, and may remove the hair.

G. Schleg's mixture is recommended in Germany, because of its efficaciousness and harmlessness. It is composed of 1 dram each of arsenious acid and potass, and 3 pints of water, to which 3 pints of vinegar are subsequently added.

H. The emulsion of cresyl or creoline—10 to 15 per cent. water—promises to assume an important place in the treatment of phthiriasis, by reason of its innocuousness and the readiness with which it can be employed. Two or three dressings with it are sufficient.

Whatever may be the remedy adopted, it is well to repeat the dressing at intervals of five to eight days, in order to kill the parasites hatched from the eggs, and which have resisted the first dressing. The majority of the eggs are killed by vinegar, and this is the reason why it is so often added to parasiticide decoctions in the proportion of 18 ounces to the quart.

For house Dogs, fatty preparations, and in general all those which are likely to soil furniture or the hair, are to be avoided. For them, frequent baths, and washing with creoline water and carbolized soap, are to be recommended, together with the use of the comb and brush.

Lastly, when a number of animals are invaded, independently of the curative measures, disinfection of the dwellings—stables, sheepfolds, pigsties, kennels, etc.—is necessary. Boiling water at first, afterwards limewash, or merely creoline water—5 per cent.—answers very well. All litter should be destroyed, and dressing of the animals should be performed out of doors if possible.

Birds.—There are also numerous means for destroying vermin on Fowls. Flowers of sulphur, or one of the insecticide powders mentioned above, may be used; they can be blown among the feathers by an instrument ad hoc. As the Fowls in flapping their wings, or the Pigeons in their flight, may shake out the powder, it is a good plan to lubricate the roots of their feathers with soapy water before blowing in the powder of pyrethrum or stavesacre.

But individual treatment will not suffice. The floors, ceilings, walls, perches, and nests are the haunts of parasites, which will soon take the place of those that are destroyed; and sometimes there is great difficulty experienced in finally abolishing them. Schneider\(^1\) speaks favourably of fumigations with sulphuret of carbon. Small open phials filled with this liquid are placed in the hen-roost or dovecot, at those parts where they are not likely to be upset, and very quickly all the vermin are destroyed or expelled. This can be repeated whenever a new invasion is apprehended.

\(^1\) Schneider. Bull. d'Insectologie Agricole, 1878, p. 56.
Zürn reproduces an article from the Dresdener Blätter für Geflügelzucht (No. 39, 1881), in which lime-dust is indicated as a means as simple as it is infallible. In the absence of the Birds, two small handfuls of this is thrown against the roof and walls, so as to produce a cloud of dust. A portion falls into the nests and crevices, and the remainder reaches the ground. The vermin are killed, and in about two minutes the place is carefully swept out, and the sweepings placed on the dung-heap. This measure is analogous to that given in Le Poussin (1884, p. 86). A peasant took lumps of old plaster from buildings which were being demolished, and placed them on the road, so that the wheels of carriages reduced them to powder: this he threw into the dovecot, where it formed a somewhat thick layer on the floor. The Pigeons scratched and pecked at it, so that they powdered themselves with it and spread it about all parts of the dovecot when they flew. The effect was rapid, for soon there did not remain a single Insect in the dovecot or on the Birds. Besides, the shells of the Pigeons' eggs had acquired more hardness.

The procedure which is the most recommended and employed is the following: All the masonry is lime-washed at least twice a year, and everything in the roost is taken out—spars, perches, nests, etc.—and steeped in water containing 3 drams of carbolic acid to the quart of water. Then with a hand-pump or any similar instrument, throw the water with force upon every part of the interior of the dwelling; this kills and washes down the insects. After emptying the hen-roost and closing all the apertures, a quantity of powder may be burned therein. The place should be kept shut up for three days, then opened widely for twenty-four hours before allowing the Fowls into it. The Fowls themselves are advantageously protected against parasites by sand-baths. To form these there should be made in the run, under some kind of shelter, a shallow square hole, which is to be filled with fine sand, cinders, and light soil, with which powdered sulphur is mixed. If the Birds are much troubled with vermin, insecticide powder may be added to this sand-bath.

According to the Hausfrauen Zeitung (1889), instead of spreading straw on the floors of the roost, wood wool should be used, or wood chopped up into fine pieces, such as are used for packing. A layer of this is warmer than straw, drives away the vermin by its aromatic odour, does not rot so quickly, and furnishes an almost odourless manure very suitable for clayey, heavy soil.

For some time there has been sold an engine named 'Lagrange's Exterminator,' which serves to kill the parasites on the Birds themselves. This is a wooden box into which the Bird is introduced with its feet tied, its head being kept outside by a special opening. In the box a brimstone match is burned, and five minutes of this vapour bath suffices to kill all the parasites.1

1 E. Leroy. L'Éleveur, 1890, p. 358.
Lastly, it may be mentioned that there is another means, somewhat insufficient, but very often adopted, and which consists in putting into the roosts a branch of alder-tree. The Lice, attracted by the odour, gather upon it, and next morning early the branch is carefully removed and burned outside. This is repeated until there are no parasites.

Independently of the parasites mentioned, and those to be alluded to hereafter, some Insects may accidentally torment Birds, and form part of their vermin.

The Fowl, and particularly the Gosling and Duckling, are sometimes attacked by small Diptera, which pass into their nostrils and ears. They may be protected by some one of the remedies already noticed, or, better, by a decoction of walnut-leaves — 2 ounces to the quart of water and 5 ounces of vinegar added; or by assafætida — 4 ounces to the same quantity of water and vinegar as in the preceding. With this the threatened parts should be impregnated.

In unclean roosts and dovecots there are sometimes large numbers of Bugs that belong to a particular species—the Dove-cot Bug (*Acanthia columbaria* Jenyns)—closely allied to the Bed Bug (*Acanthia lectularia* Linn.), which is so well known. These Bugs exhaust young animals by sucking their blood, and fatigue them by the itching they induce after the bites. According to Railliet, hens having are so tormented by these Insects that they finally abandon their eggs, on which are then seen small specks formed by the excrements of the Bugs.¹

Pigeons also suffer from the larvæ of the Dermestes lardarius (Linn.), the Tenebrio molitor (Linn.), and various Necrophores (*Necrophorus* Fabr.) and Silphes (*Silpha* Fabr.). These larvæ of the Coleoptera, which are at first developed in old manure of the dovecot, finish by attacking the young Pigeons, gnawing the skin of the neck and abdomen—even the superficial muscles—and producing wounds which are often fatal, and in which burrow the larvæ of Muscidae. This evil is closely allied to the uncleanliness of habitations, and should be remedied. Otherwise, these vermin can be made to disappear by the means already indicated: but in this particular case the floor of the dovecot should be covered with pine sawdust mixed with sand, some of this mixture being also put in the nests.

The attention to individuals consists of removing the larvæ from the surface of the wounds, and in dressing these with a solution of carbolic acid—1 to 10.

CHAPTER V.

ACARIASES.¹

By the term Acariasis (Kirby and Spence) is understood every disease caused by Acarina. These form a separate order in the class Arachnida.

The Acarina—often designated Acarida—which were at one time named Acari, Mites, etc.—are generally creatures of small dimensions, with short, thick, non-articulated bodies, and having the head, thorax, and abdomen all in one mass. In some instances, however, the head and thorax are separated by a groove, and it may happen that the thorax is rendered distinct from the abdomen in the same way.

The chitinous integument usually shows very fine parallel ridges, and in places varied enlargements with bristles, hairs, prickles, etc., that may be collectively designated trichomae (from ῥιξ, ῥυχός, hair).

The anterior portion of the cephalo-thorax has a depression named the camerostoma, because it lodges the buccal parts or rostrum, which is generally formed of distinct pieces arranged for biting or sucking, and comprising from above to below: a pair of cheliceræ or mandibles, a pair of jaws or maxille, each carrying on the sides a maxillary palp or lower lip. This rostrum projects beyond the camerostoma, or remains concealed beneath the epistoma—the upper wall of the camerostoma.

The four pairs of legs—composed of six, five, or even three articles (or joints) only—have their base either inserted directly into the non-modified integument, or into its skeletal enlargements, which are designated epimera. They are terminated by hairs or claws, and have often, besides, a kind of vesicular lobe, or membranous caruncle, which, by its power of adhesion, singularly facilitates the progress of the Insect. In the majority of the parasitic species, these ambulacra are constituted by a small pediculated sucker.

A large number of terrestrial or aquatic Acari have one or two pairs of stigmata—the external openings (tracheæ) of the respiratory apparatus—pierced in the tegumentary thickenings named peritremæ. The stigmata are absent in the majority of permanent parasitic forms, in which the respiration is simply cutaneous.

The sexes are separate in all the Acarina. The males are much fewer than the females, and are distinguished from them by their smaller

size, certain details in conformation, the presence of copulatory organs, etc. They also often lead a different kind of life, and have a different régime.

Amongst the males and females in the colonies of Acarina, there are found a larger or smaller number of individuals who do not present definite sexual characters. These are the larvae, which are usually provided with only three pairs of legs (hexapodal larvae). They undergo a succession of metamorphoses, one of which leaves them with a fourth pair of legs, and the creature is then termed a nymph (or nymph or pupa). Another metamorphosis brings about the development of the genital organs, and the Acarus is now a pubescent male or female (or imago). Finally, a last transformation, proper to the female and consecutive to copulation, makes her an ovigerous female.

The majority of the Acarina are parasitic—either temporarily or permanently. Among the first there are some which are merely commensal, the presence of which is not accompanied by any particular disturbance, and which only require a host as a means of transport. Others live on epidermic débris and natural excretions of the skin; while others, again, prick the integument in order to suck the blood, or instal themselves in its superficial layers and determine cutaneous affections, which are sometimes very serious.

The order of Acarina contains a very great number of forms, and has been divided into families, the arrangement of which varies according to authorities which describe them. We recognise ten, which we classify as follows:

<table>
<thead>
<tr>
<th>Non-vermiform Acarina</th>
<th>Vermiform Acarina</th>
</tr>
</thead>
<tbody>
<tr>
<td>Legs inserted directly into the integument, without epimeres.</td>
<td>Legs articulated on distinct epimeres.</td>
</tr>
<tr>
<td>Legs with 5 articles (provided with hooklets)</td>
<td>Legs with 5 articles</td>
</tr>
<tr>
<td>Legs with 6 articles.</td>
<td>Legs with 3 articles</td>
</tr>
<tr>
<td>Chelicerae.</td>
<td>Chelicerae.</td>
</tr>
<tr>
<td>Without trachee.</td>
<td>With trachee.</td>
</tr>
<tr>
<td>Chelicerae styloform; palpi free, antenniform</td>
<td>Palpi free, ravisher</td>
</tr>
<tr>
<td>Ambulatory Legs.</td>
<td>Chelicerae didactylous; palpi cylindrical or conical, and partially adherent to the lips</td>
</tr>
</tbody>
</table>
| Natatorial legs (aquatic Acari) | Barnacle.
| | Chelicerae styloform or in claws; |
| | Palpi free, ravisher |
| | Trombidiidae. |
| | Chelicerae didactylous; |
| | Palpi cylindrical or conical, and partially adherent to the lips |
| | Sarcoptidae. |
| | Phytophagidae. |
| | Demodecididae. |

Of these ten families, only five concern us: these are the Ixodidae, Gamasidae, Trombidiidae, Sarcoptidae, and Demodecididae. Each of these may have representatives on the domesticated Mammalia or Birds, with the exception of the Demodecididae, which, so far as is at present
known, are only found on Mammals. The following are the principal characters of these five families:—

1. *Ixodidae.*—These are relatively voluminous Acarina, and are more or less flat when fasting, globular when replete. The rostrum (Figs. 53, 54) is composed of: 1, two elongated chelifers, terminating in a harpoon-like article with three or four teeth; 2, an undivided maxillolabial dart, formed by fusion of the two maxillae along with the inferior lip and tongue, the dart being furnished beneath, and sometimes on its sides, with several longitudinal rows of teeth, the points being retrograde; it has, laterally, two quadri-articulated cylindrical or flattened palpi, or they may be channelled on their inner surface, so as to form for the dart, when brought together, a bivalve sheath. The legs have six articles terminating in an ambulacrum, formed by a caruncle plaited like a fan, and having a pair of hooklets. The respiration is tracheal, the apparatus terminating in a pair of stigmata situated behind the fourth pair of legs, and protected by a discoid peritrem pierced like a sieve. Often there are two pairs of eyes. The opening of the sexual organs is situated between the haunches of the first pair of legs. The Insect is oviparous.

2. *Gamasidae.*—The integument is coriaceous, partially or wholly, and has two chitinous plastra: a superior, dorsal, and an inferior, ventral, which give attachment to the legs. The rostrum is arranged for pricking or sucking: the chelifers are generally disposed as didactylous pincers, and are usually dissimilar in the two sexes; the maxillae are fused into a perfect tube on the upper surface by the labrum, which is festooned; the maxillary palpi are simple, free, antenna-like, composed of five articles, and provided inwardly with galea or secondary palpi. The legs have six articles, terminating by two hooklets and a trilobate membranous caruncle. There are two stigmata situated near the posterior legs, and protected by a very long tubular peritrem, lying along and above the haunches, and opening in front. There are no eyes.

3. *Trombidiidae.*—These are nearly always soft Acarina, more or less hairy, generally bright-coloured, their skeleton being composed of epimers. The rostrum is a conical sucker formed of a pair of hooked or styliform chelifers, rarely as didactylous pincers, contained in the tube constituted by the joined maxillae and the lower lip; the palpi are more or less voluminous, and the second last article is frequently terminated by a hooklet, the last being fixed either at its base or, more rarely, at the middle part or summit. The legs have five or six articles, usually terminating in two hooks, and often accompanied by a cirrus or a small caruncle. The respiration is tracheal. There are often two eyes (Figs. 56, 57, 58).

4. *Sarcoptidae.*—These are the smallest of the Acarina, their size being between 1 mm. and 1 mm. The body is soft, white or reddish, the integument being sustained by epimers. The rostrum is composed of two short didactylous chelifers, gliding on a middle piece, spoon-shaped, and formed by the junction of the two jaws with the lip and tongue; the maxillary palpi have three cylindrical articles. The legs have five articles disposed in two groups of two pairs each—one near the rostrum, the other near the abdomen. The tarsi are terminated by one or more hooklets, which are often accompanied by a cam-
panulated sucker or a vesiculous caruncle. There is no respiratory apparatus, the respiration being cutaneous. There are no eyes.

5. Demodecidæ.—These are very small, vermiliform, glabrous Acarina, the skeleton of which has epimers for its base. Their bodies are distinctly divided into cephalothorax and abdomen; the latter being conical and elongated. The legs are short, and have three articles: haunch, thigh and tarsus. The Insect is oviparous. There is only one genus—the Demodex (Owen).

The numerous species of parasites of the domesticated animals which these five families of Acarina contain, are far from producing the same degree of disturbance on or in the skin they inhabit. There are some which are merely commensals, living on the epidermic scales, and the remains of hairs and feathers. Others prick the skin in order to suck the blood, but their action does not extend beyond the points they attack. And a certain number, by their multiplication, the multiplicity of their bites, by the venom they implant, by the galleries they excavate, and by the deep situation in which they locate themselves, give rise to a disease which is generally grave—psora or scabies.

It is necessary, therefore, to distinguish between non-psoric Acariases and psoric Acariases. The latter are produced either by the Acarina forming a special tribe in the Sarcoptidae—the psoric Sarcoptida or Sarcoptinae, or by the Demodex. The non-psoric Acariases are due to the Gamasidae, the Trombidiidae, the Ixodidae, and the non-psoric Sarcoptidae.

On the other hand, it is advantageous for study to consider separately the acariases of domestic Mammalia and those of Birds.

On these principles are established the following divisions, in which, under the term 'acariases,' are passed in review all the Acarina—pathogenic or non-pathogenic—which live on the domesticated animals.1

A.—ACARIASES OF THE DOMESTICATED MAMMALIA.

Article I.—Non-psoric Acariases.

These acariases will be studied here in the same order as the families which produce them: Ixodidae, Gamasidae, Trombidiidae, and Sarcoptidae.

1. Ixodidae.—The Ixodidae (see p. 94) are temporary parasites which may attack all the terrestrial vertebrata, but there is no constant correspondence between the species of host and that of the parasite; the female nearly always only shows a kind of specific preference, the larvæ, the nymphæ and the males being often found on the most diverse animals, differing in orders, and even in classes. P. J. Beneden has included them in his group of 'free parasites in early age.'

1 It has been considered advisable to study auricular acariases when treating of the parasites of the sensory organs (Book VII.).
This family only comprises two genera: the *Ixodes* and the *Argas*, which have been needlessly constituted two tribes: the *Ixodinae* and the *Argasinae*.

The *Ixodes* (Latreille) have the rostrum terminal, *i.e.*, inserted in a depression on the anterior surface of the cephalothorax; it is articulated, consequently, to a shield of variable shape and colour, according to the species, being small in the female, and covering all the upper parts of the body in the male. The maxillary palpi are sometimes thick, in other cases flat, and are generally grooved on their inner surface.

The *Ixodes* are popularly known as *Ticks* and *Wood-mites*. They have been recognised for a very long time, as Aristotle speaks of them as *Kwopato-Ti^s*, from which Hermann has derived the generic name *CynorhcesUs*, signifying *the Dog tormentor*. For it is on Dogs—and particularly sporting Dogs—that these creatures are most frequently found, as they frequent woody places and go amongst underwood and low plants which the *Ixodes* prefer, and where they live in a vagabond condition. According to Latreille, the *Ixodes* maintain themselves suspended to plants by their anterior legs, ready to fall upon any animals which pass within their reach.

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**Fig. 53.**—Rostrum of the *Ixodes ricinus*, seen from below; magnified about fifty diameters.—Delafond.

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**Fig. 54.**—Transverse section of the Egyptian *Ixode*, magnified fifty diameters.

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The *Ixodes* propagate more or less distant from their host, they thus attach themselves to him, either to be transported by him, as in the case of the larvae and the males; to be nourished on the small quantity of pus produced at that point in the skin where their barbed rostrum is implanted, as happens with certain nymphæ and also males; or to feed upon blood only, as occurs with the fecundated females.

In order to obtain this living nourishment, the Tick fastens itself firmly on the host with its legs, directs its rostrum perpendicularly towards the skin, and on the selected point thrusts in the terminal hooks of its chelifers. In proportion as these penetrate, the dart
follows, and the retrograde teeth on the under surface of this organ ensures the stability of the apparatus in the wound. In this way the dart is driven in as far as its base, while the maxillary palpi remain external, and are applied to the skin on each side of the wound. The adherence of the rostrum in the derma is so close, that by violent traction on the Insect there is risk of only obtaining its body, the buccal pieces being left in the wound. Otherwise, methodical removal of the parasite nearly always results in tearing away a small shred of skin fixed on the teeth of the dart, and held between the palpi. The aspiratory apparatus consists of a thin membrane, expanded like a bell around the rostrum and the salient borders of the buccal cavity.

In gorging themselves with blood, the fecundated females acquire a considerable size—sometimes tenfold their original volume; but some of this increase is also due to the development of the enormous quantity of eggs contained in the uterus, and which renders this intense alimentation necessary. When satiated, and having attained the size of an olive—and even of a nutmeg—the female withdraws her rostrum from the skin of the host, falls to the ground, and—concealed beneath some object—lays an immense number of eggs agglomerated in a mass, and with which she remains for some time in contact. Hatching lasts from fifteen to twenty days. The female Ixode, now empty and shrivelled, and even less than her primitive volume, soon dies.

The hexapod larvae that issue from the eggs are very small. They sally out on every side, and are often observed in the fur of wild rodents; they do not attach themselves by the rostrum, and they preserve their primary clear colour. They may live for months without nourishment, and it is probable that they effect their transformation into nymphæ in the ground. The latter are distinguished from the larvae by their being somewhat larger, and by the presence of four pairs of legs and respiratory stigmata. They are also distinguished from the adults by the absence of sexual organs; but they live like the latter, with the rostrum implanted in the skin of their host—penetrating sometimes beneath it, and causing the formation of purulent tumours. Their size increases and their colour becomes darker. Finally, they leave their host for the ground, where they undergo the change which endows them with sexual organs.

The males find the females either on the ground or on an animal that they had located themselves upon, before or after the arrival of their co-mates; and they all prefer those parts of the body where the skin is fine, and which are inaccessible to the tongue, teeth, limbs, or tail of their host.

The Ixodes are found in every country, and are discovered on the most diverse species of Vertebrata; but the specific determination of the different forms is rendered difficult by the great confusion that prevails. There have often been mistaken for different species the male
and female of the same species, and the same species has received distinct specific names because individuals belonging to it were observed on different hosts. Mention will be made of only the most common species—at least in our climate, and with regard to which there is perfect agreement amongst authorities.

**Ixodes ricinus** (Linn.).—This Insect is very often seen on sporting Dogs. It is the longest known species, and that of which Aristotle speaks. It is named the *Common Tick* or *Dog Tick*, and is remarkable for the dissimilarity existing between the two sexes, with regard to the rostrum.

When fasting, the body of the *female* is oval, orange-coloured, not festooned on the posterior border, and measures 4 mm. long and 3 mm. broad. Replete and fecundated, it resembles a seed of the castor-oil plant, is of a leaden colour, and is 10 mm. to 11 mm. long, and 6 mm. to 7 mm. broad. The rostrum is short and square, the dart rectangular, and furnished inferiorly and on each side with two longitudinal rows of teeth—eight in each row; the chelifers terminate in a three-toothed harpoon; the palpi are wide and short, and in the form of a chopping-

![Fig. 55](image)

**Fig. 55.**—The *Ixodes ricinus* of the Dog, a fecundated female after feeding.—Railliet.


The *male* is 2·65 mm. long and 1·50 mm. broad, and has the body always flat, ovo-triangular, angular in front, rounded and non-festooned behind, entirely covered on its upper surface by a dull-brown shield; it has no eyes. The rostrum—shorter than that of the female—has only a single row of five teeth on the dart; the chelifers are terminated by a four-toothed harpoon; the palpi are more squat than in the female. The nymphae and larvae have the characters of the species, modified by the attributes of their age (Mégnin).

This *Ixode* is more particularly found upon hunting Dogs, but it has also been discovered by Mégnin on Wallachian Sheep and Sardinian...
Oxen. Man himself is sometimes attacked by it. In the larval, and even in the nymphal state, it often inhabits the skin of small wild Mammals—such as the Mole, Dormouse, Squirrel, Hare, Rabbit, etc. It appears to be spread all over France and is found in the majority of European countries. The duration of its life extends, on the average, between the months of May and October. Towards the end of September, few are observed which have not attained adult age; and from the commencement of October they are rarely found, males or females, even at that age.

Animals do not appear to notice the presence of these parasites; the quantity of blood they extract is not sufficient to injure their health, and the wound they leave after they fall off heals quickly and spontaneously. Nevertheless, it is advisable to immediately remove all the Ticks from Dogs which have brought them in from hunting, as the fecundated female, falling on the floor of the kennel, there brings forth a population of parasites which may be very troublesome to get rid of. The Ticks may be removed by gentle, gradually-increasing traction, the pain caused to the Dog being insignificant. When the Tick has been too forcibly withdrawn, it is often ruptured, and the rostrum remains in the wound, but is eliminated therefrom in a few days by a process of suppuration. It is therefore the best plan to compel the parasite to drop off, by touching it with a drop of benzine, petroleum, or oil of turpentine.

When the kennel is infested by Ticks, it may be freed from them by washing it with boiling water, which should be applied to every corner, and especially the ceiling, which these Insects prefer.

**Ixodes reduvius** (De Geer).—The rostrum is similar in both sexes; it is twice as long as it is wide, and the dart is lancet-shaped with a sharp point, and provided on each side with three rows of teeth, two rows of which are on the inferior surface—one of these being internal, smaller, and interrupted—and one on the side, with stronger and sharper teeth. The chelifers are terminated by a five-pronged harpoon; the palpi are like the blade of a razor. The scutellum is black, and the Insect has no eyes. The female is of the same dimensions as the *Ixodes ricinus*; it is reddish-yellow in colour when fasting, lead-coloured when replete; and it is not festooned behind. Its scutellum is oval, has a narrow white border in front, and studded with a few hairs. The male is 3 mm. long, and 2 mm. broad, with the body triangular, rounded behind where it is not festooned, and the entire upper surface is covered by the scutellum (Mégnin).

This Ixode is widely distributed in France, and more especially attacks Sheep and Cattle; it is also at times frequent on Dogs, and does not absolutely spare Man.

Mégnin reports having often met with it on Cattle and Horses in Auvergne, and on Sheep in the North of France; but he has never seen it on Cattle coming from Normandy, or from the West or East of

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France. It is the females, of course, which live as parasites; they prefer to attach themselves about the flanks, where the skin is thin and favourable for their implantation. Their punctures are of little importance, for Horses and Cattle do not appear to notice them. When the Insects have filled themselves, they fall to the ground, and all traces of their having been on the skin soon disappear.

'The nymph of this species,' says Mégnin, 'sometimes attacks hunting Horses that pass over land covered with underwood and broom, and cause a more serious condition than the punctures of the adults do. This nymph, which is only 1 mm. to 2 mm. long, has singular habits; it is not content with planting its beak in the skin... it lodges itself entirely beneath the integument, and by its presence there soon produces large pustules, which are really small boils, and are accompanied by intense itching.' Mégnin gives an instance of a Horse which had the extremities of all its limbs studded with pustules, and beneath the crusts on these were found the bloated parasites in question. The Horse was cured by their successive extraction.

Mégnin has found similar pustules on the ears of Dogs and Hares, which were due, doubtless, to the same species of Ixode that Trillibert obtained in a serous cyst of six months' duration, and which was situated at the end of a Dog's ear.¹

The Ixodes reduvius does not appear to cause any particular inconvenience to the Sheep. It fixes itself on parts destitute of wool—such as inside the arms and on the flanks.

Ixode of Duges (I. Dugèsi Gerv.)—The rostrum is short and alike in both sexes. The dart is somewhat spatuliform, has the end rounded, and is furnished with four rows of teeth on each side; the chelifers are terminated by a four-pronged harpoon; the palpi are shorter than the dart, are slightly valvular, and have four very distinct articles. The fecundated female, when fasting, is 6 mm. long and 2·5 broad; the body is pale-red in colour, narrow behind, and not festooned. When distended, it is 14 mm. long, 8 mm. broad, and is of a dark leaden hue. Its scutellum is narrow, short, and pentagonal, the sides parallel, and posterior angle rounded; it is of a dark-brown, dull tint, roughened, and has an eye at each of the two external and posterior angles. The male is 3·5 mm. long and 2·5 mm. broad, and is subtriangular in shape, the angles and sides being rounded. The scutellum, which covers all the upper surface, is brown, smooth, and shining, festooned at the posterior border, and has an eye on each side, at the second pair of pads (Mégnin).

This Ixode is common in the South of France, where Duges discovered it; it is also found in Italy, Algeria, and Morocco. It attacks Cattle, Sheep, and Dogs. There is nothing particular in its action, and the smallness of its rostrum reduces to a minimum the wounds left when it falls off or is pulled away.

We may consider as a variety of this species the Ixodes of Guade-

¹ Recueil de Méd. Vétérinaire, 1863, p. 607.
loupe, a specimen of which we owe to the goodness of Couzin, the veterinary surgeon at Moule. It is distinguished from the type—such as it has been described by Mégnin—by the total dimensions being less, the colour of the legs—the two first articles of which are brown, the others being brighter—by the tint of the female, which is uniformly a dark maroon, and the smallness of the scutellum, which scarcely measures 1 mm.

The French fauna comprises also the **Ixode of Fabricius** (*I. Fabricii* And.), the **Epauletted Ixode** (*I. scapulatus* Még.), the **Pincer Ixode** (*I. chelifer* Még.), which may be found on the Dog, according to Mégnin; as well as the **Great Shield Ixode** (*I. megathyreus* Leach), and the **Autumn Ixode** (*I. autumnalis* Leach). The first two, and the **Marbled Ixode** (*I. marmoratus* Risso), have been found on Sheep and the *I. scapulatus* on Cattle of the South of France (Mégnin). But there still prevail great doubts as to the reality of these species, which some have attempted to differentiate by their rostrum and scutellum.

Their effects have not been distinguished from those of the preceding species. Nevertheless, serious losses have been reported among Lambs in Kent, by the debility resulting from Ixodes, which had multiplied in an extraordinary manner in 1869. The species was not well determined.1

Ticks have also been reported as very frequent among Cattle in the South-west of France. They more particularly fix themselves at the summit of the head, behind the ears, and render the animal irritable; so that it is often really difficult to put Oxen in the yoke.

A **Camel Ixode** (*I. camelinus* G. Fischer) has been described, which has been found on Camels in the steppes of Asia.

A very widespread species which infests Cattle in Northern Africa, and which is found on those brought into the European markets from that country, and particularly into the French markets, is the **Egyptian Ixode** (*I. egypti*us Linn., *I. Savignyi* P. Gerv.).

The rostrum is alike in the two sexes, and is large, salient, cylindrical, and distinctly truncated; the dart is a little spatuliform, and has three rows of teeth on each side of its lower surface; the chelifers are terminated by a three-pronged harpoon, and the palpi are as long as the dart, but have no valves. The scutellum is black, roughened, and polygonal. The articles of the legs are brown at their base and yellow at the other extremity. The fecundated *female*, when empty, is 9 mm. long and 7 mm. wide; it is red in colour, nearly square in form, and the posterior border has eight slightly-marked festoons. Its scutellum is nearly one-third of its length, is sub-rhomboideal, and has two eyes—one at each of the lateral angles. The *male* is 8 mm. long and 4·5 mm. broad, and is irregularly oval, being wider at the posterior border, which is cut into eight deep festoons. The scutellum covers all the upper surface, with the exception of two lateral, narrow borders of a yellowish-white colour, and has an eye on each side, at the second pair of legs (Mégnin).

Mégnin has given the name of **Algerian Ixode** (*I. algeriensis*) to a

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1 The Veterinarian, June, 1869.
form which is distinguished from the preceding chiefly by its smaller dimensions, by the quadri-dented harpoon of the mandibles, and by the uniformly brown colour of the articles of the legs. To us this appears to be merely a variety of the Egyptian Ixode, in the company of which Mégnin states he found it in very great numbers on Cattle from Africa.

The Egyptian Ixode— the largest known species—is very common in Egypt, in Algeria, and in most parts of Africa. We believe it to be related to an Ixode we received from Guadeloupe, through Couzin, where it is known as the *Tique sénégalaise*. It has been considered, in fact, as derived from Senegal, whence it must have been imported with Cattle into the countries in which it is now seen. It is stated to be a stranger in Martinique, which, notwithstanding its proximity to Guadeloupe, will doubtless remain exempt from it, as that island does not receive African Cattle.

We have the opportunity of meeting with this Ixode in the abattoirs of France, on Algerian Oxen; and Mégnin even affirms that it will eventually become acclimatized in the South of France, in the neighbourhood of Marseilles, by the temporary sojourn of African Cattle in that town and its environs, before their departure for the different markets. He bases this assertion on what he has observed with regard to the Green Lizard of Provence, on which he found a male Ixode that he believes is an Egyptian one. It has been known for a long time that the male of this species often fixes itself upon reptiles—such as the Greek and Mauritanian Tortoise—and on Lizards.

The Cattle that Mégnin has seen carrying swarms of these Ixodes about their flanks, and the other parts of the abdomen, did not appear to suffer, nor did they try to remove them; they arrived at Paris in good condition. Nevertheless, in Africa the Algerian Ixodes are not always inoffensive, for Lucas relates having seen, in 1845, in the district of Calle, Algeria, Oxen die from exhaustion through the effects of the parasites, which were incessantly renewed on the surface of their bodies. Each female, in fact, attaining in its full plenitude the size of a hazel nut, it can easily be understood how this great subtraction of blood, repeated so very many times, should operate prejudicially on nutrition, to say nothing of the irritation set up on the skin. And the same effects have been witnessed by Couzin on the Horses, Cattle, and Mules in Guadeloupe. In addition, the wounds resulting from the punctures of these Insects become ulcers under the influence of the climate. According to the opinion of Mégnin, it is possible that this ulceration is primarily due to the custom of removing the Ticks by means of hot knives; the rostrum remaining in the skin causes eliminating suppuration, which leads to obstinate sores.

In Guadeloupe, the Ixodes of Senegal are supposed to play an important part in the development of a serious affection known there as *farey*,

and which is witnessed in Horses, Cattle, and Mules; the ulcerous wounds just referred to are the starting-point of the disease. Nocard has recently demonstrated that this 'farcy of the Ox' is a malady of microbic origin; and it can be conceived that the Ixodes may be the agents of inoculation of the micro-organism that determines such a disease. It may be mentioned that this 'farcy' is not known at Martinique, where there are no Senegal Ticks. Dugès' Ixode, which is also frequent in Guadeloupe, where it is named the 'creole Tick,' is not implicated in this etiology of facry, as its puncture does not leave any trace because of the rostrum being so slender.

Various parts of Central and South America are much infested by numerous Ixodes belonging to different species, as, for instance, the *I. americanus* (Linn.), of Surinam, Pennsylvania, etc.; *I. Rugica*, of Surinam and Brazil; *I. bovis* (Riley), of Texas; *I. rotundatus* (Koch), of South America, etc. These are popularly designated by such names as *Ticks, Prickers, Garapattes, and Garapatos*. But there can be no doubt that under these denominations are confounded Ixodes and Argas. Of six Ixodes we have received from Guatemala (sent by our colleague Soulà), four belonged to one species and two to another; the species are quite distinct, and yet they are often confounded and referred to by the name of the American Ixode (*I. americanus* Linn.), or the *Nigua Ixode*. These specimens were collected on the Horse. 'This animal, owing to its being reared on the prairie—potrero—is frequently literally covered with these parasites. They are seen on all parts of its body, but they prefer those regions that the Horse cannot reach—as the sides of the neck and shoulders, and the inner surface of the thighs. Animals do not appear to suffer from their presence.'

Kalm, cited by De Geer, relates having seen horses 'which had the under part of the belly and other regions of the body so covered with these Ticks that it was scarcely possible to introduce the point of a knife between them, and they were so deeply buried in the flesh of the animal that it finally succumbed.' Cattle, and even Man himself, are very frequently attacked by these parasites. The Ixode which fixes itself on Cattle in Texas has been named the *Ixodes bovis*.

Mégnin mentions, on the authority of J. Salé, that the inhabitants of Central America firmly believe that these Ixodes can be made to fall off spontaneously by giving the infested animal salt to eat.

The most simple and efficacious means of getting rid of them is to remove them one by one by means of forceps, or, better still, to touch them with benzine, petroleum, tobacco-juice, etc.

(What is called the 'scrub Tick' in Australia, from its frequenting the shrubs on the immense plains of that country, appears, from all accounts, to be a most formidable Insect. Unfortunately, I can obtain no exact description of it, but the latest writer who refers to it is Dr. Bancroft, of Melbourne, a summary of whose paper appeared recently.1

He says there are many kinds of Ticks which attach themselves to Man and the Dog, but it is from the 'scrub Tick' alone that harm arises. The scrub Tick is flat, brown in colour, and about one-eighth of an inch in length and breadth. When distended, it is as large as a pea. The female Tick only, like the mosquito, appears to bite. Ticks attach

1 *British Medical Journal*, May 16, 1891.
themselves by their mouth organs, and never become buried under the skin, as some persons have imagined. The Tick is particularly active in summer, and is found under leaves, ready to drop on any moving object. The poison appears to be absent, or only in a minute quantity, when it first attaches itself. A solution made of eight Ticks and a few drops of water, when injected under the skin of a Dog, produced no effect, but the same Dog afterwards succumbed to the bite of two Ticks. The Tick sucks blood from the animal to which it has attached itself, and it is presumed that some poison, probably of the nature of a ferment, passes from the Tick into the animal. Most Mammals are susceptible to the attacks of the scrub Tick; even Horses have been killed by it. Human beings would succumb were the Ticks suffered to remain long enough on the skin; but by reason of the irritation caused they are discovered a few hours after attaching themselves, and are invariably removed. The Guinea-pig and Kangaroo-dogs seem to be insusceptible to the poison. Dogs that have recovered from tick-bite become tick-proof. The native Australian animals are tick-proof by heredity. Dogs influenced by tick-poison generally show signs of paralysis on the sixth day, and die about the seventh or eighth. The Tick takes about a fortnight before it is ready to bite again. Providing a Tick be removed from a Dog before the fourth day after attaching itself, no symptoms will arise. To make a Dog tick-proof, proceed in the following manner: Make a slight cut, not sufficient to bring blood, behind the ear of the Dog, and gently press the snout of the Tick into the wound, when it will, as a rule, bite and hold on. Two Ticks should be placed on the Dog; after they have been on two days, remove them. Grease, turpentine, or kerosene smeared over them will kill them. Allow a week to elapse, and then place two others upon the Dog, and remove them after being on three days; then allow another week to elapse, place two more Ticks upon the Dog, and remove them before the fifth day. After this the Dog will be tick-proof. Valuable dogs which live in a locality where Ticks abound should be carefully examined every two days.)

**Argas** (*Argas Latr*.).—In the general form and habits, these Insects greatly resemble the *Ixodes*, from which they are distinguished by the following characters:

The rostrum, instead of being terminal, occupies the inferior face of the cephalothorax. The maxillary palpi are antenniform—that is, formed of cylindrical, subequal articles, very movable on each other. The scutellum is altogether absent.

Only one species is met with in France: this is the *bordered Argas*, which lives on Birds. In hot countries, such as in Asia, Africa and America, there are several species that attack Man and the domesticated animals.

Laboulbène and Mégnin have described two species of *Argas* found in Persia, and which are a scourge to travellers. One is the *Persian Argas* (*A. persicus* Fischer), chiefly known by the name of the *Miana Bug*, by reason of the locality which it more particularly infests. The information relating to it does not allude to its action on the domesticated animals.

The other species is the Argas of Tholozan (A. Tholozani Lab. et Még.), the body of which is relatively narrow, its sides parallel, the anterior extremity terminating in a blunt point, the posterior round, and the skin very finely gauffered. The adult females measure 8 mm. to 10 mm. long, and 4 mm. to 5 mm. broad. In a state of repletion their colour is a deep violet. In Persia this species is reputed to be very dangerous to Man. It is named Kéne or Sheep Bug, which leads to the supposition that, besides the human species, it also attacks the domesticated animals, or at least the Sheep.

There are no precise details as to the characters and habits of the African Argas.

Those of America have often been confounded with the Ixodes, under the name of Garapattes. They are more especially prevalent in Central America. Those of Mexico have been particularly studied by Alfred Dugès and by Mégnin. Two species attack Man and the domesticated animals: these are the Argas turicata and the Argas of Mégnin.

The Argas turicata (Dugès), as it is thus popularly named in Mexico, has a sub-rectangular body, nearly square, the anterior border angular and obtuse; it measures 5 mm. to 6 mm. long. The Turicatas infest the Pigs of Ganajuato, Mexico, fixing themselves on the inside of the forearm, and running somewhat rapidly. Their punctures sometimes cause very serious accidents to Man, and the Pig cannot always sustain them with impunity. 'It often happens,' says Dugès, quoted by Mégnin, 'that newly-purchased Pigs are put into pigsties where, owing to the carelessness of the owners, the Turicatas abound; some of the Pigs die during the night, and others are found incapable of getting up; if compelled to rise, they stagger and stumble about, and cannot maintain themselves. In the dead Pigs, the connective tissue is distended around each puncture with an ecchymotic effusion to an extent of 5 centimètres in diameter. I have never examined further to ascertain if there were any other disorders. Fowls which feed on the Argas, if only for a day, die in about three days, after becoming dull and ceasing to eat.'

Dugès has given the name of Argas Mégmini to a species the body of which is lyriform, the wide end being anterior, slightly angular forward, rounded behind, the female measuring 5 mm. to 6 mm. long and 3 mm. to 3·5 mm. broad. This kind is, according to Dugès, very abundant in the State of Ganajuato, and is seen on the Horse, Ass, and Ox, principally in the ears; but it often fixes itself on other animals, and on Man in particular. Mégnin supposes that the numerous Ixodidae that infest animals in Mexico, and with which the Horses of the French military expedition to that country were so much afflicted, ought to be included with this species, which is, otherwise, more troublesome than the American Ixodes mentioned above, and with which it has been confounded under the designation of 'Garapattes.'

II. Gamasidae (see p. 94).—Two of the genera of this family have species living as parasites on the domesticated animals. These are the Gamasae and the Dermatoglyses.

The Gamasae (Gamasus Latr.) have the integument partially or wholly coriaceous; the mandibuli are cheliform, and are similar or but little different in the two sexes. The larvae are hexapodal.

One species only merits mention here—the *Gamasus pteroptoides* (Mégnin), so named because of its resemblance to the Gamasidæ of the genus Pteroptus. It lives in complete and permanent colonies at the bottom of the fur of Field-mice, Moles, and Rabbits, as well as on some Bats.

The whole rostrum is salient and uncovered; the inferior plastron is very small in the two sexes, and united by a membraneous integument to the superior plastron, which covers all the dorsal surface. The legs are nearly altogether of the same size, and similar in the two sexes; the hooklets and caruncle which terminate them are very developed. The nymphæ have a short peritreme. The body is squat, oval, and brown-coloured. The length of the female is 55 mm., and the male 45 mm., the width of both being 30 mm.

This parasite subsists on the natural exudations of the skin of its host, and perhaps, also, on that which it produces by the bites of its mandibles; but up to the present time it has not been observed to do any particular harm. It has only been mentioned expressly as related to the Rabbit. Turnbull has found in the ear of an Ox an Acarus that Leidy considered belonged to the genus *Gamasus*. It will be referred to when treating of the 'Parasites of the Ear.'

The *Dermanysses* (*Dermanyssus Dugès*) may be found on the domesticated Mammals—such as the Horse, Ox, Dog and Cat. But they are always accidental, and come from Fowls, which are their natural hosts. They will therefore be considered when dealing with the acariases of Birds.

### III. Trombidiidae (see p. 94).

This family is divided into numerous sub-families, only two of which interest us. These are the *Trombidiæ* and the *Cheyletiæ*.\(^1\)

The Trombidiæ are Trombidiidæ with soft integuments, chelifers terminating in hooklets, palpi composed of five articles, the fifth being club-shaped and articulated at the base of the fourth, which is prolonged beyond the fifth by a sharp hook. The legs have six articles, each leg ending in two hooks and a hairy cirre. The Insect has two eyes.

In this sub-family is found the genus *Trombidion* (*Trombidium Latr.*), of which a species—the *Trombidium holosericeum* (Linn.)—lives as a parasite during its larval condition.

Like all the Trombidions, the latter has pedunculated eyes and a skin covered with bristly hairs. Specifically, it is recognised by its scarlet colour, its nearly square body—a little wider in front than

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\(^1\) In the sub-family of *Tetranychidae* is placed the *Bicho colorado*, of the Argentine Republic and Uruguay, which, according to G. Haller, is only a *Tetranychus* (*Tetranychus moletisissimus* Wegenbergh). This small Acarus, which is of a red colour, lives on the inferior surface of the leaves of *Xanthium macrocarpum*, in a web that it spins; but from December to the end of February it throws itself on warm-blooded animals, Man himself not escaping its visitations. *The Bicho colorado* buries its rostrum in the skin, and causes insupportable itching.—A. Railliet. *Élémens de Zoologie Médicale et Agricole*, p. 1006.
behind, where the terminal border is notched on the middle line; hairs and cylindrical papillae cover the body: these are round or obtuse at the summit on the dorsal surface, bristly on the ventral surface and the legs. The length is 1.35 mm., and maximum breadth 1.8 mm.

This is a very widespread species—especially in the centre and West of France—abounding from the end of spring on grass-lands and sandy slopes, and in woods, but rarely in gardens. It is phytophagous, and is often designated—as well as the neighbouring species—the Red Mite.

According to Mégnin—whose opinion, however, has been disputed—the larval hexapod of the *Trombidium holosericeum* is the parasite long known as the *Rouget, Red Flea, Harvest Bug*, etc., and which the older naturalists described as a species by the name of *Leptus autumnalis*.

The various designations given to it are significative of the period when it is most abundant. The female lays her eggs in July. The larvæ are orbicular in shape and orange-red in colour, the body being sprinkled with short, sparse hairs; they have the eyes and stigmata of the adult, and six long cylindrical legs, each with six articles. The insect attaches itself to any animal that comes in its way, implanting its mandibles in the skin. Its abdomen gradually becomes distended, and assumes comparatively considerable dimensions; it is then that it attracts attention, and is recognised by the various names given to it. It measures .40 mm. long and .25 mm. broad.

The Harvest Bugs attack the small Mammalia by preference, such as Moles and Hares, which are sometimes literally covered with them; and Man is often invaded by them in the autumn, the Insects creeping rapidly along the limbs and fixing themselves on any part of the body, especially those parts which are clothed. Their punctures are accompanied by insupportable itching.

Among the domesticated animals, sporting Dogs are most exposed to trombidian acariasis. The first mention of the existence of this parasite on the Dog is due to Defrance; it has since been confirmed by Delafond, Mathieu, Mégnin, Friedberger, and other authors.¹

On returning from the field, Dogs often exhibit symptoms of great itching around the eyes and nose, and on the paws and belly. A close examination will discover the cause to be the Harvest Bugs, wandering or fixed by their rostrum either in the sudoriparous gland-ducts, or, according to Gruby, at the root of the hair. They are sometimes in groups of ten or a dozen around one hair.

Cats which frequent gardens may be affected in the same way, Delafond states.

Fig. 57.—Harvest Bug, or larva of the Trombidium holosericeum, seen from the ventral surface; magnified one hundred diameters.—Railliet.

According to an observation of Moreau (of Saint-Benin d'Azy), and confirmed by Railliet,\(^1\) what is known in France as the rasle or feu d'herbe, and described by Chabert, Fromage de Feugré, Lafore, Cruzel, etc., is nothing more than a case of trombidian acariasis. This affection, which appears towards the end of summer, has been ascribed by the older writers to feeding the cows on the grape-stalks or newly-gathered forage. It occupies the inner surface of the limbs, and extends beneath the belly and on the shoulders, neck, and head, and consists of an eruption of pustules or hard pimples, from which exudes a serous or purulent matter that dries into crusts, and finally disappears as dust. In this way the malady disappears of itself. On cows so affected, Moreau has found colonies of this Insect, forming small disseminated patches of one or two square centimètres in extent.

On cavalry Horses returning from the manœuvres after harvest, Blaise has observed an erythematous affection which did not extend above the

knees or hocks, and which had been mistaken for symbiotic scabies, but was due simply to the Harvest Bugs.

Csokor and Éloire have made a similar observation with regard to Poultry.

Otherwise, this affection is not serious. To free animals from the parasites, some frictions with a cloth sprinkled with benzine, with benzinated glycerine, or with sulphur ointment, are sufficient. A very dilute solution of carbolic acid (1 or 2 per cent.) is a good preventive, and also a curative agent.

Certain warm countries of America are infested by the Leptus of undetermined species, which torment Man and animals, and are named Tlalsahuante in Mexico, Bête rouge in Guiana, the Antilles, and Honduras, Colorado in Cuba, Niaibi in New Granada, Mouqui at Para, etc.

The sub-family of Cheyletinae contains the soft-skinned Trombidiiidae, with styliform chelicerae, and the palpi composed of three articles, the second of which has one or two hooklets that extend beyond the last article. The legs have five articles, usually terminating in two hooklets and a cirre. They have no eyes.

The Cheylete (Cheyletus Latr.) are recognised by their enormous maxillary palpi, the second article of which has a single, large, falciform hooklet extending beyond the last article.

There is a vagabond species that may be accidentally met with on the bodies of animals; this is the Cheyletus eruditus (Schrank), so named because it is sometimes found in old books, as well as among rags, mouldy forage, etc. Picaglia has attributed to it a dermatosis observed on a Horse, resembling that produced by the Dermatophyssus gallinae; but this opinion rests only on the fact that hay with which the horse was fed contained numerous Cheylotes.¹

The Cheyletus parasitivorax (Még.) lives normally on the Rabbit. It is commensal, or, rather, a useful mutualist, if it is true, as Mégnin affirms, that it pursues the soft parasites on its host, principally the Listrophores. The body is an elongated hexagon in shape, and of a pale-yellow colour. The rostrum is large and pentagonal, and equal to a fourth or third of the size of the body, while the palpi are about one-third the volume of the rostrum. The anterior legs are shorter than the posterior. The female is '45 mm., and the male '32 mm. long.

IV. Sarcoptidae (see p. 94).—The Acarina comprised in this vast family live in very diverse conditions, which are nearly fixed for each type, and to which their conformation is subordinate. Their division into five tribes or sub-families, as proposed by Mégnin, is generally adopted; these are: 1. Sarcoptidae detriticoles or Tyrolyphinae; 2. S. gliricoles or Listrophorinae; 3. S. cysticoles or Cytoditinae; 4. S. plumicole or Analgesinae; 5. S. psorica or Sarcoptinae. To these may be added a somewhat, as yet, limited tribe, the Sarcoptidae epidermicoles.

The last four of these tribes will not be alluded to here. The *Sarcoptidae cysticoles* or *Cytoditinae*, the *Sarcoptidae plumicoles* or *Analgesinae*, and the *Sarcoptidae epidermicoles*, are exclusively peculiar to Birds, the first living in the connective tissue and air-sacs; the second among the feathers, being nourished by the greasy matters excreted by the skin; the *Sarcoptidae epidermicoles* conceal themselves among the epidermic cells, the formation of which they expedite, and in this way constitute a transition to the psoroptic *Sarcoptidae* or *Sarcoptinae*. The latter are the agents causing the *psorae* or scabies, which will be dealt with in the following article, when treating of the *psoric acariases* of Birds.

The *Sarcoptidae detriticoles*, or *Tyroglyphinæ*, are Acarina which subsist on decomposing animal or vegetable matters. Trouessart and Mégnin have provisionally attached them to the *Sarcoptidae insecticoles*, which have been studied by Berlese, and which resemble that tribe more than any other. The *Tyroglyphinæ* are only exceptionally met with on the domesticated animals, and then as foreign bodies. They correspond to the following description:

Body covered with a smooth, even, sometimes nodular integument, having silky, plumose, or palmate hairs. Legs alike, similar in each anterior and posterior group, and in the two sexes. The abdominal extremity also rounded in the two sexes (Mégnin).

These characters, compared with those of the other *Sarcoptidae*, always permit the *Tyroglyphinæ* to be eliminated as simply accidental errant insects when they are found on a domesticated animal. We shall, therefore, limit ourselves to an enumeration of the five genera in this tribe: *Tyroglyphus*, *Carpoglyphus*, *Glyciphagus*, *Cepophagus*, and *Serrator*.

It is probably the *Glyciphagus cursor* (Gerv.) that Hering discovered on a Horse’s foot affected with ‘canker’; the horse had recently died. He regarded it as special to the disease, and consequently designated it *Sarcoptes hippocodos*.

The *Listrophorinæ* have been designated *Sarcoptidae gliricoles*, for the reason that they have been considered as peculiar to Rodents.
ACARIASES.

(Glires); they are also found, however, on other Mammals. They live at the bottom of the fur, and cause not the slightest irritation, the greasy matter of the skin sufficing for their nourishment. They are divided into two genera—Listrophorus and Myocoptes—only the first of which will be noticed.

The Listrophores (Listrophorus Pagenst.) have the body ovoid, compressed laterally, a large cephalo-thoracic plastron, the lip transformed into a kind of elongated pincers adapted to seize the hair. The male is provided with two copulatory suckers, and its posterior extremity is more or less notched. The female has the vulva between two groups of legs, and the posterior extremity is not notched.

**Listrophorus gibbus** (Pagenst.).

—The cephalo-thoracic plastron is simply notched above. The posterior extremity of the male has a flat, bifid prolongation. The length of both sexes is about 0.50 mm. It abounds in the fur of wild and domesticated Rabbits and Hares, on which it is seen twenty-four to forty-eight hours after the death of its host.

**Listrophorus mustelae** (Mégnin.).—The cephalo-thoracic plastron is divided into two pieces, which are movable on each other. The posterior extremity of the body of the male is simply notched. The length of the male is 0.40 mm. to 0.44 mm.; of the female, 0.45 mm. to 0.54 mm. It lives among the hair of the muzzle and anterior part of the body of the Ferret and Pole-cat.
Psoric acariases, *scabies*, or *psora*, are caused by Acarina belonging to the tribe of Sarcoptinae or Demodecidae. Their common features are their gravity, their greater or less difficulty to cure, the multiplication of the parasites, and the more or less serious alterations in the skin. They differ by the zoological nature of the Acarina producing them, and by the location of these—the psoric Sarcoptinae living at various depths in the epidermis, the Demodecidae locating themselves almost exclusively in the sebaceous follicles. It is advantageous to study separately the scabies due to the Sarcoptinae—*sarcoptinitic scabies*—and that caused by the Demodex—*demodectic scabies*.

1. Sarcoptinitic Scabies.

Sarcoptinitic scabies possess a high degree of interest, as they comprise nearly all the itching or *psorae* of Man and animals.

The *scabies* or *psora* was designated by the Greeks *ψόρα* (from *ψό*, I rub), and by the Romans as *scabies* (from *scabere*, to scratch).

It is known as *scabbia*, *rogna*, *raspa*, in Italy; *sarna*, *roña*, in Spain; *itch*, *scald*, *yuck* (mange), in England; *gale* in France; and *Krätze*, *Krätzaußschlag*, in Germany.

History.—The history of scabies in animals is closely allied to that of the same disease in Man. It was nevertheless in the former that it was first mentioned in the Bible (Lev. xxii. 22). Moses excluded mangy animals from being offered at sacrifices.

Polybius speaks of an epidemic itch (*limopsoron*) which affected the whole of the people and horses of Cisalpine Gaul, and which Hannibal attributed to privations ('History,' Book III. 87).

The Greeks, and particularly the Roman agriculturists, were aware of the contagiousness of scabies, and the disasters that *turpis scabies* produced in the flocks. The Romans applied the word *scabies* to various affections of the skin, so that we cannot conclude from what they have written that they were really acquainted with the parasitic disease; but what proves that there was no confusion in the mind of Celsus, at least, with regard to it, is that he extends to Sheep-scabies several of his remarks on contagion, and indicates the course and treatment of the malady.

It is not until we arrive at the time of the Arab physicians that we find the first precise notions on itch, and learn that there was then an idea of its parasitic nature. Avenzoar (Ibn-Zohr), who lived in the twelfth century (1072—1161), makes the first mention of it, and indicates the existence of a disease caused by the presence of a little creature, popularly known as *soab*. He says: 'Oriuntur aliqui in

corpore sub cuti exterius pediculi parvunculi qui, cum excoriatur cutis, exuvit animalia vivu tam parvuncula quod ex possunt videri." Although the term pediculi is employed, there can be no doubt, from the mention of the seat of disease and the minuteness of the animalcula, that he had seen the Sarcoptes. But he was content with alluding to the fact, and did not seek to realize its great importance; for, like his contemporaries, he only saw in scabies the result of an alteration in the humours.

According to Fürstenberg, we find in the Physicae Sancti Hildigardis (A.D. 1200)—the writer of which was the abbess of a convent on the Ruppertsberg, near Bingen—an indication of the remedies against the animalcula of the itch. This is named suren—a term popularly in use, and which shows that a knowledge of the parasite of psora had become vulgarized in the North as well as in the South; the denomination was retained until the end of the seventeenth century.

After the time of Abenzoar, the notion as to the animalcula of itch was perpetuated in traditions, in teachings, and in publications, but with alternations of éclat and obscurity which allowed it to remain somewhat of a doubtful matter. A number of authorities of the thirteenth and following centuries speak of it. In Ambrose Paré (1664) is to be found this passage: 'The flesh-worms (ciron) are little animals concealed in the skin, in which they burrow, crawl, and gnaw bit by bit, causing a troublesome and scratching itchiness. . . . These flesh-worms should be extracted by means of pins and needles.'

The year 1634 is an important date in this history, because of the appearance of the book of Thomas Moufet (Insectorum seu minornorum animalium theatrum, London). For the first time, it clearly indicates the precise point where the sarcopt of human itch was to be found; for he expressly mentions that it was not to be sought for in the vesicles, but at the side of them: 'Hoc hobiter observandum, syrones istos non in ipsis pustulis, sed prope habitare.'

About the same period, Hauptmann consecrated one of the first applications which had been made of the microscope—discovered in 1619—to an examination of the acarus, though he only gave a very imperfect drawing of it (1657). A book on Horses (Pferdeschatsch) appeared at Frankfort nearly at this time, and in it mention is made of the acari as Moiben, which live among the hairs of the tail, mane, and forelock of the Horse; but according to Gerlach, the writer mistook epidermic scales for animalcula. Wedel, in 1672, pointed out that acari were the cause of itch in the Cat. The attempts of Hauptmann were subsequently repeated by other observers, and notably by Michael Ettmüller, who published a more exact representation of the Insect.

In 1687, Cosimo Bonomo, in a letter addressed to Redi, gives a remarkably exact description of itch and the acari, after the investigations he had personally made, in common with the pharmacist, Diacinto Cestoni, of Livorna. He speaks of the form of the acari, and even mentions that he saw one of these animalculi lay an egg at the moment when he placed it under the magnifying glass, so that he was able to make a drawing of it. Along with Cestoni, he arrived at the conclusion that the acarus is alone the cause of itch; that the disease is not engendered by perverted humours; that the contagiousness of the malady is perfectly explained by the passage of the creature from one person to another; and that internal remedies are
useless in the cure of the disease, treatment being limited to external applications that would kill the parasite.

These exact notions, however, did not penetrate the mass of medical men. But in 1734, Linnaeus recognised the insect of itch (Acarus humanus subcutaneus), though he committed the grave error of considering it as belonging to the same species as the cheese-mite, of which he thought it was only a variety. The dissertation of Nyander, a pupil of Linnaeus (Exanthemata viva), which appeared in 1757, raised a hot discussion; Nyander clearly proving that the acarus should be sought for in the furrows and not in the pustules; while Avelin—another pupil of Linnaeus—attributed the itch of the Sheep, as well as that of Man, to the presence of an acarus, which he had perhaps not seen. So that the physicians remained divided between the humoral and the parasitic theories of psora.

In 1763, Sauvages wrote (Nosologie): 'The illustrious Linnaeus has observed an itch on Cattle, which has much resemblance to leprosy in the thickness and hardness of its tubercles; it was caused and maintained by insects that were found located in these tubercles.'

In 1778, De Geer personally observed the Sarcopt, and gave the first exact figure of it, indicating, at the same time, the characters that serve to distinguish it from the cheese-mite. In 1786, a great observer—the Hanoverian physician, Wichmann—published an important memoir (Ätiologie der Krätze), in which, by new facts, he magisterially and decisively established the parasitic doctrine of scabies almost as it is known to-day; and in a second edition of his work (1791), he successfully combated the objections raised against his views, with regard to metastases, repercussions, etc. He also published the hypothesis that the scabies of Sheep is likewise due to an acarus, and that the wool plays an important part in its propagation. Abilgaard, professor at the Copenhagen Veterinary School, wrote to him in 1787, to the effect that the treatment justified his theory, as by the exclusive employment of local applications he had cured a large number of mangy animals.

Unfortunately, Wichmann had left a loophole for the old prejudice in favour of psoric repercussions, as he admitted that these might be the possible consequence of the absorption of the excremential matters of the acarus; so that doubts and denials persisted. Kersting, the first director of the Hanover Veterinary School, had plainly seen the animalcules on mangy Horses; but he did not consider them the cause of the disease, as he could not succeed in producing it on a healthy Horse, by sprinkling the dust from the skin of an affected animal on it for fourteen consecutive days.

It is true that in Germany, Viedebrandt, who was entrusted with the task of studying itch in the Sheep—the disease was then prevailing in a disastrous manner among flocks—attributed it, in 1790, to insects which were in the air and on the pastures, and succeeded in transmitting the affection from one Sheep to another. But this assertion is accompanied by so many errors on all points, that it is very evident that Viedebrandt had not seen that of which he spoke, and that his statement is nothing more than a hasty and chance generalization with regard to what Wichmann had so well established, in reference to the itch of Man.

To Walz belongs the honour of the real discovery of the Sheep acarus in 1809. Soon after (1812), Gohier collected the parasites on mangy Horses, and Saint-Didier gave an illustrated description of them.
Gohier mentions Dorfeuille, sen., as the veterinary surgeon who, in 1813, discovered the acarus of the Ox; and he himself observed it during the following year on Hungarian cattle which had accompanied the Austrian army to Lyons. He adds that, by means of a magnifying-glass, he had seen the acarus of the Sheep, Dog, and Rabbit.

Notwithstanding the observations of Wichmann, Walz, Gohier, and numerous naturalists, the existence and action of the psoric acarus were generally unknown or disregarded in medicine; for, forgetful of the past recommendations, it was sought for in the vesicle, but could not be found, and therefore the conclusion was arrived at that it did not exist. Discussions on the opinions of the Ancients with regard to the animalcule continued until 1812, when Galès, pharmacist to the Saint-Louis Hospital at Paris, published a dissertation on the itch, and announced that he had constantly found in the *pustules* the creature so much sought after, and of which he gave a sketch. This work attracted considerable attention, and according to Alibert, Galès appeared to have established the reign of the Sarcopt. But nobody else could discover the mysterious flesh-worm, and it was still sought for in the vesicles, on the indications of Pinel, who had assigned it that location. During more than fifteen years, the figure published by Galès was reproduced in every book on the subject, as an exact representation of the itch parasite. He had communicated the disease to himself by the transfer of an acarus, and he had experimentally transmitted it to children. Nevertheless, it was asserted that his pretended discovery was a gross error, if not an imposture. Raspail, who, like so many others, acting on the directions of Galès, had unsuccessfully attempted to find the parasite in the vesicles, in 1829 demonstrated that the animalcule represented by Galès was only the *cheese-mite*.

After these unfortunate attempts, incredulity resumed its sway, and was extended even to the writing of the older observers. The inescrutable animalcule was all but renounced when, in 1834, a Corsican—Francis Renucci, studying medicine at Paris—hearing the existence of the acarus denied at the Saint-Louis Hospital, proposed to show it forthwith; he imitated the procedure of the poor women in his country, in extirpating the Sarcopt at the point of a needle carried to the extremity of the irregular furrow leaving each vesicle. From that moment the nature of scabies was definitely recognised, and the correctness of the observations of Moufet, Nyander, Wichmann, and so many other previous observers, was fully acknowledged.

The most recent investigations have had for their principal object the anatomy and physiology of the acarus, as well as the scientific treatment of scabies based on the teachings of natural history. The excellent thesis of Renucci (1835) is evidence of this; also the work of Albin Gras (1834), who, from a therapeutical point of view, studied the action of certain agents on the Sarcopt; that of Aube (1836), in which the parasite is represented as a noctambulous creature; and the memoirs of Raspail, Eichstedt, Lanquetin, Robin, etc.

With regard to scabies in animals, we have already mentioned the first allusion made to the acarus of the Cat by Wedel in 1672, then to its real discovery on the Sheep and Fox by Walz in 1809, and on the Horse, Ox, Dog, and Rabbit by Gohier in 1812 and 1814. It should also be mentioned that, at the commencement of this century, Hamemann, quoted by Zürn, knew the itch acarus of the Horse, and gave a passable drawing of it. The itch parasite of the Pig and Wild Boar...
was found by Spinola in 1846. But our knowledge of the various species of Acarina of scabies has been more especially extended by the classical works of Gurlt and Hertwig (Vergleichende Untersuchungen über die Haut des Menschen und über Krätze und Räudemilben, Berlin, 1841), of Gerlach (Krätze und Räude, Berlin, 1857), of Fürstenberg (Die Krätzemilben der Menschen und Thiere, Leipzig, 1861), of Ch. Robin (Mémoires sur diverses espèces d'Acariens de la famille des Sarcoptidés, Moscow, 1869), and of Delafond and Bourguignon (Traité pratique d'entomologie et de pathologie comparées de la psore, Paris, 1862). The name of Mégmin should also be honourably associated with these, because of the numerous memoirs he has contributed on the various groups of Acarina, and especially those of psora.

**General Characters of the Psoric Sarcoptidæ.**—The body of these is oval or orbicular, obtuse at both ends, convex above, flat below, marked by fine, symmetrical, and sinuous streaks, except at those parts where there are the thickenings named *plastrons*. It has, besides, at different points, trichomæ—pricking bristles or hairs.

There is a conical, mobile rostrum in front; the maxillo-labial spoon, situated at the inferior surface, comprises two lateral pieces or maxillæ joined to a posterior middle piece or chin, and is united, in the opening of the angle thus formed, by a thin membrane or lip. The floor of the mouth is constituted by the languette, a single lancet-shaped piece. The chelicæ are placed longitudinally on the upper surface of the lip and languette, but does not adhere to them; they are flat on their inner surface, by which they come into contact, and so limit the supero-lateral walls of the mouth, which is a prismatic cavity with three surfaces. Each of them is formed of two articles, one of which, the shortest, is articulated on the other, which is the entire length of the organ; from this results a kind of pincer, with dentated branches. The maxillary palpi are cylindrical or conical, and situated on nearly the same plane as the chelicæ; they curve round these, their convexity being external; of their three articles, the basilar, which is very large, articulates with the corresponding maxilla, or with the latter and the chin. Finally, outside the palpi there are sometimes transparent, cariniform, membranous expansions which Ch. Robin terms *cheeks*, and which, leaving the margin of the anterior part of the cephalothorax (*camerostoma*), are applied to the palpi, the curvature of which they follow.

The legs have for base the *epimère*, skeletal pieces that strengthen the integument. Each of the five articles (or joints) composing them—and which are, passing from the base to the distal extremity, the
haunch (coxa), trochanter, thigh (or femora), shank (or tibia), and tarsus—comprises a solid piece and varied appendages, hairs, or bristles. The tarsus is terminated by a long bristle, or by an ambulacrum composed of a transparent pedicle of one or three pieces, and a campanulated expansion or ambulacrous sucker, which ensures adhesion to the smoothest surfaces.

The digestive apparatus, with rare exceptions, is only observable at its two orifices. The anus is a longitudinal, median slit, usually situated at the posterior border, but sometimes on the upper surface, and only at a tangent to the posterior border.

The sexes are distinguished by peculiarities in the legs and the general shape of the body, by details in the organization of the external parts of the genital apparatus, and by the size—the male being always smaller than the female.

The male organ is situated between the two last legs, on the middle line. It comprises a small number of strong chitinous pieces that form a complex genital armour, and which protects or directs the penis. Behind this arrangement there are often two circular suckers, placed sym-
metrically on each side of the middle line, and which serve to fix the male to the female. The posterior border, in regard to these two copulatory suckers, has usually two prolongations or lobes furnished with several bristles, which may have a share in copulation.

In the female the anus serves also as vulva; and for this purpose, at a certain period, it assumes large dimensions, being then designated the vulco-anal slit. When the young female has become fecundated, and is therefore an ovigerous female, this orifice becomes of a greater size, and is a special organ for ovulation. This ovulating vulva (the tocostoma of Railliet) is seen on the inferior surface of the cephalothorax, at or behind the second pair of legs, appearing as a transverse slit with wrinkled lips, and sometimes provided with accessory chitinous pieces.

The psoric Sarcoptidae attack the epidermis of the animals upon which they live, and their punctures are followed by the formation of more or less thick crusts, probably because they deposit a venomous saliva in the small wounds.

They are oviparous, sometimes ovoviviparous. The eggs are ovoid, their contents granular, and the shell transparent. When they are advanced in hatching, the embryo can be distinguished with its three pairs of well-developed legs bent beneath the body, and converging towards the centre, the hairs lying along them.

Incubation-only lasts for a few days, as has been ascertained by Eichstedt, Bourgiguon and Delafond, Gerlach and Burchart, Gudden and Fürstenberg. Bourgiguon, like Eichstedt, fixes the period at ten days, he having seen the eggs of the Sarcoptes scabiei which had been kept in a small stove at the temperature of the body, hatched in about that time. Fürstenberg states that the period is from six to seven days. Gerlach has hatched them in about three days; after assuring himself of the limpidity of the contents of the eggs, he placed them between two glass plates which he carried upon himself day and night, from time to time allowing a drop of water or saliva to pass between the plates. Burchart, who experimented at the same time, placed the glass plates in a pocket in his underclothing, which he left off at night; the eggs were two days later in being hatched, or five days' incubation (S. Verheyen). These different results are conformable with the varied physiognomies the course of scabies may assume. The disease seems to sleep in winter, to waken up into activity on the return of warm weather. It is therefore established that the duration of incubation varies according to more or less favourable conditions, dependent upon the season, the activity of the local circulation of the manguy animal, the thickness of its coat, etc. Considering the rapidity with which the disease is developed in certain cases, Mègnin is inclined to diminish this duration; and he estimates that when all the conditions are favourable, from twenty-four to forty-eight hours may suffice for incubation.

The duration of the germinative faculty of the eggs—the maximum
time about which, when removed from the body of the host, they can yet give origin to the embryos—has not been determined. Gerlach has, however, seen the eggs of the Sarcopt of the Horse hatch after four weeks. It is certainly an interesting question to solve, as it is the one upon which the duration of activity of the contagion of scabies depends.

When the larvae issue from the eggs, they undergo those metamorphoses which have been more especially made known by the researches of Delafond and Bourguignon, and Fürstenberg and Mégnin.

1st Age. Larva.—The small acarus just hatched differs chiefly from the adult of the same species, by the absence of the fourth pair of legs and the genital organs, and by its smaller size. At the back part of the abdomen is a pair of more or less long bristles. In this state it is named a larva (De Geer), and before passing to the second age it has to submit to two or three moultings, in order to allow it to grow. At each of these crises it becomes inert, and all its parts are reduced to a cellular mass, at the expense of which the organs are formed anew—the change taking place within the integument, this playing the part of a shell; according to the expression of Claparède, the animal again becomes an ovum.

2nd Age. Nympha.—The last moulting of the larva brings it to the second age—that of nympha (Dugès). It is characterized by the presence of the fourth pair of legs, which are a little smaller and are less complete than those of the female, which the nympha most resembles. There are as yet no sexual organs. With the nympha there is not so much variation in size as is the case with the larva, proving that there is little or no moulting during this age, which is otherwise very brief. It may be remarked, however, that there are two different sizes among the nymphæ, but both in moulting are arrived at puberty, the smallest being the males, the largest the females (Mégnin).

3rd Age. Male and Female at Puberty.—The metamorphosis of the nympha brings the Sarcoptidae to the age of coupling; it is the last for the males, which are now recognised by their sexual characteristics, the females having only the vulvo-anal slit and are named pubescent females. The pubescent male and female have the various parts of the integument more accentuated and deeper coloured than in the preceding states. Copulation is accomplished in varied conditions. The termination of existence in the male is principally devoted to the accomplishment of that act; but the female undergoes another moulting and then arrives at the fourth age.

4th Age. Ovigerous Female.—This fourth age—the egg-laying age—is recognisable by the presence of the sub-thoracic vulva, and the ovigerous female, as she is now termed, also undergoes modifications in the third and fourth pair of legs, or in the latter only, varying according to the genera. In the abdomen—the walls of which are transparent—can often be perceived one or more eggs, which will be extruded according to circumstances connected with the habitat and genera of the creatures.

* Judging from the number of ova Gerlach found in a gallery of the
Sarcopt, he certainly did not exaggerate in attributing to each female an average production of fifteen individuals—five of them males and ten females. The generative faculty being reached when fifteen days old, he fixed a progressive rate of increase which had no pretension to mathematical exactitude, but which gives an idea of the multiplication of these parasites, and the rapidity with which scabies is propagated among agglomerations of Men or animals.

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So that from two individuals, male and female, there are one million five hundred thousand descendants in about three months. The production of an animal species is on a par with its chances of destruction; when animals affected with scabies are left to themselves, these chances are fewer than is the case with many other invertebrates, and if we might judge from the extent of the crusts and the number of animalcules necessary to cause the formation of these and to maintain them, the enormous multiplication established by this computation does not appear to be exaggerated' (S. Verheyen).
The habits of psoric Sarcoptidae vary with their genera and species. All the Acarina are divided into three very distinct genera: Sarcoptes, Psoroptes, and Symbiotes.

The Sarcoptes (Latr.) (σάρξ, flesh; κοπτεῖν, to cut) are recognised by their rounded or slightly oval body; short rostrum, margined by two cheeks; short, thick, conical legs, the two posterior being quite or nearly concealed beneath the abdominal surface; the tarsus has often an ambulacrous sucker, in the form of a simple and somewhat long pedicle; the male is usually destitute of copulatory suckers, and never has abdominal lobes.

The Psoroptes (Psoroptes P. Gerv., Dermatodectes Gerlach, Dermatokoptes Fürst.) (ψόρα, psora; πτυχωσεῖν, to conceal) have the body oval; rostrum conical, elongated, and destitute of cheeks; the legs are thick, especially the anterior ones, and are all visible outside the lateral margins of the body; the ambulatory suckers are carried on a long tri-articulated pedicle; the male has copulatory suckers and abdominal prolongations.

The Symbiotes1 (Symbiotes Gerlach, Choriopites P. Gerv., Dermatophagus Fürst., Sarco-dermatodectes Del. and Bourg.) (σίμβιον, with; βίος, life) have an oval body; rostrum slightly conical, as wide as it is long, and destitute of cheeks; the legs long, thick, and visible beyond the sides of the body; the ambulatory suckers are very wide and carried at the end of a short pedicle; the male has copulatory suckers, and more or less developed abdominal prolongations.

Sarcoptes.—The genus Sarcopt comprises a small number of species forming two sections2 or sub-genera—Eusarcoptes Railliet, proper to the Mammalia, and Kneumidokoptes Fürstenberg (Dermatoryctes Ehlers), special to Birds.

The Sarcoptes properly so called, or Eusarcoptes, have the body orbicular or ovoid, provided with squamiform prominences, and spinules on the notogastrum. The males have no ambulatory suckers on the third pair of legs, and never have any copulatory suckers. The pubescent and ovigerous females have on the first two pairs of legs ambulatory suckers, and on the other two pairs only hairs. They are oviparous.

This section comprises two species—the Sarcopt of scabies and the dwarf Sarcopt.

The Sarcopt of scabies (S. scabiei De Geer, S. communis Del. and Bourg.) has the body slightly oval, marked by parallel ridges, which are interrupted on the dorsal surface, as far as the sides, by acute conical projections. This surface has, besides, two long needles or spinules on the border of the epistoma; three short and thick spinules,

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1 The name of Choriopites, created by P. Gervais in 1859 for an acarus of this genus found by Delafond on the Goat, cannot be substituted for that of Symbiotes introduced by Gerlach (Krätze und Räute, Berlin, 1857), the latter name having only been employed at a later period by Redtenbacher to designate a genus of Coleoptera of the family of Cryptophagidae (Fauna Austrica, Die Käfer. 2te Auflage, Vienna, 1858, p. 371).

in triangle, on each side, behind the origin of the second pair of legs; seven spinules disposed in four rows—two on each side of the middle line—on the posterior quarter of the body; and a chitinous, grained plastron on the cephalothorax, in front of the groups of three spinules. There are two long bristles on each side of the anus, which is retro-dorsal. The first two pairs of legs are provided with ambulatory suckers; the fourth pair have them in the male. In the latter the third pair, and in the female the third and fourth pair of legs, carry a long bristle, instead of an ambulatory sucker.

The *Sarcoptes scabiei* live on Man and a large number of Mammals, and by their presence cause the development of ordinary itch or mange.

One peculiarity in their habits consists in the female depositing her eggs at the bottom of furrows or sub-epidermic galleries, a circumstance that renders the cure of scabies somewhat difficult.

The *Sarcoptes scabiei* varies in its dimensions and in secondary anatomical details, according to the species of Mammal it lives upon; hence it happens that there are somewhat numerous varieties, which many authorities have described as so many species. According to Mégnin, it is more particularly the dimensions that may serve to characterize varieties; and these dimensions are closely related to the thickness of the skin of the animal which affords them a habitat. So it is that the Pachydermata maintain the largest variety; then come the Carnivora, next the Ruminants, the Rodents, etc.’ These varieties—which we distinguish after the name of their host—are nine in number,
and may be classed in the order of their decreasing dimensions: *suis, equi, vulpis, lupi, caprae, camelii, ovis, hydrochaeri, hominis*. We will only notice here those which live on the domesticated animals.

The *Sarcoptes of the Horse* (*S. scabiei, var. equi; S. equi Gerlach*) has the body of an elongated oval shape, measuring 43 mm. to 47 mm. in length in the ovigerous female, and 25 mm. to 28 mm. in the male; the breadth being in the former from 32 mm. to 35 mm., and in the latter 18 mm. to 20 mm. It lives on Solipeds.

The *Sarcoptes of the Sheep* (*S. scabiei, var. ovis; S. squamiferus ovis Gerl.*) has the six anterior spinules on the back short, in the form of an acorn; the fourteen posterior spinules are longer and fusiform. In the Sheep it causes scabies of the head. Mégnin has also found it on Moufflons and Gazelles. The length of the ovigerous female is 35 mm. to 49 mm., of the male 22 mm. to 25 mm.; the width of the former is 20 mm. to 36 mm., and of the latter 16 mm. to 19 mm.

The *Sarcoptes of the Goat* (*S. scabiei, var. caprae; S. caprae Roloff*) is identical with the preceding, and its dimensions are nearly the same. The length of the ovigerous female is 35 mm. to 44 mm., of the male 21 mm. to 25 mm.; the width of the former being from 27 mm. to 34 mm., and of the latter 17 mm. to 22 mm.

The *Sarcoptes of the Pig* (*S. scabiei, var. suis; S. squamiferus Fürst.*) resembles the preceding two. The ovigerous female measures 40 mm. to 50 mm. long, and the male 25 mm. to 35 mm., the former being 32 mm. to 39 mm. wide, and the latter 19 mm. to 30 mm. This variety has also been observed on the Dog.

Another variety found on the Pig by Guzzoni is much smaller in size, the female being 29 mm. long, and 21 mm. broad; the male 17 mm. long, and 13 mm. broad.

The *Sarcoptes of the Wolf* (*S. scabiei, var. lupi; S. sc. crustose Fürst.*) has been found by Mégnin on Wolves affected with mange, and he has identified it with that which, according to Fürstenberg, causes in Man the crusty form of scabies known as the *Norwegian itch*—the country in which it most frequently appears—and that form of mange which affects Deer kept in menageries. Railliet and Cadiot have also seen this parasite on a Dog affected with crusted mange.
The Sarcopt of the Camel (S. scabiei, var. cameli) has the integumentary markings less marked than they are in the other varieties. The length of the ovigerous female is 44 mm., and that of the male 24 mm., while the former is 33 mm. broad, and the latter 16 mm. (?) It causes the mange of the Camel, Llama (P. Gervais), Giraffe (Mégnin), and the Bubalis Antelope (Railliet).

The Sarcopt of the Dog (S. scabiei, var. canis) has been found on several occasions by Railliet and Cadiot, as well as by ourselves, on many dogs. It is distinct from the varieties suis and lupi, which are also sometimes met with on the Dog. Its dimensions are slightly greater than the following, which are those of the Sarcopt of Man (S. scabiei, var. hominis): Length of ovigerous female 30 mm., male 20 mm.; breadth of former 26 mm., of latter 16 mm. Sarcoptes of exactly these dimensions have been seen on the Dog by Delafond and Mégnin.

The Sarcopt of the Capybara (S. scabiei, var. hydrochari), which Mégnin allies with that of the Ferret, has nearly the same dimensions as that of the Dog. The ovigerous female measures 36 mm. long, and the male 22 mm., while the breadth of the former is 30 mm., and that of the male 16 mm. It causes the sarcoptic mange of the Ferret.

The diverse varieties of Sarcoptes are not localized on a determinate species of Mammalia, for several may pass from one to the other, as will be shown hereafter when studying the scabies they give rise to.

The second kind of Sarcopt found on Mammals, is the Dwarf Sarcopt (S. minor Fürst.; S. cati Hering; the notædra Sarcopt of Delafond and Bourguignon).

The body is spherical; the dorsal folds of the integument are disposed in a circular manner, become confounded with each other, form large blunt ridges, and encircle the anus, which is dorsal, near the posterior border in the male, in the posterior quarter in the female. There are two hairs longer than the rostrum on the epistoma, instead of the prickles. The six anterior spinules are arranged in a curved transverse

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1 Hence the name of Sarcoptes notædra (νοταδρα, back; ἀνα, anus) given to this species by Delafond and Bourguignon.
row, the convexity being forward. There are twelve spinules instead of fourteen, eight being arranged symmetrically in a transverse curved line, parallel to the preceding, in proximity to the anus, and four in two pairs near the borders of the anal slit. There is a pair of short anal bristles. The arrangement of the ambulatory suckers is the same as in the *Sarcoptes scabiei*.

The dwarf Sarcopt lives on the head of the Surmulot, Rabbit, Cat, and Coati. It is very variable in dimensions; that found in mange of the Cat and Rabbit (var. *cati* or *cuniculi*) is, for the ovigerous female, \(0.16 \text{ mm. to } 0.25 \text{ mm. long,}

and for the male \(0.12 \text{ mm. to } 0.18 \text{ mm.}, the width being for the former \(0.13 \text{ mm. to } 0.20 \text{ mm.}, and for the latter \(0.09 \text{ mm. to } 0.14 \text{ mm.}

That of the Surmulots (var. *muris*), also found by Colin on the Coati, is nearly double the size. According to Mégnin, the fecundated female does

not burrow in a linear channel, but excavates for itself a veritable sub-epidermic nest.
Psoroptes.—The genus *Psoroptes* only contains a single species—the *Psoroptes communis* (Fürst.; *Psoroptes longirostris* Még.). It is recognised by the characters already described for the genus (p. 121). In addition, the following should be noted:

The presence of bristles relatively constant in length, five placed symmetrically on each side of the dorsal surface; some similar bristles, though few in number, on the ventral surface and on several segments of the legs. The male has triangular abdominal lobes furnished with five bristles, the three terminal ones being the largest; the first three pairs of legs are complete, but the fourth pair are very short, and have no ambulacral suckers. In the ovigerous female, the lips of the vulva are much plicated, and the commissures rest on two arched pieces, which are divergent and directed backwards. There is an ambulacral sucker on all the legs except the third pair, which are terminated by two long bristles. The pubescent female is recognised by her smaller size, the large vulvo-anal slit, the absence of a sub-thoracic vulva and of the ambulacral sucker on the fourth pair of legs; in addition, beneath the dorsal surface, and on each side of the posterior commissure of the cloacal slit, are two hemispherical prominences (copulatory tubercles) which assist in copulation by being received into the copulatory suckers of the male. The nympha has not these tubercles. The larva has the third pair of legs terminating in suckers.
The common Psoropt does not make sub-epidermic galleries like the Sarcopt; it lives, in society, among the crusts which it forms by prick- ing the skin of its host. It produces special dermatoses on the Horse, Ox, Buffalo, \(^1\) Sheep, Goat, and Rabbit. Here, again, the difference of habitat coincides with the existence of varieties, which are scarcely distinguishable from each other by their size and unimportant details, but which, according to their hosts, are designated by the names of 

*Psoroptes communis equi*, *Ps. c. bovis*, *Ps. c. ovis*, *Ps. c. capre*, and *Ps. c. cuniculi*. Their average dimensions are: for the ovigerous female

\[ 0.65 \text{ mm., } \text{and male } 0.45 \text{ mm. long; and for the former } 0.40 \text{ mm., and latter } 0.30 \text{ mm. broad.} \]

Otherwise, in the absence of information as to their source, there are no special features which will allow one variety to be certainly distinguished from another.

**Symbiotes.** The genus Symbiot comprises four species—the common Symbiot, the auricular Symbiot, the setifer Symbiot, and the ancestral Symbiot. The setifer Symbiot (*Symbiotes setifer Még.*) has been found by Mégnin on the Hyena and Fox; the ancestral Symbiot (*S. avus Trt.*) has been discovered by Trouessart on the Sparrow. We need not describe these two kinds of Symbiot.

\(^1\) Mégnin. Comptes Rendus de la Soc. de Biologie, November 28, 1885.
Common Symbiot (S. communis Verheyen, S. spathiferus Ménin).—This has on the middle of the back a wide, granular, chitinous band, twice as broad behind as in front, with its borders concave outwardly, and extending from the margin of the epistoma to the point of origin of the second pair of legs. Behind each of the two posterior angles of this band is a short hair, and behind, but near it, are two long bristles; there are several other parts of the body which, though constant, vary in number, length, and situation according to the sexes. The male has its rectangular abdominal lobes, each carrying four bristles at their extremity—one ordinary, external, round, and free; three grouped at

their base, one of them being similar to the preceding, the two others lie on each other and are widened to form a thin foliaceous membrane. The four pairs of legs are provided with ambulacral suckers; the fourth pair are thin and short. The ovigerous female has the lips of the ovigerous vulva very much plicated, and in contact, by their commissures, with two pieces similar to those of the ovigerous female of the Psoroptes communis. It has an ambulacral sucker on all its feet, except the third pair, which have two long bristles. The pubescent female differs from
the preceding by the same peculiarities as the *Psoroptes communis*; and
the same observations apply to the *nympha* and the *larval hexapod.*
The length of the ovigerous female is 36 mm. to 40 mm., and the male
28 mm. to 32 mm., while the breadth of the former is 23 mm. to
26 mm., and the latter 21 mm. to 24 mm.

The common Symbiot lives in the same manner as the common
Psoropt—*in colonies, and without excavating sub-epidermic galleries.*
It causes a localized scabies, the extension of which is slow, and which

![Fig. 79.—*Symbiot communis,* var. *equi:* pubescent female, seen on the ventral surface; magnified one hundred diameters.](image)

![Fig. 80.—*Symbiot auricularum* of the Dog: male, seen on the ventral surface; magnified one hundred diameters.—Railliet.](image)

is more particularly observed on the Horse and Ox; but it has also
been witnessed on the Goat, Sheep, and Rabbit (?). The varieties *equi,*
*bovis, caprae, ovis,* and *cuniculi* (?) might also be distinguished here.

The *Auricular Symbiot* (*S. auricularum* Lucas and Nicolet, *Chori-
opites caudatus* Mégnin, *Sarcoptes cynotis* Hering) differs from the
preceding species principally by the absence of the abdominal lobes in
the *male,* which are represented by two small round projections
separated by a notch, each of them having three bristles, the middle
one of which is very long. The *ovigerous female* has no suckers on the
two last pairs of legs, and the fourth pair of legs are rudimentary; while the *pubescent female* has the fourth pair of legs reduced to simple knobs carrying one hair each. The length of the ovigerous female is \( 0.42 \text{ mm. to } 0.49 \text{ mm.} \), and the male \( 0.30 \text{ mm. to } 0.34 \text{ mm.} \); the breadth of the former being \( 0.29 \text{ mm. to } 0.31 \text{ mm.} \), and of the latter \( 0.23 \text{ mm. to } 0.28 \text{ mm.} \).

This species lives in the auricular concha of the Dog, Cat, and Ferret, and gives rise to a disease which is very remarkable because of the nervous disturbance accompanying it.

The foregoing zoological remarks will suffice to indicate the genera and species of the Sarcoptinae that are likely to be met with. In such

![Fig. 81.—*Symbiotes auricularum* of the Dog: an ovigerous female, seen on the ventral surface; magnified one hundred diameters.—Railliet.](image)

a determination great assistance will be afforded by a knowledge of the host from which the parasites have been derived, and the character of the lesions they have produced—that is, by the study of the various forms of scabies.

**General Nosography.** — The various domesticated animals may serve as hosts to the Acarina of one, two, or three genera of Sarcoptinae. By their pricking, and, no doubt, also by the irritant saliva they discharge, these parasites excite an alteration in the skin which is mani-
fested by redness, loss of hair, thickenings, effusions, crusts, and an intense pruritus.

The redness can only be perceived on skin destitute of pigment, and then it is one of the most marked signs of the disease. The thickening is little observable at the commencement, but it gradually increases because of the continued irritation of the parasite, and the energetic friction which the animals apply to it under the influence of the pruritus. In some parts—as the extremities, where the skin is thick and covers only a small amount of connective tissue—it becomes augmented in thickness; but where the skin is thin, movable, and only slightly adherent—as on the face, neck and shoulders, sides, etc.—it forms thick folds and deep ridges, which give the animal an altogether peculiar physiognomy. The bottom of the ridges is moist and often excoriated; the majority of the hairs, if not all, are removed by the rubblings and the morbid process; and at the same time the secretions of the superactive and altered skin lead to the formation of crusts which are irregular in shape, thickness, and distribution, and are composed of serum, dried blood, epidermic débris, hairs, etc.

The pruritus, which contributes so much, by the frictions it provokes, to produce this alteration in the skin, is of variable intensity, according to the temperament of the affected animals, the seat and extent of the disease, and the time of day. It is particularly intense during the night, causing loss of sleep (and rest), which, added to the restlessness during the day and the disturbed cutaneous functions, induces debility and emaciation, and leads to marasmus when the malady has been widely extended.

The characters of scabies are more particularly subordinate to the kind of parasite producing it. In this respect it is difficult to establish any general rules, as we do not find between the Psoroptes and the Symbiotes differences in habits analogous to those which separate the two species of Sarcoptes. That which especially characterizes the latter is the fact that the ovigerous female, immediately after fecundation, excavates in the substance of the epidermis a gallery or furrow (cuniculus), in which it deposits its eggs; consequently, it happens that sarcoptic scabies offers a greater resistance to the action of curative agents.

Other differences belong to the seat preferred by the parasite. There are scabies which may appear on all parts of the body; others that always commence at the same points and extend to other regions; and others, again, which are very localized. All these differences will be indicated in their place.

An essential element in diagnosis being the detection of the parasite, care should be devoted to this. But sarcoptic scabies offers the greatest difficulties in this respect. The following recommendations, given by 9—2
Mégin for the scabies of the Horse, are equally applicable for all the other domestic animals.

When the weather is cold or windy, it is difficult to find the Sarcoptes, and to be successful in the search it is best to have calm weather and sunshine, to which the mangy Horse should be exposed. After about an hour of this exposure, the crusts and débris are collected from the diseased parts; but one must not be satisfied with the crusts that are most easily removed, for on them may be found nothing more than some larval hexapods which have a more superficial habitat than the adults. To obtain the latter, it is necessary to scrape the surface to the blood, through the entire thickness of the epidermis, with a sharp or slightly blunt instrument. Amongst Horses equally mangy in appearance, some will be found which do not nourish nearly so many Sarcoptes as others; and the inverse is equally true, for lymphatic Horses which have the thickest and most abundant crusts, have fewest parasites, while Horses of a nervous, wiry temperament have them in largest numbers. It is, of course, understood that it is only on mangy Horses which have not been submitted to any treatment that a search for the parasites is likely to be successful; for it often happens that with those which have been treated, the scabies has disappeared, and in its place is a chronic or artificial lichen if the treatment has been too energetic.

When a good quantity of crusts has been collected, these are put in a well-heated box, and if possible at a window exposed to the sun—for without this precaution the Sarcoptes will remain motionless, and can only be distinguished with difficulty from the dust in which they lie. A small quantity of this dust is spread on a glass plate, and examined in the microscope by a power of 40 or 50 diameters—direct, and not reflected light being employed. Under the influence of the sunlight, the Sarcoptes can be seen disengaging themselves gradually from the masses of dust or crusts covering them; then with the point of a handled needle they are carefully isolated from the foreign matter surrounding them, and lifted by the needle or a fine brush on to a drop of glycerine on another glass. After placing over them a covering glass, but without compressing them, they may be studied alive, in their true form, and magnified to any size—that of 150 to 300 diameters to examine the general conformation, and from 400 to 500 diameters for details of structure.

It may be added that the operation may often be successfully simplified by warming the surface of the Horse’s body by means of a blanket, and that the activity of the Sarcoptes can be excited by exposing them to the gentle heat of a fire—their movements being rendered visible in examining the crusts on a piece of black paper, by means of a good hand-lens.

A procedure that avoids loss of time and patience, as well as errors,
consists in immersing the crusts for an hour or two in a 10 per cent. solution of potass, and then examining them; when it will be found that they have become diffusent and colourless, are easily spread out under the cover-glass, and the Sarcoptes whose skin resists the alkaline solution, can then be very readily seen. We have many times succeeded in this way, after failing in every other, notwithstanding all our perseverance.

By reason of their relatively greater dimensions, the Psoroptes and Symbiotes are readily found, even by the hand-glass, among the crusts, where they can be seen moving.

Care must be taken not to confound the psoric Sarcoptidae with other Acarina—dead or alive—that may be found on animals, and which come from forage—such as the Tyroglyphæ, Glyciphages, Cheyletes, Gamases, etc. An attentive examination will avert this error, for the characters we have described as peculiar to the first will not allow of such a mistake.

With regard to the etiology of scabies, it is needless to refer to the hypotheses found in ancient medicine to explain their genesis. We say nothing of the humoral theories, which had their day, nor of the 'psoric vice,' nor of spontaneous generation, to which there was a tendency recently to attribute the appearance of the psoric Acarina. It is to-day beyond dispute that for an animal to have the mange, it must have received the principle of the disease—the contagium, the acarus—from another mangy animal with which it has been in immediate or mediate contact.

Numerous experiments have established that fact, so far as animals are concerned; on every occasion on which an outbreak of mange has been traced to its source, it has been ascertained that it was introduced by a mangy subject; in every case a psoric Sarcopt can be found; the means which cure the mange also destroy the parasite; lastly, direct experiment confirms the doctrine. Hertwig has inoculated animals—by friction and by puncture—with serum from the vesicles, with pus, and with dry and dissolved crusts, and yet failed to produce mange. On one occasion, when he neglected to assure himself that the products with which he inoculated did not contain ova or acari, a psoric eruption resulted. Hering tested these experiments, and came to the same conclusions as Hertwig; and Delafond and Bourguignon, as well as Gerlach, arrived at identical results. The constant correlation between the Acarina and the psoric eruption cannot therefore be disputed.

It is not the movement of the parasites which causes the irritation and the pruritus. The Sarcopt is not felt when it wanders on the surface of the skin, nor yet when it is burrowing into that membrane. What induces the itching is an irritant principle deposited by the parasite in the living portion of the integument. Bourguignon has obtained
a vesicular eruption by inoculating crushed acari, or the fluid derived from them; and he therefore justly concluded that the animalcule secretes an acrid matter which it insinuates into the skin. But he erroneously believed that this matter, when absorbed, would produce a general eruption. It is a long time since Hertwig practised transfusion of blood from a mangy to a healthy animal of the same species, without result; and it is well known that when a Sarcopt is placed on the skin of Man, the papule and vesicle appearing soon after, always correspond to the precise point of the integument pierced by the animalcule.

Gerlach has given a complete demonstration of the purely local effects of the matter secreted by the acarus. With a very fine needle he traced a groove in the epidermis, and then moistening the point of the instrument with fluid from the crushed parasite, he reintroduced it into the epidermis, but only experienced a vague sensation; but when the point of the needle reached the derma, there was instantaneous pain, succeeded by a papule and a vesicle, with pruritus. By this mode of procedure, Gerlach satisfied himself that the *Psoroptes* secretes the most acrid fluid, then the *Sarcoptes*, and, lastly, the Symbiotes.

All these facts thoroughly establish the predominating, essential, and exclusive part the parasite plays, locally and specifically.

Ought there to be admitted, besides this, a predisposition—if not necessary, at least favourable—to the development of the disease? Delafond and Bourguignon, in particular, have replied to this question in the affirmative; their observations were in relation to the scabies of Sheep, and the response was made with them. With regard to the Horse and the other domesticated animals, it is true that weak, badly nourished, dirty, and neglected creatures are more frequently attacked than those in the opposite conditions. But this is only owing to the unclean state of the animals themselves—to the filthy litter, coverings, harness, and insufficient grooming. The parasites, being left in almost absolute tranquillity, can multiply at leisure, and the mange extends gradually on the same animal, or from an affected to a healthy one—not because of its constitutional weakness, but rather because of its unsanitary condition and the natural course of contagion; and it is to these circumstances that must be attributed those epizooties of mange which usually occur during wars, and among great agglomerations of Horses, and which are so serious for the public treasury.

The treatment of scabies consists in the employment of so-called *antipsoric* or *acaricide* remedies, which act by reason of their toxic properties on the Sarcoptinae. They are extremely numerous and varied.

In choosing them we are guided by the kind of scabies which is to be treated, the nature of the affected animal, its species, age, size, and susceptibility; as well as the resources at our disposal, and especially the particular activity of each of the remedies.

In the following table, Verheyen has given interesting indications
with regard to the principal agents tried and their acaricide properties. They are principally the result of the researches of Walz, Hertwig, Raynal, Mathieu, and Gerlach, which consisted in putting the animal-cule in contact with the various substances, and noting, by means of the microscope, the moment when death occurred.

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<tr>
<th>Duration of Life.</th>
<th>Hours</th>
<th>Minutes</th>
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<tr>
<td>Creosote, benzine, and naphtha</td>
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<td>Preparations of these materials</td>
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<td>Juice of tobacco from the manufactories</td>
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<td>Solution of caustic potas (1 to 24)</td>
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<td>Empyreumatic oil</td>
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<td>Oil of turpentine and petroleum</td>
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<td>Tar</td>
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<td>Decoction of tobacco (1 to 5)</td>
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<td>Solution of chloride of lime (1 to 30)</td>
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<td>&quot; of sulphuret of potassium (1 to 10)</td>
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<td>&quot; of corrosive sublimate (1 to 46)</td>
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<td>&quot; aluminio-arsenical of Mathieu</td>
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<td>Liniment of sulphuret of potassium (1 to 10)</td>
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<td>Infusion of henbane and belladonna</td>
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<td>&quot; digitalis purpurea</td>
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An absolute signification cannot be accorded to these figures, the experimental resistance of the Acarina being, in fact, subordinate to their vitality at the moment of testing. Von Schröder, by analogous researches, obtained somewhat different results from the above.

As a general rule, treatment should be preceded by complete removal of the hair from the whole of the body, unless the disease is strictly localized, in which case partial clipping may suffice. Then there should be general washing, by means of a coarse brush, with alkaline or soapy water. Then the selected remedy is be applied. In four or five days afterwards the washing and dressing are to be repeated, in order to destroy the Acarina recently from the eggs, and which the first treatment could not reach. If there is emaciation and tendency to cachexia, the food should be substantial and abundant.

The following sketch, which is conformable with the conditions of practice, deals successively with the different kinds of mange in all the domesticated Mammalia; but for the present no reference is made to the auricular acariases due to the Psoroptes or Symbiotes, as owing to their very localized seat, their symptoms, and their lesions, they are distinct from the psoric acariases, properly so called, and also because, from the plan of this work, their place is more naturally among the parasitic diseases of the sensory organs.
A.—Scabies of the Equidæ.

The Horse, Ass, and Mule are affected with three kinds of scabies: 1. Sarcoptic scabies, due to the Sarcoptes scabiei (variety equi); 2. Psoroptic scabies, due to the Psoroptes communis (variety equi); 3. Symbiotic scabies, due to the Symbiotes communis (variety equi). These different forms have been chiefly observed on the Horse.

1. Sarcoptic Scabies.

This form of scabies is probably that which authorities have described as the dry mange (gale sèche La Guérinière), symptomatic mange (gale symptomatique Huard, jun.), epizootic mange, etc. Our knowledge of its nature—that is, of the discovery of the Sarcopt which causes it—is due to Delafond and to Gerlach, who, about the same time—1856—found it upon the Horse, and gave a description of it. The epizooty that prevailed among the Horses of the French army during the war in the Crimea, may certainly be ascribed to this parasite, though it was then attributed to misery, privations, bad forage, etc. The same observation has been made after the war (Franco-German) of 1870 and 1871.

Symptoms.—The first sign of the disease is pruritis. The animal seeks to rub itself everywhere; it bites itself wherever it can reach, and appears to enjoy, and even seeks, the contact of the currycomb during grooming, leaning towards the groom as if to accentuate its desire. If scratched by the fingers, it manifests its pleasure by very characteristic movement of the nose and upper lip, and this is a provisional means of assuring one’s self of the existence of the disease, as well as of the reality of its being cured. This pruritus is greater at night than during the day, in warm than in cold weather, in the stable than out of it, when clothed than unclothed.

An attentive examination of the skin will reveal the presence of the mange papules at the pruriginous parts. When the hand is passed over the surface of the skin, slight prominences or granules are felt, and which are formed of a little crust around one, two, or three hairs; this is easily removed by the finger-nail, and then there is left in its place a red, moist, denuded surface about 2 mm., or sometimes 4 or 5 mm. in diameter. At other points, mixed with the crusted patches, are slightly salient papules which are scarcely visible—this is the first degree of the preceding lesion, the papule raising its epidermis by a serous effusion that gradually dries and forms a crust. In the earlier stage these small

1 The horses and transport animals—mules and camels—of the British army in the Crimea equally suffered from ‘mange,’ which was recognised as such by the veterinary officers. I and others never had any doubt as to the nature of the terrible scourge, while having to contend with it.—See the Veterinarian for 1857, p. 264, and my ‘Veterinary Sanitary Science and Police,’ vol. ii., p. 407.

2 For a history of scabies, and an account of the various serious outbreaks recorded—especially among army horses, see my ‘History of Animal Plagues,’ vols. i. and ii.)
lesions are disseminated; they bring about the fall of the hairs in small, nearly circular patches, which are multiplied and extended, and finally become confluent, forming large dry patches covered with epidermic débris and sparse thin crusts. It is very rare that any vesicles are seen, as their duration is very ephemeral, the friction caused by the pruritus quickly replacing them by crusts.

The depilated patches extend and, by a rapid generalization, finish by invading the entire surface of the body except the limbs. The animal then presents a particularly miserable appearance. The brilliancy of the coat has vanished; large patches with sinuous borders, dusty and grayish in colour, uneven and crusted—often bleeding—on the surface, impinge on the yet hairy portions. A particular feature is the limit of the patches, which is always undecided; and in the adjoining parts, which at first sight appear to be healthy, the initial lesions of the malady are recognised.

The skin becomes considerably thickened, and in the regions where it is attached to the subjacent parts by a loose connective tissue, it is raised into hard, thick folds; these are more especially observed about the neck and shoulders. Friction is a very important agent in bringing about the alterations in the skin; it excoriates the papules, accelerates the formation of the crusts, produces subcutaneous infiltrations, haemorrhagic exudations, pustules, fissures, and ulcers.

Besides the pruritis and the eruption, a third symptom—and the most important, as it is the only pathognomonic one—is the presence
of the Sarcoptes. The nymphæ, and the adult males and females, are met with among the crusts on every part attacked. The young larvæ and the ovigerous females live in the intra-epidermic galleries or grooves which, in Man, are indicated by a fine red line, from 10 mm. to 20 mm. long. These galleries are not visible in the Horse, because of the pigmentation of the skin and the thickness of the epidermis. They are excavated by the female immediately after copulation; and they are rapidly formed, for in from 15 to 30 minutes the work is completed, and all the more promptly if the temperature be elevated. It is for this reason that these parasites have been considered as noctambulant; if they torment animals more by night than by day, it is because then the conditions of temperature—warm stable, litter, and probably clothing—are more favourable. At the point where the Sarcopt penetrates, an inflammatory papule forms, but the parasite is not to be found beneath it, but at the other extremity of its gallery.

The female lays its eggs in this gallery, one after the other, and here they are seen mixed with excrements. The larvæ which issue from them are nourished in the gallery for some time, and may even undergo moultings before making their exit by the small orifices that are seen along the course of the passage, and which were believed to be air-holes.

It is not certain whether the nymphæ and pubescent females also live in the galleries. In any case, copulation takes place beneath the crusts and the epidermic scales; it is of short duration, and the males are relatively few, their proportion being estimated at only 5 or 6 per cent. of the total number.

The habits of the Sarcoptes explain the greater tenacity of this form of scabies, as well as its more rapid extension—from the fact that the parasites escape ordinary causes of destruction—and the difficulty in finding them. The latter object can be achieved by the procedure indicated at p. 132. It is rarely necessary to resort to that recommended by Gerlach—transferring the acari to a Man, and then searching for them on him. To do this, the experimentalist places on his arm some of the crusts from the suspected animal, fixing it by means of a piece of tissue paper covered by oiled silk or a silk ribbon. In about twelve hours the Sarcoptes have penetrated the skin, and on removing the crusts they can be seen as white points beneath the slightly congested membrane, or on a papule, and they may be seized by means of a fine needle. If we wait until the papule becomes a vesicle, the acarus is no longer there, as it has traced its gallery. This diagnostic procedure does not cause any
inconvenience, as a little oil of turpentine or any other acaricide will avert contagion.

Course, Duration, and Termination.—Sarcoptic scabies is somewhat slow at its commencement; so that it may remain unperceived for some time. A small number of acari do not give rise to anything very marked during the first fifteen days of their installation, and it is only during the succeeding fifteen days that the phenomena of invasion are manifested, although they are still sufficiently vague as to make diagnosis doubtful. The affection is more clearly revealed in the course of the third fortnight, and during the fourth it has made more progress than in the previous six weeks (Gerlach). Nevertheless, when circumstances are favourable, the extension of the disease may be at least twice as rapid, and the incubative period be reduced to fifteen days. It would seem, therefore, that the prosperity of the colony is absolutely conformable to the geometrical progression of the multiplication of the parasites, as given by Gerlach (see p. 120). When the disease is well established on an animal, it may within eight days have reached parts of the body the most distant from where it commenced.

Sarcoptic scabies begins most frequently at the withers, and extends to the sides of the neck, shoulders, back, and sides. It does not easily invade the extremity of the limbs, and it respects the parts covered with strong hairs—crest, tail, legs—which remain with their hairy covering in the midst of neighbouring denuded regions. The Psoropt, on the contrary, appears to seek those parts exempted by the Sarcopt. Sometimes, though rarely, Sarcoptic scabies commences at the head, flanks, croup, etc., this depending upon the initial point of contamination.

When the disease is not interfered with, by the disturbance in the functions of the skin and the restlessness due to the pruritus, it occasions a serious alteration in nutrition and marked marasmus that may, if slowly, lead to a fatal termination. Such a result, however, is only witnessed among animals which have not received sufficient attention; and as diseased animals are not the objects of careful observation, and as nearly always the malady is interfered with in its course by more or less judicious treatment, there is no reliable information with regard to the minimum, average, or maximum duration of this kind of scabies.

On a Horse which has been recently cured of mange, the hairs grow unusually fast, owing to the greater activity of the capillary circulation of the skin; they are longer than the neighbouring hairs that remained healthy and were clipped in treatment, while their colour is generally darker; this difference is perceived until the next shedding of the coat.

Etiology, Contagion.—All experiments and observations demonstrate the contagiousness of sarcoptic scabies from the Horse to other Horses, Asses, or Mules, and reciprocally. This transmission takes
place in every way by which the parasite can be transported, and principally by litter, rugs, grooming utensils, walls of stables and partitions of stalls. It also occurs, though less frequently, by direct contact of diseased with healthy Horses. The mange which prevailed among the French army Horses in the Crimea made startling progress during the voyage, owing to their being so closely packed in the transports; and here we have a proof of the direct transmission of the Sarcoptes, all the Horses having been attacked with the malady on the parts where they came into contact with each other (Delafond and Bourguignon).

The danger of contagion is related to the phase and intensity of the disease. At the period of their installation, the Sarcoptes have little tendency to emigrate, and cohabitation of healthy Horses with one which is just infected is often followed by no bad results; but after the formation of scales and crusts, the parasites pass quickly from one Horse to another, a slight and fugitive contact between them being sufficient to ensure infection. Gerlach asserts that he has seen Horses in good health, placed alongside mangy horses covered with crusts, contract the disease in a quarter of an hour.

The larva and nymphae, and the young fecundated females and males, are more especially the active agents in transmitting the malady. The egg-laying females, concealed in the galleries, scarcely concur in this transmission, unless they are violently exposed by energetic scratching which reaches the blood.

With regard to the persistency of contagion by articles from mangy animals, and which harbour the Sarcoptes, Gerlach on the one side, and Delafond and Bourguignon on the other, have made interesting experiments as to the vital tenacity of the parasites.

According to Gerlach, no variety of the Sarcopt exposed to a dry heat of 60° (Cent.) can live beyond an hour. Kept in a watch-glass, the Sarcopt of the Horse died on the fifth or sixth day; with the crusts, it lived eight or ten days; and in an inhabited stable, death only took place on the twelfth to the fourteenth day. On a fragment of skin covered with crusts, and exposed to heat, the Sarcopt perished when the piece was completely dried, which was on the ninth day; when the skin preserved its humidity, the animalcule gave feeble signs of life on the twenty-fourth day, but these had entirely ceased on the twenty-eighth day.

Delafond and Bourguignon have obtained similar results.

The Sarcopt of the Horse being only a variety of the Sarcoptes scabiei, it is well to know if the Horse can contract sarcoptic mange by mediate or immediate contact with any other of the Mammalian species susceptible of being affected with a similar form of the disease.

So far as the scabies of Man is concerned, Delafond and Bourguignon have, on different occasions and in the space of forty days, deposited
on the skin of an old and feeble Horse 176 Sarcoptes obtained from people affected with itch. These parasites attacked the skin, buried themselves in the epidermis, and produced a papulo-vesicular eruption on the shoulders and neck. The Horse died on the fourteenth day, and at the autopsy it was impossible to find any of the parasites on the skin. In another experiment, 187 Sarcoptes, collected from affected Men, were deposited at several times within twenty-six days on the side of the neck of an old lean Horse. They traced numerous galleries and occasioned a vesicular eruption; but this disappeared, and on the animal being clipped on the seventy-ninth day, there was no evidence of scabies or parasites. These experiments demonstrate that the Sarcopt of Man will only temporarily implant itself on the skin of the Horse, and that there is nothing to fear from Men suffering from itch attending Horses.

We cannot be so certain with regard to the transmission of the Sarcopt of the Dog to the Horse. In three experiments made by Delafond and Bourguignon, great numbers of the Sarcoptes of the Dog—110, 58, and 220—were placed on the skins of two Horses; they attacked the integument, raised the epidermis, and made galleries; living for twenty to twenty-four days, they occasioned a secondary eruption, accompanied by the majority of the symptoms of mange: but they eventually died, and the symptoms spontaneously subsided.

Gerlach has also made some attempts at transmission, which have likewise yielded undecisive results. He believed, however, that an emigration en masse of the Sarcopt of the Dog might give rise to a transient eruption on the skin of the Horse; and he thought that to this cause might be attributed the mange contracted by horses—according to the statements of hunting-men—when mangy Foxes, killed in the chase, are thrown over the backs of their steeds.

It is also interesting to note the fact of the transmission of mange from the Lion to the Horse, as observed by Delafond and Bourguignon. Five Lions in a menagerie were affected with sarcoptic scabies. The brush and sponge employed to clean their skins were used for some days in grooming six Horses; in about seven to nine days afterwards, the latter had a very pruriginous papular eruption on the croup, back, shoulders and chest, and in the crusts collected from them were found the Sarcoptes of the Lion. This mange was readily cured by the application of benzine, but it is probable that it would have disappeared spontaneously. A similar observation is cited by the same authors, to that made by Hertwig, in which it is a question of a Cat communicating mange to a Horse, through resting on the back of the latter. Lastly, the sarcoptic scabies of Goats has been transmitted to Horses, in an epizoöity reported by Wallraff.¹

Communication of the Sarcoptic Scabies of the Horse to other Species of

¹ Wallraff. Repertorium der Thierheilkunde, 1854, p. 297.
Mammalia.—A. Man.†—The sarcoptic scabies of the Horse may be transmitted to Man, although this occurrence is comparatively rare. For a long time instances have been recorded—long before the three kinds of Horse mange had been distinguished. The greater portion of the following résumé is taken from Delafond and Bourguignon's work.

Enaux and Chaussier have recorded cases of contagion of mange of the Horse to Man. Chabert asserts that he, as well as several other veterinary surgeons, had caught mange from Horses; and Delabère-Blaine also gives an instance. Chavassieu d'Audebert advanced the opinion that mange may be communicated from the Horse to Man. Barat reported to the Lyons Veterinary School, an instance of several persons having received mange from a Horse. Grognier relates that a mangy Horse had communicated its disease to a number of people who had dressed it before it was sent to the Lyons Veterinary School. Robert Fauvet, an Italian veterinary surgeon, states that a farmer having bought a mangy horse, rode it home, and the day after his arrival he felt a great itching all over his body; the same was the case with his son and a friend who had accompanied him on the journey. The groom to whom he had entrusted the horse, scratched himself very much the second day after he had been grooming the animal. These persons afterwards conveyed the disease to others on the farm, and more than thirty persons were successively attacked. The farmer sold the mangy horse to a miller, who, with his sons, who had touched the animal, were soon after suffering from the itch. The psoric nature of the affection was recognised by distinguished physicians.

Montaut-Laforest reports a case of contagion to Man from a mangy Mule. Lavergne, Carrère, Girou, Soulé, Grève, Pachur, Hertwig, and Stütz, have published very circumstantial facts in relation to this conveyance of Horse scabies to Man.

Sick mentions an epizooty of mange in a regiment of Hussars, and more than one hundred of the soldiers being infected.

Marrel, a veterinary surgeon at Valréas, Vaucluse (France), was attacked by the disease when treating mangy horses, and saw the same accident happen to a farmer, who communicated the malady to his wife, and she to a child she was suckling; four other children who were attended to by the mother were also infected.

Dupont, veterinary surgeon at Bordeaux, sent on an official mission, reported cases of people being infected with mange from old Horses kept to feed the leeches in the marshy districts of the Gironde.

Ritter reports having been himself, as well as a servant, infected while attending on a mangy Horse.

In 1856, several pupils of the Alfort Veterinary School contracted the itch through operating upon a mangy Horse. This was the occasion on which Delafond discovered that this form of scabies was due to a Sarcopt, and which he considered was identical with that of Man. The discovery raised the number of species of psoric Acarina of the Horse to three.

Gerlach, in the experiments on himself and several pupils of the Berlin Veterinary School, has seen the Sarcopt of the Horse fix itself on the human skin, like the Sarcopt special to Man, and cause an itch that was generally fugaceous.

Mégnin has also observed instances of contagion to Man, during the epizooty of mange prevailing among the Horses of the French army in 1871.

(In the Crimea, I saw a large number of Turks suffering severely from itch, due to their sleeping on the saddles and blankets worn by their Horses, whose skins were covered with mange.1)

Longchamps informs us that, in 1794, the Horses and Mules of the French army in the South of France were affected with mange to a very serious extent, and that the disease was transmitted to, and propagated among, the soldiers.2)

Géraud has also published instances, and a great number of others will be found in the thesis of Néréot Got.

All these facts prove that the sarcoptic scabies of the Horse can be transmitted to Man, and also that the parasite does not find a favourable soil for its multiplication, as the itch it produces generally disappears spontaneously in from fifteen days to six weeks; but in any case it readily yields to simple treatment, such as alkaline and sulphur lotions.

A proof of the difficulty of this transmission is also to be found in its rarity, when compared with the frequency of sarcoptic scabies in the Horse. In the epizooties of mange occurring among the Horses of the French army during great wars, it has been quite exceptional that cases of the conveyance of the disease to Man have been noted; and if the itch caused serious disability among the soldiers during the Crimean War, it is not clearly established that its origin was due to mange among the Horses, which was the opinion widely prevalent; and though many cases were adduced as being derived from this source, yet the evidence is not so satisfactory as could be desired.

But an exaggerated significance should not be given to this rarity of contagion, for the transmission from Man to Man is not as subtle as is generally believed. 'The itch,' says Besnier and Doyon, 'is not usually contracted except by cohabitation—intimate contact prolonged and repeated, and particularly at night; it must not be affirmed that this never happens accidentally, but it is sufficient to know that it is exceptional.'3

B. Domesticated Animals.—Sarcoptic scabies of the Horse appears


(2) Ibid.)

to be capable of transmission to the bovine species, although up to the present time no one in practice has observed this form of mange on Cattle. The possibility of this transmission rests on facts published by Robert Fauvet and Grognier, of which mention has already been made (p. 142). The Horse of Fauvet communicated mange to a Cow which had rubbed its neck against the manger of that animal. The Horse of which Grognier speaks, transmitted its disease to two Cows placed alongside it in the stable.

Beyond these facts, where the sarcoptic nature of mange of the Horse was established by its transmission to Man, but where the equine origin of bovine mange was not sufficiently demonstrated, there are doubts as to the possibility of this transmission.

Neither is there any more authority for stating that Horse mange may be communicated to the Sheep, Goat, Dog, etc.

Diagnosis.—An important element in diagnosis is the discovery of the Sarcopt, with all its characteristics. Sarcoptic scabies differs from psoroptic scabies, as we shall see hereafter, by its more rapid generalization, by its more subtle contagion, and by its seat—psoroptic scabies commencing and localizing itself nearly always at the upper part of the neck, towards the forelock and the tail, which become denuded of hair, tumified and wrinkled. Psoroptic scabies also assumes a form in which the patches are better defined, they being tumified at the base, crusted, and more humid.

Sarcoptic scabies differs from symbiotic scabies in the latter being confined to the limbs at first, commencing at their most inferior parts, and slowly extending upwards; it is also only feebly contagious.

Otherwise, the three forms of scabies may co-exist, and the remembrance of this important fact may avert grave errors in diagnosis.

At its commencement, sarcoptic scabies is difficult to diagnose from dermanyssic acariasis—due to the transference of the Dermanyss of the Fowl to the body of the Horse. But it is distinguished from it, nevertheless, in the latter disease appearing on Horses which live in the vicinity of poultry-yards and pigeon-houses, in its becoming very quickly generalized over all the body, and in its obduracy to all treatment until the Horses quit the locality, when it is readily cured. Besides the absence of the Sarcoptes, dermanyssic acariasis is also recognised by the small depilations it produces, which, though similar at first to those of sarcoptic scabies, become multiplied, but do not extend by a centrifugal development, like those of mange.

It is difficult to mistake mange for phthiriasis, as this only causes slight depilations, while the parasites are very visible; and by the uncleanliness which has permitted their multiplication, mange would have assumed quite another development than the slight lesions produced by the Lice.

When fully developed, sarcoptic scabies looks like strangles eczema
(eczema gommeuse) and humid eczema (eczema dartreus6), but in the former there is no pruritus and it runs on rapidly to recovery; while the latter, which is accompanied by the same kind of pruritus as mange, extends only slightly less rapid, becomes chronic, and assumes a lichenoid form; though there is great difficulty in distinguishing it from sarcoptic scabies when microscopical investigations are without result. But the humid eczema is not contagious, and yields only to internal treatment, while external treatment alone will succeed with mange.

Prognosis.—Sarcoptic scabies is the most serious of the three forms affecting the Horse. It owes its gravity to its great contagiousness—which allows it to assume an epizoötic form—and also to its possible transmission to Man. In itself, it does not cause irreparable injury to the health of animals; but by the debility and anaemia that ensue when it is of long duration, it predisposes to serious diseases which may terminate in death. It also causes great economic inconvenience and loss, as animals affected with it cannot be worked. With regard to its resistance to treatment, this varies according to the condition of the animals suffering from it and the duration of the disease. Young and vigorous Horses in good condition are less rapidly invaded by sarcoptic psoriasis, and are more easily cured, than are old, feeble, and worn-out animals. The disease is also more quickly combated when it is recent; and it is rare that well-directed treatment does not succeed in curing it.

Pathological Anatomy.—Besides the cutaneous alterations described when treating of the symptoms, dissection affords a more exact idea of the lesions accompanying the malady. Delafond and Bourgignon state that, if a fragment of the skin of a mangy horse be exposed to moist heat for 24 to 48 hours, the epidermis can then be removed by means of a fine scalpel and forceps. By a slight magnifying power and direct light, in the parts recently attacked can be seen the furrows or galleries, straight or sinuous, narrow and shallow, more or less near each other, and 2 mm. to 4 mm. in length. At various points they show widenings which are somewhat deeper than the other parts, where two or three eggs are deposited; and at the end of a gallery is an ovigerous female. On the sides of the furrows the dermal papillae are red and hypertrophied, and the superficial layer of the derma is infiltrated with a yellow serosity; while in the vicinity of the galleries.

(1 My experience of sarcoptic scabies has been chiefly derived from army service during war, and I have found it a most formidable malady to contend with, and one causing somewhat heavy loss, death often ensuing in a wonderfully short time. And even during peace, it not unfrequently leads to a fatal termination when it has been allowed to go on unchecked for a certain period, and especially if the horses are old and weak, or over-worked and badly cared for. German authorities also consider it a grave malady. For instance, Friedläuger and Fröhner in their classical work—Lehrbuch der Spezielle Pathologie und Therapie der Haustiere—state that the prognosis is more grave than is generally admitted, and that at an advanced stage it is inveterate to all medication, even the most energetic; that nearly always, after months of treatment, relapses occur; and that in chronic cases more or less generalized, the animals become emaciated, fall into a state of marasmus, and may perish from exhaustion.)
—and even some distance from them—are vesicles, each formed by an elevation of the epidermis containing a little serum, the papillae beneath being exposed, and are red and infiltrated. Vertical sections will also show these lesions.

At the points where the changes are not so recent, the galleries are distorted and disseminated, and the derma and papillae are altered to a very high degree; there are numerous elevations and depressions—for the Sarcoptes no longer live in the tunnels, but in depressions beneath the elevated and detached epidermis. All the derma is thickened by a sero-sanguinolent infiltration; the lesions extend to the glands of the skin and the hair-follicles, and this explains the shedding of the hair, the dryness of the crusts, and the thickness of the epidermis, the formation of which is irregular.

Lastly, in the parts where the disease is oldest, the skin is indurated and thickened, and all the secondary lesions are observed, depending on the cracks, erosions, etc., consecutive to the friction during life. There is nothing particular to note, either with regard to the engorgement of which the limbs may be particularly the seat, or of the internal complications which may occur in the disease (Delafond and Bourguignon).

Treatment.—On the first suspicion of mange, the suspected animal should be isolated. When there are several horses affected, it is well to divide them into categories, according to the period of treatment they have undergone.

In the treatment—in addition to the destruction of the parasites—when the malady is of some duration, the general debility, the consequences of which are especially to be feared, has to be overcome.

a. Treatment is to be commenced by clipping the patients, out of and at some distance from the stable. This clipping always shows that the malady is more extensive than was supposed, and is the only way of reaching all the parasites. (The hair should be carefully collected and burned.)

b. The body is then subjected to a general lathering with soap and water in the following manner: Two to four pounds of soft soap are smeared over the surface of the body, and rubbed well into the skin, so as to cause it to penetrate the crusts. In an hour afterwards, the skin is scrubbed by means of a brush and tepid water (soft water if possible), and then tepid water is thrown over the body to remove all the soap; the skin is dried by a scraper, followed by straw or hay wisps, which should, when done with, be burned (or buried in the dungheap). One lathering generally suffices, but another may be applied if crusts still remain.

c. When the skin is dried, antipsoric remedies are had recourse to. Those which have fatty or oleaginous matters in their composition should not be applied over the whole surface of the body at one time, in order to avoid sudden suppression of the cutaneous functions. When
ACARIASES.

147

the scabies is generalized, the dressing should be applied over one half of the body at a time—right or left side, or anterior or posterior moiety—an interval of forty-eight hours being allowed to elapse between the two applications, and then another general lathering after the same period.

Petroleum and benzine are often used, and they are excellent acaricides; but they have the inconvenience of producing irritation of the skin, which continues for a long time, prevents the practitioner easily ascertaining if the disease is cured, and hinders the employment of the animals immediately after recovery. So that there is reason to reject them in practice.

In Germany creosote is very much employed, the experiments of Gerlach having demonstrated that it is at the head of all the acaricides, as it causes the death of the Sarcoptes in 15 to 45 seconds. It is used mixed with alcohol and water (creosote and alcohol 10 parts, water 25 parts), or with oil (creosote 1 part, oil 25 to 40 parts), or lard (same proportions). The liquid form is the best. One to three energetic applications at intervals of three to five days, suffice to effect a cure.

In France, the agents which succeed most rapidly are found to be tobacco, sulphurated potash, and sulphur.

The liquid refuse of tobacco manufactories, in the proportion of 2 ounces to 1 pound of oil, constitutes an efficacious and economical preparation. When a manufactory is not near, and this refuse cannot be procured, tobacco itself must be dispensed with, as it is too costly.

Sulphurated potash in concentrated solution, 9 ounces to the quart of water, acts efficaciously, and is very frequently employed.

The Codex gives the following formula, under the heading ‘Sulp'urous Pomade for the Cure of Mange (Trasbot)’:

Solid trisulphuret of potassium — — — 10 parts.
Carbonate of potash — — — 2 "
Lard — — — 300 "

Mix thoroughly.

This is destined to replace the pomade of Helmerich.

Sulphur is used in the form of a sulphur pomade (sublimed sulphur 10, lard 30 parts), or Helmerich’s pomade (sublimed sulphur 200, potassium carbonate 100, lard 800 parts). Numerous formulae have been given for the antipsoric employment of sulphur; but the two preceding, and especially the pomade of Helmerich, are those which merit the preference.

The Codex gives the following formula for a mange-dressing:

Benzine — — — 300 parts.
Oil of tar — — — 100 "
Coal-tar — — — 100 "
Soft soap — — — 100 "
Oil of turpentine — — — 100 "

Triturate the soft soap and coal-tar in a mortar, and add the oil of tar; the mixture being perfectly homogeneous, gradually incorporate the oil of turpentine, then the benzine.

10—2
In employing these different remedies, the entire surface of the body should be dressed at one time; nevertheless, in using the tobacco there is danger of poisoning, and it is safer to dress only one-half of the body at a time. The preparations of sulphurated potash or sulphur have not this inconvenience, and they are cheap. The medicament is allowed to remain on the skin for three or four days; and then a last washing with soap is made in the same manner as the first. When the medicinal rubbing has been well done, and no part of the body has been overlooked, it is rare to see the itching persist. A most careful repetition of the treatment will most certainly triumph over the disease.

At the Toulouse Veterinary School, the treatment successfully employed consists in the use of a pomade named ceverdille oil, prepared according to the following formula, which is almost that of Pujol and Bonnet:

| Powder of ceverdille (Asagreca officinalis) | - | - | 4 ounces. |
| Caîined alum | - | - | 1 1/2 " |
| Sublimed sulphur | - | - | - | 2 " |
| Olive-oil | - | - | 1 quart. |

Digest for two hours in a water-bath.

In the case of localized mange, the oil of tar is sometimes employed. For some time, creoline or cresyl has been successfully used in solution, 10 to 15 per cent.; and it is as simple as it is inexpensive.

To prevent the reappearance of the disease, it is obvious that disinfection of the harness, clothing, grooming utensils, and stable is necessary. The best disinfectant is boiling water, the Acarina and their eggs being destroyed at a temperature of 70° to 80° (Cent.). If there is apprehension that this may spoil the harness, it can be disinfected by plunging it into an antipsoric solution of sulphurated potash or creoline.

Internal treatment, which played so large a part in the older medicine, should only have for its object remedying the constitutional debility. Abundance of food, tonics, and good general hygiene are the simple means to be resorted to.

(This treatment of sarptic scabies does not differ much from that resorted to in England. When the skin has been thoroughly washed with soap and water as recommended above, it is soaked for some time with a solution of pot. carbonate and oil, and the parasiticide is then rubbed in, a second dressing being made in about a week. Washing with lead acetate solution relieves the eczema that frequently accompanies mange, while diluted alkaline solutions and oil of eucalyptus abate psoriasis. Chronic inflammatory sequelæ are treated by weak solutions of Goulard’s lotion, glycerin and water; with salines, arsenic, and iron salts internally.]

**Sanitary Police.**—Sarptic scabies of the Horse is not comprised

1 Finlay Dun. *Veterinary Medicines, their Actions and Uses*, 1859.)
in the list of contagious diseases dealt with in the (French) law of July 21, 1881, on the sanitary police of animals. But because of the serious outbreaks which occur in the army, it is the object of special measures to be now referred to. These measures are prescribed in article 10 of the decree of December 26, 1876, with regard to the regulations for the veterinary service of the army; article 79 of the decree of December, 1883, bears upon the internal service of troops of horse, and by the notes B and D annexed to this decree—

When a Horse is recognised as affected with mange, it is immediately removed from the ranks, and isolated in a special stable, which ought not to be occupied by any healthy Horses, or those suffering from any other disease. It is attended to every day by the same soldier, who leaves his grooming articles in the stable; it should not be taken to the general water-troughs, and exercise ought to be given in a place apart from that to which other Horses are taken. Its harness, clothing, and grooming equipment are to be taken charge of by the veterinary surgeon, who keeps them in a special place, and does not allow them to be issued until they are disinfected.

The two Horses which stood on each side of the affected one are considered suspected, and are to be kept in a special stable, if possible; if this cannot be done, then they must be moved to the end stalls of their stable and carefully watched; the veterinary surgeon visiting them every day, and keeping them under observation for ten days. The three stalls rendered vacant by the removal of these Horses must be disinfected, the veterinary surgeon directing this operation.

When mange prevails in a regiment, and, because of the number of Horses attacked, it assumes an epizootic character, the veterinary surgeon should exercise a minute watchfulness over all of them. Every day he will attend stables and successively examine the Horses, paying particular attention to the mane, root of the tail, and the inner surface of the limbs; he will also advise the officers—commissioned and non-commissioned—to report any Horses which rub themselves.

In this situation, every Horse which shows depilations and exhibits the slightest signs of itching should be considered suspected, removed from the ranks and isolated, its stall being cleansed and disinfected.

Two stables at least should be placed at the disposal of the veterinary service—one for the Horses affected with mange before their treatment, where they will be clipped and dressed; the other for the reception of the Horses immediately after the application of the antipsoric remedy, and where they will remain until they are cured. No matter how much or how little a Horse may be affected, it should be clipped and dressed all over the body.

The most certain and simplest treatment to employ in these circumstances is the mixture of equal parts of petroleum, benzine and oil of earth-nut (arachis hypogaea). It is merely applied to the skin without friction, and its irritant action may of course be diminished by increasing the proportion of oil.

The hair which has been removed should be gathered into a corner of the stable, well wetted with a 1 per cent. solution of carbolic acid, then removed to a distant place and deeply buried.

After the Horses are cured, they are placed under observation in the infirmary stables—or a special stable if there is one disposable, and they
should not be sent to duty until all traces of the disease and treatment have disappeared—that is, when the skin has regained its suppleness, and the hair has begun to grow everywhere.

A Ministerial circular of January 6, 1872, states that no Horse suspected of, or affected with a contagious disease, is to go on the line of march.

In armies on a campaign, Horses affected with, or suspected of contagious diseases are to be immediately separated from the others, and the authorities of the localities in which they are halted are to be informed of the malady. Horses affected with mange are to be sent—with all their equipment—to special depôts, which are to be established only for Horses suffering from diseases of this kind, in farms or villages outside the lines of communication and marching routes. Horses which are cured will not leave these depôts to join their corps until all traces of the disease and of treatment are effaced, and their equipment has been thoroughly and completely disinfected.

Note B indicates the means of disinfection to employ in cases of contagious disease.

1. Disinfection of Stables and their Contents.—Whether it concerns an entire stable, or only a portion of it which has been occupied by mangy or suspected Horses, the litter should be carefully removed theretofrom and deeply buried in the manure-heap. Then the interstices in the floor, internal surface of the walls, mangers, and hay-racks should be scraped and thoroughly cleansed. A general washing with water as hot as possible, must be done immediately afterwards, in order to remove all the dirt that the scraping has left. This operation must be followed, a few hours later, by a washing of chloride of lime—1 pound to 120 gallons of water. Next day the walls, mangers, racks, etc., are to be whitewashed with lime, which is also to be spread over the floor. If the latter is macadamized or laid in concrete, it is necessary to scrape it well, and even to repick it, according to its state of preservation.

If the whole of the stable has been disinfected, the windows and doors should be opened in order to dissipate the damp.

The stables or places so disinfected should not be reoccupied within eight to ten days.

With regard to the articles in the stable—such as the bales, corn-chests, forks, shovels, buckets, troughs, etc., they should also be scraped, well washed with water and afterwards with chloride of lime, and allowed to dry before being used again.

2. Disinfection of Equipment.—The bridles, bridoons, and head-collars should be taken to pieces, and the accessories removed from the saddle.

All the parts of leather or hide, thus separated, are to be washed one by one, and repeatedly, with a hard brush, and frequently dipped in a solution of chloride of lime (1 pound in a bucket containing 2 gallons of water). Those parts which have been immediately in contact with the animal's body should receive particular attention. As each article is washed with the lessive, it is thrown into a bucket of water, from which it is taken, dried, and dressed with neat's-foot oil. The parts which are not to be oiled should be dried in the shade.

Those parts which are of cloth or linen, as well as iron articles—bridle-bits, curb-chains, stirrups, rugs, surcingles, etc.—are steeped for three or four minutes in boiling water.

As a rule, all articles that will not be damaged thereby should be disinfected by a few minutes' immersion in boiling water; otherwise,
they ought to be lessived in chlorinated water and immediately after washed in clean water.

Those parts of the saddle which cannot be disinfected—such as the pannels, etc.—should be replaced.

3. Disinfection of Men’s Effects and Grooming Kit.—The combs and brushes of the men who attend to these Horses, and the clothes they wear, should be passed through boiling water.

The grooming tools used on mangy Horses ought to be disinfected by a few minutes’ immersion in boiling water.

2. Psoroptic Scabies.

Synonyms.—The Rouviére of the hippiatrist; the Gale humide of La Guérière; the Gale par acare of Huzard, jun.; the Gale dermatodectique of Delafond.

This form of scabies has been the longest known, and is the most common. It affects the Horse, Ass, and Mule, and sometimes prevails epizoötically.

According to Delafond and Bourguignon—who have thrown much light on the history of this malady—like the majority of the forms of psora, the parasite of this form (Psoroptes communis, var. equi) was observed about the middle of the last century by Lonting; but the first illustration of it was by Gohier and Saint-Didier, and was presented to the Agricultural Society of Lyons in 1813; then came the drawings of it by Bosc in 1816, in the Dictionnaire des Sciences Médicales; afterwards those of Raspail in 1833, of Hertwig and Hering in 1835, of Gervais in 1841, of Dujardin in 1843, and of Gerlach in 1857.

Symptoms.—Psoroptic scabies of the Horse may appear on any part of the body except the extremity of the limbs; but it more especially affects the upper part of the neck—at the root of the mane—the poll, and the tail; and as it immediately gives rise to pruritus, attention is often directed at first to the state of the long hairs, which are mixed and rubbed. The pruritus has the same characters as that of sarcoptic scabies.

The first alteration noticed is in the form of small papules—which are red on the non-pigmented parts of the skin—from 7 mm. to 8 mm. in diameter, and 2 mm. to 3 mm. high. At their summit the epidermis on these papules is raised by an accumulation of serosity, which quickly causes it to be broken, and from this results a crust, owing to the dessication of the fluid; but as this continues to exude, the crust becomes thicker in mixing with the epithelial débris, and remains moist and viscid—a feature that distinguishes it from the always dry and furfuraceous crust of sarcoptic scabies.

As each vesico-pustule is the result of the puncture of a Psoropt, and as the parasites live in agglomerated colonies on the surface of the epidermis, these punctures are made near each other and become multiplied as the Psoroptes increase in numbers, until at last they are confluent, and form veritable plates of crusts.
The rubbings that the patient energetically practises against every-
thing within reach, contribute to the inflammation of the skin, to the
abundance of crusts, and to the formation of sores and ulcers. The
crusts themselves—which are naturally of a light-yellow tint—are often
red or dark-coloured, from the blood impregnating them. The hairs
become uprooted, and fall off during the rubbing or grooming, leaving
a smooth, shining, greasy patch. The skin is infiltrated, thickened, and
hard, as well as wrinkled where the subjacent connective tissue will
permit it to be so. The crusts are agglutinated together, and become
more and more abundant, adhering more or less closely to the surface
of the derma.

Contrary to what occurs with the Sarcopt, the Psoropt looks the parts
sheltered by the long hairs, notwithstanding the thickness of the skin
at the parts. The progress of the troubles that it excites are more
important, owing more to the increasing gravity of the local altera-
tions, than because of the rapidity of extension of the disease. A large super-
ficies of skin may still remain intact, while serious changes are accumu-
lating in a short time around the primary point of invasion. The
regions in which the disease remains at first for a long time localized,
are the forelock, mane, and base of the tail; then it extends to the
submaxillary space, the breast, and the internal surface of the thighs
and neighbourhood of the prepuce. It increases by a regular extension,
the limits of the patches incessantly growing, but not in the diffuse
manner seen in sarcoptic scabies. It may be transplanted by grooming
to any part of the body, but its extension is always centrifugal.

The upper part (or ridge) of the neck affected with sarcoptic seabies
is thickened, infiltrated, marked by large transverse folds, partially
depilated, or covered by very short hairs mixed with some long ones;
while crusts are extended over them, and in the deep furrows between
these folds exudes an abundance of viscid, often fetid serosity, that,
in summer, may contain the larvae of Muscidae. This localization of
the disease has received the name (in France) of Rouvieux.

The presence of the Psoroptes gives to all the symptoms their precise
significance. They are always in great numbers at the points invaded,
and are readily found beneath the crusts, especially towards the limits
of the patches. In examining scrapings from these parts on black
paper, by means of a magnifying-glass, or even with the unaided eye,
numerous Psoroptes will be seen moving about actively, in all phases
of development, and often in a state of copulation (Figs. 63, 73, 74, 75,
76).

Course, Duration, and Termination.—Sarcoptic scabies progresses
slowly, and very rarely invades the whole surface of the body. While
at the end of a month the Sarcoptes will have spread to the most
distant parts of the skin, the Psoroptes at this time will be still located
at the upper part of the neck or base of the tail, where they had
established their first colony. No fixed duration can be assigned to this form of scabies, even approximately; but in any case it has no tendency towards a spontaneous cure. If it is admitted that it could cause death by marasmus when it becomes absolutely generalized, instances might be given of Horses allowed by their owners to fall into this miserable condition.

Etiology, Contagion.—It has been already mentioned (p. 118) that of the three kinds of psoric Acarina, the Psoroptes are those which secrete the most acrid fluid, and this explains the intensity of their morbid effects. Psoroptic scabies, like the other forms, can only be developed by contagion; so that there is no occasion to take predisposition into account; and uncleanness, from whatever cause, can alone play a preparatory part.

Contagion is effected in the same extrinsic conditions as in sarcoptic scabies; it is as much more active as the contagious animal is seriously affected.

With regard to the persistency of contagion in articles coming from mangy Horses, the experiments of Gerlach have shown that the vital resistance of the Psoropt exceeds that of the Sarcopt. Removed from its host, it lived from ten to fourteen days in a dry atmosphere, and from twenty to thirty in a stable. Plunged into a state of apparent death, it may yet at the end of six to eight weeks be revived by means of heat and humidity, though it will not recover so much as to be able to puncture the skin. Fecundated females have a greater vital resistance than the males, and the latter than non-fecundated females.

The majority of the experiments appears to demonstrate that it is always from the Horse that the Horse receives the original Psoropt that invades it. Gohier vainly endeavoured to transmit the scabies of the Ox to Horses and Asses, and Delafond also failed with the Psoroptes of the Sheep conveyed to the Horse. Nevertheless, if Hosseus has unsuccessfully attempted to transmit the Psoroptes from the ear of the Rabbit to Horses, Mathieu has, in the same conditions, obtained a positive result. On the other hand, facts given by Cagny and by Cadéc would lead to the belief that, in some circumstances, the psoroptic scabies of the Horse may have its origin in the auricular acariasis of the Rabbit (see Parasitic Diseases of the Ear).

When placed on the skin of Man, the Psoroptes cause a violent pruritus; but they never give rise to a psoric eruption, and soon disappear. Gerlach could not succeed in transmitting the psoroptic scabies of the Horse to the Sheep and Ox; and Delafond also failed with the latter animal, notwithstanding the apparent identity of the Psoroptes that the Horse and Sheep may harbour. Experiments of transmission made with the Pig, Dog, and Cat have always given a negative result.

Diagnosis.—What has been said with respect to the symptoms of
sarcoptic and psoroptic scabies, and the resemblance that has been spoken of when alluding to the differential diagnosis of the former, will enable us to dispense with further reference to this point. The difference between this form and symbiotic scabies has also been sufficiently indicated (p. 129).

The usual readiness with which the parasite can be found renders diagnosis easy. At the commencement of the affection, its presence may be demonstrated in fixing the crust on the arm of a Man; in one or two hours afterwards a pricking sensation will be experienced in the part, due to the punctures of the Insect.

It should always be remembered that the three forms of scabies may co-exist on a Horse, although simultaneousness of two of the types is absolutely rare. Psoroptic scabies may also be mistaken for pityriasis—the principal form of the Rouviére of the hippiatrists—and which often affects the upper border of the neck and root of the tail of dirty horses; it also often coincides with phthiriasis, of which it is then only a manifestation. And, besides, it may be distinguished from psoroptic scabies by its chronicity, its slight tendency to extend, the trifling pruritus, and, above all, by the absence of the Psoroptes.

**Prognosis.**—Psoroptic scabies is a much less serious affection than sarcoptic scabies. Its extension is less rapid, it is much longer localized, is not so frequently epizootic, is much more easily combated, and rapidly yields to proper treatment. The skin often retains, for an indefinite time after the disease has been cured, the morbid thickness it had acquired, and many of the hairs are not reproduced.

**Pathological Anatomy.**—There is nothing particular in the description given by Delafond and Bourguignon of the morbid lesions of the psoroptic scabies of the Horse; it applies to all the irritations of the skin, and is subordinate to the intensity of these.

**Treatment.**—The same prophylactic, hygienic, and therapeutic measures are necessary for this form of scabies as for the sarcoptic form. Failure is rare, and the treatment may even be more simple, as it can be limited to the affected parts, or be only extended for a little distance on the healthy skin surrounding these; while, in order not to disfigure the animal, portions of the hair of the mane and tail can be allowed to remain. On the neck, only the hair in the furrows of the skin is removed with scissors, that on the summit of the ridges being left. At the tail, transverse cuts are made through the hairs, so as to leave wide lines on the most affected places; these will allow the air to circulate more readily among the hairs, and so to dry the crusts, rendering cleansing and the application of remedies more easy.

With respect to remedies, these, from motives of economy and in view of limited employment, should have vegetable tar as their base; though this does not answer for sarcoptic scabies, in which, the application being of necessity general, the animal would be exposed the
danger of cutaneous asphyxia. This tar is generally mixed warm with soft soap (2 parts of the first to 1 of the second), and it is rubbed into the patches on the skin by means of a brush, without making the application general. This remedy has the inconvenience of soiling the skin, but the same objection applies to the cade-oil. It is only used for common Horses, and, in general, recourse is had to one or other of the remedies indicated for sarcoptic scabies.


This form of scabies—the Gale du pied (of the French), the Fussräude of Gerlach—was first described by Gerlach in 1857, and was subsequently studied by Delafond and Bourguignou. It is due to the common Symbiots (Figs. 77, 78, 79).

Symptoms.—The disease commences at the fetlocks and pasterns—chiefly those of the posterior limbs. It afterwards reaches the shanks, hocks, and knees, rarely extending to the body or croup. It is indicated by signs of itching, which are much less active than in the two preceding forms, and are more particularly noticeable during the night, and while resting after work. The Horse stamps, rubs one leg against the other, endeavours to bite the limbs, and kicks. (Such horses are very troublesome to shoe, as they try to rub the affected leg while the shoer is holding it up, and therefore he is much pulled about.)

In a variable time—sometimes several months—the region affected is covered by an abundant epidermic desquamation, in the midst of which the Symbiotes are readily discovered; the hairs are shed, and in the parts limiting the depilations they can easily be pulled out in tufts, leaving the subjacent skin bare and smooth. At a later period, the skin becomes thickened and exudes; crusts of variable thickness form, and cracks appear in the hollow of the pastern, which may granulate and become somewhat serious.

(Coarse-bred, heavy Horses are generally those most liable to become affected, the thick hairy legs affording good shelter for the parasite. The skin is scurfy and the hair much broken and woolly.)

Symbiotic scabies follows an extremely slow course, and a Horse must be greatly neglected by its owner, even for several years, before the disease invades the upper part of the limbs and the trunk. It shows itself almost exclusively during the winter—not that the Symbiotes abandon their host during the summer, but probably because, during this season, the natural excretions of the skin dispense with the necessity for actively pricking it, in order to excite the exudation of nutritive fluid.

The disease may persist for several years if the Horses are badly

(1) This cade-oil—Oleum Cadum, or Pisselatum—is much employed in France and Germany. It is the aromatic tarry oil obtained by the dry distillation of the wood of Juniperus oxycedrus.)
groomed. The skin then becomes infiltrated, and cracks more or less deeply in the hollow of the pastern and above the fetlock; in the course of time the papillae of the derma become hypertrophied, and this is shown by round or conical prominences close together, and covered by a smooth and shining epidermic layer. These increase in volume; and in the furrows between them appears a fætid, sero-purulent matter, chiefly composed of serosity and a mass of epidermic cells. In this product, the Symbiotes of all ages—males and females—are found in considerable numbers, as well as their eggs, the débris of their moultings, and their excrements.

**Etiology, Contagion.**—Symbiotic scabies is never seen in well-bred Horses, because of the orderly way in which they are kept, and the fineness of the hair on their legs. It is the appanage of common Horses, which have coarse long hairs on their limbs, and the skin is always dirty. This is the reason why it is most frequently seen on young Horses which, not yet at work, are not regularly groomed; as well as on old worn-out animals which have fallen into careless hands, and which are near their final stage—the knacker's establishment.

Contagion is effected by grooming articles, but more especially by litter, in which the Symbiotes may live for a long time. Gerlach has kept them with crusts in a warm place, and at the end of ten to twelve days they appeared to be dead; but heat and moisture rendered them active in fourteen days. In the spring, or in a place not warm, they have succumbed in fourteen days, and in fifteen in a stable. Delafond and Bourguignon have kept them alive from sixty to sixty-five days, in boxes placed in a stable, with a temperature of 14° to 15° Cent. (57·2° to 59° Fahr.), care being taken to renew the air in the box and to maintain a proper amount of humidity.

The disease owes its extension to transmission from diseased to healthy Horses. The Symbiot of the Ox conveyed to the Horse, disappears without attacking the skin; while that of the Horse transplanted to Man, and other creatures than the equine species, has produced no results.

Symbiotic scabies is the least contagious of the three forms of equine scabies, as the Symbiot has little tendency to emigrate, often remaining localized on one limb, or on two anterior or posterior limbs. Gérard and Railliet completely failed in their well-conducted attempts to develop the disease on Horses, by depositing the parasites in the hollow of the pasterns. It is true that they experimented with old horses; and Railliet is inclined to believe that the disease is proper to young Horses, the cases recorded as occurring among old Horses being due to the persistence of the malady from their earlier years.¹

**Diagnosis.**—With regard to this, there is nothing to be added to

what has been already said concerning sarcoptic and psoroptic scabies. The markedly special seat of symbiotic scabies, its symptoms, and the facility with which the parasites are always found, should prevent mistakes, and particularly if it be remembered that the simultaneousness of the two forms of scabies is possible.

**Prognosis.**—This disease—the most benignant of the psorae of the Horse—only persists when the horse-owner allows it to do so; as it is most easily got rid of, and is only serious when complicated with cracks in the skin and papillary growths, which, after they have been cured, often leave thick cicatrices.

**Treatment.**—To prevent the somewhat inactive contagion of symbiotic scabies, it is well to isolate the affected Horse, or, at least, to often renew its litter and look well to grooming, for cleanliness is always one of the most efficacious of the curative agents.

The hair should be removed as close as possible from the invaded regions, and even a little beyond them; then the brush or wisp will remove, along with the crusts and scurf, quantities of parasites and ova. The whole of the affected parts are then to be well rubbed with soft soap, which should be allowed to remain on for about twenty minutes, when it is to be washed off with warm water, and the skin treated with the scraper and well dried.

The antipsoric medication properly prescribed by Delafond and Bourguignon, consists of friction either with a concentrated decoction of tobacco, the pomade of Helmerich, or—which is more expeditious—benzine or oil of turpentine. One, two, or at most three, rubbings with one or other of these agents suffices to completely cure the disease. At the Toulouse Veterinary School, a mixture of equal parts of oil of petroleum and linseed-oil are employed. A mixture of Stockholm tar or cade-oil with an equal part of soft soap, applied warm over the whole of the affected surface, gives excellent results when the disease is chronic; but when it is accompanied by hypertrophy of the papillae, then there should be applied, and more than once, the mixture of tar and soft soap, to which should be added 1 to 2 drams of finely-powdered arsenious acid to every pound of the mixture.

**B.—Scabies of Bovine Animals.**

It had been known for a long time that bovine creatures might be affected with psora, as Delafond and Bourguignon state that it is mentioned in the writings of Columella, who lived in the first century of our era, and also in those of Vegetius. Since the establishment of veterinary schools, bovine scabies has been frequently observed, and its parasitic nature has been clearly recognised. It might appear at first sight that the Ox, like the Horse, should be affected with the three forms of scabies, of which the pathogenic agent is a Sarcopt, a Psoropt, and a Symbiot.
1. Sarcoptic Scabies.

Sarcoptic scabies of the Ox is only incidentally mentioned here, as its history is limited to the possibility of its existence. Grognier, indeed, mentions that the mangy Horse alluded to at p. 142 communicated its disease not only to several people, but also to two Cows placed alongside it in the stable. The transmission to Man demonstrated the sarcoptic nature of the affection. It was the same with the case recorded by Robert Fauvet: the mangy horse sold to a miller infected a Cow that had rubbed its neck against the manger.

Wallraff has reported the history of an epizooty of mange that prevailed among Goats in the valley of Prättigau, Canton of Grisons. The disease was communicated to Man, and was therefore sarcoptic; it was transmitted to cattle and Horses. Delafond produced a fugacious form of mange that disappeared spontaneously, in depositing some Sarcoptes from a diseased Dog on the skin of a Bull and a Calf.

These are all the facts that are known of the sarcoptic scabies of the Ox. Rademacher relates that a mangy Cat, which was in the habit of resting on the back of a Cow, infected the latter; the Cow gave the disease to a servant, and she, in her turn, gave it to all the family. It will be shown hereafter that the scabies of the Cat can be conveyed to Man; but as it is due to the Sarcoptes minor, and not to S. scabiei, the instance given by Rademacher cannot be accepted as of equal value—so far as the history of bovine sarcoptic scabies is concerned—with that of equine scabies, due to the S. scabiei. For the same reason, the incomplete, and even inexact, observation of Thudichum, relative to the development of scabies in people who had been in contact with a mangy Cow, cannot be utilized.

2. Psoroptic Scabies.

Synonyms. — Dermatocoptic scabies Röll; Gale dermatodectique Delafond.

History. According to Sauvages, Linnaeus observed on cattle a mange that was caused and maintained by insects, which were found located in the tubercles of the skin; but, in reality, the first mention of a parasite—in 1815—is due to Dorfeuille, a veterinary surgeon at Port-Sainte-Marie (Lot-et-Garonne, France), who reported his discovery to Gohier, who, in the following year, found this acarus on the Hungarian cattle which the Austrians brought in large numbers with their army to Lyons. Gohier did not remark any difference between this animal and that which he had seen—the Psoroptes communis—in a form of mange of the Horse. After long search, Delafond in 1856 discovered this parasite on English and Limousin cattle, at the same time that Gerlach did on mangy cattle at Bromberg. This form of scabies was

1 Wallraff. Repertorium der Thierheilkunde, 1853.
2 Rademacher. Magazin für Thierheilkunde, 1842. Cited by Delafond and Bourguignon.

(For an account of the German discovery of this parasite by Gerlach and Müller, see my work on 'Veterinary Sanitary Science and Police,' 1875, II., p. 427.)
again seen by Müller in 1860, and since that time it has been observed at intervals on French cattle. (The disease is not uncommon in the United Kingdom.)

**Symptoms.**—The psoroptic scabies of the Ox has great analogies with the same form in the Horse. It commences at the root of the tail or—though less frequently—at the neck or withers, and gradually extends to the head, back, shoulders, sides of the chest, and finally invades the entire surface of the body, except the limbs.

There is violent pruritus: the animal scratches and rubs itself in every possible way, and often causes blood to flow from the affected parts. An attentive examination discovers—at the place where the disease commences—small, miliary, epidermic elevations, discrete or confluent, filled with serosity. This escapes, agglutinates the hairs, dries, and gives rise to very adherent crusts, which increase in number and extent. There are soon seen on the skin numerous patches of mange—depilated, borders irregularly festooned, covered with thick, grayish, scaly or lamellar crusts. Beneath and between these crusts the Psoroptes multiply. They can be readily seen by the naked eye, or by means of a lens, in spreading skin-scrappings on black paper in a warm place. The skin itself, when freed from crusts, is seen to be depilated, thickened, hard, dry, and cracked, with thick folds on the sides of the neck, shoulders, and chest.

In serious and neglected cases ulceration may ensue, due more especially to the continual rubbing. The animals then fall into a state of extreme cachexia; the superficial lymphatic glands in the adjacent regions are hard and prominent, but not painful; and death is the sequel to this miserable condition.

Gerlach and Müller have remarked on the modifications occurring in this form of scabies by change of season. On a farm in the circle of Inowraclaw, the disease prevailed among the cattle every year, commencing towards the end of autumn when the animals began to be housed, reaching its maximum in February, and diminishing in spring, when the Oxen were employed at labour; the crusts then became detached, the hairs grew, and there only remained a few bare patches at the root of the tail and on the neck, while around the horns and on the neck epidermic scales were abundant. The train of symptoms reappeared each autumn. Gerlach and Müller recognised that the Psoroptes persisted in summer, although the Oxen appeared to be cured; the parasites were in great numbers on the neck and around the horns, and Symbiotes were mixed with them.

It would appear from these facts, that the residence of the Oxen in warm stables during the winter favours the development of the parasites.

**Etiology, Contagion.**—The immediate cause of this scabies is the *Psoroptes communis*, var. *bovis*. Conveyed to healthy animals, it
develops the same disease on them. It may, nevertheless, be admitted that poverty and uncleanness are predisposing causes; and it has been shown that dwelling in a stable during winter favours the development of this malady, while living in the open air during the summer does not.

May the Ox contract the psoroptic scabies of other domesticated animals with which it comes in contact? Gohier and Carrère have reported affirmative facts, in which Cows have acquired the disease after being—for a variable period—beside a mangy horse. But they have not given details as to the characters of this psora, either on the Horse or the Cows; so that it is impossible to give an opinion as to whether it was this, or one of the other forms of scabies. The experiments with regard to the transmission of psoroptic scabies from the Horse to the Ox, made by Gerlach, and more especially by Delafond, carried out under the most satisfactory conditions, have always yielded negative results—Delafond only once having observed a fugitive pruritus that was not followed by scabies. And it is also the fact, as demonstrated by the experiments of Delafond, that the Psoroptes of the Sheep cannot be acclimatized on the Ox. Only on two occasions in five did the transplanted parasites attack the skin of the calves experimented upon—thin crusts were formed, but the Psoroptes died or disappeared in from three to six days. Inversely, attempts at transmission of the psoroptic scabies of the Ox to the Horse were without result in the hands of Gohier and of Müller.

**Diagnosis.**—The psoroptic scabies of the Ox might, in one of its phases, be mistaken for certain cutaneous affections which somewhat resemble it. But the error may be averted by a careful examination, which will decide whether or not the Psoroptes—so easily found and distinguished from every other parasite—is present.

The *phthiriasis* due to the *Hematomatipus aurysternus* or *H. tenuirostris*—which are very pruriginous, cause depilations, and locate themselves on the upper part of the neck and withers—is easily recognised by the presence of the Lice; but as it may coincide with scabies, something more than a superficial examination is necessary. However, the treatment usually employed against the parasitic Insects will destroy Acarina.

The *prurigo* that results from heating food, or the transition from a poor régime to an abundant ration—and which also often appears without any appreciable cause—may extend to various parts of the body or be limited to some. It is characterized by discrete papules—which may be small and soft, or voluminous and hard—that cause a violent pruritus, particularly when the body is heated. In consequence of rubbing, the excoriated papules are covered with blood-tinted crusts,

and the skin is thickened, chafed, moist, and depilated in patches. This
disease may quickly subside spontaneously, but it may also continue
for months. It has a great resemblance to scabies, and especially
when it manifests itself on several animals at the same time in one
place; then contagion might be suspected. The diagnosis will be
decided by the absence of acari, and by the utility of internal treatment
—alteratives, purgative salines, arsenious acid, etc.

In *tinea tonsurans*—which is contagious, like scabies—the patches
invaded by the *Trichophyton* are always circular, and have limited
dimensions—from 3 cm. to 5 cm. in diameter; while those of scabies
are irregular, and have a disposition to extend along the body. Besides,
each of these two affections has its own proper parasite, the presence
of which fixes the diagnosis.

**Prognosis.**—Psoroptic scabies in the Ox can only become serious
when it has been absolutely neglected, and the cachexia accompanying
it has become chronic; for it readily yields to various antipsoric
remedies.

**Pathological Anatomy.** —G. P. Piana¹ has given the following
résumé of his researches into the lesions of the psoroptic scabies of
the Ox.

The *Psoroptes* induce very limited exudative inflammation in the
regions of the derma corresponding to the points where they insert
their mandibles in the epidermis; the exudate resulting from each of
these inflammations is infiltrated between the cells of the rete mucosum,
and also collects in the substance of the epidermis itself. This
exudation is very rich in leucocytes, which, owing to their sarcodic
movements, become insinuated—along with the fluid portion—between
the deeper epidermic cells.

Consecutive to these changes, and according to the intensity of the
dermal inflammation, the alterations may assume two different aspects.
In the first, the formation of the exudate ceases, and new epidermic
layers are established beneath the already developed exudative masses,
which fall off afterwards with the epidermic scales. In the other case,
the exudation continues, and the product already accumulated in the
substance of the epidermis continues, until it causes rupture of the
hairy layer, and complete destruction of the rete mucosum—hence
more marked irritation and the possible formation of a veritable ulcer.

When the punctures of the *Psoroptes* are confluent, instead of small
and distinct inflammatory points, a very extensive exudate is thrown
out, which, in drying, forms a crust.

**Treatment.**—The curative measures indicated for the psoroptic
scabies of the Horse are in every way applicable to the same form of
psora in the Ox. Mercurial preparations should on no account be

¹ G. P. Piana. *Ricerche sulle lesioni istologiche . . . nella pelle del Bue per la
employed, as they may be absorbed and cause more or less serious poisoning; for cattle are particularly liable to hydargyrisim, and numerous instances are recorded to prove the danger incurred from the use of these preparations. These dangers are due, for the most part, to the great tendency of the larger ruminants to lick themselves, and especially whenever they experience any itching sensation. In addition to the mercurial preparations, all toxic substances—such as cantharides, arsenic, etc.—likely to create another disease than that to be combated, should be absolutely proscribed.


Synonyms, History.—Dermatophagic scabies Röll, Chorioptic scabies Mégnin. This form of scabies is very rare in France, but it has been particularly studied in Germany. According to Gerlach, the first mention of the acarus which produces it is due to Kegelaar in 1835. But it was Hering, of Stuttgart, who was the first to make known in a positive manner, in 1845, this form of psora, and who described, distinguished, and exactly figured the Symbiot that lives on the Ox.¹ This study was undertaken and happily developed by Gerlach in his treatise on scabies. Delafond and Mégnin have also, though rarely, met with the Symbiot of the Ox.

Symptoms.—This form of scabies has its seat almost exclusively at the base of the tail. The pruritus is moderate. An abundance of scurf covers the affected part; the hair gradually falls off; then crusts and cracks form, which are inhabited by numerous acari. It is only when cleanliness of the skin is altogether neglected, that the disease goes beyond the root of the tail, and extends to the back and neck in one direction, and to the perinæum, mammae, and inner surface of the thighs in the other direction. In general, it remains localized for years at the base of the tail and in the anal fossa. In some cases observed by Müller, during the summer the parasite was located along with Psoroptes at the nape of the neck.

It is not a serious malady that injures the health of the affected animals to any sensible extent, unless, by negligence—prolonged for months, or even years—it is allowed to spread to other parts of the body. Then, owing to the general disturbance in the cutaneous functions, it may bring on anaemia and the unthriftiness observed among such animals.

According to Johne,² bovine animals often have the Symbiotes on their posterior pasterns without manifesting the slightest pruritus.

Etiology, Contagion.—Symbiotic scabies of the Ox is little contagious. Diseased cattle have been known to cohabit with healthy ones for four years without transmitting the disease. It is not con-

tagious for Man, nor for the other domesticated animals. Deposited on the human skin, the Symbiot of the Ox may produce a few red points and a slight itching, but these phenomena do not persist beyond twelve to sixteen hours.¹ Scurf applied in the pasterns of the Horse causes papules and pruritus that disappear in a few days.

Inversely, Delafond and Bourguignon have, on two occasions, deposited a large number of Symbiotes of the Horse—males and females of all ages—on the tail and around the anus of four emaciated and weakly Cows; the parasites attacked the epidermis, caused scurf, and produced the disease; but in fifteen days afterwards they had all disappeared, and the scabies was cured spontaneously in twenty days.

**Diagnosis.**—The symbiotic and the *psoroptic scabies* are difficult to distinguish from each other at their commencement. To arrive at a sure diagnosis, prepared by the differential characters of the lesions, it is indispensable to discover the parasite by means of the microscope.

A superficial examination might lead to the supposition that symbiotic scabies was the *phthiriasis* due to the *Trichodectes scalaris*, when this has its seat on the posterior parts of the body and root of the tail; as it is accompanied by a furfuraceous eruption, depilation, and slight pruritus. The distinction between the two diseases is very easy, inasmuch as the dimensions of the Trichodectus are at least four times greater than those of the Symbiot, and their specific characters are widely different.

The *tinea tonsurans* of the calf can scarcely be mistaken for this scabies, as that dermatomycosis has always a more or less regularly circular form.

In the same way, *prurigo* is distinguished by the character indicated above, à propos of the psoroptic scabies of the Ox.

**Treatment.**—The treatment of this form of scabies does not require any special recommendation. To cure it, the same procedure as for psoroptic scabies of the Ox will suffice.

**C.—Scabies of the Sheep.**

The Sheep, like the Horse and Ox, may present three forms of scabies—sarcoptic, psoroptic, and symbiotic. Living in flocks—which is the rule with ovine animals—gives to their psora a particularly serious character, as it considerably facilitates contagion. And this is also increased by the long time the litter is allowed to lie in the sheep-folds, only a small number of parasites being at wide intervals carried to the

¹ Nevertheless, Schérémétewsky, according to Bogdanoff, met with the *Symbiotes communis*, var. *bovis*, more than twenty times on the skin of people affected with itch (A. Bogdanoff, Bull. de la Soc. Imper. des Naturalistes de Moscou, 1864, p. 341). Zurn (Bericht der Med. Gesellsch. in Leipzig, 1877, p. 38) asserts that he has seen the same acarian on the skin of the head in a case of alopecia. In admitting the reality of these facts, we can only look upon them as simple coincidences, as R. Blanchard has justly remarked, in *Tr. de Zoologie médicale*, II., p. 322.
manure-pit. Besides, the development of the wool furnishes an effi-
cacious shelter to the Acarina, and offers great opposition to the action
of antipsoric agents—difficulties which are augmented by the fact of
the large number of animals that the shepherd has to look after, and
consequently gives rise to irregularity in the effects of treatment. All
these causes explain the tendency of scabies to be perpetuated in flocks
which these diseases have invaded. And what adds still further to their
gravity, is the circumstance that not only do they injure the health of
the animals, but they also at times greatly depreciate the value of the
wool.

These various reasons account for the large amount of attention
that the scabies of the Sheep has received, and the careful studies of
which they have been the object, and principally with regard to
treatment.

They will also justify the somewhat detailed allusion we will make
to them in the following pages.

1. Sarcoptic Scabies.

This form of scabies has been for a long time designated (in France)
Gale de la tête, Dartre de la tête, Teigne, Vidragne, Lizard, and more
especially Noir-museau—a name also given to an ulcerous affection of
lambs, attacking the lips and around them. Jehan de Brie,\(^ 1\) in the
fourteenth century, named it Poacre. ‘Et est le poacre une maladie et
manièr de ronge, qui prent et tient ès museaux des brebis.’ But until
the time of Delafond no one knew that this disease was a real psora,
caused by the Sarcoptes scabiei, var. ovis. It was in 1858 that he ob-
served it on Neapolitan Sheep brought to Paris;\(^ 2\) and it has since been
described by Gerlach.\(^ 3\) We have observed it in the neighbourhood of
Toulouse, where the shepherds call it Musarail. In Beauce its ordinary
name is Becquérail.

**Symptoms.**—This scabies has its seat almost exclusively on the head.
It appears first on the upper lip and around the nostrils, much more
rarely on the eyelids and ears. Later it extends to the face, forehead,
cheeks and eyelids, and exceptionally to the intermaxillary space.
According to Chabert, ‘it is only when the disease is of long standing
that it shows itself between the forelegs, beneath the belly, around
the joints, and especially behind the knees, the hocks, and the pasterns.
In this way it differs,’ he adds, ‘from ordinary scabies, for it appears
to avoid the parts covered with wool.’ Gerlach, in fact, could not
succeed in developing it on the woolly parts of Merino Sheep; and
this was probably due to the abundance of yolk in these regions, for

\(^1\) Le vray regime et gouvernement des Bergers et Bergeres : compose par le rustique


\(^3\) Gerlach. Sarcoptes-Räude des Schafes, Scabies ovis Sarcoptica. Archiv f. wiss.
with dry-wooled Sheep—Zackel Sheep, Fat-tailed Sheep, and the Neapolitan Sheep—the malady may gradually extend all over the body.\(^1\)

It commences by an eruption of small vesicular papules, accompanied by violent pruritus, which compels the animal to rub itself against everything about it, and less frequently to scratch itself with its hind-feet. The papules, being chafed by this friction, exude a serosity that, in drying, forms small, hard nodosities adhering to the skin, and which the finger-nail discovers among the hair. Cracks may be seen on the ears when the disease begins there. The multiplication of the parasites and their extension, generalize the disease over large surfaces. The anterior surface of the head is covered with crusts, at first thin, but becoming afterwards thick, light-coloured or grayish, hard and adherent. At a more advanced stage, all the diseased places merge into one, and the lips, nostrils, face, cheeks, forehead and ears are a vast crusted surface—dry, thick, and made even by repeated rubbings.

The skin is thickened and raised in folds, at the bottom of which are fissures and cracks that bleed at first and then cicatrize. Delafond says the ears may have sero-sanguinolent cysts, due to the irritation induced by the friction.

The animals may have some difficulty in taking their food; and the conjunctivae may be injected and the eyes muco-purulent.

The acari are found beneath the adherent layer of the crusts, which is moist when removed by forceps.

The duration of this scabies is subordinate to the care taken in curing it; it may be indefinitely perpetuated if not perseveringly treated.

**Etiology, Contagion.**—The older (French) authors and shepherds believed the *noir museau* to be due to wounds and scratches, produced on the nose and around the lips of the Sheep, when these animals were grazing among stubble, briars, thorns and stones, or in rubbing these parts against the bars of the rack when taking forage. The lambs are seldom affected, the *noir museau* seen on them being quite different, and of an ulcerative nature. The true cause of the disease is contagion, and this is why it is perpetuated in sheepfolds, by immediate and mediate contact; and especially by the fact of the racks against which the Sheep rub themselves—either in taking their food or to allay the itching—being soiled by crusts charged with the Sarcoptes, and which transmit the malady to healthy animals.

Can the sarcoptic scabies of the Sheep be derived from the sarcoptic scabies of any other domesticated species? Viborg admits that the scabies of the Pig may be transmitted to the Sheep, though

Am-Pach is of the contrary opinion; but there are no facts in support of either view, and the same may be said with regard to Chabert’s assertion, that the scabies of the Dog may be conveyed to Sheep. Only for the sarcoptic scabies of the Goat has transmission to Sheep been demonstrated, as Wallraff and Roloff have shown; the communicated disease bore the closest resemblance to the psora just described.

The sarcoptic scabies of the Sheep may be conveyed to Man. Delafond has seen a breeder contract the disease through attending Sheep affected with it; while Gerlach succeeded on several occasions in effecting transmission to a student, and each time treatment had to be resorted to for the arrest of this experimental malady. Nevertheless, the contagion of Man should be extremely rare, as no other instance has been observed in practice.

Gerlach has stated that if sarcoptic crusts from the Sheep are placed on the skin of the Horse, Ox, or Dog, there is developed at the places a local scabies that has not extended at the end of four weeks. With the Goat—contrary to what had been observed by Roloff and Railliet—at the expiry of three weeks it was still doubtful if transmission had occurred, as there was not a trace of scabies.

**Diagnosis, Prognosis.**—The sarcoptic scabies of the Sheep cannot be mistaken for any other disease. Its seat distinguishes it from psoroptic scabies, and the presence of the special parasite found in the moist portion of the crusts is sufficient to remove any doubts.

It is not a serious disease, and readily yields to treatment. But if left to itself it may cause conjunctivitis and painful otites; while it may prevent fattening by the pruritus it occasions, and the changes it may induce in the skin of the lips. Its gravity consists more especially in the difficulty experienced in purifying the sheepfolds, without an operation that seems out of proportion to the object to be attained.

**Treatment.**—The prophylactic measures for preventing the invasion of the disease—the contagion—are those mentioned with reference to psoroptic scabies.

With regard to curative treatment, this always yields good results if the application is rational; the rapidity of cure is subordinate to the age of the disease. If at its commencement, antipsorice remedies may be applied at once; but if it is of long standing, and the skin is covered with thick crusts, then these should be softened by repeatedly rubbing them with some greasy matter for several days, when they may be removed by soap washing and picking.

Then, over the entire diseased surface and the adjacent parts, there should be well rubbed in the oil of turpentine, or—what is better, being less irritating—the essence of spike lavender. According to

Gasparin, a cure may be obtained by a single application of cade-oil over the affected surface. Two or three rubbings with a mixture of equal quantities of pine tar and soft soap, or with the pomade of Helmerich, will also promptly cure this scabies (Delafond).

The same treatment is applicable to exceptional cases, in which the scabies has extended to between the fore-limbs, belly, mammae, knees, hocks, and pasterns.

The local complications—cracks, fissures, cysts, conjunctivitis—are to be treated according to the general principles of therapeutics applicable to them.

Sanitary Police.—The first article of the law (French) of July 21, 1881, on the sanitary police of the domesticated animals, includes ‘scabies (gale) in the ovine and caprine species’ among the reputedly contagious maladies requiring the application of sanitary measures; and it might be asked if, in practice, this general denomination of ‘scabies’ should comprise sarcoptic and psoroptic mange, or only the latter, which alone, because of its gravity, justifies the solicitude of the authorities.

An order of the Minister of Agriculture (April, 1888), issued on the proposition of the Comité Consultatif des Épizooties, has answered the question affirmatively. Consequently, sarcoptic scabies ought to be the object of the measures applicable to the ‘scabies of the Sheep,’ which shall be referred to presently.

2. Psoroptic Scabies.

Synonyms, History.—The Rogne, Tac, and Gale épizoûtique of the older (French) writers; the Dermatodectic scabies of Gerlach, Delafond and Bourguignon (the Scab, Shab, Ray, Rubbers of the English shepherd; the ῥιθος or ῥηθος—Scab, Sceal, or Tetter—in the early Anglo-Saxon manuscripts; the Rötde, Krätze, Schabe, and Grind of the Germans; the Rogna and Scabbia of the Italians; the Sarna of the Spanish; the Tschesotka of the Russians; the Ḥūh of the Hungarians; the Skab of the Danes; and the Scabb of the Swedish). Delafond and Bourguignon, in their Traité pratique de la Psore, have given extensive details in the history of our knowledge relative to this malady. From this it is seen that the first mention of it extends as far back as Cato the censor, about 160 B.C. Then it is spoken of in Virgil’s Georgics and Juvenal’s Satires, and in the works of Celsus, Columella, Pliny, and Vegetius. In the Middle Ages, Belon mentions it, and indicates its treatment with cade-oil, which he called tac.

(In England, ‘sheep-scat’ has been known from the earliest times, and it is frequently mentioned in ancient Anglo-Saxon manuscripts; it is also alluded to by Chaucer and other writers of a later period; while evidence of its destructiveness is found in the record of such an epizooty as that described by Thomas of Walsingham and Stow, which persisted among the Sheep throughout this country for more than twenty-eight years.1

1 Fleming. History of Animal Plagues, I., pp. 79, 80.)
Laws were made in Britain with regard to it as early as the reign of Howel the Good of Wales—when it was known as *ar clauri* or *clauery*—at the commencement of the eleventh century; and at a later period it frequently received legislative notice.  

Although in the twelfth century Avenzoar had made known the existence of the Sarcopt of human scabies (see p. 112), it took a very long time for this knowledge to be extended to the important psora of the ovine species. It is doubtful if Linnaeus in 1735, Eitmüller in 1754, Morgagni in 1760, or Werlhof in 1765, ventured on the hypothesis as to the existence of a parasite in Sheep scabies. Many subsequent writers on the disease are absolutely silent on this special point. It has been shown (at p. 114) that Wichmann, in 1786, was the first to think that scabies of Sheep was of the same nature as that of Man, and that both diseases are produced by *the same acarus*. He even goes so far as to say, that if the persons who handle wool are often affected with itch, the cause must be sought for in *the transmission of the acarus of the Sheep*. Abilgaard, director of the Copenhagen Veterinary School, accepted this idea, for he said, in 1787, that 'the Sheep itch was cured by simple external remedies, without having recourse to internal ones.'

But Walz, a veterinary surgeon of Wurtemberg, should be placed in the front rank of those who have made known the causes, nature, seat, and rational treatment of Sheep psora. In his memoir, published in 1809, and translated into French in 1811, he had, by varied experiments, given a positive basis to ulterior researches. From that time, the notions of the parasitic nature of scabies and its contagiousness, are seen to be more clearly understood in the writings of Tessier in 1810, of Bosc in 1811, of Gohier in 1814, of Gasparin in 1821, etc.

Lastly, the precise researches on the entomology of the *Psoroptes* of the Sheep, and the nosography of the scabies it causes, have been pursued with science and method by Hering (1835), Hertwig (1835), Delafond and Bourguignon (1854), and Gerlach (1857).

**Symptoms.**—Attention is at first attracted by slight alterations in the fleece, which is fluffy and matted in places. If the suspected Sheep is carefully watched, it will be observed rubbing, scratching, or gnawing itself, and tearing out the wool. These phenomena become all the more apparent when the flock is heated by travelling. Rubbing with the hand on the parts where the wool is matted or thin, still further excites the sensation of pruritus; the animals move their lips in a tremulous manner, shake the head, seek to bite the skin with their teeth, and scratch it with their feet. When the latter are dirty they soil the fleece at the itching part.

On examining the skin, papules will be found the size of a lentil or larger, of a whitish or yellow colour, which contrasts with the faint rosy tint of the integument—this is the result of the puncture of the *Psoroptes*. The punctures becoming more numerous, the papules are closer together and become confluent, while the skin is thickened to a generally limited extent. At the summit of the papules serum accumulates, which transforms them into vesicles and pustules, and in


drying forms crusts. In a few days the mangy surfaces are covered with a yellowish, scaly layer, greasy to the touch, beneath which the parasites are concealed. The repeated and multiplied action of the Psoroptes extends the inflammation of the derma, increases the exudation, and gradually changes what were at first scales, into crusts of average thickness. These are loosened, particularly by the continual rubbing, tearing the fibres of wool from their follicles; so that the depilation increases. The crusts fall off, and are replaced by others, which are thicker, and more compact and adherent. The psoric patches extend at their periphery, as the acari forsake the centre, the crusts of which are replaced by an abundant desquamation of the epidermis; but little by little this part recovers its integrity, while the morbid process is continued beyond, though for a long time it remains thickened and wrinkled. With animals which are clipped, there usually forms at the diseased points a thick, dry crust, like parchment, that covers the greatly tumefied skin.

The fleece of the mangy Sheep has a quite characteristic neglected appearance—the wool being agglutinated in certain parts, absent in others, and is easily pulled out in the regions which appear to be yet intact. The rubbings in which the Sheep indulge accelerate the depilation and augment the irritation of the skin, which becomes inflamed from contusion, and even by superficial necrosis.

Contrary to what happens with the Sarcopt, the Psoropt seeks the regions covered with wool. Therefore the ordinary mange usually begins at the upper and middle part of the body—the withers and back—and thence extends to the neck, flanks, and croup. The Psoroptes are rarely found in the sternal and sub-abdominal regions; they agglomerate on circumscribed surfaces, and the scabies they produce is manifested in the form of patches always increasing at their periphery; the number of these patches is that of the points of invasion. But as incessant contact facilitates the mutual passage of the Psoroptes from one individual to another, the process becomes more confused, as the patches become multiplied and are of various dimensions, until at last they become confluent.

The parasites abandon the regions where their presence has caused the formation of dry compact crusts, or where the derma is thickened and indurated; so that very few can be found there. On the contrary, however, they are found in abundance at the parts more recently attacked—the margin of the mangy places, where they are visible to the naked eye as small white points, brownish at one extremity, and may be lifted up by means of a pin or small brush. If they are then put on a sheet of black paper in a mild temperature, they can be seen moving about, and the males may even be distinguished from the females—especially by means of a hand lens—and pairs are seen in copulation, which are relatively very numerous.
The Psoroptes multiply abundantly on lambs and tegs, the skin of which, being tender and delicate, offers them a more favourable habitat. They prefer parts where the wool is close, and after the Sheep are shorn they emigrate in a body to others which have not yet undergone that operation.

Course, Duration, Termination.—The seasons and the conditions in which the animals live exercise an influence on the course of scabies. In autumn and winter (in France), when they are collected in the hot and damp atmosphere of the sheepfolds, and covered by their fleece, the disease makes rapid progress. In summer, when at pasture, and after shearing and washing, it is often checked, and sometimes even suspended.

The age and temperament of animals, the length, fineness and abundance of their fleece, their condition and energy, their breed, and the hygienic conditions to which they are subjected, all have much influence on the course and terminations of this malady.

Animals debilitated from any cause offer little resistance to it. Those of the pure or mixed merino breed, sooner give way to it than the indigenous breeds.

Left to its natural course, this seabies has a fatal result, because of the cutaneous disturbance, the fatigue, and want of rest and sleep from the pruritus. Marasmus and cachexia precede death, which, in emaciated and debilitated subjects, may take place in two or three months. An abundant and substantial nourishment prolongs life; but if even then an incomplete external treatment is applied now and again, the disease may last for years, and remain stationary in a country or on a farm.

Etiology, Contagion.—All the experiments made, as well as all the observations from the earliest times, have demonstrated the predominant part played by contagion in the etiology of Sheep scabies. The intimate contact of animals in the sheepfolds renders this contagion very easy, and it often suffices for one mangy Sheep to be introduced into a flock to infect the whole. The experiments of Delafond have demonstrated—what to-day appears superfluous—that, as Walz and Hering had already stated, the morbid humours of Sheep scabies contained neither Psoroptes nor their eggs, and therefore could not transmit the psora; and that contagion could only occur by means of the eggs or the fecundated females.

Transmission of the scabies is produced by the mediate or immediate contact of the diseased with healthy animals in the sheepfolds, parks or pastures, and by the collection of flocks at fairs, markets, and watering-places. It also occurs when healthy Sheep come in immediate contact with objects on which the mangy ones have rubbed themselves a short time previously, and on which they have left crusts and shreds of wool with their parasites.
From the experiments of Hertwig and Gerlach, and particularly of Delafond, it results: 1. That the Psoroptes of the Sheep infesting crusts, portions of wool, or pieces of fresh skin, kept at a medium temperature, can live in these débris for ten to twenty days; 2. That they will remain torpid in these matters if they are subjected to a slight degree of cold, but become re-animated by a mild damp heat; 3. That they die quickly when remaining in contact with animal matters kept at a temperature of zero; 4. That they soon perish if exposed either to a high or a low temperature.

These diverse experiments demonstrate that the Psoroptes may persist in living in sheepfolds, though exiled from the bodies of animals for at least twelve to fifteen days; and they also demonstrate the necessity there is for removing from these places all litter, remains of wool, and the skins of Sheep which have died or been killed, as well as disinfecting the localities inhabited by mangy sheep.

The experiments and observations of Delafond have placed beyond doubt, the influence of the health of animals on their power of resistance. Good condition, energy, and a succulent and abundant alimentation, are all antagonistic to the multiplication and existence of the acari; while emaciation and poverty of the secretions are favourable to the nutrition of these animalcule, the incubation of their ova, the alimentation of the larvæ, and multiplication of the colonies, and, consequently, contribute to the extension, persistence, and aggravation of the disease. With robust and well-fed animals, mange will disappear spontaneously, or be readily cured by cleanliness and some antipsoric remedies; while with poor, weakly, and chlorotic Sheep it will persist and become tenacious, and most difficult to cure if the organism is not restored by good food and attention to cleanliness, as well as recourse be had to an energetic parasiticide medication.

It has been stated above (p. 153) that, although of the same species as that of the Sheep, the Psoropt of the Horse does not become acclimatized on ovine animals, according to the experiments of Delafond. If similar attempts have not been made with the Psoropt of the Ox or that of the Rabbit, yet it may be provisionally admitted that it is always from Sheep to Sheep that psoroptic scabies is conveyed.

With regard to the possibility of transmission of this scabies to other species of animals, it has been mentioned (pp. 153, 160) that Delafond obtained negative results on the Horse and Ox; he also failed with the Goat. The influence of seasons on the extension of Sheep scabies has also been indicated; the effects of cold and damp are also shown by the geographical distribution of the disease—for it is more frequent in Germany than France, and in the latter country it is more common in the north and west than in the east, and particularly in the south.

**Diagnosis.**—Psoroptic scabies cannot be mistaken for sarcoptic
scabies: their localization is altogether different, and they never interfere with each other; the first only affects parts destitute of wool, the second only the woolly parts of the body; and when they chance to co-exist on the same animal, they are easily recognised by their distinctive characters.

Confusion is more likely to occur with inflammation of the sebaceous glands, described by Delafond, and which appears most frequently in the autumn, when the Sheep have suffered from lying on the cold ground, and have lost condition. It is marked by somewhat severe pruritus, followed by the shedding of tufts of wool; the skin is also red, sensitive, painful, and—an important feature—it is covered with a large quantity of yellow, rancid, and viscid yolk, which smells very strongly. This latter symptom, the absence of the Psoroptes, and the facility of cure by the employment—after shearing—of any amylaceous lotion on the diseased parts, serves as a differential diagnostic indication.

The pruritus due to the Melophages, the Trichodectes, and the Ixodes, is readily attributable to its cause by the discovery of these large and distinctive parasites.

The Germans designate by the name of ‘Rain-rot’ (Regenfäule) an eczema due to humidity, and which may manifest itself on the whole flock. Its rapid cure on the advent of dry weather or residence in the sheepfold, the benignity of the cutaneous alterations, and the absence of pruritus, render diagnosis easy.

It may also happen that an exaggerated secretion of the yolk agglutinates the locks of wool, and might for a moment lead to the suspicion of scabies; but the absence of pruritus, and the complete integrity of the skin, will dispel this error.¹

Prognosis.—Psoroptic scabies of the Sheep is not serious, if only the dangers individual animals incur from it are considered. It is always easy, in fact, to cure a mangy Sheep by isolation, an abundance of substantial food, and good antipsoric treatment. But what gives the disease a character of exceptional gravity, is the circumstance that Sheep always live in flocks, so that the malady is quickly propagated by this mode of existence and the close promiscuity that it entails; and also that the fleece constitutes a special difficulty in the application and action of medicaments; while it is necessary to treat the whole flock at the same time, and under expensive and troublesome conditions.

Besides, when the animals are, by their feeble temperament, in conditions favourable to the development of scabies, the mortality by cachexia or other intercurrent affections exacts its tribute from the revenues of the flock. It is often disastrous in the autumn, and during the winter and spring, by the seasonable recrudescence of the disease.¹

per cent.; in the case of involterate scabies the mortality may increase to 40 and 50 per cent.; and in instances in which the disease is complicated by any other serious affection, and especially by dropsy, it may reach 70 to 80 per cent.' (Delafond).

In addition, the torment experienced by the animals hinders their growth and fattening; a large number of ewes remain unfruitful, abort, or only produce small and feeble lambs, the majority of which die. Lastly, the wool undergoes a notable depreciation, which will be alluded to presently.

In 1862, Delafond, after what he considered moderate calculations, estimated that the psora every year attacked one thirty-fifth portion—or about one million—of the Sheep in France, and that through the mortality or otherwise the damage was five francs per head, or an annual loss of five million francs to French agriculture. If at the present day the number of Sheep has diminished, yet their value has increased in proportion. Otherwise, the improved methods of breeding and rearing Sheep, the greater care bestowed on them, and the application—though incomplete—of sanitary police measures, have much reduced the prevalence of Sheep scabies. In fact, according to the report on the epizooty service (of France) in 1887, the disease had only attacked 10,591 Sheep, of which 10 per cent. died. It is, nevertheless, a serious affection, against which all the accumulated resources of experience should be brought to bear.

(The loss occasioned by this form of Sheep scabies appears to be very heavy in Bavaria and some other parts of Germany; for Haubner has estimated it as high as two thalers—six shillings per head. Zundel reports a loss of 5,000 francs in a flock of 200 Sheep in three years. Jacoby calculated the annual loss in wool from this disease, in the Erfurt district of Prussia, at 30,000 thalers; and Fürstenberg estimated that, in the Griefswalder district, where the malady had not long been known, the loss every year was from 35,000 to 40,000 thalers.

In 1859, according to Straub, the number of Sheep affected in the Wurtemberg districts was 683,842—497 flocks being infected in that and the two succeeding years. Reckoning the loss at three or four thalers per head, it will be seen that a very large sum of money was lost during that period. The deaths from marasmus and other complications were very numerous in 1862.)

Pathological Anatomy.—On a portion of the skin where the disease is recent, the epidermis is raised by purulent serosity; and on a surface of 2 cm. to 3 cm. in diameter, there is a sero-sanguinolent infiltration, and, later, induration. The extent of these lesions may be from 4 cm. to 5 cm. When the disease is very advanced, the skin, which has been for a long

(1 Fleming. Veterinary Sanitary Science and Police, II., p. 437. For the history of the disease in England during many centuries, and the losses caused by it, see also my Animal Plagues, I. and II.)
time depilated, is often double or treble its normal thickness, and is hard, ridged, and cracked in certain places, while its papillae are hypertrophied. The subcutaneous connective tissue is infiltrated by serum, which is already organized in the deeper parts of the derma. The adjacent lymphatic glands on these greatly altered surfaces are enlarged, infiltrated, and rich in lymph. The lesions of the skin may extend to the formation in its substance of little purulent foci, which are red in colour, and vary in size from that of a hemp-seed to a pea; while others, as large as a nut, are situated in the skin and subcutaneous connective tissue. The nearest glands are then inflamed, enlarged, and very salient beneath the skin; and, lastly, there may be found in the different digestive and respiratory organs the lesions of concomitant cachectic affections.

The alterations in the wool are serious, from an economical point of view. It is matted, soiled, and yellow, mixed with foreign matters, diminished in quantity from the shedding of numerous locks, and has lost much of its value. The fibres are unequal, and this is particularly noticeable in the following conditions described by Delafond:

'With many animals, and after the depilation, beneath the portions of the fleece remaining adherent on the surface of the diseased skin is developed a new secretion of wool, and soon these fibres become mixed in the detached ones and form a mass composed of old and new wool. This alteration, which the farmers, shepherds, and wool-dealers call wool with two ends—because each lock is composed of two layers of unequal length—may be observed not only in the wool covering the mangy surfaces, but also on the healthy parts when the Sheep have suffered for a long time from repeated attacks of the parasites.

'This alteration is recognised when, holding the locks between the eye and the light, there is a clear zone at the part where the new fibres become interwoven with the old ones; and when, in pulling the lock by both ends, the two growths become disunited and constitute two separate locks. If, otherwise, the fibres are examined microscopically, it will be found that the older the growth is than the new, the diameter of each fibre is alternately constricted and enlarged, a condition that gives an inequality of resistance to the wool, and diminishes its value.

'Such an alteration in the wool is very detrimental to its employment in manufacture, as it is shorter, and the thread made from it is disunited or breaks when spun, while the material which it makes has no lustre, and is dry and of poor quality. It is also probable that wool so damaged, and which is impregnated with a yolk that has also under-

1 Magne and Ranson designate wool with two ends that of which the fibres have an irregular thickness. In general, the thinnest part is in the middle of the fibre, and the thickest at each extremity. This form is seen in flocks, the feeding of which has been irregular. The extremities of the fibres correspond to the summer growth, and the middle to the winter, during which the flock has been scantily fed.
gone changes, cannot dye so well as that from Sheep in good health. We have some authority for expressing this opinion, after the experiments made by Roard, director of the dyeing department of the Gobelins manufactory in 1803, on wools from diseased and healthy Sheep.'

Treatment.—The treatment of Sheep scabies consists in the employment of antipsoric remedies. But it is, above all, necessary to protect the flocks from contagion. As this is very subtle, we ought not to lose sight of the information given by Delafond with regard to the influence of previous health on the development of psora. Animals should, therefore, be placed in the best hygienic conditions, and kept as much as possible from humidity; while the sheepfolds ought to be maintained in a proper manner, so far as ventilation and light are concerned. The qualities of the shepherd are of the first importance in this respect—the vigilance, zeal, intelligence, and practical knowledge of this auxiliar will detect the disease at its commencement, and hinder its extension.

Alimentation occupies the chief place among the reliable prophylactic measures. Reuss, Hering, Daubenton, and Lullin—cited by Delafond—have published facts that demonstrate the happy influence of an abundant and substantial nourishment on the resistance of Sheep to scabies, and the readiness with which they can be cured. According to Gerlach, adult animals resist the malady all the better if they are well fed, and so may have it among them for years. 'The Spanish shepherds,' says Delafond, 'know very well that the flocks which contract the disease during the winter in the warm provinces of Estramadura, are easily cured by the most simple remedies in the succulent pastures on the mountains of the Sierra Morena, of Old Castile, of Navarre, and of the Asturias. The shepherds who have charge of the wandering flocks which, from the southern provinces of France, are driven to the pastures on the mountains of Cevennes, Dauphiny, and the Alps, every year make similar observations. In Switzerland these facts are common, and are well known to all the farmers and sheep-dealers.' Delafond strongly and justly insists on the importance of the régime and good health of the Sheep, in getting rid of the disease.

To cure scabies necessitates the employment of antipsoric remedies. The treatment is complicated when a large number of animals have to be cured at the same time. At the commencement, when one, two or three Sheep are only slightly attacked, the shepherd—if he is careful—may arrest and destroy the disease by simple means: such as tobacco juice, oil of turpentine, cade-oil, etc. But when the malady is installed in the flock, and all the Sheep are suspected of being more or less affected—so that it is impossible to determine the diseased places with certainty—recourse must be had to medicated baths, into which the animals are plunged one after the other.

Many substances have been for a long time tried and recommended
for the treatment of Sheep scabies. Sea-salt and the various fatty bodies are abandoned as insufficient. Mercurial ointment, employed alone or mixed with other agents, ought not to be used, because of the danger of poisoning: for the facts reported by Gasparin, Jauze, Tessier, Numan, etc., as cited by Delafond, demonstrate the possibility of grave, even fatal, accidents following the absorption of this remedy either by the skin, or by the digestive mucous membrane when the mangy animal licks itself, when the Sheep lick each other, or when the lambs lick the ewes. Empyreumatic oil and cade-oil are very active; but they have the inconvenience of giving off a bad odour, and particularly of staining the wool, and therefore much diminishing its selling price. The solution of sulphurated potash is only efficacious when concentrated, and then it makes the wool yellow, as well as hard and brittle.

In many countries, and especially in mountainous regions where the black hellebore is common, recourse is had to the rhizome of that plant, which is employed in decoction after reducing the fluid to two-thirds:—water, 1 quart; fresh rhizome, 4 ounces, or dry rhizome, 2½ ounces.

We may, according to the local resources, substitute for the black hellebore either the green, foetid, or white hellebore. In Germany, owing to the cheapness of tobacco, a good antipsoric decoction is made by boiling the prepared leaves of that plant in water, in the proportion of 8 ounces to the quart of water.

These preparations are efficacious, but are scarcely suitable for a somewhat numerous flock. And the proper treatment of Sheep scabies really consists in the employment of antipsoric baths, the composition of which is somewhat varied.

To obtain all the results desirable from this treatment, the re-invasion of the parasites must be avoided. When the disease has existed in the flock for some time, it is well to disinfect the sheepfold. All the manure should be carried to the dung-pit, as well as the soil, to a depth of four to five inches. All the woodwork—doors, windows, hurdles and racks—should be dressed with boiling lye, then whitewashed to the height of a man. Brick or stonework parts should be scraped. Then the soil is to be replaced by new, which is to be well beaten down. Lastly, for two weeks the cleansed sheepfold is to be left vacant; after which, if scabies reappears, it will not be because of the sheepfold, but rather because the animals have been insufficiently treated. During this time the Sheep must be kept in another locality or park, and after being treated can be returned to their sheepfold. If the temporary locality is to be uninhabited for two or three weeks, it will be well to disinfect it; but if before that time there is occasion to put other Sheep in it, it will be necessary to submit it to the same operation as the sheepfold.
Before employing any remedies, the old writers prescribed scraping the diseased parts, and Delafond insists on the importance of this preliminary operation. It is done either with the _grater_ of Daubenton, or with the _ongle_ of Chabert and Fromage de Feugrè. The first is a kind of knife, the blade of which is made of bone, and 1 mm. to 2 mm. thick. The _ongle_ is an iron blade, bent at a right angle at one of the ends, which has a series of small teeth that are passed gently over the skin where it is covered with crusts; it has the inconvenience of causing bleeding. Many shepherds use their finger-nail in place of these instruments. But it is best to employ a simple blade of hard and flexible wood (like a paper-knife). The diseased part is scraped with the blunt edge, then rubbed with the side of the blade. This operation has the advantage of removing all the crusts, and with them a large proportion of the Psoroptes and their ova, crushing many of them, and rendering the action of the remedy more efficacious. The scraping and rubbing should be practised outside the sheepfold. But it may be noted that they are useless if the crusts are thin and few in number.

The Sheep should always be shorn before remedies are applied. But when scabies prevails at a time not favourable for this operation, the Sheep-owners hesitate to cut the fleece which has only been growing for six or eight months, as its commercial value is then not so great. So most frequently the fleece is allowed to remain on until the proper time arrives; consequently, the effects of the treatment are incomplete. But it has at least the advantage of keeping the disease within certain limits, and allows of the usual shearing time being waited for without incurring much more damage.

Whichever may be the bath employed, it should not be given until four or five hours after feeding.

Exceptionally, animals whose skins are thickened like parchment ought to have a soap bath (soft soap, 2 pounds; soft water, 22 gallons). This bath is given at a temperature of 30° to 35° (C.), in a tub large enough to plunge a Sheep into. The animal is immersed for about two minutes, then rubbed for another two minutes with a brush. This bath cleans the skin, softens the crusts, and frees the animal from a great number of parasites. Next day the antipsoric bath may be given. If washing on the back has preceded the shearing, then the soap bath is useless.

*Antipsoric Baths.*—In France, the antipsoric baths have arsenious acid for their base. *Tessier's bath*, which was proposed by that agriculturist in 1810, and which has been the most employed for a long time, has the following composition for 100 Sheep:

| Arsenious acid | - | - | - | - | 3 pounds. |
| Sulphate of iron | - | - | - | - | 22 gallons. |
| Water | - | - | - | - | 24 gallons. |

Boil for ten minutes.
The reactions which take place during boiling reduce the quantity of arsenious acid in solution to about 4 drams to the quart of water (Rossignol). But the sulphate of iron is more especially a corrective, for it acts as an astringent, prevents the absorption of the toxic agent by the skin, and also hinders the Sheep licking. Numerous facts, published by Godine, jun., Gohier, Youatt, etc., show that arsenical baths, containing no astringent substance, may cause serious poisoning. Nevertheless, the result of experiments made at Melun in 1879, go to prove that cutaneous absorption is not to be apprehended in arsenical baths which do not contain more than 5 drams to the quart of water, especially if immersion is not longer than five minutes; and that pure arsenical solutions, free from any astringent salt, may be employed if they do not contain more than 4 drams to the quart of water.

The ferro-arsenical bath of Tessier has the inconvenience of giving a rusty colour to the wool, from its containing the sulphate of iron. Clement, in 1846, proposed replacing the iron by the sulphate of zinc in half the quantity—so that after boiling the proportion of arsenious acid fell to $5\frac{1}{2}$ drams per quart (Rossignol). It is therefore more toxic than Tessier's bath. Mathieu, in 1856, substituted alum for the sulphate of iron to the same amount. The baths of Clement and Mathieu have given as good results as that of Tessier, and without staining the wool, as Delafond has stated; but they have not been employed so extensively. Besides, they are more expensive than the sulphate of iron, and increase the cost of the bath for 100 Sheep from fifteen pence—Clement's bath—to thirty pence—Mathieu's bath.

Tessier's bath has been blamed for serving in criminal attempts at poisoning, or giving rise to fatal mistakes on farms. Consequently, on the proposition of a committee of professors at the Alfort Veterinary School, a Ministerial Order decided that this bath should be coloured by the peroxide of iron, and made bitter by the addition of gentian powder, according to the following formula:

<table>
<thead>
<tr>
<th>Component</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenious acid</td>
<td>35$\frac{1}{2}$ ounces</td>
</tr>
<tr>
<td>Protosulphate of iron</td>
<td>17$\frac{1}{2}$ &quot;</td>
</tr>
<tr>
<td>Anhydrous protoxide of iron (colcothar)</td>
<td>14 &quot;</td>
</tr>
<tr>
<td>Powder of gentian-root</td>
<td>8 &quot;</td>
</tr>
</tbody>
</table>

This was the only preparation druggists were authorized to sell, and represents the quantity for 100 Sheep, when boiled in 22 gallons of water. But the formula has become obsolete, and is replaced by that of the Codex of 1844, given under the name of 'Trasbot's Arsenical Bath,' in which the astringent is represented by the sulphate of zinc and the bitter substance by aloes, which, as Delafond has well demonstrated, may advantageously take the place of gentian. The following is the formula of the Codex, the quantity being sufficient for 100 Sheep:

...
Arsenious acid  
Sulphate of zinc of commerce  
Aloes  
Water  

Dissolve the arsenious acid in four gallons of boiling water, also dissolve the aloes and sulphate of zinc in two gallons of cold water; then mix the two solutions, and add the remainder of the water. 1

The price of this bath amounts to about fifty pence per 100 Sheep, and though a little dearer than Tessier's bath, it has the advantage of not staining the fleece, while it is as effective in curing the disease; as it is Clement's bath, only rendered bitter and coloured by aloes—the good effects of this bath being testified to by Delafond and numerous practitioners. According to the statistics collected by Delafond, dealing with 36,000 Sheep, treated from 1816 to 1852, 35,963 were cured by Tessier's bath, the remaining 37 having succumbed from anaemia and marasmus before treatment; only 60 Sheep required a second immersion to make the cure a radical one.

The following recommendations with regard to the manner of employing arsenical baths, are borrowed from the conscientious work by the same author.

As has been already said, the animals should be shorn as much as is possible. This precaution—which is always useful, in order to ensure the effects of the bath—is necessary if the primitive bath of Tessier is had recourse to, as it depreciates the fleece by the coloration it gives.

The bath is kept always tepid—30° to 35° (C.). The temporary locality in which the Sheep are kept should be divided into two spaces by hurdles—the animals passing from one to another as they are dipped. At least four men are employed in the operation—one to bring the Sheep, and three to dip it, two of these having a coarse brush.

Tessier expressly recommends that the hands of the dippers be provided with leather gloves; but experience has shown that this precaution is needless, as men may be employed in this work for twenty-four hours, and even for several consecutive days, without any harm occurring—the epidermis of the hands and arms merely becoming dry, as if tanned, and rust-coloured in the Tessier bath, this tint disappearing promptly if the parts are washed with a weak solution of hydrochloric acid, which may also be employed to remove the iron stains on the clothes made during the dipping. But notwithstanding the numerous favourable experiments, men who have wounds on their hands should abstain from taking part in the operation.

1 Beucler has made known an interesting case, in which, of fifty-one Sheep dipped in Clement's arsenical bath, forty-nine died in less than twenty-four hours. The expert showed that the sulphate of zinc had been replaced by the sulphate of soda—a mistake of the druggist. Consecutive experiments made by Nocard appeared to establish that, in animals, the absorption of the poison had taken place by the surface of the skin. Archiv. Vétérinaire and Bulletin de la Soc. de Méd. Vétérinaire Pratique, Nov., 1879. But those which Rossignol undertook at Melun rather tend to prove that absorption occurred cutaneously. Bull. de la Soc. de Méd. Vétérinaire Pratique, 1859, p. 50; La Presse Vétérinaire, 1858, passim.
The udder—and more especially the teats of the milch ewes, should have been previously smeared with grease, to prevent the astringent action of the fluid, which otherwise would diminish the secretion of milk for some days. The other animals of the flock do not require any preparation.

Each Sheep is kept in the bath for two minutes, the entire body being immersed, except the head; though in the case of very mangy animals particular care should be taken that the fluid penetrates all the folds of skin on the head, in the arms, flanks, and between the claws. After one or two minutes, the animal is placed standing in the bath, and brushed and rubbed over every part, and especially the mangy places—but without causing them to bleed—for from two to five minutes at most. The same procedure is carried out on the limbs and nude parts of the head, where the Psoroptes often take refuge. The dippers then pass their hands over the body to press out the fluid, the Sheep is set free in the place set apart for the dipped animals, and the operation is terminated.

Four men can dip from 12 to 14 Sheep in an hour, or 120 to 130 in a day.

Tessier recommends putting the ears over the eyes of the Sheep while in the bath, to prevent the fluid entering the ears and injuring the eyes; but Delafond considers this precaution useless, as the bath does not cause any irritation to these organs.

What remains in the bath is kept for local application, in cases that require a second application; and when the disease has completely disappeared, the surplus fluid is buried in the ground.

The caldron in which the fluid has been heated should be carefully washed out, as well as the bath-tub, buckets, brushes, and other articles used in treatment.

Tessier recommends leaving the Sheep for twenty-four hours in a place without litter, straw, or forage, so as to avoid impregnation of these with the fluid that drips from the animals, and so to prevent accidents by poisoning; but Delafond assures us that they rarely show any tendency to take food which is made bitter, and that when fed for three to eight days on food containing every day from one to three centilitres of Tessier's bath, they did not suffer any harm. He also found that animals which were dipped in this bath, and whose wool and skin were moist with it, did not lick themselves; or if they did so, they did not swallow sufficient poison to do them any injury; for in his experiments Sheep have taken from two to ten centilitres of this fluid without being indisposed, and it required a dose of five decilitres to induce fatal poisoning.

When taken out of the bath, it is observed that the parts denuded of epidermis, and the cracks and ulcers, are cauterized. In three to four hours afterwards there is general febrile excitement—often scarcely
perceptible—which persists in a more or less marked manner for ten or twelve hours.

From the third to the fifth day, the skin is hard, difficult to fold, and covered—especially at the mny parts—by a sedimentary adherent crust, which is rust-tinted if Tessier's bath has been used. The animals no longer rub or scratch themselves, and have an excellent appetite. In the crust, the microscope only reveals dead Psoroptes, and dried and withered eggs.

From the eighth to the twentieth day, numerous crusts become detached, showing the cicatrizcd, rosy skin, which is thin and supple. In the parts which were badly affected, the latter result is only attained towards the thirtieth, and even the fiftieth day. The wool grows soft and shiny, and the reddish tint at the end of the locks disappears from day to day, while the animals quickly regain their liveliness and condition.

Sometimes, though rarely, the disease re-appears in some animals at certain points; but scraping, and the application of one or two dressings with the bath fluid, will suffice to effect a complete cure.

The process of cicatrization in the affected parts often produces intense pruritus, which must not be taken as an indication of persistence of the malady; it is well, nevertheless, to watch the Sheep carefully during this period, and to be assured that the diseased places are really recovering.

The cure of scabies is all the more rapid the less constitutional disturbance there is. It is realized in about eight days, when the skin is not greatly altered. In other instances the cure is subordinate to the reactional power of the animals; and it may be remarked that, according to the observations of Cagnat, the antipsoric baths are injurious to cachectic Sheep, and may cause their death.

Scheuerle and Kehm employ an arsenical bath which they consider the best, with regard to efficacy and rapidity of cure; it leaves the wool of a fine white colour, and never causes poisoning if the precautions they give are adopted. It is composed of:

<table>
<thead>
<tr>
<th>Component</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenious acid</td>
<td>18 ounces</td>
</tr>
<tr>
<td>Alum</td>
<td>2,103 lbs</td>
</tr>
<tr>
<td>Water</td>
<td>22 gallons</td>
</tr>
</tbody>
</table>

The Sheep are dipped in the open air. There are two iron caldrons of four to five gallons capacity, which are filled with water and placed on a fire; two other caldrons of about six and a half gallons capacity, not quite full of water, are also heated. In the two first caldrons is put the arsenic, which, by reason of its density, sinks to the bottom; but

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3 The alumino-arsenical bath of Mathieu is composed of arsenious acid, 36 ounces; crystallized alum, 3,505 ounces; water, 22 gallons.
after boiling and stirring for fifteen to thirty minutes, it is completely dissolved, and the fluid has the limpidity of water. At the same time the alum, broken, is thrown into the boiling water in the larger caldrons, and is concurrently dissolved. The two solutions are then poured into a tub or bath, and cold water is added sufficient to make up the amount stated in the formula. To dip 200 Sheep recently shorn will require 5 pounds of arsenic, from 54 to 66 pounds of alum, and a corresponding quantity of water.

A quantity of the solution sufficient to cover a Sheep is placed in the bath; a man takes the Sheep by the fore-legs and crosses them on the neck, while a second man seizes the hind-legs and turns the animal over on its back; the creature is then immersed for two minutes, the eyes and mouth being kept out of the fluid. On removal, it is put into an empty tub, and three men rub and brush it vigorously, squeezing out the fluid remaining in the fleece. To protect themselves from the corrosive action of the fluid, if long employed at this dipping, the men frequently soak their hands in linseed-oil. One of them is occupied with the head of the Sheep, which had not been moistened; he holds in one hand a basin containing a quantity of the solution, while with the other hand he applies this all round the head, taking care not to allow it to get into the eyes. The very mangy parts are scraped, so as to remove the crusts. When all the Sheep have been dipped, they are set at liberty in an enclosed place for some hours, in order to facilitate evaporation, but without exposing them to a hot sun or a dry wind.

Creolin.—There is a tendency to replace the various antipsoric baths by creolin baths, and this preference is justified by their efficacy, their innocuousness with regard to health and the quality of the wool, the facility with which they can be employed, and their cheapness. Trials of them have been more particularly made in Germany, and their use is now officially prescribed in Prussia. Shearing having been carried out as much as possible, the crusts are softened by rubbing the most diseased places—neck, back, and croup—with a liniment composed of soft soap, 8 parts; creolin, 1; alcohol, 1. The bath is afterwards prepared for 100 Sheep, as follows: water, 55 gallons; creolin, 2 gallons. Every Sheep undergoes two dippings at an interval of seven days, each dip consisting in an immersion in the bath for three minutes, followed by a good brushing for the same time, and a second but brief immersion. Each Sheep requires about three pints of the solution. It is, of course, understood that the general rules applicable to antipsoric baths are as important in regard to this one. The value of the creolin bath has been many times recognised, and Hohenleitner and Gsell have quite recently confirmed the reports as to its utility.1

1 Hohenleitner. _Wochenschrift für Thierheilkunde und Viehzucht_, 1889, No. 15. — Gsell. _Progrès Vétérinaire_, 1890, No. 4.
**Walz's Bath.**—The oldest bath employed is that of Walz. Hering and Hertwig have particularly recommended it, and it is still in frequent use in Germany. It is composed of:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity</th>
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<tbody>
<tr>
<td>Slaked lime</td>
<td>4 parts.</td>
</tr>
<tr>
<td>Carbonate of potass</td>
<td>5 &quot;</td>
</tr>
<tr>
<td>Cow's urine</td>
<td>q.s.</td>
</tr>
<tr>
<td>Dissolve by boiling, and then add:</td>
<td></td>
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<tr>
<td>Empyreumatic oil</td>
<td>6 parts.</td>
</tr>
<tr>
<td>Vegetable tar (or coal tar)</td>
<td>3 &quot;</td>
</tr>
<tr>
<td>Mix perfectly, and dilute the whole with:</td>
<td></td>
</tr>
<tr>
<td>Cow's urine</td>
<td>20 &quot;</td>
</tr>
<tr>
<td>Water</td>
<td>800 &quot;</td>
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</tbody>
</table>

Twenty-two gallons are sufficient for 100 Sheep. The dipping requires to be repeated three times at least, sometimes four and five, at intervals of eight days, in order to ensure a complete cure. This bath is therefore inferior to the preceding preparations. The three parts of tar are usually replaced by two parts of the carbolic acid of commerce.

**Zundel's Bath.**—Zundel has devised a special bath, the formula for which has been inspired by the energetic acaricide action of pyrogenous substances, such as were employed in the comparative experiments of Hertwig, Gerlach, etc. ‘Our system,’ he says,¹ 'is really economical, as it does not cost more than twopence per head, and is a certain cure, often after only one bath. This is composed of crude carbolic acid, 53 ounces; quicklime, 36 ounces; carbonate of soda, 107 ounces; soft soap, 107 ounces. These articles, on being mixed, form a thick paste; this is diluted, when required for use, in 57 gallons of hot water—which makes a sufficient quantity for 100 previously shorn Sheep. With this rational imitation of Walz's bath, in which there is formed a caustic soda that dissolves the carbolic acid, the Sheep are washed by means of a strong brush—of dog-grass, and plunging them in the solution, which is placed in a large tub. Two men and two assistants are sufficient for the operation. Sheep which are badly affected should be washed again in four to six days.' The caustic soda which is formed in this preparation dissolves the crusts and the Psoroptes they conceal, and also dissolves the shell of the parasites' eggs; but it slightly irritates the hands of the operators. Zundel asserts that, with the degree of concentration of this bath, there is no fear that the soda will saponify the yolk, and, corroding the wool, render it dry and brittle. He prefers the crude carbolic acid to the pure article, as the essential empyreumatic oils in it are also useful.

**Tobacco.**—In Germany, the relatively low price of tobacco and its certain acaridic action, causes it to be often employed for the treatment of Sheep scabies. It was strongly recommended by Gerlach, and the following is the manner of applying it, as indicated by Zürn.²


² Zürn.
An alkaline bath is first given, composed of 9 pounds of potash, 4½ pounds of lime, and 22 gallons of water. The next day the antipsoric bath is given; this is made of 33 pounds of ordinary tobacco to 24 gallons of water. Two to three pints are required for each clipped Sheep, and double the quantity in winter when the wool is long. Each animal is kept in the bath for three or four minutes, the head being plunged in it several times, and the creature's eyes protected by the hands. The Sheep is then placed on its feet in an empty tub, where all the superfluous fluid is squeezed out of the wool. This fluid is returned to the dipping-tub. The manipulations are otherwise the same as for the arsenical baths.

These tobacco baths are limited in their action to the living Psoroptes. The eggs remain intact, and are hatched; so that the parasites from them should be destroyed before attaining the age of reproduction. This is why a second antipsoric bath is required in five, six, or eight days after the first. If there are many crusts, it is advisable to give a second alkaline bath; and in some cases, in which the pruritus continues, it is requisite to administer a third, and even a fourth, tobacco bath.

Ostertag has modified this treatment in the following manner: Employing by preference the juice of tobacco, because of its low price, he makes a decoction of 11 pounds of tobacco in 55 gallons of water, adding—after he has dissolved them separately—6½ pounds of common soda, the same quantity of soft soap, and 3½ pounds of quicklime and of crude carbolic acid. The same veterinary surgeon has also successfully employed a bath composed of water 55 gallons; pure carbolic acid, 2 pounds; potash, 2 pounds.¹

Because of its originality, we may here mention the manner of treating the disease in the Pampas of the Argentine Republic, in flocks of 2,000 to 2,500 Sheep.

The shepherd, a gaucho on horseback, drives the Sheep towards a palisaded enclosure ending in a narrow passage, through which they are obliged to defile, one after the other, the space being too small to allow two to go through at a time. This passage is continuous with a kind of trench in wood or masonry, with a sloping entrance and exit, which is filled with the antipsoric bath. The Sheep, not being able to turn round to escape, has to pass through this wet ditch, and so is gradually immersed deeper and deeper until up to the neck in the fluid. The animal finds its way out by the opposite slope, with its fleece impregnated by the fluid. The operation is very simple, and scarcely occupies more than an hour for the whole flock. The curative agent is tobacco or its refuse.²

(It is recognised in Britain, that the treatment of Sheep scabies, to be satisfactory, must be cheap, simple, and readily and quickly practicable;

² This information is obtained from Messrs. Cornouls-Houles, cloth manufacturers at Mazamet.
while it must neither hurt the Sheep or their wool, or the men who apply the remedy. It may beneficially continue in the fleece for some time after application, so that it can destroy the young acari as they are hatched from the eggs, and which have escaped destruction or removal; as most applications require repeating after a few days, and sometimes even a second or third dressing is necessary. The systems which have been found practicable are dipping, smearing or salving, and pouring. 'Dipping' consists in the thorough immersion of the Sheep in the acaricide fluid contained in a bath—or a dipping-well in some cases; and its proper performance depends on the adoption of a number of precautions, and exercise of the greatest care. The liquid used varies much in different cases and countries; every chemist has his formula for a 'Sheep-dip,' ranging from McDougall's excellent compound and Tuson's equally valuable soluble mixture, to the poisonous empirical preparations of local country chemists, and the ancient recipes in possession of shepherds and farmers.

In Australia, 'Sheep-dipping' is, as may be inferred, carried out on a very extensive scale, and instructions are issued officially. When the process is undertaken, there are generally two yards—the receiving and forcing yards—which are mostly of a circular form, which turns to advantage the habit which Sheep have of 'ringing' when disturbed in a yard, and saves labour of men and dogs; as the Sheep cannot 'pack' or stop, however much they may try. It is recognised as advisable to have the exit of the yard near to the entrance, as the instinct of the Sheep impels it to escape by the opening through which it entered. If the Sheep are tardy in moving on, a man jumps over the fence and runs through the flock in a direction opposite to that in which they are required to pass; this will start them at once. There must be several yards in series, so that too many Sheep are not in any one of them at a time; from the last yard to the dip there must be a path or race, 2 feet 3 inches wide, and 20 feet long; the last 5 feet being smooth, and at an incline of 25° to 30°, in order that the Sheep may slide along it into the dip. These yards can be used for drafting purposes, after being disinfected, by simple modifications. The race and commencement of the dip should have high fences, to prevent the Sheep jumping out. Around the dip should be a stage from which the Sheep can be thrown into the dip, either by men or by means of a tilt. The Sheep on the race and stage should not be allowed to see the dip, nor those in the yards be able to see the stage and dip. Decoy pens may be placed in such a position that the Sheep coming up see those in these pens and suspect nothing; this economizes much time. A slide gate separates the race from the dip, and is better than simple hurdles for the purpose.

Three kinds of dipping arrangements are used in Victoria and South Australia:
1. Round, 9 feet in diameter, and 8 feet deep in the clear, having a drawgate 4 feet wide at the commencement of the race from the dip into the draining yard, which race is 10 to 15 feet long by 4 feet wide, commencing at 2 feet from the bottom of the dip, and gradually rising to the level of the draining yard.

2. Oblong, 20 to 25 feet long, by 4 feet long at the stage end, gradually narrowing to 2 feet 3 inches at 12 feet from the end of the stage, remaining that width to the race to the draining yard, which is 2 feet 3 inches wide and 10 to 15 feet long.

3. This is employed with circular yards, and is similar to No. 2, but is 2 feet 3 inches wide throughout. The dip is made of pine, tongued and grooved, or of colonial timber, sawn or in slabs. Around the race and dip should be puddled to a thickness of 2 feet if colonial timber be used, and the slabs should be secured with stays attached to posts in the ground behind the dip. The depth and contents in gallons should be indicated by a plainly-marked scale on the sides. There should be a depression on the side next to the boilers to collect the mixture. Both dip and draining race should have watertight covers. The draining yards—which may be two in number, each for 200 to 300 Sheep—and the gangway which leads to them, should have battens so arranged as to allow the drippings to flow back into the dip.

The tobacco and sulphur dip is used. Infusion boilers with airtight covers must have one pound of tobacco to five gallons of water, and the infusion is made as if making tea—it is allowed to stand for eight to ten hours—then fresh water may be boiled with the tobacco for two hours, and this may be drawn off and a second boiling tried, after which the tobacco is exhausted. A measure, consisting of a cask gauged and marked, lies on the tube running from boiler to dip, and serves to measure the quantity of water passing in. The sulphur water must be thoroughly mixed with the tobacco infusion.

Six men and the overseer are required for the operation—one to the yard, two to throw in the Sheep, one to the boilers, and two men armed with crutches, consisting of a 7-foot handle attached to the middle of a head 12 inches long, made of ¼-inch round iron, bent so as to either pull or push.

The dip is filled to within 12 inches of the top, and each Sheep is made to swim round the No. 1 dip at least twice, but with Nos. 2 and 3 swimming the whole length is sufficient. By means of the crutches each Sheep is made to pass at least twice completely into the solution.

The overseer at the drawgate of the draining gangway passes each Sheep as sufficiently dipped. Care has to be taken to keep up the strength and temperature of the bath; it should not be allowed to fall lower than 2 feet 3 inches from the top, lest the Sheep's legs be broken against the bottom when they are thrown in. With a short
fleece, the bath should be at 110° Fahr. in winter, 100° in summer, and the Sheep ought to remain in it for about a minute. If the bath is colder they must be kept in longer, but the temperature of it should never be less than 85° Fahr.; with a long fleece, 90° to 95° in summer, and 95° to 100° in winter, will suffice, and each may be kept in a little shorter time, as it will take longer to drain.

The sulphur must be kept well stirred up from the bottom, in order that each Sheep may carry some away on the fleece. Mr. Bruce, of New South Wales, says: 'In putting through the first and second dipfuls of Sheep, it was at first found that some of them were killed—as has generally been supposed, by the fumes of the sulphur, which, when allowed to do so, collects at the commencement of the dipping on the surface of the mixture; and the practice has been to keep the mixture well stirred up until the third or fourth lots have left the dip.' When care is taken, there are few deaths.

4. Small portable zinc dips, 4 feet wide by 4½ deep, 6 feet long at the bottom and 9 feet long at the top, are employed for the smaller stations; they will hold three Sheep at a time, and 600 Sheep can be dipped in them daily.

Another description of Sheep-dipping is given in a Scotch newspaper which is of interest. The dipping apparatus may be in the form of a pond or trough, and may be fixed or movable. It should be narrow and deep to economize the liquid, and narrower at the bottom than the top. It should not hold more than 80 to 100 gallons of fluid; if for flocks of thirty to forty score a movable dip capable of containing 50 to 60 gallons will be sufficient. One end of the trough should slant, to facilitate lifting of the Sheep on to the drainer, and should be fitted with battens to enable the animal to walk up when turned on to its legs by the shepherd, who lifts the head, while his assistants leave the hind-legs free and lift the fore-quarters. The trough should be freely washable and have a ready outlet, and water ought to be constantly kept in it to maintain it water-tight. The drainer is a wooden or metal grating on a wooden channel inclined towards the trough, sufficiently large to accommodate forty or fifty Sheep at once, surrounded by a railing, and divided into halves, each with a gate of entry and one of exit, the latter being furnished with a sliding-board to prevent injury when the Sheep are lifted off the drainer. The dipper should have beside him a stool or inverted pail, on which to turn the Sheep, to prevent rough and hurried handling. Not fewer than six men are required for the movable apparatus, and four for the fixed. One catches the Sheep, the shepherd holds the head, two men seize the legs and turn the animal into the bath; two more men hold it on the drainer. Two enclosures should be to hand, one near the apparatus for three or four

(1 The Scottish Farmer, February 13, 1864.)
Sheep, and a larger for fifty Sheep. The fixed dipping apparatus may be paved, and roofed to keep out the rain.

The bath fluid should be of extra strength rather than weak, and it ought to be at a temperature of 80° to 95° Fahr. Not more than fifty Sheep per hour should be dipped; six men can dip 500 animals in a day, giving two or three minutes’ immersion for each. The mixture recommended is Melosson dip, which dissolves rapidly in tepid water, and is non-poisonous, even at five times the necessary strength of 1 to 40.

A good dip is the following: Take terebene—cresylic acid, a liquid residue obtainable from carbolic acid—and water, and mix in proportion, 1 to 40; add bar soap in proportion of two pounds to each gallon of the terebene, and stir with a wooden rod, warming the mixture in a water-bath until the soap is dissolved, but do not allow it to boil. When the mixture, removed from the fire, ceases to give off vapour, add oil of turpentine one pint to each gallon of terebene, and pour the mixture into casks or carboys ready for use. Add water according to circumstances. When about to use it for Sheep with chronic scabies, one gallon of the mixture is allowed for forty gallons of water; for recent cases, one to fifty; and for lambs—especially for the removal of Lice or Ticks—one to a hundred.

The Sheep should be kept in it for at least two minutes, but longer in severe cases; the dipping should be repeated in eight or ten days.¹

Sanitary Police.—The first article of the (French) law on the sanitary police of the domesticated animals of July 21, 1881, enumerates the contagious diseases which demand the application of sanitary measures, and includes ‘the scabies of the ovine and caprine species.’ Psoroptic scabies is evidently the only serious form that justifies the solicitude of the authorities; but, nevertheless, as has been stated (p. 167), the law is also applicable to sarcoptic scabies.

With regard to the measures relating to scabies, it is necessary to distinguish them as applying to the interior and to the frontier of a country.²

¹ 1. Internal Sanitary Police.—In the decree of June 22, 1882, concerning the regulation of the public administration of the law on the sanitary police of animals, it is stated:

‘Art. 39.—When scabies is discovered among animals of the ovine or caprine species, or in a flock of animals of these species, the Préfet issues an order by which these animals are placed under the observation of the district veterinary surgeon. They are not to be allowed to be driven to pasture until curative treatment has been applied, and everything has been done in conformity with the measures prescribed in the order to prevent contact with healthy animals.


(2) We cannot do better than borrow our information on this subject from the excellent Précis de Police Sanitaire Vétérinaire of our colleague, Professor Peuch.
From this it follows that the scabied animals ought to be sequestered until submitted to curative treatment; so that it is the interest of the owner to apply such treatment as soon as possible, in order to avoid the inconveniences of this sequestration. The treatment of scabies in Sheep and Goats can only be prescribed by a veterinarian, in conformity with Article 12 of the law of July 21, 1881.

This veterinarian may be either that of the sanitary district or any other, as the cost of treatment is defrayed by the owner of the flock. In any case, the scabied flock remains on the spot, under the surveillance of the sanitary veterinarian, who has the right, and whose duty it is to see that the treatment has been applied in a rational and complete manner. After this visit he decides whether the animals can be driven to pasture, and if so he recommends the shepherd, and particularly the local authority, to be careful that the recently-treated animals do not mix with the healthy animals in their vicinity; for it may happen that all the parasites are not destroyed, and then the disease will return. It is necessary for the authority to prescribe the roads, lanes, etc., by which the animals are to travel to the pastures. It may also happen that the treatment of the disease will be incomplete and insufficient if the sheepfold be not carefully disinfected.

Disinfection.—Article 19 of the Ministerial order of May 12, 1883, prescribes the procedure of disinfection in the case of Scabies as follows:

1. The litter and manure in the sheepfold and the forage left in the racks should be well sprinkled with a disinfecting fluid, then conveyed immediately on to the land. If it cannot be so disposed of, then it must be mixed with the manure in the manure-pit, which should be covered with earth to a depth of four inches.

2. The floor, racks, and the walls and woodwork to the height of five feet, are to be washed with water and cleansed, then sprayed with a disinfectant fluid.

3. Fumigation is then to be carried out as already prescribed.¹

The Sale of Diseased Animals Interdicted.—This interdiction is specified in Article 40 of the Regulations for Public Administration.

Art. 40. The disposal of animals affected with scabies is forbidden, no matter what their destination may be.

This prohibition has a very general bearing; it applies to animals sold for slaughter, or any other purpose, and its object is deduced from the facility with which the malady is transmitted, its gravity, and the necessity there is for interdicting any movement of the diseased animals before they are cured; and all the more as the specific treatment for it is simple, cheap, and prompt. Consequently, those who, misunderstanding the prohibition of the administrative authorities, expose for sale or sell these diseased animals, are liable to penalties laid down by

¹ This fumigation is made with chlorine or sulfurous acid gas. Art. 3.
the law (Art. 31). Besides, this correctional prosecution does not prevent an action for damages before the proper tribunal, if any injury has been caused by the sale of scabied Sheep.

'Obligation to Disinfect Skins and Wool.—This obligation is set forth in Article 14 of the Public Administration Regulations.

'Art. 41. The skins and wool from animals affected with scabies must not be disposed of until they have been disinfected. This obligation to disinfect is applicable to all the wool from a flock in which scabies has been detected.

'This article is due to the dangers incurred from skins and wool, so far as the contagion of scabies is concerned—at least, to animals of the same species. It should be remarked that the obligation to disinfect is extended "to all the wool from a flock in which scabies has been found," because these products may shelter the parasites or their ova, and these would spread the disease. In conformity with Article 14 of the Ministerial order of May 12, 1883, disinfection of the skins consists in their immersion in a 2 per cent. solution of sulphate of zinc. With regard to the wool, it should be disinfected by washing in a solution of carbonate of soda, in the proportion of 2 ounces to the quart of water, this wash being afterwards disinfected by the addition of carbolic acid or sulphate of zinc.

'Removal of the Declaration of Infection.—This is accomplished by a prefectural order as soon as the sanitary veterinarian has ascertained that the animals are cured, and the localities have been disinfected (Art. 24, Regulations). The owner is therefore most interested in having his flock treated without delay.

'Measures to be adopted when Scabies is discovered in a Fair or Market.—These measures consist in putting the Sheep or Goats in quarantine and immediately treating them. But if the discovery takes place in a town provided with a public slaughter-house, and the owner of the scabied animals is desirous of selling them to the butcher, the district authority will allow him to do so on condition: 1. That removal to the slaughter-house shall take place under the surveillance of a particular person, so as to prevent straggling of the diseased animals; 2. That the purchasing butcher, or other person who buys them, shall disinfect the skins and wool in the slaughter-house (Arts. 89, 90, Regulations). But it is generally more advantageous for the owner of a scabied flock to treat the animals, than to sell them in bad condition to the butcher.

'The Sheep and Goats which may have been in contact at the fair with the diseased flock, should be notified by telegraph to the authorities of the place or places to which the animals proceed, by the market authorities, so that on their arrival they may be kept under observation.
2. Sanitary Police at the Frontier.—Paragraph 7 of Article 70 of the Public Administration Regulations merely states that, in cases of importation of scabied flocks, these shall be sent back.

This measure is relatively easily carried out when the diseased flock arrives at a land frontier; but when it is a maritime one, it is evident that the animals cannot be re-embarked, nor can they be treated on board ship, supposing the disease has been discovered before they are disembarked. Then they must be isolated on shore, and subjected to treatment as soon as possible; or if local circumstances will not admit of these measures, the Sheep should be consigned to the slaughter-house or the knackers, according to their condition. In any case, their skins and wool should be treated as above directed.

With regard to those animals which have been in contact with the diseased, but which do not yet show any signs of infection, they must be considered as strongly suspected, and this should be signified by the sanitary inspectors to the authorities of the place to which they are sent, so that they may be watched. It is to be apprehended that, to avoid this surveillance, the senders may make false declarations; but this may be remedied by preventing their return, and applying to them the penalties awarded under the sanitary law.'


This form has been observed by Zürn and by Schleg. The Symbiot is similar to that of the Horse, of which it is a variety—Symbiotes communis, var. ovis—though of smaller dimensions than the type.

Like the symbiotic scabies of the Horse, this is principally located on the limbs—in the hollow of the pasterns of fine-bred but neglected Sheep, especially the Negretti breed. And like the Horse Symbiotes, those of the Sheep emigrate with difficulty from the region they have invaded, and only slowly ascend towards the upper part of the limbs. The scabies they produce is very slightly contagious, and in a flock there is only a small number of Animals attacked—sometimes no more than one per cent. Zürn is inclined to ascribe an important share to predisposition and immunity in the etiology of the disease.

At its commencement, this scabies is characterized by the redness of the skin and an abundant epidermic desquamation; later, there appear pale-yellow crusts. The pruritus is somewhat severe—the animals stamping, rubbing and gnawing the affected parts, and so giving rise to an exudation, and the formation of crusts varying in thickness; while cracks, more or less deep, appear about the pastern. Numerous Symbiotes—among which the males are nearly as abundant as the females—burrow beneath the crusts. The shepherds considered this eruption was due to food too rich in salt, because they observed it when the Sheep were stabled in winter. The hind limbs are first affected, then the fore ones, and the scrotum in the ram, the mammary region in the ewe. The body, neck and head always remain free from it.

This form of scabies is not serious, and always disappears with simple cleanliness. In any case, it readily yields to antipsoric treatment.

(Goodall, Christchurch, Hants,\(^1\) has quite recently—June, 1891—discovered this Symbiot on the feet of English Sheep, and he believes it occasions one of the forms of foot-rot, as he has discovered it where that disease was prevalent. He has found it in abundance—the males being very few—around the upper part of the claws, in the sebaceous follicles, and more especially on the interdigital skin and in the sinus there. His description of the parasite agrees generally with that given by Neumann. He states that, in his experience, glycerine kills the Symbiotes immediately they come in contact with it. To observe them and watch their movements, he makes a thin circle of Canada balsam on the glass, places the parasites within it, and puts a covering glass over them. They may then be observed alive for hours, and it will be noticed that the analculae always spread out their legs in good positions as the cover-glass gradually falls on them.)

D.—Scabies of the Goat.

On the Goat are found Sarcoptes, Psoroptes and Symbiotes. But up to the present time only two forms of scabies have been observed—the sarcoptic and symbiotic. The Psoroptes have only been seen in the pavilion of the ear, producing a benign acariasis, which will be studied when the diseases of the sensory organs are dealt with. The Goat, to judge by the experiments of Delaond, cannot contract psoroptic scabies; as he vainly tried to transmit the ordinary scabies of Sheep to that animal, by placing on its skin numerous Psoroptes taken from scabied Sheep.

1. Sarcoptic Scabies.\(^2\)

Among Thibetan Goats imported into France in 1818, through the instrumentality of Huzard, and in 1819 through the action of Joubert and Ternaux, a large number were affected with scabies, and many of these died. It is difficult to say if the disease was due to the sarcoptic or the symbiotic forms; but there can be no doubt as to this with regard to the scabies of a Persian Goat, the history of which was published by Henderson, for its disease was communicated to men and horses in the form of sarcoptic mange. And so it was with the epizootic scabies that affected the Goats in the valley of Prättigau, canton of Grisons, Switzerland, in 1851, 1852, 1853. Though Wallraf, who observed it, did find the acarus, the contagiousness of the malady with regard to Man, Horse, and Sheep, and its clinical characters in these, well demonstrated its sarcoptic nature. But it was Franz

\(^1\) Goodall. Foot-rot in Sheep: its Relation to the Presence of the Symbiotes spathiferus—ovis. The Veterinary Journal, October, 1891.

Müller, of Vienna, who first—in 1853—found Sarcoptes on the dwarf Goats of Africa, and Hebra considered them identical with those of Man. Füirstenberg studied them, and concluded that they were a distinct species—\textit{Sarcoptes capre}; and Roloff, who also undertook their study, regarded them as the \textit{Sarcoptes squamiferus} of Füirstenberg. But it is more just to name the parasite \textit{S. scabiei}, var. \textit{capre}.

\textbf{Symptoms.} — From its commencement to its termination, the disease is characterized by great itching. It begins at the head and ears, reaches the trunk and abdomen, the mammary, and finally the limbs—appearing at first in the form of small pimples, from which a viscid fluid exudes, and that soon produces dry, scaly crusts, sometimes furfuraceous, sometimes great thick plates of a shining bluish-gray tint. The hair falls off; the skin becomes thickened, dry, ridged, cracked and adherent; and the nose and lips are tumefied. Numerous Sarcoptes are found under the crusts.

At first limited to a few restricted patches, the malady, if left to itself or insufficiently treated, becomes generalized, and causes rapid emaciation, which may terminate in death.

It is capable of assuming an epizootic character. Wallraff remarked that, after the disease had shown itself in some communes of Prättigau during the summer of 1851, it extended in such a manner that in the spring of 1853, in ten communes, containing 2,596 Goats, 1,015 were affected and about 250 had died. When the epizooty had subsided, the total loss amounted to about 500 animals. Klingau reported 100 deaths in a year in one commune.

\textbf{Etiology, Contagion.} — The relatively few observations published with regard to sarcoptic scabies of the Goat, show that it attacks, by preference, breeds of Asiatic or African origin. The only exceptions to this are the outbreaks recorded by Wallraff and Klingau, in which the diseased animals belonged to the local mountain breeds. In the instance recorded in the \textit{Comptes rendus} of the Lyons Veterinary School, they were Thibetan Goats; in that reported by Henderson, it was a Persian Goat; in that mentioned by Müller, they were dwarf Goats from Khartoum, Africa; and it was in a fat-tailed ram from Africa that Roloff first saw it.

The scabies of that ram was transmitted to a male Goat, which died from it. And it is not impossible that the sarcoptic scabies of the Goat had its origin in the psoriic form of \textit{noir-muscat} of the Sheep. An experiment made by Railliet would tend to demonstrate this, as he was able to communicate a generalized and fatal scabies to a Goat by means of the Sheep sarcopt.\textsuperscript{1}

Inversely, this scabies of the Goat is transmissible to the Sheep, on which it is localized on the head, as in the natural form of sarcoptic scabies.

scabies of that animal. It is only in breeds with dry wool, poor in yolk—like the Zackel breed and the Somali Sheep—that it may extend to the other parts of the body, where the wool is scanty and coarse.

In Henderson’s case, the Goat disease was conveyed to men, who were considered as suffering from itch by the doctors attending upon them. It was the same in the epizooty at Prüttigau, where the itch, transferred to the people, assumed a particularly severe character. Horses were also infected in these two instances, and in that alluded to by Wallraff the malady extended also to the Cattle and Pigs. A herd guarding the Goats observed by Müller, was attacked on the hands by an eruption of itch, which was cured by sulphur ointment. Roloff has also collected a number of instances of pure itch occurring in people who had been in contact with his scabied Goats. On the other hand, in his experiments he could not succeed in implanting this Goat mange on other animals except short-woolled Sheep—Somalis—or Sheep with scanty wool—fat-tailed Sheep. With Merino Sheep, the Pig, Dog, Ass and Rabbit, he only obtained a very ephemeral scabies, or absolutely negative results.

**Treatment.**—In cases in which flocks of Goats are affected, the treatment by antipsoric baths—as in the psora of the Sheep—is applicable; but it is attended by greater difficulties, owing to the greater vivacity of the Caprine species. Wallraff was completely successful with Walz’s bath, which was followed by an ointment having sulphur and soft soap for its base. But some of the Goats plunged their head in the liquid, swallowed some of it, and died from poisoning.

For isolated cases, after clipping off the hair, recourse may be had to one of the antipsoric applications already mentioned for the sarcoptic scabies of the Horse.

**Sanitary Police.**—What has been stated with regard to the psoroptic scabies of the Sheep, is applicable—according to the law—to the sarcoptic scabies of the Goat.

2. **Symbiotic Scabies.**

This scabies has been studied by Delafond in the Jardin des Plantes, Paris, on Angora Goats in 1854. He recognised the parasite as belonging to the genus he named *Sarco-dermatodecete*—the Symbiot.

Railliet observed—even on Delafond’s preparations—that the male of this variety had many of the foliaceous bristles indicated by Mégin as characteristic of the *Symbioles communis*. Mollereau has recently witnessed an altogether peculiar instance of this psora.¹

The symbiotic scabies studied by Delafond began on the sides of the neck, behind the ears, on the withers, the back and loins, and sometimes at the root of the tail—more rarely on the sides of the chest and at the flanks. It produces more or less extensive, though at first incomplete, depilations, in consequence of shedding of the wool and

persistence of the hair. Yellow, hard, thick and coarse crusts form, which are very adherent; and beneath them the skin is hypertrophied, dry, wrinkled, cracked and adherent. ‘Arrived at this stage, the scabies might be mistaken for an ichthyosis,’ without the presence of the parasites. Softened with tepid water, the crust rapidly becomes a whitish pulp, which, under the microscope, is seen to be composed of granules, distorted pus cells, and almost exclusively of epidermic cells. The Symbiotes are always beneath the crusts, and especially those of recent formation. The lesions of the skin induce tumefaction of the neighbouring lymphatic glands.

The wool of the Angora Goats becomes matted and falls off in locks, the hairs of which are dirty at the roots, and have lost their elasticity, softness and lustre; so that combing it out is difficult, and there is much waste. At those points where the disease is very old, the fibres of the wool are short, thin, and atrophied, very fine at the end, and much intermixed with the hairs proper.

This scabies has a slow course, and may remain for two or three months confined to the sacro-lumbar region; it is only after that period that it has descended to the chest and flanks, and on the limbs to the knees and hocks. It does not affect the face, ears, testicles, mammae, tail, or lower part of the legs.

It is easy to mistake it for sarcoptic scabies; but they may be distinguished from each other by their seat—at least, by their extreme generalization—by the appearance of the crusts, and more particularly, though not exclusively, by the characters of their special parasites.

In the instance recorded by Mollereau, the scabies was localized on a hind-pastern, and was manifested by a hard ring which had compressed the neighbouring parts, producing an oedematous swelling, and even commencing mortification of the skin; consequently, there was intense lameness. This thick crust was formed by shreds of straw agglutinated by serosity; its inner surface covered a multitude of the Symbiotes communis.

The treatment followed by Delafond consisted in clipping off the wool, then employing alkaline baths—about 7 to 11 pounds of carbonate of potass or soda to 22 gallons of water. The concentration of the fluid is subordinate to the thickness of the crusts, and the immersion is for a quarter of an hour, being accompanied by vigorous rubbing. ‘Two or three baths, and four or five rough rubbings, at four or five days’ interval, are sufficient to effect a cure.’ Delafond advises, in addition, local applications of Helmerich’s pomade, oil of turpentine, tar, etc.; but every kind of convenient antipsoric treatment, judiciously applied, will yield good results.

E.—Scabies of the Pig.

The Pig has only one kind of scabies—the sarcoptic form—due to the Sarcoptes scabiei, var. suis; the S. squamiferus Fürstenberg.1

It was a long time ago described by Viborg, but search for the acarus

1 We cannot admit that there are two kinds of sarcoptic scabies, due to two different varieties of Sarcoptes scabiei. This distinction has been made by Mégren after an incomplete examination of Delafond’s description, and of too brief notes supplied by Guzzoni. One of these forms was scabies of the trunk, the other that of the ears, and the sarcoptes which caused them differed in size; the one must have been the S. sc. suis, and the other was mistaken for the S. sc. hominis. Our notice of Pig scabies will show our reasons—until better informed—for rejecting this distinction.

13—2
producing it was unsuccessful. In 1847, Gurlt and Spinola had certainly found a Sarcopt in the scabies of a wild Boar, and some years afterwards the same experience occurred to Hertwig and Gerlach; but all failed to find the parasite on the domestic Pig. It was Delafond who, in 1857, discovered it at Alfort on two young Pigs of the Anglo-French breed, and intended for surgical operations. Subsequently, Müller, of Vienna, in 1864, and Kocourek, in 1865, found this Sarcopt on Chinese Pigs. We have also seen this scabies at Toulouse, affecting a Yorkshire sow and her progeny.

Symptoms.—This scabies begins with a violent pruritus. It appears to be at first localized on the head—chiefly on the ears and around the eyes, then at the withers, croup, and inner surface of the thighs; later it invades the entire surface of the body. In recent cases, no galleries are observed, but only some red, closely-set papules. The morbid secretions and the abundance of epidermic cells cause the formation of dry, whitish-gray, lustrous crusts, which are adherent while yet thin, but easily detached when not so, and sometimes attaining a thickness of 5 mm. to 10 mm. The skin is wrinkled, and the bristles are either shed or pushed from their follicles: they lie on the surface of the integument, agglutinated into small tufts, to fall off afterwards. The crusts are more or less extensive, according to the age of the disease. Frequently the whole head is invaded, and even the greater part of the trunk, when the animals look as if powdered with dry guano, according to the remark of Müller. Beneath the crusts the skin is excoriated and cracked, especially at the bottom of the wrinkles; and on the chest and abdomen it may become 3 cm. or 4 cm. thick. In the other regions—and particularly at the base of the ears—the hypertrophied papillæ form tubercles from the size of a pea to that of a bean, and which may be compared, for shape and dimensions, to the papillæ on the Ox’s tongue, or the warts on a Cow’s teats or lips of the Dog. These hypertrophied cutaneous papillæ are embedded in the crusts, beneath which the Sarcoptes are found.

In order to discover the parasites, it is sometimes necessary to scrape the skin to the quick, and even then the search will often be without result; this explains the non-success of the earlier investigations. The size of the parasites renders them perceptible to the naked eye, and especially if a pocket lens is used. They are the largest variety of the Sarcoptes scabiei, the ovigerous female measuring from 40 mm. to 50 mm. long, and 32 mm. to 39 mm. broad; while the male is 25 mm. to 35 mm. long, and 19 mm. to 30 mm. broad. Guzzoni found some, in scabies of the ears, the dimensions of which were about those of S. scabiei, var. hominis, the ovigerous female being

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197

197

ACARIASES.

30 mm. long, and 26 mm. broad; and the male 20 mm. long, and 16 mm. broad.

Swine scabies progresses slowly. When it has invaded a large surface of the body, it hinders fattening and gradually causes marasmus.

Etiology, Contagion.—This scabies appears to be rare, although it is stated to be relatively frequent in Holland, and more prevalent in the centre and west of France than in the other parts of the country. It is possible that, as Viborg asserts, excessive misery and uncleanliness are the predisposing causes.

Contagion is evidently the only efficient cause, though it does not appear to be alike for all animals; for it has been already shown that the disease has been more particularly studied on Pigs of improved breeds; and it has been observed that young Pigs of common breed have been in daily contact with those of English breed—and which contracted the disease from their parent—without becoming infested. There is nothing in the accounts of this scabies which allows of the disease being traced to its source. 'It is not rare,' says Viborg, 'for Pigs to take the mange from burrowing in the manure of mangy Sheep, Cattle and Horses.' This is a bold assertion which experiments do not justify, as Gerlach has inoculated Pigs with Sarcoptes from the Horse and Cat, with a negative result; and according to Spinola, the Sarcopt of the wild Boar only will, when transferred to the domestic Pig, cause mange.

The scabies of the Pig is contagious for Man, as the clinical observations of Bateman,1 von Gemmern, Bontekoe, and Heckmeyer—quoted by Delafond and Bourguignon—prove; but the eruption disappears spontaneously in about five days. Depositing the Sarcoptes of the wild Boar on the arm of Man induces an exanthem which disappears in eight to ten days (Gerlach). Delafond contracted the disease in studying and dissecting the skin of an affected Pig; the malady progressed slowly, and it was only towards the thirtieth day that it threatened to become generalized, when Delafond cured himself with Helmerich's pomade. At the Dresden Veterinary School,2 two students, by means of a bandage, fastened on their arm a piece of diseased skin from a mangy Sow, and there resulted a very pruriginous itch that, in one of them, subsided of itself in about forty-eight hours, but in the other had to be treated by creosote ointment.

Scabies of the Pig is transmissible, according to Viborg, to all the domesticated animals; but Am-Pach—quoted by Gerlach—states that it is only communicated to the Dog. At Dresden, a fragment of the skin of a mangy Pig was fixed on the neck of a dog; this gave rise to a violent pruritus that reached its maximum in about forty-eight hours; then it gradually subsided, and on the eighth day had disappeared.

2 Bericht über das Veterinärwesen im K. Sachsen für 1877, p. 66.
The same experiment made on the back of a Sheep was absolutely negative; but the proof would have been more convincing if the attempt had been made on the face of the Sheep, which is the seat of the sarcoptic scabies special to the ovine species.

Treatment.—The disinfection of the pigsties is a necessary prophylactic measure. Treatment consists at first of alkaline baths, accompanied by vigorous friction, so as to remove as many of the crusts as possible. As an antipsoric remedy, Viborg has recommended a decoction of an ounce of tobacco in half a gallon of water, to be reduced to a quart. In the case of chronic and extensive disease, Delafond counsels several hard rubbings with Helmerich's pomade, or with a mixture of oil of turpentine 8 parts and flowers of sulphur 1 part. The use of Helmerich's pomade has given us an easy and complete success in the case of a Sow and her litter.

F.—Sarcoptic Scabies of the Rabbit.

We have already seen that, in the fur of the Rabbit, we may find three kinds of microscopical Acarina not belonging to the psoric Sarcoptidae, and rarely causing cutaneous lesions. These are the pteroptoid Gamasus (p. 105), the parasitivorous Cheyletus (p. 109), and the Listrophorus gibbus (p. 111). Independently of these Acarina, a Sarcopt and a Psoropt live on the head of the Rabbit and produce two diseases—a sarcoptic scabies, and a psoroptic acariasis having its seat in the ear. The latter will be studied hereafter, when the parasitic maladies of the sensory organs are considered.

Gohier asserted that he had seen this scabies on the domestic Rabbit, and discovered the parasite. Hrazard has given a description of the affection; and Gerlach also describes it, and gives a figure of the parasite, which he names the Sarcoptes cuniculi. We have already said that it belongs to the Sarcoptes minor, var. cuniculi—it being so placed by Fürstenberg. Railliet has had occasion to study this scabies.

Symptoms.—Sarcoptic scabies at first affects the nose, then the lips and the forehead. Gerlach has never seen it extend beyond this; but in a Rabbit which died from it, Railliet noted that, after the malady had attained the margin of the eyes, the face, forehead, and lips, it reached the lower jaw to the root of the neck, the lower half of the outer surface of the auricular concha, the fore-legs as far as the elbows, and the hind ones to the hocks. It produces an acute pruritus, which compels the rabbits to rub against anything near them, and to scratch

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1 We believe we ought—at least provisionally—to make an exception in the case of a symbiotic acariasis, the existence of which has been indicated by Zürrn in the Augsburg 'Wochenschrift' for 1874, and which appears to have been due to a Symbiotes cuniculi. The disease was located in the external ear, like sarcoptic scabies, of which it showed all the symptoms. Perhaps there was confusion in determining the parasite.

themselves with their hind-feet. The hair falls off, and white or grayish crusts appear; these are at first thin, but later become more than a centimetre thick, and are very adherent. When they are removed, the skin is red and bleeding, and on their lower surface are found the Sarcoptes, which are imbedded in them like the *Sarcoptes mutans* of the scabies of the feet of the Gallinace.

According to Huzard, this disease is very contagious. It arrests the growth of young Rabbits, sometimes renders the prehension of food impossible, and may result in fatal marasmus.

Diagnosis is easy in presence of the Sarcoptes, as these cannot be mistaken for any other of the three non-pсорic Acarina which live in the fur of Rabbits; neither can it be mistaken for the favus that sometimes attacks these animals—the tinea favosa, which is not necessarily localized on the head, and which manifests itself by limited, circular, cupped, and thick crusts (*favus*) of a yellowish-gray or sulphur hue, formed by a Fungus—the *Achorion Schënleinii*, which requires a higher magnifying power to distinguish it than is needed to discover the Sarcopt.

**Etiology, Contagion.**—It is not established that the sarcoptic scabies of the Rabbit may be derived from that of the Rat or Cat, which are both due to the same kind of Sarcopt. Gerlach was certain that the Sarcopt of the Rabbit could neither live nor produce scabies on any of the domesticated animals—not even the Cat—when a large number are deposited on their skin. On the skin of Man they cause a trifling disturbance—scarcely pruriginous—that disappears in two or three days; though Zürn asserts that the Rabbit scabies is transmissible to Man.

This disease appears to be very prevalent in Germany. According to the *Australasian Medical Gazette* for June, 1888, it was proposed to introduce it into Australia to destroy the Rabbits there, the multiplication of which has become a scourge.

**Treatment.**—Remove the hair over the diseased part, and even beyond it; rub the skin with soft soap, allowing it to remain on for a short time before washing off; repeat this a second time, if need be, and at five hours' interval; apply twice or thrice to all the mangy and adjoining healthy parts the pomade of Helmerich. Five hours after the last dressing wash these parts (Delafond).

**G.—Scabies of the Dromedary and Camel.**

The Dromedary and Camel are very often affected with scabies, and the prophylaxis of this malady occupies an important place in their hygiene.

This is a sarcoptic scabies, the parasite of which was seen in 1827, according to the report of Biett, by an anatomical assistant in the King's Garden, who thought it was a Sarcopt. In 1841, P. Gervais found it on a Dromedary recently sent from Africa to the Museum of
Natural History, Paris. The Sarcopt of the Dromedary and Camel belong to the species *Sarcoptes scabiei*, in which it forms the variety *comelli*—common also to the Llama, Giraffe, and the *Antilope bubalis*.

The scabies of the Dromedary, which the Arabs have doubtless known from time immemorial, has been particularly studied by the veterinarians of the French army of Africa—Flaubert, Gourdon and Naudin, Chevalier, Imbert, and especially Vallon. Haslam and other veterinarians of the English army in India have also given much information with regard to this disease in the Camel.1

**Symptoms.**—The scabies of the Dromedary and Camel is accompanied by a violent pruritus, which keeps the animal in a state of continual agitation, and causes it to rub itself against everything within its reach—trees, ground, its companions, etc. The malady commences where the skin is thin—inside the anus, flanks, and inferior parts of the abdomen; then it invades the trunk, withers, tail, legs, and interdigital region. It is manifested at first by pimples, which attain a centimetre in diameter, and soon become hairless and exoriated by rubbing. Crusts form; the hairs are detached in places and fall in tufts. The skin is thickened, wrinkled, and covered by dark, thick, and very adherent crusts. The disease makes rapid progress; the crusts increase in thickness and extent; the skin is wrinkled, ridged, cracked, and fissured; from ulcerations flows a scanty, but very foetid discharge, and the animal presents a repulsive appearance.

The affection quickly determines a grave cachexia, and multiple adenites and lymphangites, as well as anasarca, phlebitis of the posterior limbs, traumatic arthritis, repeated and furious rubbings, and in some cases tetanus.

The rapid progress of the disease, the complications accompanying it, and the living in herds, contribute to give a particular gravity to the prognosis. Isolated cases are easily cured at the commencement, but when the disease has become generalized, recovery from it is doubtful. What justifies the redoubtable reputation that is attached to Camel mange, is the employment of this animal in caravans travelling far from places where the necessary medicaments are to be procured.

**Etiology, Contagion.**—Predisposing causes have been, from the earliest times, more invoked for this scabies than for any other, to explain its appearance. Debility, physiological misery, and uncleanli-

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ness no doubt play an important part. Young and old animals are more often mangy than adults; and it is in the springtime that the malady prevails among Dromedaries, and invades the greater part of the cutaneous surface.

But it is clear that contagion is the efficient cause, favoured by the promiscuousness in which the Camels and Dromedaries employed in caravans live—carrying baggage, food and munitions of armies. Vallon states that when a mangy animal is introduced into a healthy troop, fifteen or twenty days afterwards cases of the disease appear among the latter, and soon all arc infested.

The scabies of the Camel and Dromedary is transmissible to Man. Louis Franck, Straus-Durckheim, and Hamon have given instances. The best-known case is that which Biett has reported. Six Dromedaries sent from Egypt to the Museum of Natural History (Paris), in 1827, were attacked by scabies, which was communicated to the men who cleaned them. 'Ten of these men,' says Biett, 'were admitted to the Saint-Louis Hospital. The eruption was so intense on several of them, that there supervened symptoms of gastro-intestinal inflammation, and in two of them—vigorously-constituted men—there was general infiltration.'

According to Palgrave, the itch that frequently affects mankind in Arabia appears to be derived from the Camel, on which it is very common. Béranger-Féraud has observed a psoric disease in Senegal, named larbisch by the Oulofs and Toucolors, and which is characterized by the presence, on the fingers and other parts of the body, of furrows like those of scabies. The parasite has not yet been seen, but Carpot thinks that it is the Sarcopt of mange of the Dromedary (R. Blanchard).

Treatment.—The development of scabies in the Dromedary, as well as its transmission, can be prevented by keeping the skin always clean, in properly sheltering the animals, in sparing them from long fatigue and privations, and more especially in preventing them from coming in contact with mangy animals.

During treatment, they should have alible nourishment, with exercise every day, and their hygiene should be ameliorated in every way possible.

The treatment is begun by general clipping, if the malady has not yet caused vast depilation. On the shores of the Red Sea, the mangy Camels are often treated by simply bathing them in the sea for half an hour every day, and when they come out of the water an experienced native rubs the skin with a polished stone, while another throws water over the parts that are rubbed—the operation being terminated by thorough washing. The rubbing with the stone has to be carefully

carried out, so as not to produce new excoriations or cause the old ones to bleed.

Lotions of sulphurated potash completely failed at Alfort in 1827. In Africa, from time immemorial, tar has been considered a panacea against scabies. The Prophet said: 'For mange of the Camel, tar is the remedy' (Vallon). And when the Dromedary is two years old, the Arabs are in the habit of rubbing it with tar three times a year after clipping, in order to protect it from mange and the attacks of flies. This tar is obtained from the wood of the Juniperus phœnica and Thuya articulata. They make a mixture of two parts of tar to one of water, rubbing it on the skin moderately warm, when it appears homogeneous. This tarring requires particular care; for when the mixture is too strong, the animals succumb to a kind of cutaneous asphyxia—instances of which occur every year. Such accidents are averted by employing a mixture of tar and soft soap, applied rather warm. The Arabs in Egypt dilute the tar with fish-oil.¹


Independently of the demodec scabies, the Dog may have an ordinary scabies—the sarcoptic—due to the Sarcoptes scabiei; an auricular acarasis—symbiotic—caused by the Symbiotes auricularum of Lucas and Nicolet, the Choriopites ecandatus of Mégnin. The latter will be noticed in the chapter on parasitic affections of the ear.

In practice, the sarcoptic scabies of the Dog is considered a common disease; but many of those who have assiduously sought for the Sarcopt regard it as rare. Fürstenberg and Delafond, in their numerous investigations, have met with it—the first in one instance, the second in two; and Mégnin has only found it in two or three cases among the hundreds of Dogs he examined, and which were considered mangy. Our own researches remained fruitless until we began to employ the solution of potass (see p. 132); since then the parasite has not been rare.

Observers—such as Bosc, Gohier, Bonnes, Hertwig and Hering²—have for a long time noticed the occurrence of psoric Sarcoptidea on the Dog; but the descriptions they give are too brief or too incomplete, and it is not at all certain that they had to do with the Sarcoptes.

¹ 'The itch, and its best remedy, sulphur, abound from one end of Arabia to the other; but the unskilfulness of the Arabs themselves in the application of the mineral often thwarts its effect, or leaves it only partial. This unseemly affection is common among Camels, and from them is frequently communicated to men.' Palgrave. Eastern and Central Arabia, II., p. 34. In the Soudan expeditions in 1855 and 1857, the Camels supplied to the English troops suffered very much from mange, and the losses were, consequently, very heavy.

Gerlach has described the Sarcoptes of the Dog and the scabies it determines; but his description of the Sarcopt is, unfortunately, incomplete and inexact in many points.

Gurlt and Fürstenberg found on a mangy Dog a variety of Sarcopt of large dimensions, which might be the same kind met with by Railliet and Cadiot on a Dog affected with crusted mange; the same was also observed by Mégnin on Wolves in a menagerie, which also had this crusted form of scabies—this was the S. scabiei, var. lupi; and it was also the same as that found by Fürstenberg in the scabies of Man known as Norwegian itch—so named from the country in which it is most frequently seen—a variety of the parasite that he designated S. scabiei crustose. The Sarcopt of ordinary sarcoptic mange of the Dog—which was certainly seen first by Delafond, then by Mégnin, Railliet and Cadiot, etc.—is a little larger than that of Man; it is the S. scabiei, var. canis.

**Symptoms.**—Sarcoptic scabies may appear on any part of the body, but it usually begins on the head, muzzle, around the eyes, and on the ears. It then reaches the belly, the under surface of the chest, the sides, root of the tail, legs, etc., and this so rapidly, that at the end of a month the invasion is general.

It first manifests itself by red punctiform spots, resembling Flea-bites, and which can only be seen where the skin is thin and not pigmented—as on the abdomen, in the arm-pits and flanks—though rubbing often renders them diffuse. On these surfaces the early red points are soon converted into papules from the size of a lentil to that of a pea, the summit of which becomes vesiculous, ruptures, and allows much serosity to escape. This effect is most frequently due to the repeated scratchings under the influence of the pruritus, which lead to the production of more or less extensive moist patches. There may also be seen—and particularly on the fine skin of the belly and flanks—vesicles which are being transformed into pustules—a dark point in their centre communicating with the gallery of the Sarcopt. Sometimes the mange remains dry, and is marked by an abundant formation of scurf and by depilations. As a rule, the surfaces first invaded become dry, and are covered by grayish-yellow crusts, which gradually scale off. The depilated and thickened skin becomes ridged, wrinkled, and excoriated; and in cases of generalized scabies the Dog exhales an offensive odour, and presents a repulsive appearance.

The pruritus is always intense, particularly if the patient is kept in a warm place, and after running. The disease induces a grave state of cachexia and marasmus by the insomnia, continual agitation, deprivations.

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1 According to the celebrated dermatologist, Hebra, the Norwegian itch is not due to a particular kind of Sarcopt, as was at first believed, but to the S. scabiei, var. hominis, of ordinary scabies, from which it only differs in the greater number of the Sarcoptes and the accumulation of their débris.
tion of rest, and suspension of the cutaneous functions; and death ensues in two or three months if treatment is not adopted.

Diagnosis.—*Follicular* or *demodecic* scabies is often mistaken for sarcoptic scabies, and this confusion entails an erroneous prognosis; for while the first is very difficult to cure, the latter is comparatively easy to get rid of. *Follicular* scabies commences like sarcoptic scabies, but the surface it affects is dry; in the latter form it is covered with small yellow crusts, and the papules rarely become pustules—while the acne pimples are, on the contrary, an almost constant sign of follicular scabies, which is also less pruriginous and slower in its course. But discovery of the parasite confirms the diagnosis.

Sarcoptic scabies may also be confounded with what has been termed red mange (*rouge* or *rouget*)—a frequent, but non-parasitic, skin affection of young Dogs, which commences beneath the chest and abdomen and inner surface of the limbs, and is characterized by the red colour of the skin, the almost total absence of humidity, and much itching.

Another skin disease is the *roux-vieux, dartre sèche, rogne* (dry mange), which is frequent on old or fat Dogs, and is located on the back, more especially on the loins, where it is recognised by the erect hairs—which are reddish at their base—and by the induration of the skin, which is thickened, wrinkled and cracked, brownish-red, slightly pruriginous, and from its cracks there may exude a sero-sanguineous fluid that, on drying, becomes brown irregular crusts. These different signs, as well as the absence of the parasite, lead to a diagnosis.

The *humid mange* or *tetter* (*dartre humide* or *dartre vire*) has a varied seat, and consists in more or less depilated, irregular patches, showing numerous small vesicles, the contents of which escape and keep the diseased surface always moist. There is no parasite, and the malady extends slowly.

The *dry* or *scaly eczema* (*dartre sèche, dartre farineux*), or *pityriasis*, is very tenacious in old Dogs, and is situated on the head, neck, and back, causing moderate pruritus, and having little tendency to spread; it is also recognised by the abundance of epidermic pellicles that cover the diseased surface.

Lastly, *trombidian acariasis*, due to the larval hexapod of the *Trombidium holosericeum* (see p. 106), has its principal seat around the eyes, and on the paws and belly. A careful examination will discover the parasite, and thus eliminate scabies from the diagnosis.

Etiology, Contagion.—Youth, debility, or a sickly condition may be considered as predisposing, but not necessary causes; for the Sarcoptes will live on animals of all ages and in all conditions. The existence of follicular scabies also predisposes to the invasion of sarcoptic scabies; but it is evident that contagion is the essential cause. The admitted rarity of this malady has led to the supposition that Dogs suffering from it have been in contact with itchy people, or have con-
tracted it while hunting game (Wolf, Wild Boar) affected with psora. But it has been seen in an epizoötic form; for in Germany, in 1800, it attacked 10 per cent. of the Dogs, especially in such cities as Berlin, Munich, Stuttgart, and Cologne. 1 During the year 1886–87, of 8,999 animals attending the canine clinic of the Berlin school, 639 were affected with sarcoptic mange. The asylums for Dogs contributed largely to its dissemination' (Friedberger and Fröhner).

Facts of contagion from Dog to Dog—to-day a matter of current observation—have been published by Rayer, Littré, Leblanc, Sabatier, 2 and have been well established by Delafond, who also observed that the sarcoptic scabies of the Cat may be transmitted to the Dog, although due to the Sarcoptes minor, and not to the Sarcoptes scabiei. He deposited on the skin of a bitch in perfect health, 125 Sarcoptes taken from a mangy Cat; and in about a month she was covered with a generalized scabies. In another experiment, four mangy kittens were put to a bitch, which suckled them along with three puppies that she was already nursing. She became mangy, as well as her own progeny, which died of the disease in about two months.

Delafond did not succeed in developing mange of the Dog by Sarcoptes taken from psoric people. On the contrary, however, numerous examples show that Dog scabies can be transmitted to Man. 3

Chabert says that Dog mange is communicated to Man in a very obstinate form. Grognier has seen a student whose hands were covered with itch after having rubbed a mangy Dog. Viborg gives an instance of a Man and Woman who became psoric from a Dog they possessed. Mouronval furnishes a similar instance. Chavassieu d'Audebert assures us that the Dog and Cat may transmit a very troublesome itch to Man. Biett has seen a child which became infected through caressing a mangy Dog. Hertwig, Heckmeyer, Stütz, and Marrel have published observations of the same kind. Delafond saw a student contract the itch on attending a diseased Dog; and he himself became infected by depositing the Sarcoptes of the Dog on his skin, the itch resulting continuing for about forty-five days, and only ceasing on the adoption of antipsoric treatment. The same experimental result was produced on a student; on two others there was only a fugacious eruption. Lastly, Gerlach was likewise able to transmit the mange of the Dog to Man, and states that he on two occasions witnessed spontaneous transmission. More recently, Friedberger has seen such transmission from Dogs to women and children; in the latter there was a very pruriginous eruption between the fingers, and

1 L'Éléveur, 1891, p. 13.
2 Thesis of Got, 1844.
on the arms and abdomen. Leonhard reports an analogous case. We have also known of another; and in the epizooty that occurred in Germany in 1890, hundreds of people who had been in contact with mangy dogs in Berlin were contaminated. Fröhner in one month reported twenty-one cases of this contagion.

According to Zirn, the Sarcopt of the Dog can be conveyed to the Pig and Horse.

**Treatment.**—Contagion must be prevented by isolating diseased from healthy Dogs, burning litter, washing kennels—the wooden portions with boiling water kept so in the place to be cleansed, or with creolinated water, 5 to 100—the parts in masonry being lime-washed; in a word, carrying out the various measures already repeatedly indicated.

To combat the debilitating effects of the mange, an abundance of animal and vegetable food—varied and substantial—should be given, combined with tonics. Exercise, and living in the open air as much as possible, should also be allowed.

With regard to medical treatment, the first operation to be carried out is general clipping for long-haired Dogs, no matter how limited the diseased parts may appear. Cleanliness is indispensable. The litter must be frequently renewed, and the patient must be well washed with soft soap and water; a vigorous brushing in the bath at the same time will remove the crusts and diminish the number of parasites. Care must be taken that the animal does not lick off the remedy—especially if it is toxic—by employing a muzzle or a leather covering.

The antipsoric remedies that may be employed are numerous. Friedberger and Fröhner much recommend creolin in the form of a liniment composed of creolin and soft soap, 1 part of each, alcohol \( \frac{1}{2} \) to 10 parts, according to the extent and degree of the malady. In generalized scabies, one-third of the body is dressed each day, and a cure is effected in from eight to twenty days. Alcoholized creolin may be employed, 1 to 10, or 1 to 20, or creolin soap. This agent is very efficacious, and absolutely without danger.

At the Toulouse Veterinary School, cevadille-oil is usually employed (see p. 148), sometimes cade oil, or a mixture of equal parts of oil of petroleum and linseed oil.

Gerlach approved of Peruvian balsam dissolved in alcohol, 1 to 30; its vanilla-like odour renders it suitable for house Dogs. Styrax may be used in the same way. These medicaments give excellent results. Many practitioners employ simple carbolized soap—that is, carbolic acid incorporated with soap in the proportion of 1 to 20; the animal is smeared over with it before it is washed off.

The pomade of Helmerich—about 100 grammes for a medium-sized Dog—is a simple and frequently-employed remedy. When the Dog

(1 Creolin is better known in England as a refined preparation of Jeyes' Fluid.)
has been well dried after its soap bath, it receives a first dressing, which is left on for twenty-four hours. Next day this is washed off with soap and water, and a second dressing is applied. If it has acted well, there is rarely any necessity for applying a third dressing.

Tar cannot be recommended, as it is dangerous to cover all the surface of the skin with it. Ellenberger and Hofmeister\(^1\) have reported a case of fatal poisoning of a Dog which was affected with mange, and had the whole body covered with tar. If this substance is employed, it should be mixed with an equal quantity of soft soap, and alcohol added to give the mixture the consistence of a liniment. The dressing should be extended over three days, only one-third of the body being dressed each day, and a bath given on the fourth day. This series of operations ought to be repeated three or four times.

The oil of lavender and oil of turpentine have often been used for mange of the Dog; but the first is uncertain in its effects, and the second is too irritating, although it forms the most active ingredient in the following application, which is much appreciated by sportsmen and veterinary surgeons:

Sea salt - - - - - - 150 grammes.
Gunpowder - - - - - - 10 "
Flowers of sulphur - - - - - - 140 "
Vinegar - - - - - - 1 litre.

The mixture is made at a boiling temperature, and continually stirred. When it is homogeneous, it is allowed to cool until tepid, and then there is carefully mixed with it:

Oil of turpentine - - - - - - 90 grammes.

This remedy is employed tepid. It causes an irritation of the skin that does not disappear for some days, and it is therefore not to be recommended.

Another remedy generally employed also by sportsmen and dog-keepers, and which was indicated in 1740 by Gaffet de la Brifardière, and recommended by Prangé under the name of oleo-sulphuret of tannin,\(^2\) comprises:

Nut oil - - - - - - 1500 grammes.
Powdered nut-galls - - - - - - 30 "
Sublimed sulphur - - - - - - 80 "

Heat the oil until the finger cannot be held in it, then gradually add the sulphur, and constantly stir with a wooden spatula, adding in the same way the nut-galls; afterwards heat the whole for half an hour.

This remedy is efficacious, but it possesses no real superiority, and has the disadvantage of irritating the skin.

Benzine and creosote are recommended by Gerlach and Zürn, when mixed with oil or alcohol—1 to 30 to 60; but it has been reported that they are too irritating, and even toxic.

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Naphthalin, lauded by Fürbringer, Fischer, etc., has been successfully employed by Siedamgrotzky, in the following form:

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<td>Naphthalin</td>
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The cure is complete in twelve to fourteen days. This is a cheap remedy and soothing to the skin; it answers when the disease is commencing, and for house Dogs.

I.—Sarcoptic Scabies of the Cat.

The Cat may be affected with a sarcoptic scabies, due to the Sarcoptes minor, var. cati (see p. 124), and a symbiotic acariasis due—like that of the Dog—to the Symbiotes auricularum. (See Parasitic Diseases of the Ear.)

The earliest mention of Scabies of the Cat is due to Wedelius. In 1672, he described an epizoöty which, in two years, and for an extent of some miles, prevailed in Westphalia with such violence that nearly all the Cats perished. Notwithstanding the manifest exaggregation in his account—and particularly with regard to the changes occurring in the eyes—it seems very probable that it was scabies he saw. Girtanner has also published some positive documents on this affection. Rigot, in 1811, remarked on an outbreak of scabies among Cats in the neighbourhood of Château-Gontier, Mayenne, and which prevailed for nearly four years; and, in 1827, Sajous, a veterinary surgeon at Tarbes, presented a memoir to the Central Society of Agriculture, on an epizoöty of scabies which had existed for some years, and had killed all the Cats in entire villages. Analogous observations, of which mention will be made hereafter, have also been published; and altogether they prove that the malady has been known for a long time.

If Gohier was the first writer who speaks of having seen the Sarcopt of the Cat in 1813, Hering has given the first description of it; but he only saw the male, and is inexact in several details.

The Sarcopt is now well known, owing to the works of Rayer, Gerlach, Fürstenberg, and Delafond and Bourguignon. The latter considered it to be a distinct species, and named it the "Sarcopte notoëdre," a designation given because of the dorsal position of the anus. Fürstenberg named it the Sarcoptes minor, and in this species it forms the variety cati.

Symptoms.—Scabies of the Cat usually commences on the neck, reaches the ears and forehead, then all the head, and rarely goes beyond

the anterior part of the neck. A pruritus of variable intensity is one of the early symptoms.

The initial lesion is a vesicle or papule the size of a pin's head; this is promptly ruptured and transformed into a crust. The multiplication of the vesicles, and their replacement by crusts, brings about the invasion of larger surfaces, which are covered by grayish, hard crusts that agglutinate the hairs, the greater portion of which are rapidly shed. The skin becomes thickened, hard and wrinkled; the eyelids are inverted, the eyes are buried in their orbits, and there is more or less intense conjunctivitis. The swollen tissues obstruct the nostrils, embarrassing the respiration; the animal is feeble and languishing, has a melancholy and repulsive physiognomy, and finally succumbs to the disease, if it is not opportunely sacrificed. Death usually ensues in four to six months, though it is earlier in young animals, or when the malady is epizootic.

According to Mégnin, the dwarf Sarcopt does not excavate a subcutaneous gallery like the common Sarcopt, but makes a simple nest that appears as a miliary eminence; this, when raised on the point of a scalpel, is found to be composed of a layer of epidermis surrounding ova in all stages of incubation, as well as an ovigerous female and her excrements in the form of brown, cylindrical corpuscles. The larvæ, nymphæ and males wander in the midst of the crusts.

Diagnosis.—The diagnosis of this disease is not difficult. Its commencement on the head and persistency in that region, its rare extension to other parts, the ready discovery of the Sarcoptes, and the special characters of this psora, suffice to remove any doubts as to its nature. It should not be mistaken for a non-parasitic, very tenacious prurigo that sometimes attacks emasculated Cats, and is located on the belly, flanks, back, legs and tail—rarely the head; it consists of small, dry papules, and is very pruriginous and obstinate.

An analogous, but ephemeral eruption is at times seen on nursing Cats which are suddenly deprived of their young.

It is not possible to mistake this scabies for the prurigo of the "rouget," due to the larvæ of the Trombidium holosericeum, nor with the punctures of Fleas, or the skin affections of old house Cats, which affections have not an invariable localization, and consist of pustular surfaces with thick isolated crusts, and a moderate degree of itching.

Lastly, favus is recognised by the form of its parasitic cup-shaped crusts, which are usually sulphur-coloured, and by the presence of the Achorion.

Prognosis.—Scabies of the Cat is only serious when it is chronic, and when the animals affected have habits of independence which prevent their being submitted to regular treatment; then it follows its natural course and terminates in death. It is more especially serious when it assumes an epizootic form, and when its gravity cannot be
ascribed to any plausible cause. When it is taken at the commencement it is easily cured. Its serious character is increased by the fact of its contagiousness for Man and the domesticated animals.

**Etiology, Contagion.**—Of 45 scabied Cats, Delafond found 26 aged from 4 to 7 years, 15 from 2 to 3 years, and 5 of six months to a year. The largest proportion of Cats being aged, is probably due to the circumstance that they are less attractive and useful than young ones, and are therefore often driven from their homes and exposed to misery and uncleanliness—that is, to all the predisposing conditions of psoric affections.

Among these 45 Cats, 20 were males, 15 were females, and 10 had been castrated. Sex does not appear to be of any importance in this question; although emasculated animals, from their sedentary habits, are less exposed to contagion than the others, and especially the males, which act so readily as contagiferous agents from Cat to Cat, and to which no doubt must be ascribed the epizooties, some of which have been referred to. To these outbreaks must be added that observed in 1843 and 1846 among the Cats in Offenbourg, Grand Duchy of Baden, and which was reported upon by Bell. Delwart mentions having seen the disease in large farms, where many Cats are kept, communicated with such rapidity that in four or five weeks all these animals had perished.¹

Although the dwarf Sarcopt also causes scabies in Rats, it is not established that it is in hunting these that the Cat contracts the malady; for sufficient observations have not been collected on this point, nor has it been noted that Rats were mangy during the epizooties of scabies reported among Cats.

Delafond has succeeded in developing scabies on a Cat, by depositing on it Sarcoptes from a Lion, and on another by cohabitation with a mangy Dog; but these two Cats recovered spontaneously, for their scabies remained artificial, being due to the *Sarcoptes scabiei*, and not to the *S. minor*.

Scabies of the Cat may be transmitted to Man. Hertwig relates the case of a servant who contracted the disease through allowing a mangy Cat to lie in her bed. Berthold cites that of a child who was infected by a diseased Cat, which she permitted to rest on her breast. Marrel mentions having seen Cat scabies transmitted to two adult people and a child. Hering has observed the malady transferred from the Cat to the back, chest and arms of two young people. Gerlach has experimentally effected the transmission of the disease, by depositing some crusts taken from Cats on the arms of some students; a local scabies followed, that disappeared spontaneously in about ten days in the first, fifteen days in the second, and three weeks in the fourth student;

but in a blonde and very hairy student it continued for six weeks, and at the end of that time terminated only after a sulphur bath had been administered. Perroncito has witnessed a case of contagion from a Cat to a woman, and we have knowledge of a similar fact.¹

Scabies of the Cat may also be transmitted to the Horse. Hertwig has cited the case of a Cat which gave its mange to a Horse on whose back it was accustomed to rest; and Méguin asserts that he developed an extensive outbreak on a Horse, by fixing on its withers a piece of skin from a mangy Cat; the disease was cured by a single rubbing with Helmerich’s pomade. On another occasion he has seen a mangy Cat convey its disease to two Horses, on whose backs it usually lay.

With regard to the Ox, we have already related the case of Rademacher (p. 158), in which a mangy Cat was in the habit of lying on the back of a Cow and transmitted the disease to it; from this it passed on to a servant and to all the family. We have also mentioned (p. 205) how Delafond succeeded in transmitting the Scabies of the Cat to the Dog.

Treatment.—The treatment of Cat scabies cannot include baths, in view of the repugnance of this species to water, and the danger of affections of the air-passages to which these animals would be exposed by bathing them. So at most, after carefully clipping away the hair from the diseased parts, these can only be washed with soap and water; but it would be even better to dispense with this, and have direct recourse to topical acaracides, which may be repeated.

The pomade of Helmerich is particularly convenient and successful. If the balsam of Peru is more efficacious, it is also more dangerous. We have several times seen a single rubbing on the head with this substance produce a very acute cerebral excitement, followed by torpor, and even by death. We have also witnessed the same accidents arise from the application of rancid cod-liver oil, which is recommended by Schwarz. Styrax appears to be less dangerous’ (Friedberger and Fröhner).

In the epizootic outbreak in the environs of Offenbourg, Bell successfully employed a lotion composed of chloride of zinc and water—4 to 500.

J.—Sarcoptic Scabies of the Ferret.

Independently of a Listrophorus somewhat like that of the Rabbit (see p. 111), and which lives in the fur without causing the slightest injury, the Ferret may be attacked by two species of psoric Acarina: a Sarcopt—Sarc. scabiei, var. hydrochori, and a Symbiote—S. auricularum. We shall only notice sarcoptic scabies here, as the auricular acarasis will be described among the parasitic affections of the ear.

Sarcoptic scabies was described for the first time, in 1860, by F. Peuch, who pronounced it to be due to a Sarcopt, and his remarks were confirmed by Mégnin.1

The disease is chiefly confined to the head and feet, but it may invade all the trunk. The affected parts are covered with brown or yellow crusts, beneath which the Sarcoptes are concealed; they are the seat of an almost continual pruritus, the little animal frequently biting itself, and especially the feet, with a kind of fury. When the malady is not much advanced, and not localized on the limbs or ears, the body is moist from a gelatinous, almost viscid, sweat that strongly exhales the odour of the ferret.

'To this humid phase succeeds a stage of desiccation, with shedding of the hairs, which look as if powdered with some coarse substance; and almost at the same time that these hairs fall—detached by the disease—others grow and reach the normal length. This is an indication that the malady has disappeared from the trunk, and only exists on the feet and ears, where the parasites have accumulated and intrenched themselves' (Mégnin).

On the feet, the crusts are attached to the plantar surface and the root of the claws, which may grow to an extreme length, and straighten out or bend upwards. Progression is then slow and difficult, the weight being thrown on the posterior part of the foot.

It is scarcely admissible that the Ferret contracts the disease in Rabbit-warrens, the sarcoptic scabies of these creatures being due to the Sarcoptes minor, and not to the S. scabiei. It is more likely, as Railliet remarks, that the origin of the malady is scabied pole-cats, which are frequent in Rabbit-warrens.

Peuch could not succeed in transmitting the Ferret scabies to the Dog, nor yet to Man. But his experiments were so few that they do not justify a definite conclusion.

The disease sometimes appears in an epizootic form.

Its treatment is reduced to the following prescriptions: 'Frequent dressing of the crusts with glycerine, so as to soften them and render their removal easy; then vigorous rubbing with simple sulphur ointment, or Helmerich's pomade, on the parts freed from crusts. Frequent and complete removal of the litter, and disinfection or, better, change of residence in box, chest, or barrel' (Peuch).

2. Demodecic Scabies.

These scabies are produced by the unique genus of the family of Demodecidae (see p. 95), the genus Demodex (Owen),2 the several forms of which are generally relegated to a single species, the Demodex follicularum (Owen). These Acarina live in the hair-follicles and sebaceous glands of several species of Mammalia.

History.3—In 1842, Gustave Simon, of Berlin, in examining the

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2 From *çilca*, body, and *çik*, wood-worm.

contents of pustules of Acnea sebacea of Man, recognised in the fatty matter expressed by squeezing, in the form of small masses with their external extremity dark—Comedons—the presence of animalculae, of which he gave a remarkable description. By the advice of the learned entomologist, Erichson, he considered them to be Acari, and named them Acarus folliculorum. He made known his discovery to the Berlin Society of Naturalists, when Professor Henle, of Zurich, informed him that in the preceding autumn he had observed the same parasite in the hair-follicles of the external auditory canal—so that the discovery was made almost simultaneously; though Henle appeared to entertain doubts as to the nature of what he had seen. From that time a number of observers sought for, and found, the new parasite. Owen was the first to name it the Demodex folliculorum; but Miescher called it Macrogastrer platypus; Erasmus Wilson, Entozoon folliculorum, then Steatozoon; and Paul Gervais, Simonea folliculorum. The latter designation—Frenchified into Simonée, Simonide—has often been employed in France. The natural history of the Demodex has been well established by the labours of Wedl, Gruby, Leydig, Kichenzaister, Barenstrup, Valentin, Von Siebold, Remak, Méguin, etc.

Shortly after the discovery of the Demodex of Man, Topping found that of the Dog, of which Tulk gave a description on December 20, 1843, to the Microscopical Society of London. The disease to which it gives rise was afterwards the object of numerous investigations; it is, in fact, on the Dog that the dermatosis caused by the Demodex has been the most frequently and the best studied.

Description.—The rostrum, which is a little narrower than the thorax, is salient in front, covered at its base by the epistoma, which is itself prolonged by two cheeks united on the middle line, and advanced to near the anterior extremity of the rostrum. The latter comprises:

1. A pair of cheliceræ, or mandibuli, in the form of flattened and lamellar stylets, larger behind—where they are joined on the middle line—than in front, where they are a little divergent; they are related, above, to the epistoma and cheeks.

2. A pair of maxillae or jaws, separated at their base, lying together in front, where they are continued by the maxillary palpi obscurely articulated.

3. A narrow tongue situated between the maxillæ and their upper surface, and completing the floor of the mouth.

The cephalothorax is convex superiorly, and finely striated in various directions; it is flat on its lower surface, where it shows the four pairs of legs salient on the sides. Each leg is composed of three parts or articles: the haunch, basilar, antero-posterior, triangular, summit posterior, nearly at a tangent outwardly to the margin of the thorax; the leg of the same length as the haunch, and forming with it an angle

![Diagram of Anterior Extremity of the Demodex folliculorum of the Dog, highly magnified.](image-url)

- c, cheliceræ; mx, maxilla; pm, maxillary palpi; j, cheeks; ep, epistoma; ja, leg; t, tarsus.
open in front; the tarsus, a discoid piece crowning the extremity of the leg, and furnished with two claws. These legs rest by the base of their haunch on the transverse arched epimeric, united by a middle longitudinal piece—the sternum.

The abdomen is elongated and conical, striated transversely, and shows at the anterior portion of its ventral face a longitudinal slit, which is the anus. This slit is larger in the female than the male, and probably serves for copulation and ovulation. The males have the abdomen less developed than the females, and possess a genital armature situated immediately in front of the anus.

The length of the female Demodex does not exceed 400 µ in the largest varieties; that of the males is not less than 220 µ; while the width at the thorax varies between 40 µ and 55 µ.

The Demodex are oviparous. The eggs are 60 µ to 90 µ long, and 20 µ to 50 µ broad, and are cordiform or fusiform in shape. From the egg issues a larval hexapod, the legs of which are only represented by three pairs of tubercles, while the buccal organs are yet in a rudimentary condition. After a moulting, the larva becomes an octopod, the fourth pair of legs being still tubercles, like the other three pairs. A second moulting transforms this larval octopod into a nympha, which possesses the legs and buccal organs of the perfect state, from which it only differs in the absence of sexual organs in the male, the acquisition of these being the result of a last transformation.

The Demodex have been found on Man, and the Dog, Cat, Goat, Pig, Sheep, Ox, Horse, Aristotelian Deer (Prietsch), Fox (Gros); Rat (Hahn), Field-Mouse (Zschokke), and the Surinam Bat (Leydig). In general, the difference in habit coincides with differences in the dimensions of the parasite, which at least authorizes the distinction of varieties. We have to mention:

1. **Demodex of Man** (*D. folliculorum*, var. hominis).—The female measures 330 µ long and 45 µ wide at the thorax; the male is 300 µ long and 40 µ wide. The rostrum is a little longer than it is broad. The length of the rostrum and cephalothorax combined forms nearly one-third the total length of the body. The ova are cordiform or fusiform, from 60 µ to 80 µ long, and 40 µ to 50 µ broad.

The Demodex of Man lives in the sebaceous glands of the face, where it often remains without its presence causing the slightest trouble. When there are more than a dozen in a follicle, this becomes dilated and prominent, and forms a comedon. It is rare that acne of the face can be attributed to it. Gruby assures us that forty people out of sixty are infested with it; but this proportion has generally appeared to be exaggerated.

2. **Demodex of the Dog** (*D. folliculorum*, var. canis; *D. caninus* Tulk).—The female measures 250 µ to 300 µ long, and 45 µ broad;
the male 220 μ to 250 μ long, and the same width. The rostrum is nearly as long as it is broad; and its length and that of the cephalothorax combined is a little less than half the total length. The ova are fusiform, and from 70 μ to 90 μ long, and 25 μ broad.

This Demodex causes follicular mange in the Dog.

3. Demodex of the Cat (D. folliculorum, var. catti).
—Similar to that of the Dog, but one-fourth smaller in all its dimensions.

It was found by Leydig, in 1859, on the nose of a Cat affected with Sarcoptic scabies; and by Mégnin in the external auditory canal of two Cats. It appears to be inoffensive.

4. Demodex of the Goat (D. folliculorum, var. caprae).—The female is 230 μ to 250 μ long, and 60 μ to 65 μ broad; while the male is 220 μ to 230 μ long, and 50 μ to 55 μ broad. The rostrum and cephalothorax combined are nearly equal to half the total length. The ova are ellipsoid, and from 68 μ to 80 μ long, and 33 μ to 45 μ broad.

It has been found by Niederhœusern, Railliet and Nocard, and causes a pustular dermatosis which will be referred to hereafter.

5. Demodex of the Pig (D. folliculorum, var. suis; D. phylloides Csokor).—The female measures 240 μ to 260 μ long, and 60 μ to 66 μ broad; and the male 220 μ long, and 50 μ to 57 μ broad. The rostrum is very developed, and a little longer than it is wide; its length and that of the cephalothorax is nearly equal to that of the abdomen. The eggs are ovoid, and a little contracted and elongated at the ends; they are from 100 μ to 110 μ long and 30 μ wide (Fig. 89).

This form determines a pustular affection on the Pig.

6. Demodex of the Sheep (D. folliculorum, var. ovis).—Found by Oschatz in the Meibomian glands of the Sheep; it differs from that of Man chiefly in the greater length of its rostrum and cephalothorax. It has not been seen since Oschatz found it.

7. Demodex of the Ox (D. folliculorum, var. bovis).—The average length is 200 μ. The rostrum and cephalothorax form about two-fifths of the total length. Eggs ovoid in shape. Causes a pustular affection on the Ox.

8. Demodex of the Horse (D. folliculorum, var. equi).—Found by E. Wilson1 in the product of secretion of the Meibomian glands of a Horse. He described it as identical with the Demodex of Man. In 1845, Gros also indicated the presence of the Demodex in the “muzzle” of the Horse.

A.—Demodecic Scabies of the Dog.

Synonyms.—Follicular Mange, Red Mange, Black Mange of the older veterinarians.

History.—As has been stated, the parasitic nature of this disease was first recognised by Topping; and Röll separated the affection from the other exanthemata of the Dog. Delafond and Bourguignon pointed out its gravity, and described it under the name of Acne Simonea. Verheyen proposed for it the designation of follicular mange, by which

name it is now almost exclusively known. It has been more especially studied by Gruby, Haubner, Gerlach, Sparks, Simonds, Oresti, Weiss, Friedberger, Lafosse, Saint-Cyr, Cornevin, Pennetier, Mégnin, Laulanié, etc.

**Symptoms.**—Follicular scabies presents itself under different aspects, according to its duration; and to such an extent, that one might imagine them to be different diseases, if not informed as to this polymorphism.

At the commencement, there are merely somewhat red depilations about the elbows, hocks, around the eyes, and at the toes; and in the place of the hairs are seen small papules, with a pityriasis powder covering the parasitic patches.

Gradually these depilations extend, become redder, and reach the inner surface of the paws and the cheeks; the eyelids are swollen, inverted—entropion—and their borders are covered with an abundant purulent matter. The skin of the cheeks is thickened, depilated, wrinkled, and covered with papules and pustules more or less irritated. The pruritus, still intermittent, is more marked.

The disease at last becomes generalized, occupying the entire surface of the body. The skin everywhere presents, in different degrees, the characters that it at first showed on the head. A crowd of acne pimples is scattered everywhere—sometimes confluent, sometimes discrete; some yet in the papular stage, others pustular. Among the latter, a great number are dark-blue at their summit, and a sanguinolent serosity can be squeezed from them, in which the Demodex can be found on microscopical examination. These parasites are more numerous in the small pustules with apparently purulent contents, and in those which merely yield a kind of cylinder of sebaceous fat on pressure. The number of Acarina is often prodigious, and constitutes the greater portion of the product under observation. More or less abundant crusts are noticed at various points, due to the rupture of the pustules and drying of their contents. At the parts most severely affected the skin is moist and cracked, and in the folds there is a yellow viscid matter; the greater portion is depilated, and the animal exhales a fetid, sour odour that is absolutely nauseating. When the malady has arrived at this stage, it has produced a profound effect upon the whole organism; the appetite—which was for a long time unimpaired, and even increased—now diminishes, emaciation begins, and this gradually goes on to marasmus.

In certain cases, as Saint-Cyr has shown, the disease is generalized, but it does not cause depilation except at some rather circumscribed points; the pustules are rare, but they are irregularly disseminated everywhere, and the condition might be taken for one of generalized acne. In addition, the whole of the skin is covered with a fine dust.

as if the animal had been powdered with maize flour. In the hairless places—which are more or less circular—there is much irritation, a serous exudation, excoriations, and even small sores.

An interesting form is that which Saint-Cyr has named 'the circinated form of follicular mange.' It consists of circular patches from 2 cm. to 6 cm. in diameter, red and inflamed—more particularly towards their slightly salient borders, depilated, and often—but not always—showing chiefly at their periphery small, red, pustular, acnecous pimples. In enlarging, these patches may join each other, and form others more extensive, with largely festooned borders. Often the centre becomes pale and covered with yellow dust. This circinated form is seen in the early stages, and it may be accompanied by the acneic form; it is not very pruriginous, and the general health does not appear to be affected.

This form is related to that which Friedberger and Fröhner have designated the 'squamous form,' and which they give as of frequent occurrence. It is scarcely indicated by any other sign than shedding of the hairs and the abundance of epidermic pellicles. There is no humidity, and little, if any, trace of inflammation. The disease

commences principally around the eyelids, and the eyes are surrounded by a depilated circle, which is somewhat red and scaly. This scabies may extend all over the body, and is often characterized by the deep tint of the patches, which are sometimes circular, as in the circinated form. There is usually no pruritus, and the diagnosis is difficult—often necessitating a microscopical examination of the sebaceous matter.

**Course, Duration, Termination.**—Follicular scabies pursues a very slow course, especially at the commencement. Its duration is long, and cases have been seen of a year's, two years', or even longer duration. It usually terminates in death, owing to its resistance to parasiticides. Weiss, however, gives an instance of spontaneous recovery from this scabies of a pregnant bitch which aborted; the pustules gradually disappeared, an abundant desquamation followed, the skin became smooth, and the Demodex could not be found. The animal, nevertheless, succumbed to the cachectic condition into which it had fallen.

**Diagnosis, Prognosis.**—The circinated form may easily be mistaken for tinea tonsurans. However, in follicular scabies the hairs are not altogether absent; while in tinea they are broken close to the skin, which appears as if shaved. The microscope shows on the surface of the epidermis the *Trichophyton tonsurans* if the malady be tinea; but in scabies, scraping the skin to the blood and examining the products obtained will reveal the presence of the *Demodex follicularum*.

A mistake may also occur with regard to sarcoptic scabies; but the chief points in the diagnosis of this have been already shown, and the microscope must decide in doubtful cases.

The most frequent errors arise with respect to an erythematous skin affection of young Dogs, named *red mange* (rouge), which is distinguished from follicular scabies by its being non-parasitic; and instead of commencing, like the latter, on the paws and head, and of being aceneiform, it appears on the limbs, on the inner surface of the thighs and fore-arms, underneath the belly, and on those parts where the skin is fine and almost hairless. It is also characterized by the redness of the integument, which is more or less roughened and harsh, and is most frequently without vesicles or crusts. It is very pruriginous, and this increases the redness of the skin and induces artificial lesions, as a consequence of the rubbing and scratching.

It must be remembered that demodecic scabies may co-exist with various cutaneous affections of youth, and with sarcoptic scabies and tinea tonsurans.

The prognosis of follicular scabies is always very grave, parasiticide treatment rarely succeeding in destroying the Demodex.

**Pathological Anatomy.**—The prominent feature in the pathological

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1 Weiss. Repertorium der Thierheilkunde, 1860.
anatomy of this affection is the presence of the *Demodex follicularum* in the hair-follicles and sebaceous glands; but particularly in the former, where it is seen sometimes in considerable quantity.

Gruby, with Delafond, has counted as many as 200 in one hair-follicle. They are seen to be pressed upon one another, the rostrum being directed towards the bottom of the follicle (Fig. 88), and the ventral surface ordinarily on the side of the hair or the space it should occupy. Here they are observed in all stages of development—from the eggs to the sexualized individuals and fecundated females. By their presence they cause an irritation which is manifested by signs of variable intensity, according to their number and activity. When the inflammation is acute, it extends around the hair-follicle or sebaceous gland, invades the tissue of the derma, and terminates in pyogeny and the formation of pustules. At other times, there is merely hypersecretion of sebaceous matter, which dilates the canal of the follicle.

According to Krulikowski,¹ the Demodex, when they have been some time in their first location, pass through its walls into the derma and subcutaneous connective tissue, causing—in the first instance—inflammation of the skin and the eruption of pustules on its surface; and in the second, a small abscess and hemorrhage. The shedding of the hairs is due to the proliferation of cells on the internal surface of their follicle, and softening of their base. Relapses are brought about by some of these

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¹ Krulikowski. Russian Veterinary Archives, St. Petersburg, 1879
parasites which were encysted, and which have again destroyed the new walls of the hair-follicles. The affected animal succumbs to a septic change in the blood, as a consequence of the suppression of the cutaneous functions.

Laulanié has observed in follicular scabies a form of local tuberculosis, the study of which has contributed to establish the pathogeny of tuberculosis. He has noticed that, after the fall of the hairs, there is atrophy, and even total disappearance of all that portion of the follicles situated below the level of the sebaceous glands; while all those portions of the pilous apparatus which have persisted have undergone manifest hypertrophy; the outer sheath of the hair-root having become three or four times larger than usual, and the sebaceous glands multiplied and increased in size. The parasites are never found inside the glandular culs-de-sac, the epithelium of which remains intact. Below the level of the sebaceous glands, and within a zone limited by the glomureli of the sudoriparous glands, there are yellow, nodulated spots formed of granulation tissue. These granular masses are elongated, and occupy the place of the old hair-follicles, the direction of which they follow. This new formation tissue is composed of small groups of cells, which have the same composition as the follicles of Koster in tuberculosis—in the centre being a giant cell enclosing a Demodex, and around it a coronet of epitheloid cells, often enveloped by an embryonic girdle. In general, the irritation developed by the parasite goes beyond this; pus corpuscles penetrate to the centre of the tubercular pseudo-follicles; the central giant cell loses its connection with the epitheloid girdle—it is dislocated, broken up, and gradually the pseudo-follicle is transformed into a miliary abscess, the walls of which are formed of granulation tissue. These walls themselves are progressively destroyed by suppuration; so that eventually nothing is left of these preliminary formations, which correspond to the primary modality of the irritant cause. Thus the inflammatory action of the Demodex gives rise to two inflammatory formations, one of which is substituted for the other, and which are evolved during two distinct periods (Laulanié).

Etiology. Contagion.—Is follicular scabies due to the presence of the Demodex in the follicles of the skin; or is not the accumulation of these parasites a consequence of the state of irritation existing in the integument? It has been imagined by some persons that the Demodex is present in all Dogs—even those in the best condition—and that there is no disease until their number becomes excessive. Martemucci, accepting these views, regards the affection as a dermatitis situated more particularly in the derma and sebaceous follicles, which

1 Laulanié. Sur une Pseudo-tuberculose Cutanée du Chien, provoquée par le Demodez folliculorum. Soc. de Biologie, December 5, 1884; and Revue Vétérinaire, 1885, p. 1.
2 Martemucci. Dermatite folliculosa Reflexioni, Naples, 1866.
—then receiving a larger quantity of blood—have a greater vitality, and
can therefore furnish a more abundant nourishment to the pre-existing
Demodex; hence their extraordinary multiplication. This authority
also proposes to give it the name of *follicular dermatitis*, which
—in his opinion—is more in accord with its inflammatory character.
But these ideas are not well founded. No investigations have been
made to establish the constant—or at least very frequent—presence
of the Demodex in the skin of Dogs in good condition, as has been
observed in Man; and it would seem that Martemucci’s notions are only
a hazardous generalization of facts appertaining to human dermatology,
the only support they receive being the difficulty in transmitting the
disease; though this can be explained by the deep, intra-cutaneous
habitat of the parasites, and the necessity for a predisposition.

The latter is to be found more especially in the youthfulness of the
animals, for it rarely happens that adult creatures are attacked. Breed
also plays an important part. L. Lafosse¹ mentions that lap-dogs,
before or after having paid their tribute to the disease of youth (dis-
temper), are more frequently affected with follicular mange, although
no breed is exempt. The observations of Cornevin² are—so far as
breed is concerned—more in accord with what is usually remarked,
that the disease is more frequent in short-haired than in long-haired
Dogs.

Accepting these predisposing causes, the efficient cause is contagion.
But this is much less easy to produce than in the other kinds of scabies,
owing to the deep situation of the parasite. Delabère-Blaine and
Clater—quoted by Verheyen—assert that Dogs which cohabit for a
long time with mangy ones, do not contract the malady, and that at
other times the slightest contact will suffice to convey it. These
differences may be explained by errors in diagnosis, the demodicic
cause of follicular scabies not being known when the statements were
made. Since that time instances have been reported in which con-
tagion has not been effectc1, notwithstanding every facility for its
taking place. Weiss’s patient lived from eight to fifteen days among
other Dogs, without these contracting the affection. Rivolta has
transferred the Demodex from a diseased to a healthy Dog without
result. Martemucci has inoculated the healthy parts of the skin of
a Dog with the fluid from pustules on diseased regions, and which was
rich in parasites, and yet the result was negative. It has been the
same with the experiments of Friedberger, who, besides, has not
observed contagion occurring by making diseased Dogs associate with
those which were healthy; and the observations of Siedamgrotzky,
made at the Dresden Veterinary School, and those of Csokor, carried

² Ch. Cornevin. *Du Demodex Caninus et de la Maladie qu’il occasionne*, Lyons,
1868, p. 57.
out at the clinic of the Vienna Veterinary School, are to the same effect. 1

On the other hand, Haubner 2 has succeeded in producing the disease by depositing demodecic pus directly on the skin of a healthy Dog; for at the point where he placed the animal externally, in about twenty-four hours there was slight tumefaction of the skin; in forty-eight hours the follicles already contained a purulent fluid, in which young and adult acari, as well as ova, could be distinguished by means of the microscope. The exanthem extended, but the Demodex disappeared, and a spontaneous recovery took place. Cornevin made four inoculation experiments, and succeeded in one; but here, also, in about eight days the malady vanished of itself. This authority mentions a somewhat striking instance of contagion from a nursing bitch to two of her puppies; a third puppy remained free from the disease. 3 Of four Dogs—three of which were adults and the other smooth-haired, five months old—inoculated by Guinard, only one, the last-mentioned, contracted the disease. 4

In fine, experiments and clinical observations demonstrate that the transmission of follicular scabies from Dog to Dog is very difficult.

Martemucci and Friedberger have in vain attempted to pass the Demodex of Man to the Dog.

With regard to transmission of the follicular scabies of the Dog to Man, this has only been reported by Zürn 5 who has seen a veterinary surgeon, a coachman, and a woman, who attended on Dogs so affected, suffer from a very pruriginous eruption on the hands and feet, the pustules which formed containing the Demodex. But these persons must have had a marked predisposition for the malady; as for years, and daily, people have attended, and now attend, upon diseased Dogs without taking any precautions, and yet no cases of contagion are recorded. And Martemucci has unsuccessfully inoculated demodecic pus from a Dog on Man; while Cornevin has failed to implant the disease on himself.

Treatment.—Every known parasiticide substance has been tried for the cure of follicular scabies of the Dog, but generally in vain; as the parasites are deeply situated, beyond the reach of the remedies employed. There is no need to enumerate all the attempts which have

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2 Haubner. Repertorium der Thierheilkunde, XX., 1859, p. 81.

3 A similar instance occurred in my own experience when in the 2nd Life Guards, a valuable dachshund belonging to an officer was affected with follicular scabies when suckling two puppies, both of which became infected and soon died.


5 Zürn. Ueber Milben, etc. (Esterr. Landwirthschaftllicher Wochenblatt, 1877.)
been made to combat the malady; so we will only indicate those which have had a good result, though they are exceptional.¹

Balsam of Peru has been particularly recommended by Siedamgrotzky. It has been used diluted with four parts of alcohol, and rubbed into the skin every day, after the pustules have been squeezed, so as to remove their contents. By this means he says he has obtained a cure in a case of generalized scabies. Zundel also states that he has derived excellent results from this medicament, though it was more diluted. But the treatment is very expensive, owing to the long time it has to be continued and the care required; for in simple cases, Friedberger and Fröhner have only been able to effect a cure after fifty-eight days' rubbings. On one occasion, after sixteen weeks' treatment of a Dog that was seriously affected, it was supposed to be cured; but the disease soon reappeared when the remedy ceased to be applied.

Brusasco's method consists in the employment of sulphuret of potass and cantharides ointment. Friedberger and Fröhner assert that they have completely cured very advanced cases. The Dog being clipped, a sulphur bath is administered, 500 grammes liver of sulphur to 100 litres of water. Then, for three days in succession, one-third of the body is dressed with an ointment composed of cantharides ointment 1 part, lard 6 parts. On the fifth or sixth day, the entire body is washed, and a few days afterwards the sulphur bath is again given, followed by the ointment as before, and so on until a cure is effected. But such a result is far from being constant; for Friedberger and Fröhner have failed in one case, after sixty-eight days' treatment, during which 12 sulphur baths were administered, and 9 total applications of the ointment, plus 9 partial applications. In any case, there is reason to apprehend dangerous irritation of the eyes; so that it is advisable to employ the balsam of Peru for the parts surrounding them.

Creolín should be tried. In strong solution—30 to 100—Reul has had a cure in a case of partial disease; and the results of the trials of Guinard, with an ointment composed of creolín 5 parts and lanolin 100 parts, are encouraging. But it must be noted that this treatment has not been successful in the hands of Watkins.

Unterberger has succeeded with the essence of juniper applied with friction; four applications were sufficient. Weiss recommends the same remedy.

A writer in the Veterinary Journal for September, 1875, advises: creosote, 4 drams; olive oil, 7 ounces; solution of potass, 1 ounce. Mix the creosote and oil, then add the potass. One or two applications a week

are to be made, according to the chronicity of the disease; and the treatment must be continued for several months.

Saint-Cyr has recommended corrosive sublimate, and Cornevin has employed it in the form of bath, 1 or 2 grammes to the litre of water. But mercurial intoxication is frequent, either from the animal drinking some of the fluid or licking itself, or the poison is absorbed through the skin; the hydrargyrismus is combated with tincture of quinine and gargles of chlorate of potass. The duration of the bath, which is at first for three-quarters of an hour, is gradually reduced to half an hour.

In simple cases, Zürn says he has sometimes succeeded with benzine ointment—1 to 4 of lard; and he quotes Hofer as being also successful with an ointment of carbolic acid—1 to 30; while Vogel advises a solution of caustic potass.

Herbet has cured, in fifteen days, a case of follicular mange that had lasted six months, with the animal oil of Dippel, applying it in partial frictions, alternating with soft soap washings.

Mégnin's treatment consists in giving every day—for at least a month—Barèges baths of a quarter to half an hour's duration, the skin being kneaded in such a manner that the sulphurous solution may penetrate every part of it. In the second month the bath is only given every second or third day. Mégnin has cured obstinate cases by this treatment, and, of course, all the more easily as the affection is recent. Recently he has recommended the sulphuret of lime, prepared by boiling 100 grammes of sublimed sulphur and 200 grammes of quicklime in a litre of water. After cooling, the clear portion is decanted and kept in a well-corked bottle. To use it, it is diluted with four or five times its weight of tepid water, and applied by means of a sponge every day until the disease is cured. Lastly, Mégnin has also prescribed an ointment composed of sulphuret of carbon, 10 parts; vaseline, 30 parts.

(Whatever may be the topical treatment employed, I believe it would be advantageous to combine with it the internal administration of sulphur, in as frequent and large doses as the Dog can bear without injury to health; that substance being thrown off to some extent by the skin.)

B.—Demodic Scabies of the Pig.1

This disease has been observed for the first time, and well described by J. Csokor, who considered the parasite as a kind special to the Pig, and named it the Demodex phylloides. It is the form just described

(p. 215) under the designation of *D. folliculorum*, var. *suis*. More recently we have met with it in some portions of the skin of a Pig received from Barcelona. It has since been seen by Wright and Lindqvist.

The disease greatly resembles the follicular scabies of the Dog, and appears as pustules as large as a particle of sand to that of a hazelnut—the largest usually resulting from the confluence of the smallest. They may or may not be pigmented, are more often deep than superficial, and may be surmounted by an inflammatory zone. The inflamed tumours gradually increase in size, and, in rupturing, leave large ulcers on the skin. The papules occupy more especially the finer parts of the skin—the snout, neck, under-part of the chest and abdomen, flanks, and inner surface of the thighs. The top of the head, back, and external surface of the limbs remain free from the disease. In the smaller pustules, Csokor has found 50 to 60 parasites; while others contained 500 to 1,000. They were mixed up in the inflammatory products, pus corpuscles, and fat in the form of granules and drops. They were lodged, and appeared to multiply, not in the hair follicles, but in the sebaceous glands.

The malady ought to be contagious, for in the instance recorded by Csokor it was observed in 22 Pigs forming a single drove belonging to one owner. But Lindqvist, of Stockholm, has only seen one animal affected in a lot of 800 Pigs.

The disease should not prevent the flesh being consumed as food.

**C.—Demodecic Scabies of the Goat.**

This was observed for the first time by Von Niederhœusern, at the Veterinary School of Berne, Switzerland. A Goat showed on different parts of its body, but especially about the middle of the trunk, nodosities the size of a pea to that of a nut. They were hard, and it was only by strong pressure that a semi-solid, yellowish-gray matter could be extruded from them; this was almost entirely composed of Demodex.

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But all the parasites were in the form of larvae, similar to those of the Demodex of the Dog.

In May, 1885, Nocard and Railliet found the same parasite on a two-years-old Goat, born and bred at the Alfort School. The Demodex were in abundance in a kind of pustules of variable size, occupying the whole of the sides and flanks; and the parasites were imbedded in a considerable mass of cerumen.

D.—Demodic Scabies of the Ox.¹

The Demodex already noted by Gros, in 1845, in the muffle of the Cow, was found by W. Faxon, in 1878, in the hides of cattle prepared for tanning, and sent from Illinois and Minnesota to Boston. More especially in the region of the neck and the shoulders, these skins showed numerous pustules formed by dilated hair-follicles; they were filled with a soft, white matter, which escaped by pressure, and was composed of fat globules and a multitude of the Demodex. After being tanned, these skins exhibited small cavities, many of them extending through the substance of the hide.

A case of the disease was observed by Grimm in a heifer fifteen months old, which was badly developed and in poor condition, notwithstanding good food. With the exception of the head and limbs, the skin elsewhere—especially at the shoulders—was studded with nodules the size of a pea. The surface of these small tumours was hairless and smooth, and when squeezed yielded a thick, viscid pus containing an enormous quantity of the Demodex. The other animals in the herd were quite healthy in every respect.

B.—ACARIASES OF DOMESTICATED BIRDS.²

Birds are for the Acarina, as they are for the Pediculinae, hosts of predilection. There is scarcely an individual on which a variable number of Acarina cannot be found, the majority of which can be supported with indifference; for, living on the matters composing the feathers, they do not affect the health of their host. They belong to one or other of the following four families; Ixodidae, Gamasidae, Trombidiidae, and Sarcoptidae.

As for the Mammalia, we distinguish non-psoric and psoric acariases; the first are caused by the non-psoric Ixodidae, Gamasidae, Trombidiidae, and Sarcoptidae; the others exclusively by the Sarcoptinae.

Article I.—Non-Psoric Acariases.

I. Ixodidae.—The only Ixode found as yet on domesticated Birds is the Argas (p. 104)—the Argas of Mauritius, and the bordered Argas—the first of which has little importance for us.

Mauritius Argas (*Argas mauritianus* Guér.). This derives its name from the island of Mauritius, where it often torments Poultry, and causes considerable losses in some poultry-yards. It much resembles the next to be described.

Bordered Argas (*A. marginatus* Fabr., *A. reflexus* Latr.)—Rostrum similar in both sexes and 1·9 mm. long, the dart being 1 mm. long, and having on its inferior surface two rows of teeth on each side, with the commencement of a third row near the point, which is rounded; the chelicerae are terminated by a three-toothed harpoon. The four pieces of the palpi are cylindrical and somewhat hairy. There are no eyes. The fecundated and replete female—one-fourth larger than when fasting—measures 6 mm. long and 4 mm. wide. The body is ovoid, and somewhat broader behind than before. The central portion is of a dark hue, and corresponds to the digestive apparatus, which sends its digitations towards the periphery; the margin of the body remains of a transparent yellow, which justifies the name given to the parasite by Fabricius. The vulva is situated at the base of the rostrum, between the first pair of legs. The male—uniformly brown, and a little smaller than the fasting female—has its sexual orifice at the third pair of legs. The nympha—of the same size as the male—is distinguished by the absence of the genital pore. The larva, hexapod, has the rostrum terminal. Eggs ovoid and reddish in colour.

The bordered Argas lives in dove-cots and infests the Pigeons, sometimes in considerable numbers, and sucks their blood. It is frequent in Italy and some parts of France, but somewhat rare in Germany and England.

The Argas, of all ages and both sexes, lives on blood, the larvae even appearing to be fixed for a longer time than the adult on the bodies of the Pigeons. It avoids the light, and during the day—like the bed Bugs—it remains hidden in the interstices of the locality—fissures in boards, holes and cracks in the walls, etc., commencing its mischief at night. When these parasites have invaded a dove-cot, the rearing of pigeons is compromised. They attack by preference the young Birds,

15—2
which they cause to die from exhaustion in from eight to fifteen days. They are more particularly found on the neck and beneath the breast, but no region of the body is exempted from their attacks. The exhaustion is due not only to the quantity of blood extracted, but to the restlessness caused by the pricking; sleep is disturbed and interrupted, and the incubation of eggs is irregular, if not altogether suspended.

The Argas are readily propagated from one locality to another, availing themselves of every passage and crevice, and particularly of the beams and joists. It is not absolutely rare to find them in hen-roosts situated beneath dove-cots; though they do not annoy Poultry.

What contributes to make them more redoubtable, is their great vitality, and the faculty they possess of reproduction in the absence of everything capable of nourishing them. Successive generations have to content themselves with the organic matters furnished by the place in which they are located. Once satiated, the Argas can live for a very long time without another repast. Railliet has kept three very emaciated ones in a bottle for four months; and Perroncito mentions that Ghiliani has seen one exist, fasting, for twenty-two months.

The bordered Argas feeds also, on occasion, on the blood of Man. Latreille has found the parasite wandering in houses, and Blanchard states that Mégnin received from Strasbourg some specimens that had been gathered from the clothes of a Man. In 1858 and 1859, Boschulte, at Camen, Westphalia, remarked the presence of a large number of the parasites in a bedroom inhabited by children, and communicating with an old pigeon-house. They are only seen in the evening, and as soon as a light appears they remain motionless, giving no sign of life even when they are touched.

![Fig. 91.—Argas marginatus, a fecundated and replete Female.—Railliet.](image)

1, natural size; 2, magnified, and seen on the dorsal surface; 3, the same, seen on the ventral surface.

228

TREATISE ON PARASITIC DISEASES.
ACARIASES.

Children are bitten during sleep, and chiefly on the feet and hands, the bites being marked by a red point but no areola. There is great itching, rather along the course of the nerves than at the seat of the lesion. On a girl of fourteen or fifteen years old there were real vesicles similar to those produced by burns, and on an old Man there was a small ulcer. The pruritus sometimes persists for eight days. Chatelin, of Charleville, states that a child and a Man had most painful punctures and persistent oedema, caused by the Argas from a dove-cot placed above the house, and which had been unoccupied for six months.¹

It is necessary to destroy these insects by every possible means. When they are seen on the body of a Pigeon, they ought to be removed by gradual traction—so as not to leave the rostrum in the wound—and then crushed.

But, above all, the infested dove-cot should be purified; the walls scraped and whitewashed, chloride of lime being applied to the woodwork, scalding everything with boiling water, and putting petroleum into the crevices. In addition, some insecticide powder should be blown in among the feathers of the Pigeons, as has been already recommended for phthiriasis, taking care to damp the plumage previously with an infusion of soft soap. Lastly, it has been recommended to wash the legs and feet of the Pigeons with an alcoholic solution of the balsam of Peru (Zürrn).

II. Gamasidæ.—The Dermanysses (Dermanyssus Dugès) are the only Gamasides which live on Birds; they may also infest Mammals.

They are distinguished from the Gamases (see p. 105) by their integuments being soft and finely striated throughout, with the exception of two small transparent, lyriform plastrons; and by their cheliferæ, which are different in the two sexes—being in the shape of a long thin stylet in the female, and subdidactylicous in the male. Oviparous.

The species only interests us by its parasitism on Poultry, and by its possible extension on various Mammals.

Dermanyssis of the Fowl (Dermanyssus gallinae Redi).—Body ovopyriform, posterior end largest, slightly flattened from above to below; abdomen margined by short, well-separated bristles; colour varying from yellowish-white to dark-red, according as the insect is fasting or more or less replete; the intestinal tube, gorged with blood, can be seen as a variously-shaped figure. The ovigerous female is '70 mm. long and '40 mm. broad; the male, '60 mm., and '32 mm. broad.

A Dermanyssis of Swallows (D. hirundinis De Geer), and a D. of Birds (D. avium De Geer) have been described; but their specific value has not been well established, and many authorities are of opinion that

the Dermanysses found on Poultry, Swallows, and house Birds are only varieties of the same species, which, under the influence of a different habitat, has acquired some secondary characters related to dimensions.¹

The Dermanysses of the Fowl live in the poultry-yards and dovecots. Essentially noctambulatory, during the day they are concealed in fissures in the floors, walls, perches, nests, and in all the corners and angles of the locality—the straw nests of the Pigeons being often infested. There are to be found numerous colonies of males and females—free or coupled—with nymphae and ova. At night they scatter themselves over the Birds within their reach—Fowls and Pigeons—and by pricking with their keen rostrum, they extract a notable quantity of blood. They readily become hurtful to the chickens and young Pigeons, and produce consumption or death; while their pricking prevents the creatures resting, causes them to become emaciated, and hinders Fowls from hatching steadily.

When the Birds they torment are examined during the day, no Dermanysses are found, and it rarely happens that there are any traces of their punctures. Sometimes, however, intermittent as are their habits, they become permanent parasites, and may then be found by day, sometimes in innumerable quantities on Fowls, and—more frequently—on Pigeons, multiplying and running about with great rapidity. They are extremely prolific, multiply very quickly, and—which assures their preservation—they can remain for whole months without a host capable of satisfying their sanguinary appetite.

It is asserted that they sometimes enter the nasal cavities of Birds, and occasion a catarrhal inflammation. Zürn has observed them in young Pigeons, and Weber in Poultry (Zürn); Lax, of Hildesheim, has

¹ P. Gervais—Hist. Natur. des Insectes, Avertis, III., Paris, 1844, p. 223—has described a Dermanyssis of the Turkey (D. gallopavonis): 'Body soft without clypeacee separating the thorax from the abdomen, marked with transverse stripe comparable to those on the pulp of the human finger; small, numerous, and close circular impressions on the back; body and legs slightly hairy. Lives among the feathers of the domestic Turkey, and is nourished on blood.'
found them in the external auditory meatus, on making the autopsy of several chickens (Zürn). But these instances are altogether exceptional.

The treatment of demanysse acarasis consists in the employment of the parasiticide measures described with respect to phthiriasis—insecticide powders, boiling water, lime-wash, sulphuret of carbon, and creolin are the principal agents to which recourse must be had, according to the indications and modes of employment previously given (p. 88).

In cases of rhinitis, olive-oil—to which a little aniseed essence of

Transmission to Man.1—The Dermànysses are not limited in their

attacks to Birds, but may transfer themselves to Man and other Mammals.

So far as the human species is concerned, it is the country people of the poultry-yards, and the towns-people who handle and pluck the fowls, who are exposed to the incursions of the Dermanysses. They do not produce a true dermatosis, for the parasites do not find conditions favourable to their multiplication on the skin of Man, nor do they become acclimatized there. The disease is rather limited to an ephemeral pruriginous affection, resembling certain forms of the papular eczema of ordinary scabies. It is chiefly observed on the back of the hands, and so much of the fore-arms as is uncovered during work; but it may also exist on all exposed parts, and even on the body generally.

Alt has found Dermanysses on the neck and arms of an old cachectic woman; they were lodged in small excavations. Bory de Saint-Vincent has described and figured an Acarian that caused great itching on the body of a woman forty years old, on whom the parasites were found in large numbers; as far as can be judged from the figure—which is rather insufficient—it certainly appears to be a Dermanyssus closely related to D. gallinae. 'Erdl, on four occasions—from 1840 to 1842—found D. avium in the comedons or in tumours of the skin resembling those of molluscum contagiosum. This parasite has been figured in the Atlas of Vogel.' Simon, of Berlin, relates, in 1851, the case of a woman who was, in spite of every care, continually invaded by Acarina. Erichson recognised them as Dermanysses, and it was then elicited that every day the woman passed beneath a hen-roost in order to reach a cupboard in which provisions were kept, and it was on these occasions that the fowls, being frightened and attempting to fly away, shook the parasites which infested their bodies on to her. The following case is given by Itzigsohn in 1858: An old woman was tormented by an intolerable sensation of itching and burning that prevented her from sleeping, and was supposed to be caused by a very great number of red, closely-set pustules on her neck and chest. Soon afterwards two servants were attacked with the same affection. From the pustules came animalcule, which were recognised as D. gallinae. The parasites came from a fowl-run beneath the room—crawling along the walls and entering by a small window into the closet, where they infested the inmates. F.-V. Raspail states that he has witnessed the action on Man of the Dermanysses of Pigeons, which he named Tique, but which is readily known by the figures he gives. Children and adults were invaded by them—not only on touching the Pigeons, but also in frequenting gardens manured with the dung of these birds. This small calamity disappeared when the Pigeons were removed and the excreta was buried. In the province of Constantine, Judée has observed on Kabyles and a European woman, an extremely pruriginous affection due to a multitude of Acarina, which Bouchard recognised as
Dermanysses. Kramer gives an analogous instance in a child. Goldsmith attended a woman to whom the Dermanysses were conveyed by Pigeons; the parasites only appeared when she was perspiring, afterwards concealing themselves in the cutaneous glands. In a case observed by Geber, the Dermanyssus of the Fowl had caused a diffused eczema on a woman; it lasted four weeks, and then disappeared spontaneously.

These instances are the only ones in which the affection was serious, either because of the number of persons attacked or by its persistency. It generally subsides of itself after the parasites are got rid of, the itching being allayed by some soothing application. According to Fuchs, the best means of getting rid of the Dermanysses—which may be got by handling fowls—is to place the person for some time in a hay-stack.

Transmission to the Domestic Mammalia. —It is to the Horse that the Dermanysses are the most readily transferred, and they may excite a pruriginous affection which has often been mistaken for scabies.

The first mention of transmission of this acarisis to the Horse is as long ago as 1843, and is due to Gurilt. But it was Demilly, in 1846, who clearly defined the affection produced in the Horse by the Dermanysses. Some years afterwards—in 1850—H. Bouley gave an excellent description of the disease; and since then other observers—Henderson, Caussé, Woodger, Delwart, Moon and Taylor, etc., have published instances of it. In all the cases, the cutaneous malady of the Horse coincided with the presence of Fowls or Pigeons in the stable or its vicinity; and it ceased—with or without treatment—when the animal was placed in a healthy stable, but only to reappear when it was returned to its former dwelling. It also ceased when the latter was cleared of the Fowls, and was disinfected. It was at first attributed to the Lice of the Pigeons, or Poultry, the insects found on several occasions on the diseased Horses being recognised as such; for this reason the parasite was named the Poultry Louse, and the malady designated Phthiriasis of Birds, and Avian phthiriasis. Reynal and Lanquetin believed they had found the origin of the disorder in the scabies of Poultry, due to the Sarcoptes mutans; and some experiments—certainly badly conducted—led them to imagine that this sarcopt, so slow in movement, was capable of developing in a single night all the disturbance that characterizes this dermatosis of the Horse. Mégnin observed that the Sarcopt, when deposited on the Horse, induced some itching, but that it died on the spot where it was placed, without multiplying—it had become acclimatized. He concluded, therefore, that

Poultry scabies was not contagious for the Horse. What rendered the recognition of the part played by the Dermanysses in the disease was its noctambular habits, which impelled it to fly from the light and conceal itself at the bottom of the hairs. On one occasion, however, at the clinic of the Alfort Veterinary School, there was seen a colony of parasites in broad daylight, on a light-coloured Horse, the clothing on which had not been removed for a week—hence the insects were living in obscurity. The Dermanysses, in fact, do not gather in any great numbers on the Horse except during the night; in the daytime they hide themselves in the walls, manger, litter, etc. In consequence of the true cause of the disease, the improper name of phthiriasis given to it should be abandoned, and that of Dermanyssic Acarisis adopted.

The malady is sudden in its commencement, and is characterized by general, intense, and continuous pruritus—at least during the night; at the same time, the skin is the seat of an eruption of very small vesicles—some isolated, but the greater number agminated on a variable extent of surface. The epidermis is removed by the friction, and there is exposed a raw circular patch from 5 mm. to 10 mm. in diameter, which is soon covered with a new layer of epithelium. But usually the Horse is not observed until after this period, when the depilation succeeding the desiccation of the vesicles has commenced. This depilation is, it may be said, pathognomonic—as it gives the skin a flea-bitten aspect, in consequence of the multiplicity of smooth circular surfaces it occasions.

A general invasion of the integument may take place in three or four days, and it might be imagined, from its appearance, that one had to deal with a herpetic malady of much older date. To the lesions caused by the Dermanysses are to be added excoriations, crusts, ulcerations, etc., consequent on the rubbing.

From confluence of the depilations may result large denuded patches, on which may be seen lenticular spots, which are smoother, because of the desiccation of the vesicles.

If the malady continues for a long time, it may, by the torment it induces, lead the animals to a state of marasmus.

Dermanyssic acarisis is distinguished:
1. From tinea tonsurans, in the latter having larger depilations, these being margined by broken, brush-like hairs;
2. From the phthiriasis due to the Haematopinus macrocephalus, in that this has only depilations on limited points, and its seat is more especially the root of the mane and tail;
3. From sarcoptic scabies, which it most resembles, but which has not its sudden invasion, its rapid generalization, nor its pruritus so continuous; besides, we inquire whether the malady had its origin in the neighbourhood of Poultry or Pigeons; and if grooming is suspended and the clothing left on the body, there is a probability of finding the Dermanysses.

The treatment consists more especially in moving away the habita-
tion of the Birds. Poultry ought to be banished from the stable and its immediate vicinity. The affection will then disappear of itself in a few days, and it may be assisted to do so by some emollient or sulphurous lotion.

Gurlt states that the Dermanysses may also pass to the Rabbit; Farez has found them on the Goat, and Zürn affirms that Dogs and Cats have a vesicular eruption from their attacks. Möbius\(^1\) has observed a peculiar dermatosis on eight Cows, consisting of rounded depilations which had been unsuccessfully treated for two years, but disappeared when some Swallows’ nests had been cleared away from the cowshed; these nests contained numerous Dermanysses. Lastly, Gassner, Stadler, and Schümac her have reported cases of auricular acariasis due to the same parasite. (See Parasites of the Ear.)

III. Trombidiidae.—Like those of the domesticated Mammals, the Trombidiidae of Poultry belong to the Trombididae and the Cheyletinae (see p. 106).

In the Trombidina, it is the Harvest-bug, or Leptus autumnalis—the larva of the Trombidium holosericeum—observed by Csokor, Eloire, and by Railliet and Lucet on Fowls and chickens.\(^2\) According to the last two authorities, the presence of the Leptus on chickens hatched at the end of summer and during the autumn is somewhat common, and sometimes causes considerable mortality. The parasites fix themselves by their rostrum to the skin at the base of the feathers, and cause such an intense degree of irritation as to give rise to an epileptiform affection that leads to a fatal termination in a few days. Insufflations of flowers of sulphur among the feathers appear to have given good results.

The Cheyletinae parasites of Birds comprise the genera Cheyletus, Harpirhynchus and Picobia.

The Cheyletus heteropalpus (Mégnin) lives at the base of the feathers of Pigeons and other Columbidae, as well as Sparrows, which do not appear to suffer any inconvenience from its presence. Its body is rhomboidal in shape, elongated from before to behind; the rostrum is conical, narrow, elongated in front, bordered on each side by the palpi, which are much smaller than in the parasitivorous Cheyletinae, and do not exceed the rostrum in the female, in which the hooklet on the second-last article is small and much bent; in the male, on the contrary, they exceed the rostrum by one-third, and their hooklet is curved. The anterior and posterior legs are almost alike. The length of the male and female is 35 mm., the breadth of the female being 25 mm., and the male 16 mm. (Mégnin).

The Harpirhynchus (Mégnin, Sarcopterus Nitzsch) has, like the Cheyletus, powerful palpi, the third article of which is exceeded by the second; but the latter has at its extremity, not one, but three hooks curved upwards and backwards. The Harpirhynchus nidulans (Nitzsch) lives in numerous colonies in kinds of cutaneous tumours, especially on Sparrows. But Trouessart assures us that he has found

\(^1\) Möbius. Bericht u d. Veterinärwesen im K. Sachsen für 1880, p. 78.

it—or other species of the same genus—on many Birds belonging to
various orders. Mégnin, on his part, says he has met with the
pubescent nymphæa wandering in the plumage of Pigeons and some
other Birds (Railliet).

Zürn, who has found the nodules of the Harpirhynchus on the
Pigeon, says that if these parasites are in small number in the cysts,
they may at most disturb, locally, the formation of the feathers; but if they
are abundant they bring about deranged nutrition, and then a fatal consumption.

The Picobia (Picobia G. Haller,
Syringophilus A. Heller) constitute, in
the sub-family of the Cheyletinae, a
small degraded group, remarkable for
the elongated vermicular shape of the
body, the very marked reduction of the
palpi, and are more particularly charac-
terized by the presence of two yellow
chitinous organs like combs, placed at
the base of the hooks which terminate
the tarsus of each leg.

The Picobia have been met for the
first time by G. Haller, who found
them in the connective tissue of an
ash-coloured woodpecker (Picus canus),
and described them under the name of
Picobia Heeri. In 1879, A. Heller, of
Kiel, saw it inside the quill of the feathers of Poultry, Pigeons, and Peacocks.
For these Acarina he created the genus
Syringophilus, which evidently enters into
the genus Picobia, and he has described
two species in it which ought to be named
Picobia bipectinata, and P. uncinata.

The Picobia pectinata (Heller) shows
very distinctly the two combs on the
tarsi. The male measures 7 mm. and
the female 9 mm. long, and 14 mm.
to 15 mm. broad. It lives on Poultry, Guineafowl, and Pigeons. Heller has
found it on 90 per cent. of the Poultry
he examined at Kiel, but it is much
less frequent in France.

The Picobia uncinata (Heller), met
with on the Peacock, is distinguished
from the preceding species by its squat
shape, smaller combs, and the presence
of strong hooklets on the palpi.

The Syringophiles are found within the quills of the wing-feathers
and in those of the tail, and often also in those of the wing-coverts. In the
affected feathers, the quill has lost its transparency, and instead of

2 A. Heller. Die Schmarotzer, 1880, p. 186. — C. Norner. Syringophilus bipecti-
regular cones formed inside by the retraction of the pulp—as seen in
the normal state—there is only an opaque or powdery matter. If the
feather is split, and this matter is examined microscopically, it will be
found to consist of living, but almost inert, Syringophiles of all ages,
surrounded by the skins they have shed, their dark-coloured excreta,
and the débris of the cones they have destroyed by feeding upon them.
Isolated individuals are met with accidentally outside the feathers.
It is probable that all leave the interior of the feathers in the autumn
—when these become dry and are about to be shed—and seek a new
habitation in the young plumage (Trouessart).

According to our own observations, however, it is not uncommon
to find only the dead bodies of the Picobidae in the feathers which are
plucked during the winter.

Trouessart admits that the Picobidae find their way into the feather
by its upper umbilicus, which re-

mains widely open during the whole
period of development, and is not
closed until the quill is fused to
the shaft, which springs from it as
from a sheath; on the contrary, it
is by the inferior umbilicus that they
should make their exit, but only
after the desiccation and death of
the feather in the autumn, when this orifice becomes opened.
In support of this opinion, Troue-
sart cites what he has observed in
the Sarcoptidae plumicoles, which also
penetrate more or less accidentally
into the quills of the feathers. The
alteration in the pith of the feather
has no influence on the health of the
bird.

IV. Sarcoptidae.—The nonpsoric
Sarcoptidae of Birds belong to
three of the six families or tribes
into which this family is divided
(see p. 109). These are the Sarco-
tidae plumicoles or Analgesinae, the
Sarcoptidae epidermicoles or Epidermoptinae, and the Sarcoptidae
cylicoles or Cytoditinae.

a. Sub-family of Analgesinae.—The Sarcoptidae plumicoles are
found in nearly every species of Bird—each harbouring one or more
forms which are special to it, or which may be found on others. Often
the same species is met with on all the Birds of the same family, and there
may be a species of Bird which will carry as many as four distinct
species of insects belonging to three different genera. These Acarina
live between the barbules of the feathers, principally those of the

1 E.-L. Trouessart. Sur les Acariens qui vivent dans le tuyau des plumes des Oiseaux.
wings, where, during life, they are found on the quill feathers, sometimes on the retrices or coverts. They are entirely inoffensive.

According to Trouessart\(^1\)—whose labours have thrown great light on the subject—the drying of the feather, by arresting the afflux of fatty matter upon which the insects are nourished, compels them to emigrate towards the root. This drying may be produced either by the death of the bird, by moulting, or by cold. Thus, in winter—as Ch. Robin has noted—very few Acarina are found between the barbules of the wing feathers, but numerous nymphæ, and even adults, are observed agglomerated towards the upper umbilicus; sometimes, even at the time of moulting, they seek to reach the subcutaneous connective tissue by the lower umbilicus. Certain species seem to be able to hibernate in the quill. When the bird dies, they often leave the feathers and get on the surface of the skin, or spread themselves into places different to those they occupied during the life of their host.

The Analgesinæ are distinguished by their integuments, which are always symmetrically striated, and in general hardened by the plastrons that are remarked more particularly on the dorsal surface. The legs are rarely all alike, especially in the male, which often has the third pair very thick. The posterior extremity, instead of being simply rounded, is usually more or less deeply lobulated, particularly in the males—although sometimes also in the females—and ornamented with various appendages; the copulatory suckers are nearly constantly present in the males.

The Analgesinæ may be divided into three sub-tribes in the following manner:

<table>
<thead>
<tr>
<th>Adult female having always</th>
<th>Males having the posterior legs much more developed than the females</th>
<th>Adult female having the abdomen bilobate, each lobe being terminated by glandiform or setiform appendages</th>
</tr>
</thead>
<tbody>
<tr>
<td>the abdomen partly or entirely bilobate, without any other appendages than hairs or trichome.</td>
<td>by the development of the posterior legs ...</td>
<td>by glandiform or setiform appendages ...</td>
</tr>
<tr>
<td>Males slightly different from the females</td>
<td>Analgesinæ.</td>
<td>Pterolichæ.</td>
</tr>
<tr>
<td>Pterolichæ.</td>
<td>Proctophyllodæ.</td>
<td></td>
</tr>
</tbody>
</table>

The Sarcoptidæ plumicoles met with on the domesticated Birds belong to the genera Freyana Haller, Pterolichus Robin, Falciiger Trouessart, Dermoglyphus, Mégnin, Mégninia Berlese, and Proctophyllodes Robin—Pterophagus Mégnin. The characters of these genera are indicated in the following table:

<table>
<thead>
<tr>
<th>A dorsal cuirass</th>
<th>Freyana.</th>
</tr>
</thead>
<tbody>
<tr>
<td>The two pairs of posterior legs sub-abdominal ...</td>
<td>Pterolichæ.</td>
</tr>
<tr>
<td>The two pairs of</td>
<td>anal like ...</td>
</tr>
<tr>
<td>Males alike ...</td>
<td>...</td>
</tr>
<tr>
<td>Posterior legs ...</td>
<td>Analgesinæ.</td>
</tr>
<tr>
<td>lateral ...</td>
<td>Anterior legs spinous ...</td>
</tr>
<tr>
<td>Males dimorphous ...</td>
<td>Female with bulging abdominal lobes, setiferous ...</td>
</tr>
</tbody>
</table>

On the Fowl are found the *Pterolichus obtusus* Robin; the *Dermoglyphus minor*—*Analges minor*—Nörner, found by Nörner in the quill of the feathers; the *Dermoglyphus elongatus* Még., which has been seen in abundance in the quill feathers; the *Megninia cubitalis* Mégnin, and the *Megninia asternalis* Mégnin. The two last-named species are principally distinguished by the first being a little longer—the female 40 mm., and the male 45 mm.—having the abdominal lobes of the male articulated, and furnished with two unequal bristles and three hairs; while in the *Megninia asternalis*, the two bristles are equal and very long, and the abdominal lobes, which are not articulated, are bordered internally by a notched membrane.

In the Turkey has been found the *Freyana Chanayi* Trouessart; in the *Pheasant*, the *Pterolichus obtusus* Robin—which lives also on the Fowl—the *Pterolichus uncinatus* Mégnin, and the *Megninia ginglymura* Mégnin. The two species of *Pterolichus* are distinguished by the extremity of the male abdomen, which is simply bilobate, each lobe having two bristles, in the *Pt. obtusus*; while in the *Pt. uncinatus* it is deeply notched into two prismatic triangular lobes.

The only *Analgesinæ* observed on the Guinea-Fowl are the *Dermoglyphus varians* Trouessart, and the *Derm. minor*—*Analges minor*—Nörner, var. *similis*. The first—which is perhaps only a variety of the
Derm. elongatus found on the Fowl—is distinguished by the presence of a transparent, conical prolongation at the posterior commissure of the anus. The Dermoglyphes of the Guinea-fowl have been met with by Trouessart in the quill of the beam-feathers of the large wing-coverings, along with Picobia (see p. 236).

The Duck harbours the Freyana anatina Koch, and the Megninia velata Mégnin.

The Analgesine of the Pigeon are the Falciger rostratus Bucholz, the Megninia asternalis—which also infects the Fowl—and the Pterophagus strictis Mégnin. Zürn has described, under the name of 'Federmilbe der Tauben,' an Acarian which appears to us to be only the Megninia asternalis. The Pigeons on which he found it had incredible quantities of it, and died in a state of profound marasmus, which he attributed to this acariaisis.

The Falciger rostratus offers a special peculiarity. According to Mégnin, it may undergo deviations in its metamorphoses when there occur any changes in the normal conditions of its existence. If, for example, the molting of the Bird—and consequent dryness of the skin—happens to deprive the parasite of aliments or of necessary warmth, the colony will perish without the intervention of the interesting phenomenon described by Mégnin. The normal nympha, instead of being transformed into a young pubescent male or female, becomes a hypophous nympha—that is, it is dilated, and from its envelopes issue an acarian form quite different from the normal shape, the conformation of which is appropriate to a new kind of life. This acarian form is elongated, vermicular, and destitute of rostrum and internal organs. It introduces itself, by the feather-follicles, into the subdermic connective tissue, and contrives to live there for some time by cutaneous absorption. Then, when the normal conditions of its existence are re-established, it finds its way to the exterior by the same channel, assumes its primitive form, and subsequently resumes its regular evolution.

This transitory and accidental form has been named by Mégnin an adventive or hypopial nympha. It was allotted, before him, to a particular genus, the Hypodectes Philippi, in which several species—found on different Birds—were described; they are also probably different hypopial forms of the Sarcoptidae plumicoles.

These Hypodectes had already been found on several Birds when they were met with, for the first time, on the Pigeon by Ch. Robertson, in 1866. They were chiefly found in the subcutaneous connective tissue around the large veins of the neck, and on the surface of the pericardium; when they were few in number, it was only in these two regions they were located. Robertson examined a considerable number of Pigeons, wild and tame, and rarely found them free from these Acarina.

Slosarski—quoted by Mégnin—studied them in 1872, and made a new species of Hypodect, which he designated H. columbae.

2 Ch. Robertson. Microscopical Journal, 1866.
The presence of these hypophial nymphæ in the subcutaneous connective tissue does not cause any appreciable disturbance, and appears to have no influence on the health.

The distinction between the Sarcoptidæ plumincoles and the psoric Sarcoptidæ is not so absolute as it might appear. On the Sparrow, the Snipe of Europe and the Cape of Good Hope, and the Humming-Bird of the West Indies, Trouessart¹ has found a parasitic Sarcopt always localized at the pinion of the wing, and more or less buried in the epidermic cells, or in the bulb of the feathers, and which appears to cause somewhat severe itching. He places it in the genus Symbiotes, under the name of S. avus—ancestral Symbiot. It thus forms a link between the Analgesineæ and the Sarcoptidæ.

On the other hand, the Sarcoptidæ epidermicoles may—at least in some instances—cause cutaneous trouble resembling the psoric affections.

b. Sub-family of the Epidermoptinæ.²—Rivolta, Caparini, Friedberger, and Railliet and Lucet, have observed a cutaneous acarasis of Fowls which they considered of a psoric character. It was due to two allied species, for which Rivolta created the genus Epideroptæ. One is the E. bilobatus, and it has been regarded by Caparini and Friedberger as a Symbiot—Symbiotes avium Caparini. The other species—first seen by Rivolta—is the Epidermoptes bifurcatus.

The Sarcoptidæ epidermicoles—which as yet only comprises the genus Epidermoptes—are very small, and present the facies of the Sarcoptidæ plumincoles, especially the genera Pterolichus and Pteronyssus. But their integuments and epimerae are always colourless, or very faintly tinged.

These Acarina usually live on the surface of the skin, at the bottom of the plumage among the down. In certain circumstances, they multiply to excess, and their presence coincides with an intense pityriasis, which they may occasion.

From published observations, the Epidermoptes have been found in considerable numbers of diseased Fowls. In the parts which were affected, the skin was covered with large, thin, pale-pellow, stratified scales, which formed a sort of embedded horns inside the tube of the

¹ Trouessart. — Comp. Rend. de Acad. des Sciences, March 28, 1887; and Bull. de la Soc. d'Études Scientifiques d'Angers, 1887, p. 134.
feathers, at the points where these were implanted (Caparini). The skin was also covered with dry, dirty, grayish-yellow crusts, from 1 mm. to 1·5 mm. thick, similar to paste-crust; these were on the bare places, and especially on those which are quilled, and at the base of the erect feathers (Friedberger). The *Epidermoptes bilobatus* and *bifurcatus* cause a 'furfuraceous scabies,' characterized by the production of dirty yellow scales, which are especially accumulated at the base of the feathers (Rivolta). Over the entire surface of the body, with the exception of the head, there are crusted patches which may be of the dimensions of a four-shilling piece and a thickness of 5 mm. or 6 mm.; these contain the *Epidermoptes bilobatus*, associated with the *Sarcoptes laxis*, var. *gallinae* (Railliet and Lucet). The malady may occupy various points of the surface of the skin, and exceptionally the head (Caparini); the head and neck (Friedberger); the head, neck, region of the crop, armpits, wings, and chest (Rivolta).

In at least several instances, the Epidermoptes were inoffensive, and did not produce the lesions that have been described. Thus, on some pieces from a Fowl he had observed, and which were preserved in alcohol, Caparini has remarked the presence of the *Achorion Schönleinii* —the fungus of favus—which was evidently the cause of this dermatosis. Trouessart has found the *Epid. bifurcatus* on a Fowl, the skin of which was healthy. But we have met with the *Epid. bilobatus* in considerable numbers on a cachectic Fowl, the skin on the trunk of which was covered by a whitish squamous layer resembling the crumb of dried bread.

In cases of dermatosis supposed to be caused by the *Epidermoptes*, it will be well to make certain if the disease is not rather due to favus.
c. Sub-family of the Cytoditinae.—The Sarcoptidae cysticoles, or Cytoditinae, live exclusively on Birds—in the sub-cutaneous or intermuscular connective tissue, in that surrounding the respiratory organs, or in the air-sacs. Notwithstanding their deep habitat, we think it useful to study them here, when describing the other acarises. They are distinct from the hypophial nymphæ of the Sarcoptidae plumicoles mentioned above, and are divided into two genera.—Cytodites and Symplectopte.

The first were seen in 1859, by Gerlach, who considered them to be Sarcoptes. They were again found in 1864, by Zandel, and in 1868 by Vizioli, who described them, as well as the second. They have since been met with by a number of observers.

The genus Cytodites (χυτός, a cavity)\(^1\) was established in 1877 by Mégnin, who justly separated it from the genus Sarcoptes, to which this form had been allotted by Gerlach and Vizioli. But there was no sufficient taxonomic reason for his proposing, at a later period, to exchange this name for that of Cytoleichus. Only one species is known—the Cytodites nudus (Vizioli, Cytoleichus sarcoptoides Mégnin, Sarcoptes Gerlachi Rivolta).

This Acarian has a rounded, whitish, and nearly glabrous body without visible striae, prolonged in front by a conical rostrum, without cheeks, and which forms a tubular sucker. The legs are strong, conical, elongated, composed of five pieces or articles, which are disposed as in the Sarcoptes, and all are terminated in an ambulacrous sucker with a simple pedicle. The *male* is about 45 mm. long and 30 mm. broad, and has a conical penis in front of the anus. The *ovigerous female* is 55 mm. long, and about 40 mm. broad; she shows a vulva—tostocome—in the form of a longitudinal slit between the two posterior pairs of legs; it is ovoviviparous or oviparous, and may produce larvae or eggs, according as the latter remain for a long or short period in the oviduct.

The Cytodites inhabit the air-sacs of the Gallinacea, and especially

Fowls and Pheasants, and by reason of their relatively greater size and their white tint, they are readily seen by the naked eye. They enter the bronchi, and even reach the air-canal in the bones. Gerlach has accused them of causing the enteritis he witnessed among Poultry, in which he found them; and Zundel believed they caused enteritis and peritonitis. Zschokke has seen them in the lungs, trachea and anterior air-sacs, in the midst of yellow gelatinous masses, deposits of false membranes, and abundant quantities of mucus; but he was not certain whether there was not a mere simple coincidence between this diphtheria and the internal acarasis. The disease ran the course of a contagious affection, and was rapidly fatal.

At the autopsy of several Fowls from the same poultry-yard, and which had been ill for a long time, Holzendorff found in the lungs, liver, kidneys, etc., a great number of yellow, miliary nodules, and in the thorax innumerable Cytodites, which were also recognised in the tubercles.

But the Cytodites often exist in large numbers in the air-sacs, without betraying their presence during the life of their host; and it is only when they are extremely numerous, and crowding in the bronchi, that they may cause fits of coughing by irritating the mucous membrane. Mégnin has seen them on one occasion cause death by congestion and obstruction, and consequent asphyxia.

The name of *Symplectopt* (συμπλέκτων, tissue, πλεκτόν, to conceal), given to the second genus of Sarcoptidae cysticoles, is the rectification proposed by Railliet\(^1\) of the hybrid word *Laminosioptes* employed by Mégnin. Only one species of this genus is known; for it is almost certain that there is an identity between the *Sarcoptes cysticola* of Vizioli and the *Sarcoptes or Epidermoptes cysticola* of Rivolta,\(^2\) notwithstanding

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some differences in the descriptions. This species is *Symplectoptes cysticola* (Vizioli, *Laminosioptes gallinarum* Mégnin).

This is an Acarian with an oblong body more than twice as long as it is broad, having several pairs of bristles on the upper surface and a long pair at the posterior extremity. It is divided by a circular transverse furrow into two portions; the anterior carries the rostrum and the two first pairs of legs; the posterior has the other two pairs, the anus, and the orifice of the genital organs. The integument is finely striated transversely, and the colour is gray. The legs are short, glabrous, and provided with ambulatory suckers having a simple pedicle; the suckers are temporary on the two anterior pairs, persistent on the posterior pairs. The rostrum is analogous to that of the Sarcoptes; the anus is sub-abdominal. The male is 22 mm. long and 10 mm. broad; it has the penis between the anus and the base of the posterior legs. The *ovigerous female* is 25 mm. long and 11 mm. broad; it has its tocostome between the bases of the two pairs of posterior legs.

The Symplectoptes cysticoles are special to the Gallinacea; they live in the connective tissue, and do not appear to produce any lesions capable of affecting the health of the Birds. Nevertheless, when they are in very great numbers, the death of those which succumb to marasmus may be attributed to them; as they then cause irritation in the connective tissue—sub-cutaneous or other—and give rise to the formation of tubercles, in the centre of which are found the dead Acarina. The

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**Fig. 101.—** *Symplectoptes cysticola* of the Fowl; male, seen on the ventral surface; magnified 200 diameters.—Railliet.

**Fig. 102.—** *Symplectoptes cysticola* of the Fowl; ovigerous female, seen on the ventral surface; magnified 200 diameters.—Railliet.
corpuscles—first noticed by Voigtlander,¹ then by Vizioli, and other observers—are yellow, oval bodies from ·25 mm. to ·50 mm. and 1 mm. long, and are sometimes so abundant that as many as a hundred will be found on two and a half square centimetres of surface (Vizioli). The contents are soft, granular, and adipose or calcareous—in fact, much like those of tubercle. They may be found on the abdominal viscera, and in the peritoneum, as also in the muscles and beneath the skin; in the latter instance, they can be seen through the integument, and may even be discovered among the epidermic scurf (Rivolta). They have been seen in Fowls, Pheasants, and Turkeys. Heller, of Kiel,² states that he has met with them in 70 per cent. of the Fowls he has examined. They are especially frequent in old and cachetic birds.

**Article II.—Psoric Acariases.**

The psoric Sarcoptidæ that live on Birds belong to the genus Sarcoptes; but they offer external characters and a kind of life that justifies their union into one section or sub-genus—the Knemidokoptes of Fürstenberg (Dermatoryktes Ehlers).

These Sarcoptes aricoleæ have the body orbicular, destitute of squamous form prominences and of spinules on the notogastrum. Each of the epimerae of the first pair of legs sends over the back a prolongation, which joins its congener in such a manner as to limit a rectangular plastron. The anus is situated at the posterior part of the notogastrum. The males, nymphæ and larvæ are provided on all the legs with the ambulacrous suckers that characterize the Sarcoptes, which they much resemble in their general form. The pubescent and oviscous females are globular in shape, and almost glabrous; their legs—which are very short and conical—are destitute of the ambulacrum, and terminate in two unequal hooklets. They are ovoviviparous.

The Sarcoptidæ aricoleæ actually known, have been divided into three species, only two of which live on the domestic Birds—these are the Sarcoptes mutans and the Sarcoptes lavis.³

The Sarcoptes mutans (Rob., Knemidokoptes viviparus Fürst.) has—in the female—the dorsal surface covered with mammiliform integumentary prominences; the length of the parasite is ·40 mm. to ·45 mm., and breadth ·35 mm. to ·38 mm., while the male is ·20 mm. long and ·15 mm. broad, and is destitute of copulatory suckers, like all the other Sarcoptes with the exception of the following species.

This Sarcopt lives on the Fowl, and causes the leg scabies.

The Sarcoptes lavis (Railliet) has no dorsal integumentary prominences in the female, but very fine parallel, regular ridges; the male has two small copulatory suckers. The dimensions are less than in the preceding species (Figs. 106, 107, 108).

This species comprises two varieties:

*S. exact*, var. *columbe*.—The epimerae of the first pair of legs are joined in a Y shape in the male, and are united in the female by a transverse piece in the form of a circumflex accent. Male from 140 μ to 170 μ long, and 110 μ to 120 μ broad. Ovigerous female from 270 μ to 310 μ long, and 230 μ to 270 μ broad. Discovered by Railliet and Cadiot, in 1855, at the base of the feathers of a messenger Pigeon.

*S. lavis*, var. *galline*.—The epimerae of the first pair of legs remain free in the female. Male from 170 μ to 180 μ long, and from 120 μ to 130 μ broad. Ovigerous female from 310 μ to 350 μ long, and 270 μ to 300 μ broad. Discovered by Railliet in 1886 on a Fowl.

§ 1.—SCABIES OF THE LEGS.

Known for a long time as a dermatosis, the scabies of Fowls (*gale des pattes, grappe, blanche*) has only been considered as an acariasis since 1859, when Ch. Robin and Lanquetin discovered the parasite—the Sarcoptes mutans—and when Reynal and Lanquetin gave a description of this scabies, observed on Fowls.¹ It has since been studied by numerous authorities, who have witnessed it, besides, on Turkeys, Pheasants, Partridges, and small birds in aviaries—such as Bullfinches, Goldfinches, Paroquets, etc. (Mégnin).

**Symptoms.**—Reynal and Lanquetin state that the malady may be seated on the head or the legs, or both regions at the same time. But those who have followed them—Unterberger, Fürstenburg, Mégnin, etc.—have only seen it on the legs. We have shown that in the observations of Reynal and Lanquetin a serious mistake was made through the co-existence of favus—seated on the head—and scabies—located

on the feet. The result of all the reliable observations goes to prove that this psoric affection is exclusively confined to the legs.1

The *Sarcoptes mutans* lives under the epidermic scales covering the anterior surface of the tarsi and the upper part of the toes, and by its presence it soon sets up an irritation that is manifested in the elevation of these scales, owing to the formation of a white powdery matter that remains agglutinated by the exuded serum. There are gradually formed rough crusts, which are grayish externally, white internally, irregular in shape and mammillated, and which finish by invading the whole of the digital region. They are few on the inferior face of the toes and behind the tarsi; they are very adherent, and when detached, the irritated and bleeding skin, somewhat honey-combed, is exposed. In examining these crusts by means of the hand-lens or microscope, the inferior surface is seen to be excavated by an infinite number of alveoli, each of which is moulded, as it were, on the body of the female Sarcopt lodged therein. For they are nearly always ovigerous when they occupy these depressions, in which they lie squat and immovable, the ventral surface being turned towards the crust; they are recognised by their regular form and the rusty colour of their epimeric. Larvae, nymphae, pubescent females, and a very small number of males, wander beneath the crusts; no eggs are found except by chance, and these have escaped from the ovigerous females which have been accidently crushed.

The entire substance of the crust is so excavated by cavities that it is quite spongy, and greatly resembles the crumb of dried bread. The alveoli become smaller as they are more superficial, owing to drying of the crust, or external pressure on it; but the deeper ones alone contain the Sarcoptes, which abandon the cavities as these become old, and therefore farther removed from the moist surface of the derma. There are no furrows, as in the other forms

of sarcoptic scabies; but an epidermic proliferation takes place around the motionless ovigerous female, which has penetrated beneath the epidermis after copulation.

The prominence of the crusts exposes them to cold, and to damage that breaks them, and causes a sanguinolent effusion into the fissures at their base; the movements of the joints—otherwise much compressed and restrained—also bring this about. Progression and standing are difficult; the Bird is lame, arthrites appear, and it is not rare to see a phalanx, or even an entire toe, fall off.

The disease is accompanied by a moderate degree of pruritus, which is more intense at night or during warm weather, and which the Fowl testifies to by pawing, and often attacking the affected parts with its beak.

This scabies runs a very slow course, and may continue for six or eight months, or even a year. Gradually the general health is affected; the Fowls become emaciated, cease to lay, lose their appetite, and succumb to marasmus or to an intercurrent affection.

The most usual complications are favus, diphtheria, and psorospermosis; but it is to the two last-named diseases, and to tuberculosis, that the hepatic, and sometimes the pulmonary tubercles mentioned by Reynal and Lanquetin as lesions of the scabies, really belong.

In a cock affected with sarcoptic scabies, Csokor found the conjunctivæ swollen and red, and secreting much purulent matter; though the ocular globe was bright and the vision intact. The use of an appropriate collyrium cured this condition.

Etiology, Contagion.—Contagion—the real cause of the malady—occurs through the cohabitation of healthy with diseased Fowls; the agent being the Sarcopt passing through its various periods, except the ovigerous female, the immobility of which is nearly absolute. When the Poultry do not get much exercise, and are confined in small places, they run much risk of being infested by wandering acari from the manure. However, the contagion is not subtle, for Fowls remain a long time healthy in the midst of diseased ones; and according to the observation of Friedberger, some very severely affected ones may be seen in poultry-yards where all the others are free from the malady.

Breed appears to us to have a real influence in the etiology of the disease. Common-bred Fowls resist contagion much longer than exotic breeds. Reynal and Lanquetin had observed that the malady is more frequent in the Cochin-China breeds and its varieties, than in the Dorking and Brahmapootra breed. Perhaps this predisposition is related to the thinner skin in these breeds.

The disease is contagious for the Gallinacæ, Passeres, and Climbers; it has not been observed on Palmipedes. Reynal and Lanquetin

represent it as transmissible to Man, the Equidae, and Ruminants; but the evidence they furnish in support of their statement refers rather to the Dermanysses, and not to the *Sarcoptes mutans*.

**Treatment.**—To prevent the infection of healthy Fowls, it is necessary that the diseased be separated from them, and the locality occupied be thoroughly disinfected by washing with boiling water, such washings to be extended to the perches, beams, etc., of the roost.

The medical treatment should have for its object the removal of the crusts, and the prevention of their reappearance. They may be removed by means of the finger-nail, or a small brush dipped in tepid water; but this is painful for the Bird. It is preferable to soften them in a tepid bath for a few minutes, then remove them without causing bleeding; then, when the parts are dry, a layer of Helmerich’s pomade is to be applied to them. Generally, two days afterwards this ointment may be washed off by means of soap, when a cure will be found to have been effected.

Carbolic acid ointment—1 part of crystallized carbolic acid to 10 of lard; creosote ointment—1 of creosote to 20 of lard; benzinated oil—1 of benzine to 10 of sweet oil; and petroleum ointment, have also been recommended. But these means, though more active than Helmerich’s pomade, may have a bad effect on the general health of the Fowls, especially if they are young. The balsam of Peru is not inconvenient; its odour is agreeable and its effect certain; it is to be applied once a day for two or three days. When the disease is cured, it may be advisable, in order to calm the irritation which sometimes persists in the skin, to smear over the parts with sweet oil, cream, vaseline, glycerine, butter, oil, etc. Otherwise, with any of the acaricides we may master the disease, which is only serious when neglected, as it does not resist the most simple antipsoric treatment.

§ 2.—**Scabies of the Body, Depluming Scabies.**

This form of scabies was first observed by Railliet and Cadiot, on a messenger Pigeon from Brussels. This bird had been affected for more than a year with a disease of the skin characterized by somewhat acute irritation, and accompanied by an abundant production of epidermic scurf and shedding of the feathers, which broke off at the surface of the epidermis, the part remaining becoming a powdery mass that the slightest pressure extruded. The Sarcoptes were found at the base of the feathers. The affection yielded to the daily application of sulphur lotion, continued for a certain time. Friedberger has published a similar observation.1

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RAILLIET¹ for the first time observed scabies of the body of Fowls in 1886, in a poultry-yard in Normandy. He has since found it in the environs of Paris, and is informed that it is very common. We have seen it affecting Poultry in the neighbourhood of Carcassonne.

'The disease appears in poultry-yards in consequence of the introduction of one or more affected Fowls, and is transmitted with such remarkable rapidity that in a few days the whole run is invaded. It usually begins on the rump, then spreads to the neighbouring parts—thighs, back and belly; and often the head and upper part of the neck are early affected. The feathers fall off at all these points, and finally the skin is left denuded over a vast extent of surface; though the larger feathers of the tail and wings, as well as those of the wing-coverts, are generally retained. The denuded skin always presents a normal appearance—remaining supple, smooth, and not perceptibly thickened. In pulling out the feathers that persist in the vicinity of the invaded parts, it is easy to find—in Pigeons—a mass of white, epidermic layers occupying the limit of the quill and the shaft, and which contains a variable number of Sarcoptes' (Railliet).

As a rule, the health is not impaired, though sometimes the Fowls become emaciated, the skin around the croup becomes of a bright-red colour, egg-laying is diminished, and the flesh is insipid to eat. The malady is usually more intense in cocks, which sometimes die in a cachectic state.

This body scabies prevails most in the spring and summer, and disappears more or less completely at the commencement of autumn, usually returning in March or April. It appears to us that contagion is more particularly effected during copulation of the Poultry, the region of the croup being that which is nearly always the first to be invaded. A cock affected with the malady, will rapidly infect all the Fowls in the poultry-yard.

This somewhat common disease has often been mistaken for an abnormal moulting, early or late; and at least the majority of cases of *piquage* ought probably to be ascribed to it. This *piquage* is an affection which prevails in poultry-yards, and is recognised by the scanty and miserable condition of the plumage. The Fowls naturally peck out their feathers, being impelled thereto, not, as is generally believed, by mischief or imitative habit, but by a sensation of pruritus or *malaise*, which causes them to render each other this reciprocal service.

The treatment of this 'body scabies,' or 'depluming scabies'—as Railliet has termed it—is simple, and somewhat the same as has been recommended for dermanyssic scabies and phthiriasis (see p. 88).
CHAPTER VI.

CUTANEOUS HELMINTHIASES.

Among the domesticated animals, the Horse, Dog, Ox and Sheep are alone mentioned as being attacked with affections due to Nematodes living on the surface of the skin, in its substance, or in the subcutaneous connective tissue.

These Nematodes have all been placed in the genus Filaria (Müller), thus characterized:

Body slender, very elongated, and 80 to 100 times longer than it is thick. Mouth of variable form, sometimes encircled by lips, and often furnished with papillae. Oesophagus thin, and not forming a distinct ventriculus. Male, tail curved or spiral, sometimes provided with lateral membraneous wings; nearly always furnished with four pre-anal papillae and a variable number of post-anal ones; one or two unequal spiculae. Female provided with a double ovary, and a vulva situated very near the mouth; most frequently ovoviviparous.

The Filariae are more particularly parasites of the serous membranes and the subcutaneous connective tissue. They are also included among the worms very rarely met with in the intestines of the Horse and Dog.

Article I.—Parasitic Dermorrhage.

It has been known for a long time that the Horse is liable to small local haemorrhages on various parts of the surface of the body. According to the bibliographic researches of Leymacher,\(^1\) the Chinese were aware, from the remotest antiquity, of a breed of Horses in Khodang which perspired blood. Ercolani\(^2\) has collected a number of observations by different practitioners, of similar haemorrhages occurring on the Horse and Ox, and to which he has given the name of Haemathydrosis (blood-sweat); but the disease has been only well known since Drouilly\(^3\) and Condamine discovered in the hemorrhagic points a

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particular Nematode, which they have placed in the genus *Filaria*. We cannot deal, therefore, with the observations made with regard to the Ox, to which animal this discovery has not been carried; nor yet with those hæmorrhages on the limbs, of which Rossignol\(^1\) has furnished an interesting example.

**Symptoms.** — Parasitic cutaneous hæmorrhage begins with hemispherical, hard, painless elevations, slightly òedematosous around their margin, and of the size of a pea to that of a hazel-nut, on which the hairs are erect. They are formed by an accumulation of blood in the superficial layers of the skin, which become ruptured by the pressure, and the blood then passes in streaks along the hairs, and coagulates, the opening by which it escapes being generally at the summit of the tumour, though it is scarcely visible. The hæmorrhage takes place soon after the appearance of the tumefaction—in an hour or two—which then disappears, and everything again becomes normal, though sometimes there is suppuration.

The eruption is especially localized upon the shoulders, the sides of the body, the back, and the sides of the neck and withers. It is very ephemeral, and when the blood has escaped there remains scarcely a trace of the primitive lesion. There are always several nodules at one time, the eruption going on for several days, and gradually subsiding as the elevations become fewer and smaller. Such eruptions happen in starts, at intervals varying from three weeks to a month, during the three or four months of spring; there are none in winter, and in France the affection recovers of itself, and definitively disappears in about three or four years.

No general disturbance of the health accompanies or precedes the hæmorrhages; indeed, in some cases, according to Salle, they seem to have exercised a favourable influence on the course of climatic affections to which army remount horses are liable. Lamy,\(^2\) however, who has on several occasions observed termination by suppuration, has seen marked debility occur in these cases. Brunswig\(^3\) has reported a fatal case—a horse commenced to sweat blood over the entire skin, and in such great quantity that on the second day it was dead; while, in 1845, at Mustapha (Algeria), Liautard—quoted by Salle—observed cutaneous hæmorrhages on Mules from Spain, several of which died of splenic hæmorrhage.

We cannot decide whether these exceptional cases were really those of parasitic dermatorrhagia, as its nature is only known since the discovery of Drouilly and Condamine; and before that time it was confounded with all the diseases, otherwise rare, which are accompanied by cutaneous hæmorrhage.

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To discover the presence of the Filaria, Drouilly recommends that the hair be shaved off that part of the skin where an elevation is felt. Some hours afterwards, its summit will show an ecchymotic point, which will rupture to allow the blood to escape. Shortly before this occurs, a slight opening should be made in it, when the Worm will be perceived; but it contracts, to bury itself in the connective tissue. Sometimes it has to be sought for as deep as the muscles. 'If it be desired to hasten and to view this migration, a drop of oil of turpentine or a small portion of mercurial ointment should be placed on one of these swellings, which has been previously shaved over its whole surface and beyond; then it will be possible to follow the Worm, either by observing the small ecchymotic streaks on the skin when it is fine, or in feeling a small cord form under the finger. In twenty-four to twenty-eight hours, a new elevation is certain to appear at 3 cm. to 5 cm. from the first.'

The **Filaria of the hemorrhagic tumours** (*Filaria haemorrhagica* Railliet, *F. multipapillosa* Condamine and Drouilly) was discovered and described by Condamine and Drouilly, and has also been seen by Mégnin and Trasbot. The female alone is known.

It is white, filiform, 6 cm. to 7 cm. long, and ~355 mm. broad, gradually tapering in its posterior third. The mouth is nude; the anterior extremity of the body is covered by a large number of small conical warts, among which the vulva opens. The embryos—which are extremely numerous—are all formed in the body of the female, which is, therefore, ovoviviparous.

**Etiology.**—In France the malady has only been observed on Hungarian Horses, distributed as remounts in regiments of cavalry, and the documents we possess show that it is special to Horses of Eastern origin. 'Thus,' says Trasbot, 'Spinola considered it as peculiar to

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2 Railliet.—*Élém. de Zoologie*—has changed the specific name adopted by these two authors, because it had been previously applied by Molin to another Filaria. — Trasbot. Soc. Centr. de Méd. Vétérinaire. Recueil de Méd. Vétérinaire, 1877, p. 388. — Mégnin. Recueil de Méd. Vétérinaire, 1878, p. 1151.

3 Bernard states that he has seen the disease among Spanish Horses.—*Journ. de Méd. Vétér. Militaire*, 1877, p. 709.

Horses of the Steppe breed; Ercolani states that Sibald, in his *Histoire Naturelle du Cheval*, affirms that he has often observed it on the white Horses of Tartary. Leblanc, sen., declared at the Veterinary Society, in the short discussion that followed the reading of the interesting paper of Salle, that he had observed it on one of the Russian Horses brought to the Universal Exhibition (held at Paris) in 1867; and on that occasion the man who accompanied these animals informed him that it was frequent in that country. Leblanc also remembered that Barthélemy, sen., had often seen it in Germany, during the campaigns of the First Empire, among Horses from the Steppes. And observations recently made in Austria by Leymacher, when he was detached at Laybach in Illyria, to receive the Hungarian Horses purchased by the French Government, and those collected by Salle and Naudin shortly afterwards, when these horses had been sent to regiments, all testify that the cutaneous hæmorrhage is a malady special to Eastern breeds. In fact, this hæmorrhage has been observed from remote antiquity on Tartar Horses, including those which the inhabitants of the Middle Kingdom have designated *celestial*, and it is manifested now almost uniquely on those of the Russian steppes and of Hungary, which are apparently the descendants of the first."

(I have seen this cutaneous hæmorrhage in North China, affecting Horses from India. I have also observed it among Arab Horses in Syria. In some cases the bleeding has been somewhat profuse, and sufficient to stain the ground upon which the animals stood; but it did not apparently injure them, the only inconvenience experienced being when the tumours formed on the back where the saddle rests.

I am not aware that the affection has been witnessed in England, except among the Hungarian Horses which were purchased for trial in our cavalry a few years ago—a number of cases of this cutaneous bleeding occurring among them during the first two years after their arrival.)

Now that we can attribute this affection to a parasite, it must be admitted that its geographical localization is related to the distribution of this Nematode. But we know nothing of its migrations, but only of its last habitat—the subcutaneous connective tissue. It is possible that the embryos have to undergo evolution external to the body; for it may be mentioned that Railliet unsuccessfully injected a somewhat large number of these embryos—extracted from the body of a Filaria

—into the subcutaneous connective tissue of an old Mare.

**Diagnosis, Prognosis, Treatment.**—The peculiar physiognomy of this affection should not allow it to be mistaken for any other.

The different authorities are nearly unanimous as to its benignity. There is, therefore, little need for resorting to treatment, all that is required being merely washing off the blood and keeping the skin clean. In the exceptional instances in which debility is induced, a
tonic and fortifying régime must be adopted. The only measure to be recommended, is abstention from work that necessitates the application of harness to parts on which the eruption is seated.

**Article II.—Summer Sores of Horses.**

**Synonyms, History.**—*Estival Sores, Granular Sores, Granular Dermatitis.* We owe to H. Bouley the first description of this affection, in 1850. He considered it to be a particular complication of cutaneous wounds, under the influence of the heat of summer; and this opinion was for a long time current. In 1868 Rivolta clearly indicated the parasitic nature of these wounds; but his observations remained unsupported until a few years ago, when Laulanîè confirmed them; and now it seems to be well established that the ‘summer sores’ ought to be ascribed—at least, in a great number of cases—to the presence of a larval Nematode in the substance of the skin.

**Symptoms.**—The ‘summer sores’ have been considered, up to the present time, as a complication of ordinary wounds, due to the hot weather of summer. Therefore at their commencement—such as we know it—they do not offer anything special in their character. When they begin to attract attention, they show a tendency to spread, and are covered with a soft, pulpy layer; the granulations are of a reddish-brown colour, and separated from each other by furrows full of serous pus, or of the pulpy matter that covers the whole. The centre of the sore is soft, and easily penetrated by the finger, and in the middle of the spongy granulations are formed granules of a yellow colour, composed of fibrous and calcareous matter. If this be removed, in pressing the exuberantly granulating surface above the level of the skin, ‘on section there will be exposed a multitude of these concretions, which give to the tissue the aspect of a section of hepatized lung, the seat of a tubercular infiltration’ (H. Bouley).

The volume of these granules varies between that of a grain of millet and a pea. Some are superficial, and easily lifted out by simple scratching; while others are deeper, and are, as it were, encrusted in the indurated tissue of the granulations.

At first irregular in their form, the sores, in extending, gradually assume a circular contour; their diameter is variable, but is generally limited to three or four centimetres, though some may be a decimetre.

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They have no particular seat, but may be found on any part of the body, and especially on those regions which are most exposed to wounds—as has long been observed—such as those on which harness rests, and the extremities of the limbs.

One of their constant characters 'is the ardent, insupportable pruritus which never allows the animal a moment's rest, but compels it to rub, tear, and devour with its teeth, to the complete destruction of the sore in which the itching is experienced' (H. Bouley).

**Duration, Complication, Prognosis.**—These sores are remarkable for their tenacity, as it is quite exceptional to see a spontaneous recovery with the termination of the summer heat. The duration is always long, and it appears to be increased by the rubbing to which the animal subjects them; and it often requires two, three or more months to control them, or, at least, to effect their disappearance. And sometimes their cure is only momentary, as they break out again the following summer, on the return of hot weather.

It is their resistance and their duration that constitutes their gravity; while the damage they receive from the patient itself may seriously complicate them, according to their anatomical situation. We have seen open synovial sheaths and exfoliation of tendons brought about in this way.

**Pathological Anatomy.** —The particular tissue implicated in the sore is not so superficial as its appearance might indicate; for it often extends beyond the thickness of the skin, and involves the subcutaneous connective tissue; in this way it forms a slightly diffused tumour, greater in extent—sub-epidermically—than the cutaneous denudation.

In the pathological tissue, there must be distinguished the special granules and the neoplasy englobing them. The latter is the result of an inflammatory process, the intensity of which—according to Laulanie—appears to depend upon the period of the year in which the sore is
examined. In winter, this observer has found the derma very much thickened, and in a manner sclerous; but in summer the alterations may have a sub-acute character—the derma being infiltrated with embryonic, and more particularly fibro-plastic, elements, abundantly interposed between the connective or fibrous tissue fasciculi; in both conditions the smaller arteries are in process of obliteration. The caseous masses of the granules are surrounded by a disjunctive zone—the elements of which are more or less altered by the caseification changes, and by a fibrous circle undergoing fibrous evolution.

The granules are composed of a caseous or calcareous mass, and are especially interesting from the presence in their centre of a Nematode, or its debris; or merely the spiroidal space it occupied, and which is now only an irregular cavity with broken outlines. Rivolta—who has been able to study these granules at the commencement of their formation—has succeeded in isolating this Helminth, which had also probably been seen by Ercolani and Semmer.1

It is a very fine Worm which may attain a length of 3 mm., and the head of which is sometimes a little distinct from the body; the tail is attenuated, terminated in a point, and margined by fine notches. The mouth is orbicular, and appears to be provided with lips. A short distance from the head is seen an opening. The anus is placed at the point where the body becomes attenuated to form the tail. The skin is delicately striated transversely.

This is evidently a larval Nematode. Rivolta has recently proposed to name it the Dermofilaria irritans, but Railliet has rightly reduced this designation to that of Filaria irritans Riv.

Etiology.—Investigations are not yet sufficiently numerous to allow it to be affirmed that every granular or summer sore must be due to this Nematode. But the discovery of this element perfectly accounts for the physiognomy of the affection—its periodicity, disappearance in winter, explosion in summer—related to the natural congestion resulting from the increase in temperature; so that the parasitic granules, placed in the centre of the tissue which has become more irritable, develop the first movement in the chronic inflammation that is accompanied by pruritus, which induces the animal to scratch itself. Hence the excoriations and the sores, which are all the more obstinate

1 Rivolta. Giornale di Anat., Fisiot. e Patol. degli Animali, 1884. — Ercolani has met with the embryos of the Nematode in a Horse on which were unumbilicated crusts about a centimetre broad, and very adherent by their deep surface, which was attended to a kind of pedicle fixed in the derma. These crusts—which implicated the entire thickness of the skin—were localized on the lower surface of the body along the linea alba, where were also seen many bare patches, and others on which the hair had grown again, but was white. The deep portion of each crust looked like a white matted tissue, and was composed of a loose connective tissue, in the midst of which were the very minute Nematodes. Ercolani characterized them as keeping the caudal extremity doubled under the body, and making frequent movements of abduction (Nuovi elementi teorico-pratici di Med. Veterinaria, Bologna, 1859). Semmer reports having found numerous Nematodes between the derma and epiderma, in a horse affected with a dermatosis which was considered to be a psoriasis (Oesterr. Vierteljahresschrift, 1871, p. 179).
as the denuded derma is more impressionable, and the more readily submits to the irritating effects of the granules' (Laulanié).

With regard to the ineffectiveness of treatment, this is owing to the deep situation of the parasite, which is protected by the caseous mass surrounding it.

Its mode of introduction is still unknown. Rivolta admits that it penetrates the integument from without to within, and he ascribes, as a predisposing influence, the uncleanness of the animals and the stables. Méguin has even affirmed — though without proof to support the statement—that the Nematodes of the sores are only the embryos of the *Oxyuris curvula* Rud., an intestinal parasite of the Horse. But, as Railliet has remarked, the parasites of the 'summer sores' occupy the centre of the granules, and it is consequently difficult to admit that they are only an epiphenomenon, the granules themselves constituting the essential element in these wounds. It is probable that, according to Laulanié, the parasite is introduced—in the form of ovum—into the digestive tract, and subsequently penetrates into the blood circulation.

Besides the parasitism, a preponderant influence has been attributed to the summer heat; and it has been admitted that it causes the drying-up of the pus, and the union of its corpuscles in the form of concretions. Friction has also been considered as very important in this etiology. The malady is more frequent in hot countries—Algeria and Italy, for instance—and the Ass appears to be more exposed to it than the Horse, the extremities of the limbs being chiefly attacked in that animal.

(This granular dermatitis is the disease which is so frequent and so troublesome in India, where it is known as 'Barsatti,' and has been the subject of much writing and discussion. The granules, from their being generally calcareous, have been termed 'Kunkurs.' The nature of the malady has been much disputed among our army veterinary surgeons who have studied it in that country, some asserting that it was merely a simple sore, rendered indolent by the heat and moisture, others declaring it to be of a malignant nature, and others, again, as due to a fungus. I am not aware whether it has been seen in Egypt, South Africa, or Australasia; and I do not think it has ever been witnessed in England, where the climate would be inimical to its existence.)

**Treatment.**—An essential indication in the treatment is to prevent

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1 Méguin. Bull. de la Soc. Cent. de Méd. Vétérinaire, 1884, p. 76; L'Éleveur, 1885, p. 486. — This assertion of Méguin may have been inspired by an observation of Pflug (Rev. f. Thierheilkunde und Thierzucht, June, 1881), relative to a Horse that had numerous thick crusts at the base of its tail, which were very pruriginous. These crusts contained the ova of the *Oxyuris curvula* at different stages of development, the parasite itself being found in the faeces. Pflug thought that the Oxyures of the rectum induced acute puritus of the anus, which caused the Horse to rub itself, and so to lead to the deposition of the ova on the walls of the stable, whence they would be taken up by the hairs of the tail; they would then produce embryos which would continue to live under the protection of the crusts, and with the help of the warmth of the skin.
the animal yielding to the pruritus that maddens it; and with this object in view, means of restraint are employed, the nature of which is subordinate to the situation of the sore.

Many agents have been tried in the treatment of the sores, but the majority of them have proved of no value. Among those which have most frequently failed, has been continuous irrigation with cold water, recommended by Quin when the seat of disease permitted. The same authority has counselled frictions of glycerine, but these two methods of treatment have to be employed for a long time—fifteen days, at least. Caustics constantly fail, though Rey obtained excellent results from the yellow sulphuret of arsenic, or opiment, in powder. He took up some of this on the moistened end of his finger, and spread an imperceptible layer over the sore. One application was sufficient; the pruritus completely ceased, the wound dried, and a scab formed that became detached in eight or ten days, leaving a simple wound, which rapidly cicatrized.

Blaise\(^1\) has had equal success with ether, chloroform, and iodoform, with which he dressed the surface of the sore for about ten minutes every twenty-four or forty-eight hours—applying a protective layer of collodion over it. The cure was complete in about fifteen days.

Following this affection, may be placed the filariasis observed among a large number of horses belonging to a cavalry regiment, by Baruchello.\(^2\) It was seated almost exclusively beneath the hairs on the withers, on the neck, beneath the forelock, and at the base of the tail; and it was manifested during the spring and summer. It consisted of small dark-gray tumours—isolated or confluent—varying in size from that of a millet-seed to a pigeon's egg. These tumours soon softened in their centre, which became yellow, ruptured, and allowed pus to escape. This suppuration was followed by sloughing of a portion of the skin, with the hairs covering it, from which resulted slightly ulcerated surfaces secreting pus or serum. There was no pruritus, but only a certain amount of sensibility on pressure.

In the pus of these tumours, Baruchello discovered a great number of extremely slender agamous Nematodes, from 2 mm. to 5 mm. in length, and the most developed of which were enlarged at their cephalic extremity, or terminated in a blunt point, in the centre of which there was an orbicular mouth, apparently provided with lips. The body gradually became attenuated to the tail, which had the anus at its base. Some of them, shorter and thicker, had the cephalic extremity less distinct, had no caudal point, and the anus was terminal; these continued their development in water, and realized the preceding form. There were also intermediate states. These Worms were somewhat active, and could withstand desiccation, becoming lively again on being brought into contact with water.

A cure was effected, principally by the application of an ointment

\(^1\) Blaise. *De la Dernite Granulense.* Journ. de Méd. et de Pharm. de l’Algérie 1885, p. 174.

composed of vaseline, 2,000 grammes; flour of sulphur, 400 grammes; saturated alcoholic solution of crystallized carbohie acid, 120 grammes; corrosive sublimate in solution in q.s. of glycerine, 12 to 25 grammes.

Three horses attacked with this filariasis fortuitously died during the course of the disease, and in their peritoneal cavity were found a very large number of *Filaria papillosa* Rud. For this reason, Baruchello was inclined to believe that this cutaneous Helminthisis is due to the embryos of this *Filaria*.

The veterinary surgeons of the English army in India are very often troubled by a skin disease (of Horses), which is extremely refractory to treatment. Very pruriginous, it causes much irritation, shedding of the hairs, wrinkling and thickening of the skin, and an abundant formation of scurf; while the rubbing and gnawing induced by the itching tends still more to increase the alteration in the skin. The disease is usually manifested on the sides of the neck and shoulders, on the chest, and at the base of the tail. Its nature is not well known, and numerous hypotheses have been formed on the subject. In 1884, Gunn reported that he had found a parasitic Worm every time he examined the crusts which appear in the course of the affection, but the description he gave of the parasite is absolutely obscure.

It may be added that 'Cobbold has described, under the designation of *Pelogera Axeii*, a Worm found by Professor *Axe* in the hoofs of horses affected with ‘‘seedy toe’’; but we are of opinion that this is a thread-worm found in manure, and has no connection with the disease' (Railliet).

**Art. III.—Dracontiasis (Filaria of Medina).**

The *Filaria of Medina* (*Filaria Medinensis* Linn., *Dracunculus Persarum* Kaempfer) is chiefly known as a parasite of Man. It has, nevertheless, been sometimes found in other animals, among which are the Dog, Horse, and perhaps the Ox. It has been very often named the *Dragonneau (Dracunculus)*, and hence the designation *Dracontiasis* given to the disease it determines. In the adult state, the female only is known.

It is a white Worm, on the average from 50 to 80 centimetres long, and, according to certain authorities, it may attain a length of 4 metres (more than 12 feet). Its diameter—uniform throughout—varies between 5 mm. and 1.7 mm. The anterior extremity is rounded, and shows a *cephalic shield*—an irregular surface, elongated transversely, which has the mouth in its centre in the form of a triangular slit, having at its margin two papillæ—one dorsal, the other ventral—and behind the latter, on the border of the shield, are six other papillæ, nearly equidistant. The posterior extremity terminates in a blunt point, at most 1 mm. in length, curved like a hook on the ventral surface. The digestive apparatus is very developed in young individuals, but is atrophied in adults, being empty and reduced to a slender tube that gradually disappears behind, without opening into an

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anus. The cavity of the body is almost completely occupied by a uterus gorged with ova and embryos. The latter—hatched in myriads in the body of the female—can only escape by rupture of the Worm; the vagina and vulva, which were doubtless present in early age, have completely disappeared. These embryos measure 0.50 mm. to 7.5 mm. long, and 15 \( \mu \) to 25 \( \mu \) in diameter; they are cylindrical, scarcely attenuated in front, but in the posterior third of their length they taper to a very fine tail.

The Filaria of Medina is special to hot countries. In Asia it is observed not only at Medina, but throughout nearly the whole of Arabia and in India. In Africa it is common on the coast of Guinea, hence the name Guinea Worm given to it by the English; it has also been observed in Upper Senegal, and more especially in East Africa—Abyssinia, Nubia, Egypt, Kordofan, Darfour, and Senaar. It was introduced into South America by the negroes at the time of the treaty, and it has become endemic in Guiana and some localities in Brazil.

This Worm is found in the subcutaneous connective tissue, and in Man is met with chiefly in the legs and feet; though sometimes it is also seen on the head, neck, trunk, hands, and even in deep-seated organs. Usually rolled up in a spiral manner, it causes the formation of superficial tumours, which are occasionally very painful, and most frequently become abscesses. A certain number of observations have established the fact that it can also develop in the Dog, Horse, and Ox, among the domesticated animals.

Dog.\(^1\)—The Filaria of Medina has been observed in the Dog in the last century, by Doerssel at Buenos-Ayres and Curacao. Smyttan, Forbes, and Griffith have seen it in India, and Clot-Bey, Pruner-Bey, and Junès and Piot in Egypt. We borrow from Railliet the following symptomatology:

' The Filaria Medinensis is most frequently met with on the limbs; it is located in the subcutaneous connective tissue, parallel with the long bones, and more rarely in the superficial portions of the intermuscular connective tissue.

'The Worm first manifests its presence by the development of an oblong, flattened tumour, feeling to the touch like a skein of thick twisted cord. This tumour is indolent at the beginning, and sometimes forms a very apparent prominence; it gradually becomes painful, often

to such a degree that the Dog threatens to bite when an attempt is made to explore the diseased region. The animal becomes restless and agitated, lying down and getting up every instant, licking the tumour, and, indeed, manifesting all the signs of a most intense local pain.

‘Then there occur—at a variable point of the tumour—one or more small abscesses, which soon open, and give issue to a small quantity of purulent serosity. The wound becomes fistulous, and in time gives exit to the Worm, one of the extremities of which protrudes from the opening. Sometimes abscess takes place some distance from the tumour, and then the inflexions of the Filaria can easily be followed beneath the skin, as it has passed through the connective tissue without producing any marked degree of inflammation on its course. The pain—no doubt caused by the movements of the Worm—does not seem to be constant; for varying periods the Dog remains quiet, but at other times, on the contrary, it utters painful howls, and furiously licks the wound, sometimes seizing the worm by its teeth and trying to extract it, though the suffering this entails compels it to desist. However, one of the Dogs that Piot attended succeeded in freeing itself from one of the parasites by gradual traction, the inflammation assisting the operation.

‘In Man, rupture of the Filaria—which at times happens during extraction—is a very grave, often a fatal, accident. It does not appear to be so with the Dog, as the Worm simply retracts within the wound without the pain or inflammation being increased, the parasite ultimately appearing at the same fistulous opening, or it makes a new passage for itself through the integument.’

The number of Filariae found in the same individual varies from one to five.

Horse.—The Filaria Medinensis has been observed in the Horse by Clarkson in 1837, Fleming in 1861, and Burke in 1882. In each of these instances the Worm was situated in one of the limbs—at the lower part of the posterior pastern in Clarkson’s case, at the external aspect of the hock in Fleming’s, and below the carpus in Burke’s. The presence of the parasite was at first shown by lameness, then by an abscess, recovery following extraction of the Worm.

(In the case referred to as reported by me, the Horse was ridden by myself during the campaign in North China in 1860. It was an Australian Horse, and had been for some time in India before accompanying the expedition to China; and as the symptoms did not appear until the summer of 1861, infestation might have occurred in China, the Horse having left India a year previously. A swelling showed itself outside the left hock, at the head of the metatarsal bone, and there was considerable pain and swelling. As it was supposed to be

a contusion, fomentations were applied for some days, when one morning a Filaria, about eighteen inches long, was discovered on the litter behind the animal, and it was then found that the swelling had burst. The Horse experienced immediate relief, and was fit for duty in a day or two, the wound healing rapidly. The Worm is now in the museum of the Dick Veterinary College, Edinburgh.)

Ox. — According to Avenzoar and De Marchais, the Filaria of Medina often attacks the Ox, and the Arab physician even designates dracontiasis as the disease of Oxen. This is the only information we possess relative to the presence of this Nematode in the bovine species.

**Etiology.**—Numerous hypotheses have been framed to explain the entrance of this Filaria into the body of Man and animals. We now know, from the investigations of Fedchenko, that the embryos of this Worm find their way into the system of small soft-water Crustacea, belonging to the genus Cyclops, and there undergo their larval stage of existence; there may be as many as a dozen parasites in the body of a single Cyclops, without its appearing to suffer any inconvenience. It is very probable, therefore, that in drinking non-filtered water containing these Crustacea, Man and animals become infested.

The Cyclops, by reason of their small size, may easily pass unperceived, and on arriving in the digestive canal they would be destroyed, and the Filariae set at liberty.

We are reduced to suppositions in following their development. Fedchenko has failed in his attempts to infest young Dogs and a Cat, by giving them milk and water containing Cyclops, in which were the larvæ of the Filaria. It may be admitted that the Worm is at first a hermaphrodite, and only become exclusively female in consequence of the extreme development of its uterus—full of ova and embryos; but it is very likely that the larvæ arrive at sexual maturity in the intestine of Man, the Dog, and the Horse, and copulate there. Then the male dies and is evacuated with the faeces, while the female passes through the intestinal wall, to find lodgment in some congenial situation. In a period varying from eight months to two years, it reaches its full growth, and makes its appearance under the skin.

**Treatment.**—The sole object of treatment is the extraction of the Filaria. With regard to Man, the method generally followed from the earliest times consists in getting hold of the Worm, either by incision or through the opening it makes, and rolling it gradually round a bit of wood, or on a roll of diachylon. If extraction cannot be effected at once, without risk of breaking the Worm, then several days may be necessary, the wood being attached to the part by means of a bandage. Clarkson and Burke have in this way operated on the Horses that came under their notice.

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But this method is not always practicable with the Dog, because of the pain it produces, and the indolency of the animal. It is easier and more convenient to incise the skin for the entire length of the tumour, and at once enucleate the coiled-up parasitic mass. If the Worm happens to be extended in the form of a subcutaneous knotted cord, it can be removed at different times by repeated incisions.

**Article IV.—Indigenous Cutaneous Filariasis of the Dog.**

Rivolta has published an instance of herpetic disease in a Dog, due to the embryos of a Filaria. This Dog had at the upper part of its neck, on one side only, a moist ulcerous-pustular patch, about 4 cm. in diameter, and of a dark-red colour. The few hairs remaining were erect, and matted together by crusts. Pressure caused a purulent matter, mixed with blood, to exude from this surface; this fluid, on microscopical examination, was found to contain the embryos of Nematodes, the tails of which executed very energetic movements. These embryos were also very numerous under the crusts and in the pustules. The hairs had been partly detached from their follicles.

The embryos had an orbicular mouth; the body was a little attenuated in front and very tapering behind, where it formed an exceedingly slender tail. They resembled those Ercolani found in the Horse (see p. 259), but they were smaller. Rivolta considered them, without plausible reason, to be the embryos of *Filaria Medinensis*. This affection, which did not affect the general health of the Dog, yielded to four or five applications of mercurial ointment.

Siedamgrotzky has also published a case of dermatosis in the Dog, caused by Nematodes. The animal had, on the outer surface of all its legs, small discrete pustules surrounded by a red circle, and also small red papules, between which the hairs had been partly removed by rubbing. The pruritus was intense. In the pus from each pustule were found one, two, or three Nematodes, measuring 4 mm. to 7 mm. long and 10 μ to 25 μ maximum breadth. The anterior end of the body was slightly attenuated; the posterior extremity tapered into an acuminated tail, 50 μ to 80 μ long. The skin was very delicately striated. The mouth was surrounded by six indistinct lips, and was succeeded by a cylindrical oesophagus; stomach muscular and rounded; intestine simple; anus a little in front of the caudal point. The absence of genital organs was evidence that these were embryos.

The Dog did not pass any worms, either before or after the administration of the anthelmintic. In the dust of the kennel, parasites similar to the preceding, but smaller and dried up, were found, as well as some females, also desiccated. The latter differed from the embryos in their dimensions—length 8 mm. to 1 mm., maximum breadth 70 μ—by their short acuminated tail, by the presence of a vulva situated a little behind the middle of the body, and about 15 oval eggs 37 μ long and 25 μ broad, containing indivisible protoplasm.

By simple cleanliness, the affection disappeared in about three weeks. The kennel was thoroughly cleansed and provided with new litter.

Siedamgrotzky, in classing these Worms with Anguillulae (thread-worms) cites the observations of Möller of Berlin, who met with the latter on the skin of different mangy Dogs, and on one occasion when there were no acari. The skin was thickened, depilated, and the seat of an abundant desquamation. Möller could not assure himself whether the eruption was caused by the Anguillulae, or whether they were merely commensals living on the pathological secretions of the skin. Leuckart, quoted by Zürn, made a similar observation on a mangy Fox.

**Article V.—Verminous Foot-rot of Sheep.**

Prümers has described a contagious disease that prevailed among Sheep in the circles of Wetzlar, Coblenz, Simern, and Wissenheim, and which several veterinary surgeons mistook for ‘foot-rot’ (piétir). According to him, it differed from that affection in being seated on the plantar surface, less frequently on the inner surface of the claws; while foot-rot occupies the interungal cleft and the coronet, and is accompanied by a serous discharge. Besides, this ‘contagious foot-rot’ (anstekende Klauenfäule) is manifested by dark-brown spots, 2 mm. to 3 mm. diameter at the commencement, but in about ten or twelve days are the size of a 50 centimes piece; the superficial horny layers are destroyed, and decomposition continues its perforating progress. It usually remains localized on the sole, but it sometimes extends to the fleshy parts and produces ulcerations.

A microscopical examination of the diseased horn, with a power of 500 or 600 diameters, discovered Nematodes, the mouth of which was horseshoe-shaped, and the caudal extremity was very acute; the males were smaller than the females. These details, however, are too summary to allow the genus of this parasite to be determined.

This affection is more frequent with Sheep kept in sheepfolds, than on pasture. It is contagious, probably by means of the litter. Lambs two or three days old may be attacked, when they remain with the ewes in the folds.

It has yet to be decided whether these Worms are merely commensals, attracted from the litter by the horn already softened under the influence of a pathological condition of different origin.

CHAPTER VII.

CUTANEOUS PSOROSPERMOSIS.

For a long time there has been known a cutaneous affection which often attacks Poultry, Turkeys, and especially Pigeons, and, according to Csokor, sometimes Geese, to which the names Cutaneous Psorospermosis, Epithelioma Contagiosum, and Molluscum Contagiosum have been given. It chiefly affects the head, and consists of more or less numerous, round or oblong, yellow, salient nodules, varying in size from that of a poppy-seed to a grain of maize. The largest are found at the base and the commissures of the beak, around the nostrils and the auditory meatus, beneath the nasal mucous membranes, at the borders of the eyelids, and on the face. On the crest and barbs they form rough, yellow masses.

These nodules, which have at first the appearance of the warts that appear on the hands of children, soon show a central depression, and contain a thick, atheromatous matter of a sulphur-yellow colour.

With Pigeons, the affection may be diffuse, and invade the head, neck, inferior surface of the chest and abdomen, rump, and upper surface of the wings, at the insertion of the pen-feathers. The nodules may ulcerate spontaneously or by ready traumatism, and exude a very foetid, sero-purulent fluid.

When the disease is limited, the general health does not appear to suffer, and recovery may spontaneously occur—the nodules ceasing to grow, drying up, and falling off in a mass or in fragments. But the malady generally extends, the Birds become emaciated, the feathers erect, and anaemia and marasmus are the fore-runners of death; which is often hastened by diphtheria—an ordinary complication of this affection, and often mistaken for it.

This disease of Birds is contagious from one to another. If an affected one lives for some time among healthy ones, the elements of contagion—spread about in roost or dove-cot, or transmitted by contact—are not long before they infest Birds in good condition. According to Rivolta, transmission will not take place if the morbid matter is deposited on the skin of a protected Bird. But Pfeiffer has succeeded in conveying it by means of inoculation, through punctures, to Fowls and to Pigeons. Nodules appeared eight days afterwards at the points of inoculations, and the disease spread from these until it reached the buccal cavity, nostrils and ears, and more or less obstructed these cavities. In Poultry and Turkeys the malady has a much less tendency to invade the mucous membranes.

Cauterization with the hot iron or chemical agents constitutes the usual treatment. The employment of oil of turpentine has proved satisfactory in this respect, and also as a prophylactic after disinfection of the places soiled by the diseased Birds.

Bollinger was the first to ally this affection with that known in Man as Molluscum contagiosum and Epithelioma contagiosum, and there are certainly great symptomatic analogies between them. At the same time, Bollinger described the presence, in the tumours which mark the disease, of special foreign, parasitic elements belonging to the Coccidia: and Rivolta and Silvestrini first identified these Coccidia with the Coccidium oviforme, which infests the liver of the Rabbit (see Hepatic psorospermosis). Later, Rivolta grouped them as a distinct species, which he named Amœba croupogenæ or Psorosperma crouposum, thus confounding in a single morbid entity this dermatosis and the diphtheria of Birds. Although the question is far from being decided, there is a general tendency to regard this disease as a true Psorospermosis or Coccidiosis of the skin.

The Coccidia or Psorospermiae oviformes constitute, in the class of Sporozoa (see p. 4), an order in which the majority of the species belonging to it live as parasites in the interior of epithelial cells of the liver, intestine, skin, etc. At the commencement of their development, these Coccidia form small protoplasmic, regularly rounded masses, which are usually nucleated. Gradually each of these masses increases in volume, and becomes surrounded by a transparent membrane—the cyst or shell—and rupturing the cell into which it had penetrated, it falls into the biliary ducts, the intestine, the epidermic layers, etc. Thus liberated, the encysted coccidium passes through a phase of segmentation—its protoplasm becoming condensed, then dividing into several spheres or spores. Each spore, in its turn, subdivides into a small number of corpuscles—falciform corpuscles—which, meeting with favourable conditions, each becomes a new amœbid individual that invades an epithelial or epidermic cell, grows there, and re-commences the cycle of its progenitor.

From an anatomo-pathological point of view, the tumours of cutaneous psorospermosis are due to a subacute infiltration into the
whole substance of the skin, causing hyperplasia of the cells of the stratum Malpighii — those which are invaded by the parasite becoming hypertrophied and their nucleus driven towards the wall, and alongside of it is the more or less voluminous Coccidium, in the form of an almost spherical yellow body. The invasion of the cells is all the more general as they are more superficial, and between them can be perceived numerous falciform corpuscles emanating from the adult Coccidia.

This affection of Birds, like the Molluscum contagiosum of Man, closely resembles the 'disease of the nipple,' first studied by Paget, and more recently by Wickham, and that which has been described by Darrier under the name of 'vegetating follicular psorospermosis' (psorospermose folliculaire vegetante). These three affections of Man are caused by parasitic Coccidia. But this subject is still in the domain of preliminary study, and we can only accept with reserve what has been stated with regard to the psorospermic nature of the cutaneous nodules found on Fowls.

Following this disease, we place that which Lendenfeld has observed in Australia in lambs, which were attacked with it on the feet, behind the claws, on the lips, gums, and nostrils. The malady resembled epithelial cancer. The mucous layer of the skin was inflamed, the papille of the derma hypertrophied, and the horny layer — very much thickened — covered the suppuration of the derma. The animal might succumb to the disease; but cicatrization might also ensue spontaneously, after the horny layer had fallen off and been replaced by a new epidermis covered with hair.

Between the strata of the horny layer, Lendenfeld found granular, nucleated masses, apparently parasitic. He considered them as Amoeba, and named them Amoeba parasitica; he could not differentiate them morphologically from another species of Amoeba — A. princeps Ehr. — common in fresh water. He was able to grow them in an aquarium, and imagined that, penetrating the epidermis by sores that the Sheep had upon them, these Amoeba multiplied rapidly and provoked an acute irritation.

CHAPTER VIII.

DERMATOMYCOSES.

The Dermatomycoses (from δέρμα, skin; φύκης, fungus), Dermophytes (from δέρμα, skin, and φυτόν, vegetable), or, better, Epidermophytes, are more often designated by the name of Tinea. They are due to inferior Fungi called Epiphytes, Ectophytes, or Dermatophytes, which the majority of mycologists group into one small family—the Trichophyta. They are allied to the Mucorinae that live on decomposing animal or vegetable matters, and which—included in the large group of Moulds, comprise several of the more common moulds, such as Mucor mucido, Rhizopus nigricans, etc. Like the Mucorinae, the Trichophytae have a mycelium, several branches of which bear chaplets or spores, but they are destitute of true sporanges. Otherwise, their natural history is as yet incomplete.

The Trichophytae are characterized by their mode of vegetation, which causes them to form more or less regular circles, and sometimes cup-shaped masses on the surface of the skin.

A Dermatophyte comprises only two kinds of elements: 1. The spores, constituted by an amorphous envelope, more or less thick and resisting—the epispore—and a granular central portion—the protoplasm; they may be free or grouped in chains or masses. 2. The tubes, having—like the spores—an amorphous wall and protoplasmic contents which, in some, is not continuous: these are the filaments of the mycelium, forming altogether the thallus or vegetative part of the Fungus. In the others, the protoplasm is more or less regularly segmented, forming the sporiferous tubes, sporophores or receptacles.

But when the development of the parasite is followed, it is recognised that the distinction between these elements depends upon the phase in evolution at which they are observed. In fact, as F. Balzer has


said, 'All are derived from the spore; in becoming elongated and developed, it forms a tube or filament of *mycelium*, in the interior of which the substance of the nucleus or protoplasm buds, sending out lateral prolongations and segments in such a manner as to constitute the *sporiferous tube*; and when at last the segmentation of the sheath takes place, in enclosing the segments of the central substance, *new spores* are formed and evolved in their turn, in the same manner. In fine, evolution begins and ends with the spore.' This is clearly indicated in the following illustration:

![Diagram of the Vegetation of the Dermatophytes](image)

It should not be concluded, from what has been stated, that each tube must undergo sporular segmentation throughout its whole extent; for this only occurs at the extremities, and many of the tubes remain sterile and wither, whether or not their segmentation has been commenced.

Each Dermatophyte exhibits constant characters in relation to the disease it induces, and has received a particular name. In the opinion of the discoverer, it constitutes a proper species, quite distinct from others more or less like it, and which may also be agents in producing dermatoses. In 1830, Lowe had attempted to demonstrate that the Fungus of herpes tonsurans and that of favus are only one and the same species, and that both are derived from the *Aspergillus*. Four years later, Höbra, the great dermatologist of Vienna, based this opinion on the phenomena that were observed on the skin of Man, by the application of compresses covered with moulds. At that period, Tulasne had discovered the pleomorphism—or polymorphism—of certain Fungi; the observations of De Bary, Hoffmann, and Kühn had confirmed this fact, and it was natural that it should be sought to apply the knowledge thus acquired to the Dermatophytes. Hallier was the most ardent promoter of this generalization of the facts of polymorphism; but the experiments invoked in support of his theory have been considered by the most distinguished botanists as stained with errors. It is undoubted—so far as dermatology is concerned—that each dermatophytic species preserves its autonomy: the Fungus that is derived from favus never produces anything but favus; that of tinea tonsurans has never yielded anything else than a trichophyton, and it is the same with that of pityriasis. And all endeavours, by cultures, to obtain the transformation of these Fungi into true moulds, have been unsuccessful.

Finally, according to dermatologists of the highest authority, the
morbid phenomena determined by the application of moulds to the skin of Man, have altogether superficial symptomatic analogies with the true Dermatomycoses.

The Dermatophytes localize themselves on the epidermic tissue, and even penetrate into the hairs and between the cells of the epidermis—separating them from each other, decomposing them, living on them; and consequently determining by this action, and the shedding of the hair, a more or less acute degree of irritation, characterized by pruritus of varying intensity, redness of the naked skin, and also, sometimes, exudation.

Subordinate to the growth of the Fungus, the tinea have usually a chronic course; but the prognosis they elicit is always favourable in regard to animals, on which it is always easy to destroy, with impunity, the parasite that occasions them. They are due solely to contagion, and beyond age—for young animals appear to be most liable to them—no general conditions are known that influence their manifestation.

The diagnosis is based on the most apparent clinical symptoms; but however marked these may be, it is always useful, if not necessary, to have recourse to a microscopical examination of the altered epidermic products. This investigation should be made on the most recent—the youngest or deepest part—of the crusts that cover the circular patches of the disease, and on the hairs grown at the periphery of these parts. As the parasites are nearly always mixed with various impurities, and often with grease, it is necessary to immerse the fragments to be examined once or twice in absolute alcohol or in ether. Then they should be scrutinized in a solution of soda or potass—10 to 40 per cent.—which will disassociate the epidermic cells and render the preparation more transparent. A magnifying power of 200 to 500 diameters should be employed.

The study of the Fungi of the tinea has a solid foundation in the culture method of investigation.1

The fluids best adapted for this purpose are the simple or peptonized veal broth, skimmed milk, Liebig's broth, turnip water, malt, malt grains, and dry must of grapes. The solid media gelatine or agar-agar, are generally less adapted for the cultivation of these parasites than the fluid ones, as on them their development is slower and less abundant, and the Fungus is more promptly broken up.

The slightest acidity of the medium is opposed to cultivation, which is not so much affected by alkalinity. Cultures are made slowly at 15° (Cent.), but the most favourable temperature is 33°. They are easily sterilized by small quantities of antiseptics—alcohol, salicylate of soda, and more especially oil of turpentine, chloroform, tincture of iodine, corrosive sublimate, carboxylic acid, etc.

Cultivated in fluid media, the Fungi of the Trichophytes and favus develop a mycelium, which gradually grows, and forms on the surface a dull white, compact, cotton-like layer, sometimes 2 mm. or 3 mm. thick, and of a yellowish tint on its lower aspect. The free surface sends out aerial filaments, which terminate in aero-spores, or aerial spores, which are sometimes in such large numbers that they are clustered on the filaments like grapes on their stalk; while beneath, the mycelian filaments, deprived of oxygen by the thick stratum above them, close up, and are transformed into more or less bulging chains of cells—mycelian or conidian spores—of less regular, but larger dimensions than the preceding.

Among the dermatomyces of the domesticated animals, there need only be described in this place tinea tonsurans and favus, as they are almost the only dermatoses in which the intervention of a vegetable parasite is indisputable. Zürn,¹ it is true, adds to these several other affections which might be ascribed to Fungi, but without sufficient clinical evidence to be acceptable. Nothing is said with regard to plica polonica, nor alopecia or pellada, or pityriasis, as the parasitic nature of these is far from being admitted by the generality of dermatologists of mankind, the majority of whom only see in the parasites described accidental elements in the lesions which have been brought thither by the air or the various applications. With more reason should this be the case in regard to the domesticated animals, the hairy covering of which offers to these wandering germs a warmer and quieter abode than the skin of Man does. And so also must be passed unnoticed the "eczema of malt-grains," which consists in cracks in the skin of the posterior limbs of cattle kept in distilleries, and fed on the refuse of these establishments, and which Zürn regards as caused by alcoholic fermentation; and so on with several other maladies, the history of which only rests on some rare and insufficiency observed cases, in which the accused parasite has not been put in evidence by a trustworthy procedure.

Article I.—Tinea Tonsurans.²

Definition.—Tinea tonsurans is a parasitic and contagious cutaneous affection caused by Fungi belonging to the genus Tricophyton, and which affects Man, the Ox, Horse, Dog, Cat, Goat, Sheep, and Pig. It is characterized, clinically, by more or less circular patches, the hairs on which, at first lustreless and erect, fall off and leave the skin bare.

Synonyms.—This malady had for a long time been confounded (in France) with various other non-parasitic dermatoses, under the common name of dartre (herpes), and corresponds more particularly to what the older authors called dartre croûteuse and dartre sèche. The peasantry of Auvergne name it anders or indires (Grognier), those of Limousin anders or endai (Lemaistre), those of Poitou anderses (Gellé), and those of the South of France teigne (Carrère), brillants (Rigal), or sous-brillants (Houlès). (In English, the popular name is ringworm.)

Since the discovery of its parasite, the names that have been given to it have had regard to its nature, and have been in relation with those employed in human dermatology for the same object: such are dartre tonsurante contagieuse (Reynal); herpès tonsurante (Cazenave); trichomycosis (Gerlach); tricophytie (Lafosse, Hardy); and teigne tonsurante (Bazin). The last two designations should be preferred, although that of herpès tonsurans is often employed.

History.—Before its parasitic nature was known, tinea tonsurans was included in the badly-defined group of diseases called dartres, and the theory then in vogue with respect to the vice dartreux was naturally applied to it. This vice or diathesis was developed under the influence of physiological misery; but it is remarkable that, among the many causes invoked to explain its advent, was that which is most favourable to the development of parasitic dermatoses—that is, uncleanliness of the body, and filthy stables or other dwellings. Notwithstanding the confusion prevailing in the dermatology of animals, the physiognomy of tinea tonsurans did not remain unperceived; and it was doubtless this which Chabert had in view in the dartre rond of which he speaks, which ‘affects some parts of the body and neck;’ and of which he also mentions the contagious character, attributing this to all the other forms of gales and dartres he describes. But it is generally impossible to recognise the Trichophyton in the writings of the older veterinary authors. By its symptoms, it was evidently the dartre furfuracée or farineuse of Hurtrel d’Arboval, and it was also, apparently, the dartre sèche of Carrère, and the dartre croûteuse, or pustule-croûteuse, of Gelle and Lafore. Nevertheless, an important fact was established. Ernst, a veterinary surgeon in the canton of Zurich (Switzerland), in 1820, observed the transmission of the dartre to a young woman in the form of herpes tonsurans. In 1831, Grognier relates that the peasantry of Auvergne knew that the dartre of the Ox was communicable to Man; and Kölreuter, in 1836, Lavergne, Carrère, and Fehr, in 1838, published cases in corroboration of this, and analogous observations soon began to multiply. In 1852, Reynal and Bouley the younger witnessed contagion of the dartre of the Horse to Man also, in the form of herpes tonsurans, and numerous instances proved that it passed readily from diseased to healthy animals.

Gruby had, in the interval (1842), discovered the parasite of herpes tonsurans in Man; but it was not until 1853, that the existence of Trichophyton tonsurans in the domesticated animals was announced for the first time by Bazin, who found it in the dartre tonsuante of a Horse, which had infected the gendarme who attended to it. Some years afterwards (1857) Gerlach published an important work in which the parasitic nature of this disease in the Ox was manifestly demonstrated, and almost at the same time (June 30, 1857) Reynal brought before the Imperial Academy of Medicine (Paris) a memoir in which he gave evidence of the conveyance to Man of the dartre of the Horse and Ox, 18—2.
and the identity of this affection with the herpes tonsurans of Man. Gradually the history of the affection was completed; the preceding facts were confirmed and extended, and a great number of observers—whose writings will be alluded to hereafter—have furnished precise information with regard to the Trichophytion in the various species of domesticated animals, and the conditions under which contagion occurs.

**Symptoms and Lesions.**—The symptoms will be described successively in each of the species of animals which may be affected with tinea tonsurans; for although in all there is a character that indicates their common origin, the symptoms bear special features according to the animal soil in which the parasite is developed.

**Bovine Species.**—In this species, in which the disease appears more frequently than in any other, it is rarely disseminated over the whole surface of the skin, but prefers locating itself on the lips of calves, on the head, neck, upper parts of the body, and altogether exceptionally on the inferior regions of the limbs.

The commencement is manifested by a slightly salient ring, on the surface of which the hairs are erect. An active proliferation of the epidermis causes the rapid formation of scales more or less adherent to each other, and composing crusts of 2 mm. to 7 mm. thick—hence the name *dartre croûteuse* given to the affection by the older (French) veterinarians. According to Gerlach, the crusts are thicker on dark skins, on which they have a grayish-white, fibrous appearance, resembling the amianthus (*porrigo asbestinea*); on white skins, which are usually finer, the crust is thinner and a little yellow in colour.

The lesion progresses by a regular centrifugal radiation; other patches form, those which are nearest to each other becoming fused into a larger one, and their diameter varies in this way from the size of a florin to that of a five-shilling piece. Gerlach states that they may even be as large as a plate. The dark hairs break off at the surface of the crust, and the patches then become more apparent; but the white hairs rarely do so, for a certain number of them always persist, and they surmount the crust in such a manner that white skins never appear to be tonsured.

At the commencement the crust is very adherent to the skin, and if torn off, the derma appears tumefied and bleeding. Gradually it is detached from its centre, while the peripheral portion, which is more recent, is still fixed. There is then found beneath the crust a thin layer of pus, which, when removed, shows the derma still inflamed, and marked by numerous little openings left by the torn-out hairs. The

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Dermatomycoses.

277

pus raises the crust that covers it, gradually dries in superposed layers—which may or may not be adherent to the parasitic production—and constitutes a new crust that remains after the first one has fallen off, and, contrary to what is the case with that one, this no longer exhibits, especially in its deeper layers, the cryptogamic elements.

This second crust dries in its turn, and falls off in the form of scurf or scales (dartre furfuracee), leaving a glabrous surface on which the hair grows in a regular manner immediately, or after a brief epidermic desquamation.

The malady is accompanied by a certain amount of pruritus, which is more pronounced at the beginning and end than in the intermediate period; but it is far from having the same acuteness as in scabies.

Horse.—With this species, in which the affection is—in most countries—not so common as in the Ox, the trichophytic patches are more especially seated on the upper part of the body—on the shoulders, back, loins, croup, sides, and flanks—where, in fact, the grooming instruments most readily carry the parasites, in the dissemination of which they are the most active agents. These patches may, however, be met with on any part of the body, though they are rare on the lower parts of the legs.

However much care may be taken—even in experiments closely watched from the evolution of the malady—the abundance of hair and the pigmentation of the skin are most frequently opposed in an absolute manner to observation of the primary phenomena of the eruption. What are first noticed are the circular patches, the diameter of which is generally about that of a shilling; they are distinguished from the healthy skin by the dulness and erectness of the hairs covering them. (I have observed, some time before the circular patches appear, a very small tuft of hairs—probably from half a dozen to a dozen—slightly but markedly raised in the form of a fine pencil, and feeling as if they had a somewhat hard base, or were matted together at the bottom, when the finger is passed over them. These tufts may be several in number, and are usually best seen on the hind quarters at the very commencement of the disease, or in the vicinity of the patches, of which they are the initial symptom.)

The hairs fall off in a few days, and this is often the first symptom that attracts attention. Mégnin remarks that this phenomenon is precipitated by grooming, and that, as the hairs at the periphery are the first to fall, this is the cause of the formation of rings in tinea tonsurans—an aspect that must not be confounded with the herpes circinatus of Man, which is due to another phenomenon. But this feature soon passes away, and it is not long before the whole surface of the patch is depilated; and if the malady extends, the coat of the animal acquires, through these nummular spots, a quite peculiar appearance. The hairs do not fall by avulsion, but by breaking across,
almost on the surface of the skin, and it is readily noticed that the broken end is irregular, and as if frayed.

The epidermis of the patch falls off at the same time as the hairs; it appears to be softened, and the surface of the skin has then a dark-gray tint and is slightly moist, which might be attributed to the rupture of vesicles, though their presence has never been demonstrated. It cannot, therefore, be said, as Railliet remarks, that the disease presents itself in the form of herpes, as what is so called in human pathology includes a phase marked by the appearance of vesicles.

The humidity of the trichophytic patch is ephemeral. Its surface generally soon dries, and is covered with epidermic scales of varying thickness, which are agglutinated into flat crusts that are shed and renewed incessantly. These crusts have—more frequently than in the Ox—a shining appearance and a gray or yellowish colour that liken them to the amianthus. At the same time, the lesion progresses by peripheral extension until it attains the diameter of a five-shilling piece or more, and on each zone invaded the following successive symptoms are observed. On gaining these dimensions, the patch ceases to extend and the crusts to form, and there remains a dry, glabrous, harsh surface of a grayish slate colour, throwing off some furfuraceous scales, from which the hairs grow slowly, and are of a darker colour than the other hairs, except in light-gray horses.

This is only a local recovery, as patches are formed more or less near the preceding, to run through the same phases; and it is possible that confluent patches may unite to constitute a vast ringworm surface, the cure of which is more difficult to effect.

We have remarked on the extreme abundance of the Trichophyton, in powder and crusts collected by Couzin on a mule from Guadeloupe, the skin of which—and especially that of the legs—was almost completely hairless. The commencement of this kind of tricyphytonous alopecia did not date for more than two months.

Fleming\(^1\) has met with a circinated variety, which might be allied to the circinated trichophyton of Man, by its form and mode of growth; it being simply due to the cure of the central portion of the patch while the disease extended at the periphery. The lesion then appeared as a more or less complete ring.

Pruritus is nearly absent in the trichophytic Horse, and is scarcely even shown to exist, except by movements indicating satisfaction on the part of the animal when the patches are gently scratched.

Mégnin\(^2\) has made known another form of trichophytic tinea, which has the closest analogy to that of the Ox. The crusts are yellow, and not gray, and the hairs, instead of breaking, are shed, in consequence

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of the irritation in their follicles. Consequently, the patches differ essentially from those of tinea tonsurans, inasmuch as, instead of appearing as if shaved and covered with stubbly hairs, they are absolutely glabrous. This form is more tenacious than the other, and should be due—as well as the tinea tonsurans of the Ox—to a special fungus, which Mégnin has proposed to designate Trichophyton epilans. This clinical form of trichophytis has been observed by Viseux, Delamotte and Bogenez, and by Evrard. It may, in certain cases, be developed with remarkable rapidity. A Horse which appeared to have nothing amiss with it at night, was found next day to have five hundred patches on its body (Evrard). Mégnin has reported a contagious dermatosis met with by Weber, which consisted of papules about a centimetre in diameter, covered by a crust that was easily detached by scratching it, leaving a dark-gray denuded surface, somewhat granulating, and which at a distance looked like the cicatrix of a small-pox pustule. This last form differs also by the readiness with which it can be cured, from the type established by Mégnin. We shall again allude to the value of these distinctions.

Dog.—Tinea tonsurans of the Dog, rare in France, is more frequent in Germany. According to Gerlach and Friedberger, it has great symptomatic analogies with that of the Ox and Horse. It is most frequently situated on the head and legs, and usually commences around the lips and eyes; but patches may be found on any part of the body, when the malady has been present for some time.

At the commencement the patches are depilated, circular, and well defined; by increasing in number and extent, they may unite and form irregular surfaces. They are soon covered with crusts, which are at first thin and of a dirty-gray or amianthine hue. The pruritus may be insignificant or very intense. When the latter, in consequence of the rubbing, the crusts are impregnated with blood and serum, and have a colour varying from yellow to brown. The hairs which have not broken are agglutinated, and sores form, which alter the physiognomy of the affection. Beneath the crust there is often observed a reddish-brown or copper tint, with a large number of small nodules the size of a millet seed, formed by swollen hair-follicles. It sometimes happens that the patches project as much as 3 mm. above the level of the skin, their surface being really papulous. Spontaneous recovery is rare.

Various other Species.—We have little information with regard to

trichophytis of the Cat, Sheep, Goat, and Pig. From what has been written on the subject, it may be concluded that there are close resemblances in the symptoms to those exhibited in the preceding species, if an account be taken of the differences in their coat.

Fenger, who has seen tinea tonsurans in the Cat, says that it consists of circular depletions covered with abundant scales, the patches attaining a diameter of 15 mm. to 35 mm. in three weeks.

According to Bräuer, in Sheep affected with trichophytis, it is observed at the beginning that the wool is collected in small irregular tufts, which increase in number and volume; the fleece is matted in various places. On the neck, chest, shoulders, and along the back, appear furfuraceous and crusted patches, accompanied by marked pruritus, which assists in giving the wool its bad appearance.

Tinea tonsurans is not very tenacious in the Goat.

On two Pigs seen by Siedamgrotzky, the trichophytic patches were 2 cm. to 5 cm. in diameter; they were not regularly circular, and their slightly-red surface did not show any exudation, but only a notable epidermic desquamation.

In diagnosing tinea tonsurans, it may be useful to follow the procedure recommended by Dyce Duckworth for the dermatomyceses of Man.

If a few drops of chloroform are allowed to fall on the suspected region, after it has evaporated certain hairs will have assumed a white or primrose-yellow tint, if it be tinea tonsurans. This tint is only seen in diseased hairs, and should be attributed—as the microscope shows—to the presence of the parasite; its intensity is in proportion to the abundance of the Fungus. Besides, the parts of the integument from which the infested hairs issue acquire, under the influence of this re-agent, a particular powdery aspect and white colour in tinea tonsurans, whitish in favus. The bisulphuret of carbon also renders the hairs more transparent, and the spores and mycelia more visible.

Microscopical Examination.—The diagnosis of tinea tonsurans is not definitive until a microscopical examination has been made of the hairs, and the epidermic products and crusts from the suspected patches.

On scraping the skin with a spatula, or small curette with margins a little sharp, epidermic pellicles and hairs are collected. The products that abundantly cover the patches are very poor in parasitic elements, and it is advisable to concentrate attention on the deeper parts in direct contact with the skin. To examine the hairs easily, they should be removed from the periphery of the patches by means of a pair of forceps. A direct examination can be made at once, for it is sufficient to soften the crusts and scales in water. But it is better to employ a 40 per cent. solution of caustic potass. The particle to be examined is disassociated in itself by pressure on the cover glass, which reveals

1 Fenger. Tidsskrift for Veterinairer, 1885; Repertorium der Thierheilkunde, 1866, p. 276.
the presence of the elements of the parasitic Fungus. In general, there is scarcely any need to previously remove fatty matters by treating the substance with ether or absolute alcohol. For durable preparations, there must be substituted for the alkaline solution in which the elements were first examined, glycerine or, better, carbolized water, which has not the disadvantage of rendering the preparation too transparent. The parasites may be coloured with eosine or methylaniline, after dissolving the fat in the scrapings by ether (Balzer).

By the naked eye or hand lens, there can often be seen at the base of the hairs which have been pulled out, a whitish mass surrounding their root, and which is formed of the parasitic elements. If the examination be extended to the hairs that are much altered and broken, their ends will be found split up and frayed like a brush. At times there are found here and there, between the crusts and the skin, small, yellowish, earthy-looking masses, readily broken up, and which are exclusively formed of the Fungus in the state of spores, and more especially of filaments. But it is only by the study of all the products of the morbid process, that a complete idea can be derived as to the nature of the parasite.

This Fungus, as has been already mentioned, was discovered by Gruby in 1842, in the herpes tonsurans of Man. Some years later—in 1846—Malmsten, in Sweden, more precisely studied the pathological products of this affection, and gave an exact and minute description of the dermatophyte, assigning to it the designation of Trichophyton tonsurans, which it has retained. Bazin was the first, in 1853, to recognise it in the Horse; then Gerlach in the Ox and Dog in 1857-59; Fenger in the Cat in 1865; Perroncito in the Sheep in 1872; and Siedamgrotzky in the Pig in 1872.

The Trichophyton tonsurans Malm. comprises two kinds of elements: the tubes or filaments of the mycelium, and the spores or conidia.

The tubes are very elongated, and are composed of pieces or articles joined end to end; they are regular, slightly flexuous, and only at certain distances show rare ramifications. With those from the Dog, however, Friedberger has observed a very remarkable ramifying arrangement. And we have found, on the same Horse, two kinds of filaments more especially distinct in their diameters, which were very small in one kind and normal in the other.

According to Bizzozero, the tube is opaque and granular at its extremity, but is continued afterwards by transparent articles containing a clear fluid; then come articles containing spores in process of segmentation, which are transformed into chains of spores at the termination of their evolution. Their ordinary diameter varies from 4 μ to 6 μ, but in those of the Dog it may be as low as 1 μ to 5 μ.

The spores or conidia are round or oval, with distinct contour, and homogeneous or very refrangible contents. The majority are colourless, and some have a yellow or light-brown tint. They form irregular masses, or distinct and somewhat long chains. Their usual diameter is 3 μ to 4 μ, but it may vary between 2 μ and 8 μ. In animals, it is in general less than in the trichophytic tonsurans of Man, and it is much smaller in that of the Horse and Dog than in that of the Ox.
These two kinds of elements are not in the same abundance. Most frequently the number of conidia is so considerable as to conceal the filaments accompanying them, and which are generally more numerous at the commencement of evolution, while at other times they may predominate without any assignable cause.

The parasite is found in the form of filaments more particularly below the crusts, and in the scales from tonsurans patch, and in the form of spores more especially on the surface and in the substance of the hairs. It is principally these which should be selected for examination. By the aid of a low magnifying power, there can be seen on the roots a very dotted layer, and with a higher power the conidia are readily recognised. These penetrate the structure of the hairs, split them up into irregular fibres, and render them brittle; they accumulate around their root and in the hairs-heath, which assumes a characteristic grayish aspect. This predilection of the sporular vegetation for the hairs is one of the distinctive characters of the Trichophyton—a pilivorous Fungus.

Contrary to what occurs with the Achorion—which at first seeks the soft parts of the epidermis, and may even pass beyond them to penetrate the derma—the Trichophyton fixes itself by preference in the dry horny zones, and does not excite those relatively violent inflammatory phenomena that characterize the evolution of favus.

The Trichophyton, like the Achorion, introduces itself directly into the hair on the surface of the epidermis—from which it comes—and soon extends to the root and bulb, according to the theory of Unna. Transverse sections of the diseased hairs demonstrate that it penetrates from the surface to the interior.

Balzer asserts that penetration by the root—the détour theory—may also take place; and it is usual to observe it in trichophytis as in favus.

In relation to its particular activity, the parasite determines the breaking of the hairs and a simple epidermic proliferation—as in the Horse, or the avulsion of the hairs and slight inflammation of the skin.

According to Mégnin, the spores in tinea tonsurans of the Ox—as well as in the analogous form observed in the Horse—have a constant diameter of 5 μ or 6 μ; while in that of the Dog, and also in the gray tinea of the Horse, they only measure 2 μ or 3 μ. Relying on the morphological and pathogenic differences existing between the Trichophyton of the Horse and that of the Ox, Mégnin considers
them to be two distinct species, and names the second *Trichophyton epilans*. The *Trichophyton tonsurans* of tinea of the Horse and Dog, is epidermiculous and piliculous; the *Trichophyton epilans* prefers vegetating in the hair-follicles of the bovine species. Tinea tonsurans might therefore, with the latter, be compared with the trychophytic sycosis of Man, in causing a capillary-parietal endo-folliculitis that determines shedding of the hairs; and in this way might be explained the symptomatic differences in the affection, according to the species of animal attacked by it. We will refer again to this distinction when examining the question of the proper identity of the Trichophyton.

When the *Trichophyton tonsurans* is cultivated in a nutritive fluid, it gradually invades the whole mass by intercrossing filaments, which give it a gelatinous and semi-solid aspect. The mycelium reaches the surface, covering it with a white amianthus-like layer, formed of fine and brilliant aerial filaments. The lower surface of this layer is violet-coloured. The *Trichophyton* liquefies the gelatine, and groups form in it which are yellow on the inferior part, and which preserve the characters of the preceding. Besides the aerial and mycelian spores, Duclaux says he has noticed on the *Trichophyton tonsurans* spores of conjugation, or zygospores, due to the spiraliform inter-crossing of two adjoining filaments; but no other observer has remarked these.

**Course, Duration, Termination, Prognosis.**—In general, the patch of tinea tonsurans has not a tendency to spread indefinitely, but is limited by a maximum of diameter which it only exceptionally exceeds. When it attains this maximum it spontaneously disappears, the fungus having expended its local activity. But the animal is not cured, as the various rubbings have carried the spores to other points, where they form patches that run the same course. If these are near
each other they may join, and it is this junction which constitutes the large diseased surfaces that are sometimes seen. Nevertheless, this extension of tinea tonsurans is not indefinite. It gradually diminishes—at least, in the Ox and Horse—and the malady may in the end vanish without medical interference. This fortunate termination has not been noticed in the Dog, and it is rare in calves.

The average duration of tinea tonsurans is from forty to fifty days in the Horse, and from six weeks to three months in the Ox; though circumstances which favour the appearance of the malady may also prolong its existence. This is the reason why it is more tenacious in young animals, and especially in calves, than in adults. Absence of cleanliness is also more efficacious in this direction, as it facilitates the multiplication of ringworm patches; and indefinitely prolongs the duration of the affection. Recovery takes place sooner in Horses than Oxen, because of the former being groomed; and it is also earlier in animals which have a fine coat or are clipped, and are well fed and cleaned, than on those which have a long thick coat, and which are also badly attended to. Shedding the coat expedites recovery, and this explains the influence of spring-time on aminals at pasture.

It is scarcely probable that 'issues' have the salutary affect on this affection that Reynal attributed to them, as he did also to 'strangles;' though with regard to the latter it is not so improbable, but it needs verification. In any case, the malady is generally easily cured, and in this respect it is very different from the tinea tonsurans of Man.

When recovery has been effected, the hair grows again, and at once the diseased patches can be distinguished from those which are cured, and which have no crusts or scales, nor broken, brush-like hairs. Afterwards, and for some time, the formerly affected parts can be recognised in the coat, by the hairs covering them being very fine and darker in colour.

Tinea tonsurans is, in itself, a benign affection which does not disturb the general health, nor resists curative measures; indeed, it may disappear of itself. The general symptoms which several authors have described, were only a coincidence, and belonged to an antecedent pathological state— languor, inappetence, debility, and marasmus—that prepared the soil for the evolution of the parasite. In calves, however, in which the disease is more intractable, it may really contribute to complicate their bad condition if it is very extensive; and it does not appear doubtful that, in the cases reported by Macorps the violent pruritus hindered fattening.

The contagious properties of tinea tonsurans are its most serious feature. It may extend to all the animals on a farm, in a stable, or in a regiment, and—which is very important, because of the more malignant character it assumes—also to the people who attend to these; this circumstance renders prompt treatment necessary.
Diagnosis. — Tinea tonsurans differs too widely from favus, generally, to cause any apprehension as to the one being mistaken for the other; and the Dog and Cat are the only animals which offer them a common soil. Nevertheless, when there is confluence of patches or of favi, the physiognomy of each may be so distorted as to render a diagnosis embarrassing. But it should be remembered that the favic growths are concave in their centre, and that the trichophytic patches are, on the contrary, rather elevated in their middle by the purulent exudation beneath them, and which only attains the periphery at a later period. The hairs are much more intimately attacked in trichophytis than in favus, and the crusts of the latter are almost composed entirely of parasitic elements, while those of the former contain relatively few, and are nearly altogether made up of epidermic products, with sometimes dried blood or pus corpuscles. If the diameter of the tubes and spores of the two parasites does not admit of their being distinctly characterized, they may, nevertheless, be distinguished by the different lengths, ramifications, and the abundance of their tubes, as well as by the number and diverse grouping of the spores.

The parasitic nature of tinea tonsurans should always differentiate it, after a microscopical examination, from all other cutaneous affections exhibiting clinical signs that might at first sight cause a mistake to be made. Besides, the circular form of the patches and the appearance of their surface, and especially that of the hairs, as well as the contagious properties of the malady and the other points insisted on above, should prevent any error being committed.

Mégnin\(^1\) has described a circinat ed psoriasis in the Horse, of a herpetic nature, which might be mistaken for tinea tonsurans. But it is distinguished by the absence of any parasite, by the hairs not being altered—they being shed entire—and by the resistance of this affection to all anti-parasitic treatment, but quickly yielding to the internal administration of iodide of potassium.

The strangles herpes, which is accompanied by a viscid secretion that agglutinates the hairs on round or oval surfaces, in three or four days brings about the depilation of these, though they are not long before they are re-covered by fine and abundant hairs. This entirely different course, and the absence of the parasite, constitutes a sufficient criterium.

With the Dog, gnawing and rubbing often modify, and so alter, the primary aspect of the lesions, that eczema—which is so frequent in this animal—might be suspected. But in the majority of cases, a microscopical examination will decide the nature of the complaint. There should be less difficulty with regard to follicular scabies, the progress of which is very different, while the parasite causing it is quite accessible to observation. It is only in the circinat ed form of this

scabies that a mistake is possible; but then the hairs are absent and not merely broken, having been pushed out of their follicles by the Demodex, while the animal parasite obtained by scraping should remove all doubt.

**Etiology.**—The efficient cause of tinea tonsurans is evidently the *Tricophyton tonsurans*, from which it is inseparable; though certain conditions favour its development and transmission.

**Predisposing Causes.**—This malady, as with so many others, was attributed to various debilitating causes before its true nature was discovered. It was imagined that weakly, worn-out animals were more liable to it than others; but it can now be only admitted that, at the most, they afford a more favourable medium for the parasite. The influence of uncleanliness and want of attention is better defined. Animals badly cleaned and attended to are most frequently attacked, and it is usually to this that must be attributed the greater frequency of the affection in certain countries; while it accounts for its extension among the calves collected at Lyons in 1871, when a siege of that city was expected. But this cause evidently only acted by favouring contagion.

The coincidence of the malady with certain seasons, and which has been on several occasions alluded to, may be explained in the same way. Thus, Fleming has observed that after having persisted during the winter among Cows, it has disappeared in the spring; but this was because in winter the animals were kept in dark and dirty stables, in which the parasite could thrive indefinitely, while in the spring-time they were turned out to pasture, and consequently placed in conditions opposed to contagion.

Spinola attributed to light some influence on the evolution of the trichophytic patches. It appeared to him that, in the stable, they developed on those parts of the body which received the direct action of the light, and that they were quickly cured when these parts were removed from it, but reappeared on another region exposed to it. Gerlach, however, formally contested this statement: 'Either chance has intervened,' he said, 'or the exanthem has not been tinea.'

Youth entails a real predisposition. Animals at the teat are not exempt, but it is calves which contract this tinea with the greatest facility, while it fixes itself on aged animals with difficulty. For the same reason—as is seen in the army—it is scarcely ever witnessed on any except young horses. With the Dog, however, the published observations tend to indicate that age has not so much influence; though Horand, in his experiments on the Dog and Cat, was only able to convey the malady to very young creatures.¹

**Contagion.**—Contagion may be direct—that is, by actual contact of

diseased with healthy animals—or mediate, by grooming utensils, litter, etc. It is not impossible that it may also be effected at a distance, by means of the air carrying the spores of the Trichophyton. It takes place between animals of the same or different species, and even between these and Man.

A. Contagion between Animals of the same Species.—It is a long time since the older veterinarians—Chabert, Grognier, Carrère, etc.—had observed the contagion of dartres from one animal to another of the bovine species. 'The virus dartreux,' says Grognier, 'may be preserved for a long time in parts of stables where calves affected with the disease have been, if the precaution is not taken of burning the articles which have served to tie them up, and cleaning the different objects against which they may have rubbed.' This observation has been many times confirmed, and Pflug\(^1\) cites an instance in which a calf, the subject of tinea tonsurans, transmitted the disease—mediately—to all those which were put in the place it had occupied. But it is to Gerlach that we owe precise and definite information on this point, derived, as it was, from experiments as numerous as they were varied. 'In all these experiments, the crusts taken from diseased animals were divided by the fingers and deposited, after some slight rubbings, beneath the hair of those of various ages. The older animals were refractory to contagion, but animals one to two years old, and particularly calves, took the disease with the greatest readiness. Contagion was more certain if care was taken to previously damp the skin, or to slightly scratch or scarify it. It was noted as something remarkable, that, no matter what may have been the disposition of the inoculated surface, even if it were longitudinal, the resulting lesion constantly manifested a tendency to assume a circular form, and to constitute a veritable circle if the inoculation scratch was not too extensive.

'Gerlach even attempted the re-inoculation of parts denuded by the first eruption, but the results were always negative; while a new eruption was produced, though relatively feeble in intensity, on those parts where the hairs had partially or wholly been restored.

'In order to demonstrate that the contagion was exclusively due to the Fungus, Gerlach inoculated blood obtained by scarification from a diseased patch, as well as sanguinolent serosity derived from beneath a well-formed crust, but not containing any Fungi. In no instance was the inoculation followed by the development of the malady' (Railliet).

Transmission of tinea tonsurans from Horse to Horse appears to have been observed for the first time by Bouley the younger, in 1852. The case was that of a young Horse belonging to the gendarmerie, which arrived at the remount dépôt at Caen with a tonsurans patch on its body, and which communicated its cutaneous affection first to

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\(^1\) Pflug. Wochensch. f. Thierheilk. und Viehzucht, 1871, p. 251.
its neighbour, then successively to seven Horses in the same stable.

Two of these, sent to the Alfort Veterinary School, conveyed the malady to other two Horses, their neighbours. The agents in this contagion were the curry-combs, brushes, wisps, and clothing which had been used on the affected animals. This mode of contagion is often witnessed in regiments, either in the ordinary form of tinea tonsurans, or in that which Mégnin has attributed to the Trichophyton epilans. It may also take place by means of the working harness, and especially by the saddle. Mégnin, in 1882, published an instance in which the part played by the saddle was remarkable. About two hundred horses of his regiment had been successively affected with tinea, and in the first cases the patches occupied the seat of the saddle on the left side of the back. This was owing to the lesion on the first Horse attacked being located there, and the saddle having been successively worn on several other Horses, so that each of these had the spores of the Trichophyton sown on their skins at the same point. We possess other instances of similar epizooties observed in regiments of cavalry.

Gerlach, in 1859, observed spontaneous transmission from Dog to Dog; Friedberger, in 1876, effected this transmission experimentally; and Siedamgrotzky, in 1872, having succeeded in communicating to two Pigs the tinea tonsurans of the Horse, saw it conveyed from these two animals to other two of the same species with which they were kept. Fenger has witnessed the malady transmitted from one Cat to another.

B. Contagion between Animals of Different Species.—Gerlach succeeded in transmitting tinea from the Ox to the Horse. 'In about eight or ten days the traces of the contagion were not equivocal, and a circular patch, with sharp outline, was established in the course of the third week; but towards the fourth or fifth week it had disappeared, leaving behind it a smooth, denuded surface. The crust was not so thick as in the bovine animal, and only contained a few Fungi between the scales; the hairs did not break. In 1878, Mégnin also obtained transmission of tinea from a calf to a Horse.

Communication of the disease from the Ox to the Dog succeeded in the hands of Gerlach, when the inoculation was preceded by slight scarifications and the destruction of the epidermis. The Fungus was seen in about six to eight days. 'A young Dog experienced most acute itching; the skin was tumefied, and covered with a somewhat friable crust, which left, after its removal, a circular hairless patch, the size of a sixpence; the hair was not long in growing again. The thin crust was composed of epidermic cells, slightly adherent to each other, and between which no Fungi could be discovered.' Fenger has likewise reported the conveyance of tinea tonsurans from the Ox to the Dog.

Gerlach failed to inoculate the Sheep and Pig with the tinea of the
Nevertheless,' he states, 'in some otherwise very rare instances, communication of the disease to the Sheep and Pig has been observed.' Such was the instance recorded by Perroncito1 of a lamb infected from an Ox.

In 1852 Reynal experimentally transmitted tinea tonsurans from the Horse to two calves, in cleaning them by means of the curry-combs, brushes, and wisps used on the two Horses already mentioned; and Nettleship2 has remarked on analogous instances.

Siedamgrotzky has successfully inoculated the tinea of the Horse on a Dog, two Sheep, and two Pigs. At the Dresden Veterinary School, the tinea tonsurans of the Ox was communicated to a Goat.3

Lastly, there has been recorded the possibility of transmission from the Dog to the Cat (Zürn,4 and reciprocally, Fenger); from the Dog to the Pig (Lespiau5); and from the Goat to the Ox (Eppl6).

C. Contagion from Animals to Man, and from Man to Animals.—a. Bovine Animals.—We have seen that, in 1820, Ernst furnished an instance of transmission of the disease from a Cow to a young girl; and that Grognier, Kollreuter, Lavergne, Carrère, and Fehr had made known similar cases. The number of such recorded observations at the present day is considerable.

Such are those of Hintermüller, Eppl, in 1839—quoted by Verheyen, Rademacher in 1844, Houëlès in 1845, Höring, Hafner in 1846, of the

2 Nettleship. The Veterinarian, July, 1870.
commission appointed for the study of bovine contagious pleuro-pneumonia in 1849, Cazenave, Malherbe and Letenneur in 1851, Kowack in 1853, Chandeley and Sautlus in 1856. These facts, the most important of which relate to calves, bring us to the important work of Gerlach, in which the majority of them are analyzed, but in which there is found more particularly the experimental demonstration of the malady from bovines to Man. Gerlach made frequent inoculations on himself and a certain number of students, and had always successful results from them; though he never made these on the scalp, for fear of producing a troublesome disease—preferring to inoculate the skin of the arm, where he never failed to develop a more or less regular *herpes circinatus*, showing itself from the seventh to the fourteenth day after inoculation. Börensprung, Gerlach mentions, had also inoculated himself with the bovine tinea, and produced a *herpes circinatus*.

Since Gerlach's experiments, Rüffert, Lemaistre, Macorps, Lafosse, Fünfstück, Bergemann, Nettleship, Pflug, Kretschmar, Besnier, Chaboux, Gerlier, Boucher, etc., have reported other instances of transmission to Man of the ringworm of the Ox, and especially of the calf.

Contagion may occur in various ways. Most frequently it is caught in attending upon affected animals, and then the patches have a preference for the wrists and fore-arms, and particularly the palmar surface, although they may be found on any part of the body. Calves which are affected around the lips infect the Cows which suckle them, about the teats and flank; and this is why persons in the habit of milking Cows contract tinea tonsurans on the hands—particularly the dorsal surface—wrists and fore-arms, and also on the forehead and scalp in leaning their head against the animal's flank while operating. Horand has seen a trichophytic patch on the posterior surface of the neck of a butcher who had carried a diseased calf on his shoulders, and a similar occurrence had been previously noted by Cazenave; and according to E. Besnier, *herpes circinatus* is often seen on the back of the hands and the fore-arms of butchers who skin calves. It is evident that the parasite may afterwards be transported to any other part of the body, by touching the parts primarily inoculated.

The form which the malady assumes in Man is that of *herpes circinatus*—vesicular herpes, vesicular trichophytic erythema—for it is the hairless parts which are most frequently attacked. On the scalp it is tinea tonsurans, and on the lip it is sycosis or mentagra, as Tilbury Fox has seen it. Since the time of Bazin, it has been known that these are only three forms of the one disease. There is sometimes trichophytis of the eyelashes, according to Gailleton.

Trichophytis derived from animals is generally much more acute than it usually is in Man. The vesicles are more numerous, and sometimes suppurate, the pruritus is more intense, and the patches are
larger and more intractable to cure. This was particularly noticed in the cases observed by Boucher, Mégnin, and Gailleton.

b. Horse.1—Zürn states that transmission of the malady from the Horse to Man was first, and on several occasions, observed by Papa in 1848, during an epizooty of tinea tonsurans that prevailed among Horses in the valley of Borne, Savoy. But the first detailed observation dates no further back than 1852; it is due to Bouley the younger and Reynal, and the occasion was that already mentioned. The gens darmes who groomed the Horses alluded to contracted the disease with which they were affected, and one of these men communicated it to his wife and daughter. The two Horses sent to Alfort also infected a student and the man who looked after them. Bazin recognised in the malady the animal origin of herpes circinatus. Some years afterwards, Galligo published the case of a coachman who contracted the disease from his Horse.

These facts remained for a long time isolated. But from 1871 they became multiplied. In that year Tilbury Fox communicated to the Clinical Society of London a case of transmission of herpes circinatus or 'ringworm' from a pony to seven people. Then G. Fleming, T. Fox, and Horand made known new instances. In 1876, Dr. Dieu published an account of an epidemic of herpes circinatus, communicated from the Horse to Man in his regiment; in eight months, twenty-two soldiers were successively contaminated by young Horses which had recently arrived from the remount depot at Caen. Larger saw about one-fifth of the effective men in a regiment of dragoons attacked by herpes circinatus of equine origin. Similar facts are indicated by Mégnin, Aureggio and Touvé, Gerlier, and Longuet, who has given an excellent tableau of this question.

The infection of Man, however, is exceptional, when the frequency of tinea tonsurans in the Horse is considered; as there is scarcely a regiment in which it is not present always, on some young Horses.

Grooming is the usual means by which the disease is conveyed, and it is to this that nearly all the cases of transmission are attributed. Sometimes it is the horse-clothing, borrowed from the Horses by the men, that conveys the Fungus (Mégnin). The trichophytic epidemic at Ferney-Voltaire, described by Gerlier, began among the children of a horse-clipper, who had cut their hair with his clipping-machine.

The rubbings that accompany grooming facilitate inoculation. The principal seat of the eruption is the fore-arm and the wrist—that is,

the two parts of the arm usually uncovered during this operation. In Méggin's report, it was on the face and neck that the eruption appeared on the men who had made use of the rugs worn by Horses affected with trichophytis. The period of incubation varied from five to ten days.

Trichophytis here attacks by preference the smooth parts, and presents itself—as in that of bovine origin—in the form of tinea circinatus, which is also remarkable for the particular intensity of the symptoms. Often, in fact, it is quite equal in this respect to the disease conveyed from the Ox. Gerlier has, however, established distinct differential characteristics between the human trichophytis of bovine origin, and that derived from equines, which he was able to study comparatively—the first being very frequent in the valley of Gex, where he practised. The Trichophytion of the Cow causes a true, inflammatory sycosis, passing into a furuncle, and even to a carbuncle; a spontaneous recovery is frequent, but it is followed by a cicatrix; and this parasite appears to be incapable of producing trichophytis of the scalp. It is the opposite with the Trichophytion of the Horse, which has a greater tendency to acclimatize itself on Man, is more epidermic, and more intractable to treatment. It must be remarked, however, that Gerlier's distinctions are not to be drawn from the majority of observations by other authorities, who have not mentioned this same gravity of trichophytis of bovine origin.

c. Dog.—Friedberger reported, in 1876, a case of contagion of tinea tonsurans from a Dog to a child and servant, with whom the animal was in the habit of playing. The seat of eruption was the face in the child and the neck in the servant; and here also it was the circinated form that it exhibited. Experiments made by the author on himself and three students, with crusts from the Dog and the child, had no result. Horand had already reported a similar fact, and Haas has published another. Transmission from the Dog to Man is rendered easy by the handling and caressing the animal receives; and Fröhner has observed numerous instances of infection which had occurred in this way.

d. Cat.—Fenger, in 1865, witnessed an instance of transmission of tinea tonsurans from a Cat to twenty persons, and of other Cats infecting three children. Borch, cited by Fenger, was able to assure himself experimentally of the reality of this transmissibility.

In 1874, Lancereaux reported two cases which also prove the communicability of tinea tonsurans from the Cat to Man. In the first, three children were affected at the same time with herpes circinatus, after having played for several days with a sickly Cat, the hairs of which were diseased. The second instance was that of a hospital nurse who also appeared to have contracted the disease from a Cat.


that was affected with it. In the two instances, the result of the contagion was herpes circinatus.

The account of another very interesting case is due to P. Michelson—a young Cat, affected at the same time with scabies and tinea tonsurans, communicated the latter to all the members of a family; and experiments made upon three students with the crusts from this animal were successful in producing herpes circinatus on them, and not scabies. The Sarcoptes were found covered with spores, and it is probable that they served as media for the contagium. The earliest symptoms—which were accompanied by a violent pruritus—appeared in six to eight hours.

e. Pig.—In 1876, Lailler communicated to the Société Médicale des Hôpitaux a letter from Lespieu, relative to an endemic of trichophyitis observed in the cantons of Céret and Arles-sur-Tech, Pyrenees-Oriental. In this outbreak, 34 persons—of whom 28 were children—were attacked; the malady appeared to have been propagated from a Dog—the first affected—to a Pig, which in these parts lives with the family, and from this animal it was conveyed to Man. The humidity of the season favoured the development of the parasite, which localized itself more particularly about the head—eyebrows and cheeks—and around the genital organs, and caused itching.

Lastly, and in order to render all the preceding facts reciprocal, it should be added that Fenger has conveyed the trichophyton tonsurans from Man to the Cat; that the inoculation of the Trichophyton of Man has been attended with success on young Cats, but had negative results on Mice and Rats (Horand and Vincent), and that—according to Zürn—in the epizooty observed by Papa, there was reciprocal infection of the Horse by Man. And Gerlach has succeeded in reinoculating the Ox from Man—already infected by the Ox; while Fenger asserts that the Dog will readily take the tinea tonsurans of Man.

Identity.—From what has been now stated, it will be seen that the Trichophyton will accommodate itself to very different organisms; and because of this fact, Longuet asks if it might not be admitted that the Trichophyton of Man is always of animal origin—just as many dermatologists are inclined to believe that the favus of the Mouse is the primary source of favus of children. It is infinitely probable, he says, that the original soil of the Trichophyton is the Ox, that from this animal it is transferred to the Horse when they are at pasture together, and that from it Man, more or less directly, receives his tinea tonsurans. ‘The abundance of the eruption and its frequent inflammatory character—in the case of contagion from an animal to Man—appear to be pathognomonic of a parasite in its first cultivation—I mean derived immediately from the Cow or the Horse. This is also what Dühring has observed: “contracted directly from animals,” he remarks, “the eruptions of herpes circinatus have a much more serious character than
when due to human contagion.” Originally a parasite of the Ox, the Trichophyton is comparatively much rarer and less invasive than that of the Horse, and is still further removed from that of the Ox on being transferred to Man—as if, in leaving its native soil, it was in jeopardy on the foreign ones; its contagious power becomes enfeebled, and often fails, and the symptomatic eruptions become less and less accentuated.

This explanation is only, as yet, a reasonable hypothesis; and it is for medical men and veterinary surgeons in countries where cattle are reared, and where the malady is enzootic, to prove whether it is or is not well founded.

Another question previously raised by Megnin, and which has with the last one very close relations, is as to whether the Trichophyton is always of the same species in the Ox and Horse. We will not stop to discuss the distinction that might be drawn between the Trichophyton and the Achorion; for it will be shown, when treating of favus, that these two parasites are specifically distinct. But must the Trichophyton of the Ox, and that of the Horse and the Dog, be considered as belonging to the same botanical species?

It has been already demonstrated that the affection does not manifest itself with the same symptoms in every species of animal; but this does not offer an argument against the identity of the parasite. It would, on the contrary, be surprising if the zoological species of the host, its temperament, and the specific differences in the structure of its skin, did not entail differences in the pathological reaction the fungus provokes. Nevertheless, placing in opposition the symptoms of tinea tonsurans in the Ox and Horse, Megnin reminds us that, on the first the hairs are avulsed, while in the second they are only broken; and he explains this difference by the fact that the Trichophyton of the Ox vegetates more especially in the hair-follicles and the epidermic layers, causing inflammation of the derma and shedding of the hairs, while that of the Horse passes into the hair itself, renders it friable, and breaks it up. Inoculated on the Horse, the Trichophyton of the Ox gives it a tinea tonsurans of the same nature as on the equine species; and this form may also be observed clinically on the Horse. Finally, Megnin has transferred to the same Dog—by inoculation with the crusts—the two kinds of tinea of the Horse. The clinical differences correspond to differences in the vegetable spores, which in the Ox are double the diameter of those of the Trichophyton of the Horse; while they are slightly yellow in the first-named species and grayish in the second. In conclusion, Megnin estimates that there are two kinds of Trichophyton, and he proposes to give to that of the Horse—which, he says, has the same characters as that of the Dog and Cat—the name of Trichophyton tonsurans, and to designate that of the Calf Trichophyton epilans. This distinction would confirm the views of Bazin, which tend to admit ‘two varieties of Trichophyton’—the ton-
surans for the tinea tonsurans and the false alopecia, and the decalvans for the rapid tinea decalvans.¹

This idea of Bazin's appears to remain unsupported by the dermatologists, and for the majority the false alopecia is rather a false tonsurans, and the tinea decalvans is a true alopecia. It appears to us that in this matter we might find a satisfactory explanation in what the same authority has said in his article on Mentagra²: 'We have demonstrated by clinical observation and microscopical examination, that the Fungus of Mentagra is the same as that of herpes tonsurans and herpes circinatus. We have established that the three affections described under the names of herpes circinatus, tonsurans, and sycosis, are only three successive stages of the same morbid state; and that the seat of the Fungus on such or such cutaneous element explains why we have herpes circinatus, herpes tonsurans, or sycosis.'

It is difficult to accord a specific importance to the size of the spores, because in Man it is recognised that in one kind of Trichophyton the diameter of the spores may vary between 3 μ and 10 μ. The differences in the vegetable may be explained by the differences in the soil. A long time ago, Gerlach had shown that in the Ox itself, the dark-coloured hairs break, while the white ones rarely do so; therefore it is that, in the white skins, the exudation acts upon the vegetation of the epidermic cells; the yellow laminar crust produced by this exudation rarely attains the thickness of that covering the dark skin; and the hairs—which are not so deeply situated—are more easily uprooted. To this must be ascribed the circumstance that the Fungi less frequently penetrate the hairs, and that they are never sufficiently numerous to render these fragile.'

As opposed to Mégnin, Gerlach has seen the spores in the interior of the hairs; and Railliet and Nocard, as well as ourselves, have witnessed the same. The difference in seat is therefore not absolute.

On the other hand, Perroncito has found that the diameter of the spores is susceptible of variation, not only according to the species of animal from which they are obtained, but also individual animals, and even the parts—epidermis, hairs—upon which the Fungus vegetates.

In conclusion, if there is taken into account the fact that most frequently the differences between the two Fungi are not observable in the effects they produce on Man, we think we have good reason to consider Mégnin's specific distinction as premature. Nevertheless, it has an almost complete demonstration in the comparative cultures made by Duclaux from crusts obtained from the two varieties of tinea of the Horse. These cultures show that the Trichophyton tonsurans yields very abundant snow-like tufts, while T. epilans only gives at

² Ibid., VI., 1872, p. 752.
first a slightly yellow pellicle, and it rapidly liquefies the gelatine, whereas the first-mentioned only do so slowly.\(^1\)

To give to these cultures all their signification, inoculations should have been made on the Horse; as this would have shown whether any cause of error had been introduced, and if the two series corresponded in their pathological effects to the clinical differences which marked their point of departure. We may admit—while waiting for this complementary demonstration—that there are pathogenic and cultural differences between the Trichophytons of the two kinds of tinea of the Horse, properly distinguished by Mégnin. This is not sufficient, however, to warrant the two Fungi being considered as two distinct species in a natural history sense. They are, perhaps, merely two races or varieties of the same species, produced by differences in the soil in which they have grown. But, in a practical point of view, the distinction between them retains all its importance.

The explanation of the differences in the mode of action of the same parasite, may be found in the hypothesis of Longuet already alluded to (p. 293). The decalvans, or sycoic form of tinea in the Horse, should have a closer bovine origin; and by successive transmissions from Horse to Horse, or from Dog to Dog, the Trichophyton becomes attenuated, and its spores grow smaller, as is the case with the degenerated elements of the parasite which causes mentagra, and which Gruby—deceived by appearances—considered different from the Trichophyton, and named the Microsporon mentagrophytes.

We have not stopped to notice the opinion of Grawitz, which has been accepted in Germany, and who believes that there is an identity between the Oidium lactis and the Fungus of herpes tonsurans, favus, pityriasis versicolor, and 'thrush.' Recently, he has confessed he was deceived in assimilating the Trichophyton tonsurans to the Achorion Schönleinii, the Oidium lactis and the Oidium albicans. Duclaux,\(^2\) who has made pure cultures of the Trichophyton in milk, has never obtained the forms of Oidium lactis, while the latter has never yielded the Trichophyton. Comparative cultures made by Verujski,\(^3\) also show distinctly the morphological and biological differences which separate the Trichophyton tonsurans and the Achorion Schönleinii. What explains Grawitz's error, is the variety of forms and modes of fructification observed with the Trichophyton—either by changing its media, or in one and the same cultivation, when it is kept pure and the evolution of the Fungus—which is always very slow—has been pushed as far as possible.

**Vitality of the Parasite.**—Gerlach undertook some experiments to 'determine the duration of the germinative faculty of the spores.

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Crusts were collected in autumn, kept in paper capsules in his laboratory until the following spring, and experimented with at intervals. Those which were more than three months old had lost their potency when placed on an unprepared skin, but spores six months old—inoculation being effected by scarification—still germinated and produced perfectly developed ringworm. It was noted that, the longer the incubation period, the thinner were the crusts and more rapid the recovery. Spores more than six months old were not experimented with.' Siedamgrotzky has in vain tried to transmit tinea tonsurans from the Horse to the Goat, by means of crusts kept for five years and eight months. But he succeeded, on the caprine species, with crusts from a bull, which had been kept eighteen months. Mégnin says he has successfully inoculated a Dog with crusts eighteen months old. In Duclaux's cultures, the Fungi which had been kept for two years would not germinate.

By a long series of experiments made with cultures of the Trichophyton in Koch's nutrient gelatine, Thin¹ has obtained interesting results. He has found that in about two years and a half the spores seem to have lost all their aptitude to germinate, but he has been able to grow those which were eleven months old. The spores from tri-chophytic hairs were dead after being immersed eight days in water, but survived two days' steeping; they also preserved their germinative power after being kept forty-eight hours in olive-oil, lard, or vaseline. An hour's contact with soft soap, or a one per cent. solution of acetic acid, appeared to be sufficient to kill them; but a one per cent. solution of carbonate of soda was less efficacious, germination taking place in about three days. Sulphur ointments had a slow action upon them, and required several hours to sterilize spores. Citrine ointment was a very active destroyer, for after an hour's contact with it spores could no longer germinate; on the other hand, croton-oil was absolutely inefficacious, as after eight hours immersion in it the Trichophyton preserved its vitality.

Geographical Distribution.—Tinea tonsurans appears to be observed in every country. But it is most frequent in certain great breeding countries—as in Normandy, La Vendée, Brittany, Holland, Oldenburg, Bavaria—principally in Franconia, England, and Switzerland; and it is seen most commonly amongst Cattle. Normandy is recognised as a region from which the largest number of ringworm-affected remounts is received in France. (In the United Kingdom, so far as my experience goes, Irish horses are most frequently affected with tinea, and next to them are those of Yorkshire.) On the contrary, according to G. Fleming, trichophytis is common among Cattle in Australia, and rare among horses.

Under certain conditions, it spreads to a large number of animals, so as to constitute real epizoooties, which, however, are not otherwise serious. Thus, in the neighbourhood of Adelzingen, and especially in the Commune of Dorlikon—Canton of Zurich—Fehr, in 1838, reported an epizoooty of trichophytis that prevailed for four years, and was communicated to a number of people; indeed, the majority of the inhabitants of Dorlikon were attacked. But according to the details given by him, it is more probable—as Gerlach suggested—that it was sarcoptic scabies. But no such doubt can be entertained with regard to the observation published by Papa in 1840, relative to several hundreds of horses affected with ringworm in the Valley of Borne, Savoy; nor that of Macorps in 1859, who, in the space of three months, saw the disease affect more than a hundred Cattle in the Canton of Huy, Belgium; and Gigard has witnessed a similar occurrence in the neighbourhood of Lyons, while Pflug mentions that in certain stables the malady reigns permanently. It is the same on certain pastures.

Treatment.—The prophylaxis of tinea tonsurans consists in keeping animals in cleanly surroundings, and regularly and carefully cleaning their bodies. It is also necessary to disinfect stables, cowsheds, and kennels which have been inhabited by diseased animals, as well as the grooming utensils and harness, if these are likely to be employed on others.

With regard to curative treatment, should the malady be very limited, its extension is to be prevented by keeping the currycomb, brush, and wisp off the diseased patches, as these articles carry the spores to other parts of the body. Mégnin reports having radically cured many young Horses, by merely having the crust gently scratched off entire, along with the broken hairs, these being immediately burned.

In some cases it is advisable to resort to general clipping, as a preliminary to treatment; and it may be again suggested that all grooming should be done out-of-doors.

With regard to the medicaments to be employed, nearly all give favourable results, the vegetating of the parasite on the domesticated animals being readily disturbed or suspended by medicamentous applications. The simplest are to be preferred, and those which cause much irritation are to be avoided; as they may leave durable, if not indelible, traces on the skin. Mercurial preparations are also to be guarded against—at least, with, bovine animals, which, in licking themselves, may incur more or less serious intoxication.

Tabourin has given a fastidious enumeration of a very large number of agents that may be used for ringworm on animals. The most popular remedies are: A solution of corrosive sublimate, 1 to 300, and slightly alcoholized; carbolized glycerine, 1 to 10; tincture of

1 Tabourin. Nouv. Tr. de Mat. Méd. de Thérap. et de Pharm. Vétérinaires, 3e édit., II., 1875, p. 718.
balsam of Peru; pure alcohol; petroleum; cade-oil; white precipitate ointment, 1 to 4; red precipitate, 1 to 8; ägyptiac; an ointment composed of carabolic acid 1 part, and lard and soft soap, of each 10 parts; Helmerich's pomade; and tincture of iodine.

Pure soft soap, applied as an ointment, is, according to Thin's experiments, to be recommended.

The applications are to be repeated once or twice a day, or every second day, the frequency depending upon the agent selected, and its local irritant action. (I have usually found one application of a liniment composed of one part Stockholm tar, and two parts common oil, a cheap and effective remedy for ringworm on Horses.)

A cure is obtained when the surface of the patch is covered by a new growth of fine, close-set hairs.

**Article II.---Favus.**

**Definition.**—The *favus*, or *tinea favosa*, is a parasitic and contagious cutaneous malady, caused by a Fungus named the *Achorion Schönleinii* Remak, and capable of affecting Man, the Cat, Mouse, Dog, Rabbit, and Fowl. It is characterized, clinically, by crusts, generally of a yellow colour at first, arranged in more or less distinct cup-shaped masses, and producing alteration in, then shedding of, the hairs or feathers.

**Synonyms.**—In human dermatology, this disease has been successively designated by very varied names. In some descriptions of it, it still receives the designation of *porrigo lupinosa* of Willan and Bateman, and *porrigo favosa* of Biett. But the denominations of *tinea favosa*, and particularly of *favus*, are the most universally adopted, and ought to be always, to the exclusion of all other in veterinary pathology, in which the malady has only been recently discovered, and in which, consequently, nosology has not been encumbered as in human medicine.

**History.**—The dominant fact in the history of favus in Man, lies in the discovery of a parasite met with in him by Remak in 1837; but its presence was demonstrated for the first time by Schönlein in 1841, who placed it in the genus *Oidium*. In 1845, on indications furnished by Link, Remak saw that this Fungus should form a genus distinct from the *Oidium*, and so he named it the *Achorion Schönleinii*, which name it now holds. 3

Since that time the successive works of Gruby, Lebert, Hannover, Müller and Retzius, Montagne, Ch. Robin, etc., have permitted its natural history to be established, and to fix the exclusive part it plays in the etiology of favus. But it is more especially to Dazin that we owe the demonstration of the vegetation of the parasite, of the manner

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1 From *favus*, honeycomb—because of the resemblance of the crusts formed in this disease to the principal product of the Bee's industry.

2 From *porrigere*, to extend, in allusion to the course of the malady.

3 In the differential characters of *Trichophyton tonsurans* and *Achorion Schönleinii*, there is nothing that justifies the creation of a new genus for the latter. It would therefore be more logical to range it with the genus *Trichophyton*, under the name of *Trichophyton Schönleinii*. 
in which it alters the hairs, and of the most efficacious procedure to overcome its tenacity in Man.

So far as the favus in animals is concerned, it is mentioned for the first time in 1847, in the thesis of Jacquetant, formerly house-physician of the Antiquaille of Lyons, who observed it on Cats; Bennett, in 1850, discovered it on Mice; Zander, in 1858, found it again on a Cat; then Saint Cyr, in 1868, made known the first case of favus on the Dog, and the following year he studied it also on the Rabbit. The same year, Dr. Mollière presented a favic Rat to the Lyons Society of Medical Sciences.

Since these dates, observations more or less numerous—according to the species of animals of which they were the object—have fully confirmed the existence of favus in the Mouse, Rat, Cat, Dog, and Rabbit, and permitted its history to be established. But the most important works on the subject are, without contradiction, those of Saint-Cyr, which have become classical.

In addition to the mammalia just mentioned, tinea favosa has been observed on poultry since 1858, by Gerlach, Miller, and Leisering, and has formed the subject of several treatises.

**Symptoms.**—The symptoms of favus, which differ with the nature of the skin-covering, will be studied successively in the Mammalia—Cat, Dog, Rabbit—and in Fowls.

**Mammalia.**—In the Cat, which is the most exposed to this disease, tinea favosa attacks the extremity of the toes or base of the claws, by preference; but it may commence at the umbilicus, or on the sides of the chest. Gradually it extends—by first invading the head—especially the forehead, root of the ears, and dorsal line of the nose, then the external surface of the thighs and various parts of the body. The malady is characterized by crusts more or less thick—from about 1 mm. to 4 mm. —rather viscid in consistence, of a sulphur-yellow colour when recent, becoming gray or yellowish-gray as they are older; they are arranged quite like those of the favus of Man. 'Their contour,' says Saint-Cyr, 'sometimes very regularly circular, at other times rather notched, forms a rim slightly raised above the level of the surrounding skin; their centre is, on the contrary, more or less markedly depressed, which gives to the whole of the crust a cupulated or cup-shape.' The favic cup or favus—plural favi—has a varied diameter, there being those which are no larger than the head of a pin, while others attain the dimensions of a franc-piece—many intermediate sizes being found. Their prominence is not subordinate to their size, as some form patches which are scarcely raised above the level of the epidermis. The cupulated arrangement is much less marked when the crust is seated at the root of the claw.

Dermatomyoses. 301

There is then most frequently only a heap of yellow, viscid, split-up crusts, which the microscope shows are evidently formed by the same elements as those above described’ (Saint-Cyr). The deformation of the crusts may also be the result of their confluence; when they become multiplied on a limited surface, they are pressed together, so that their primary characters are more or less masked. From their free surface there are often seen projecting erect, rigid, and lustreless hairs, which appear to pass through them, and which the slightest traction pulls out. Later on these hairs are shed, thrown out of their follicles by the parasite.

‘If the crusts are carefully removed, the skin beneath them is observed to be thinner, depressed, and looking as if atrophied by compression; but smooth, not ulcerated, quite dry or slightly moist from serum, and sometimes pale and anaemic-looking, but more frequently red and irritated, and showing, in its transparency, some very fine bloodvessels. At the margin of the crust the skin is sensibly inflamed—red, tumefied, and forming a somewhat salient ring’ (Saint-Cyr).

The malady is accompanied by only a very slight pruritus, and does not appear to have an injurious influence on the general health.

On the Dog, the favus has the closest resemblance to that seen on the Cat. The few observations we have concerning it are due to Saint-Cyr, Trasbot, Siedangrotzky, and Cadiot. They show that, with young Dogs which are being suckled, tinea favosa often begins at the umbilical region, and that it readily invades a large extent of skin. In the instance given by Trasbot, the head was so covered with favi that there were only a few narrow, sinuous lines still covered with hairs. With a nursing bitch, the abundance of the crusts was revealed by a peculiar odour, which Trasbot compared to that of mouldy cheese, and which resembled that perceived in similar cases in Man—‘a mawkish, repulsive odour,’ says Bazin, which has some resemblance to that of Mice, Cat’s urine, moulds, or macerating animal matters.

In the case related by Cadiot, the Dog was eight years old, and had four favi—two on one shoulder, one on the neck, and the other at the root of the ear. Each of these was formed of a circular crust, which was white on the surface, sulphur-yellow internally, and around it the skin was slightly swollen. On the left flank, the croup, and at the root of the tail, were other favic patches in process of recovery; they were in the form of hairless red spots, partly covered with slate-tinted crusts rich in spores.

The favus of the Rabbit has been seen by Mourrand of Lyons, by Recordon of Corbeil, and by Méggin. Mourrand’s observation is related

to some young Russian Rabbits on which the disease was disseminated on the paws, head and body, but was more particularly localized on the first two regions. On one animal there were from 25 to 30 favi on each ear, and their dimensions were between that of a pin's head and a twenty-centime piece. Some, which were of the volume of a small lentil, had a small tuft of hairs in their centre. Otherwise, by their characters they were absolutely the same as those of the Cat. In Recordon's observation, there is mention made of a litter of twelve silver Rabbits, and the localization of the disease was the same as in the preceding instance. In fur Rabbits, Méggin has seen the malady in the form of isolated crusts, somewhat globular, circular, and flattened; they were from 1 cm. to $1\frac{1}{2}$ cm. in diameter, and coriaceous only on the surface, which was easily torn, and then there escaped a powdery white matter, that was formed exclusively of Achorion spores. By its resemblance to the Lycoperdon or Puff-ball, Méggin has given to this variety the name of lycoperdoid favus. It only affects Rabbits of two or three months old—sparing those of greater age, and disappearing altogether from the diseased ones when they attain their fourth month.

Fowl. 1—The favus of Poultry generally commences on the comb or crest, and the bars and wattles. It manifests itself in the form of small, white or light-gray, round or irregular, spots that extend, multiply and become confluent, constituting an almost continuous thin covering or coating, of the same colour as the original patches. This gradually grows thicker, and in about twenty to thirty days it may be 8 mm. It is then a dry, squamous crust, of a dirty-white colour, irregular on the surface, sometimes a little amiantaceous, and often formed of concentric depots. When this covering is removed, the skin beneath is seen to be slightly excoriated. From the nude parts of the head, the malady extends to the surfaces covered with feathers—the neck and body, and more especially the cloaca and adjoining parts. On the points attacked, the feathers becomes erect, dry and friable; their cavity is filled with discoid superposed crusts, or—if these are cylindrical—they are contained one within the other; and exceptionally there are met with here—as well as on the bars—the amiantaceous deposits observed on the surface of the nude skin. Lastly, the feathers fall off, leaving the skin denuded and covered with crusts that often compose discoid masses, having in their centre an infundibulum left by the shedding of the feather.

The disease gradually brings on debility, wasting, and a consumption that may terminate in death.

The affected Fowls exhale a mouldy odour, analogous to that noticed from people who suffer from the malady. ¹

Fig. 114.—Head and neck of a Fowl affected with Generalized Favus.

¹ Rivolta and Delprato sum-mariy describe an affection of Pigeons analogous to the favus of Fowls, and which they designate Dermomicosi aspergillina glauca. In the cases they observed, the disease had extended over the whole surface of the skin. Beneath the wings there were large, thin, yellowish crusts, which, towards the middle of the lower surface and near the armpit, were thicker, humid, fetid, and of a bluish-gray colour. At these points the authors say they found the Aspergillus glauces in process of fructification. On the other parts of the body, between the feathers, there were only small crusts. The Pigeons were very weak and anaemic. They had for a long time inhabited a hot and unhealthy dove-cot. The disease had arrived at such a stage as to be deemed incurable (L'Ornitofatria, p. 491).
Microscopical Examination.—To examine the crusts, it is sufficient to take a very minute piece of one, or a small quantity of the dust that falls from them, and on an object-glass moisten it with pure water, or that to which a little acetic acid has been added; this will give a preparation suitable for studying with a magnifying power of 300 to 500 diameters.

It will be observed that the 'cups' are formed of elements of a Fungus—mycelium, receptacles and spores—which is the Achorion Schönleinii Remak. Rivolta has named that of the favus of Fowls, the Aspergillus microsporus flavescens gallinae, while the disease itself is designated dermatomycosis aspergillos. Mégnin had named the same parasite Epidermophyton gallinae.¹

These elements are united by a viscid, amorphous, and hyaline substance, full of moving granules and rods, and known in botany as glair, stroma, and amorphous gangue or blastema. Robin² considers it an essential portion of the elements of favus, and not the result of disintegration of the epidermis or matter exuded from it. According to Balzer,³ its use is to agglutinate the elements of the cup, and to protect them from destructive agents. The favi themselves resist disunion, by the close interweaving that is effected through the filaments of the mycelium.

The mycelium is composed of cylindrical, flexuous tubes, simple or ramifying in a forked manner, neither articulated nor partitioned, apparently empty, or having a few molecular granules, but in reality containing a little protoplasm. In the domesticated animals, they are usually 1 μ to 3 μ in diameter, and are consequently finer than those of the favus of Man, the diameter of which varies between 3 μ and 11 μ. Mégnin has found them 4 μ to 7 μ in lycoperdoid favus of the Rabbit, and Zürn has seen those of the Dog measure from 4 μ to 8 μ.

In the favus of Poultry, the filaments are, according to Rivolta, 5 μ in breadth, though they may range between 2 μ and 6 μ, and even 8 μ.

Other tubes called spore tubes, receptacles, or sporophores, differ from the preceding in being straight, or only slightly flexuous, having a somewhat greater, though otherwise variable, diameter, and are sometimes empty, at other times containing true spores which give them a partitioned appearance.

Lastly, the spores or conidia—which are usually present in large numbers—are rounded corpuscles, more frequently ovoid than spherical, isolated or in chaplets of three or four. Their size in animals—like that of the tubes—is less than it is with Man, on whom it varies from 3 μ to 7 μ, and even to 11 μ. In animals, also, the round spores have an almost constant diameter of 2 μ. Zürn states that in Poultry they are 8 μ in diameter, and may exceptionally reach 12 μ in the Dog. The oval spores measure 3 μ to 6 μ long, and 2 μ to 4 μ broad.

In general, the filaments are more abundant than the spores, though it is sometimes the opposite. Balzer¹ says that 'the mycelium is more abundant in the parts of the cup in contact with the mucous layer of the derma, than in the superficial and more central portions formed of older elements, which have fructified a long time previously; and that these parts are, therefore, richer in spores. But in this there is nothing absolute, and when the section of a cup is examined, the last elements of fructification and vegetation are found in every part.' And we know that there is not, between the filaments of the mycelium and the receptacles, any essential difference, the one proceeding from the other (see p. 271).

The alterations in the hairs—which are betrayed by their lustreless and powdery appearance, and at last by their being shed—are due to the penetration of the Achorion into their bulbs and texture, in which are seen the three essential elements of the parasite—mycelium, receptacles, and spores. In order to demonstrate their presence, it is sufficient to remove the oil from the hairs by steeping them in ether, then in a solution of potass or soda—20 or 40 per cent.; they are afterwards treated with ammonia, and examined in glycerine. The action of the caustic solution must be closely watched, as it should only be allowed to act on the colouring matter of the hairs, without breaking these up altogether; the length of time during which they ought to be kept in this solution, will depend on the thickness and colour of the hairs (Balzer). It will be observed that the Achorion may be met with throughout a large portion of the hair, and that it is not confined to it, as was at one time admitted.

The ordinary procedure permits of the Achorion being also demonstrated in the shafts of feathers and on the surface of the barbs, in the amiantaceous deposit already alluded to.

The researches of Bazin, Kaposi, Unna, and Balzer have given an explanation of the manner in which the cup is formed, and the way in which the Achorion penetrates the hair, so far as concerns the favus of Man.

'At the orifice of each hair-follicle is a preformed infundibular space, for the extent of which the upper epidermic layers adhere horizontally to the emerging hair, while the lower layers are inclined towards the bottom of the follicle. It is in this space that exudates most easily accumulate, and it is there where the Fungi—accidentally brought, inoculated, or proliferating in the inferior part of the follicle—unite to form a compact mass.' At the beginning, the favus is placed between the horny layer of the epidermis and the mucous layer of the derma, being contained in the infundibulum, and limited above by the epidermic layer adherent to the hair. It gradually increases in extent, by growing in a circular manner and in height, occupying more and more of the pilous infundibulum, and assuming a conical shape with a depression in the centre. According to Kaposi, this umbilicated depression is due to the epidermis adhering to the hair in the centre of the cup, offering more resistance to the upheaving tendency of the parasite than at the periphery; and it is also owing—as Balzer asserts—to the shape of the infundibulum itself.

'On penetrating the pilous infundibulum, the spores and tubes form a sheath that immediately envelops the hair, and these elements isolate the cells of the mucous layer that surrounds it, finishing by dilating the follicular cavity—above and below. They may even penetrate between the cells of the mucous layer, though such penetration is only superficial; for it would appear that the favic matter is content with the artificial cavity it has created, and which it enlarges more and more' (Balzer).

The entrance of the Fungus into the hair may be effected in two ways. According to Unna, there is only direct penetration—the parasite at once invading the hair on coming in contact with it, no matter in what part, but principally where it has attained its definitive calibre; or even higher, at the infundibuliform depression of the hair-follicle. But while admitting this direct mode of penetration, Balzer—along with Kaposi—adds penetration by the root of the hair, according to what is called the theory of détour, the parasite being obliged to pass round the hair before reaching its point of implantation.

Finally, in certain cases the Fungus does not limit itself to the pilous apparatus. In the follicle it sets up an amount of irritation which leads to the appearance of more or less numerous leucocytes, mixed with the spores and tubes. Then this inflammation and suppuration extend to the periphery of the surface occupied by the favus, and are usually maintained with a feeble degree of intensity; though sometimes—as Malassez² has shown—the mycelium penetrates the derma perpendicularly by a real invasion—ramifying and inducing inflammatory phenomena which are traceable, after recovery, by depressed cicatrices. The course of the disease in animals leads to the supposi-

¹ Moritz Kaposi, _Leçons sur les Maladies de la Peau_. Translated by E. Besnier and A. Doyon, II., Paris, 1881, p. 396.
tion that—in default of researches on the subject—this penetrative form is limited to the favus of Man.

**Course, Termination, Prognosis.**—Tinea favosa is far from presenting the same tenacity and gravity in animals that it does in Man.

Its course is generally very slow, and eight or ten days may elapse before any notable change is observed.

Left to itself, the disease may—by its extension, the troubles it engenders in the functions of the skin, and their reaction on the general nutrition—cause the death of those it attacks. Saint-Cyr has observed this termination in Rabbits, and we have witnessed it in Poultry. But, as a rule, it is not a serious malady. Saint-Cyr has seen a Cat recover without any treatment, in about three months; in a Rabbit he observed, the disease retrograded spontaneously, though with great slowness. It was the same in the lycoperdoid favus of Rabbits noticed by Mégnin; the death of one was only due to occlusion of the anus, which the favus had surrounded. In any case, if the malady has not been inveterate for a long time, it does not resist appropriate treatment. In a case of Poultry favus, we have seen it confined to the crest and disappear spontaneously; but when it extends beyond this part and the barbs and wattles, and has invaded the parts covered with feathers, the prognosis is more serious because of the loss of condition, and consequent depreciation in value of the animals; while it is all the more onerous from the expense and trouble of treatment.

In forming a prognosis, it is necessary to take into account the contagiousness of tinea favosa. This is not of so much moment, so far as the Dog and Cat are concerned, as they do not live in communities; but it is important in the case of Rabbits, and still more of Fowls—for we have seen poultry-farms decimated by this affection.

(In some creatures the effects of tinea favosa are generally very serious, and evidently cause death if medical treatment is not adopted. With the smaller rodents it would appear to be always fatal. While in the corps of Royal Engineers at Chatham, in 1875, Mice appeared to suffer much from the disease in a certain portion of the barracks, and many were found in a dying state in the men's rooms. Several of these were brought to me, either dead or dying, and on these the favi had attained an extraordinary development, more especially on the head—ears and face being often destroyed by the Fungus. An excellent example of the ravages of the affection in Mice, I forwarded in that year to the Museum of the Royal College of Surgeons, London, where it is now exhibited.)

**Diagnosis.**—The real cause of favus is the *Achorion Schönleinii*; but certain circumstances may facilitate contagion. Every animal does not offer an equally favourable soil for the parasite. So far as Man is concerned, a particular predisposition to contract the disease is now
recognised as necessary, and this is found in youthfulness, a lymphatic temperament, and misery. And it is the same with animals.

Saint-Cyr\(^1\) says: 'All those animals which I have seen affected with favus were young; the Cats—seven or eight in number—were no more than six weeks to two months old; the Dog was about four months, and was the oldest of my patients. I have tried twice to transmit the disease to adult Cats, but could not succeed; while all the experiments—eight in number—made upon animals less than three months, have, without exception, had a positive result.' It was the same with Russian rabbits which Mourrand saw affected with favus, and which were only two and three months old; and the terms in which Mégnin speaks of those that Recordon observed, leads to the belief that they were no older.

The bitch that Trasbot exhibited before the central society of Paris, was, it is true, aged nine years; but then it was enfeebled by gestation, parturition, and nursing puppies to such a degree that it realized the condition of physiological misery necessary for the reception of the disease. It must also be remarked, that the Achorion first attacked the offspring—aged from ten to twenty days—and it was from them the parent received the malady, although she was placed in somewhat the same conditions as to contagion. Nevertheless, in Cadot's case the patient was eight years old, and there was nothing with it to constitute a predisposition.

With regard to Poultry, it does not appear that there is anything to confirm or negative this rule. Zürn only says, that if all breeds can be attacked by favus, those of large size and Asiatic descent, and principally the Cochin China sort, appear to be more especially predisposed. We have seen Bantams affected with it.

On the other hand, according to Aubert,\(^2\) any solution of continuity should be considered as favouring the reception and development of the parasite; and of the considerations he invokes in support of this view, the most probable is the following: 'Two rats lived together peaceably in a cage in which favus spores had been sown, and neither contracted the disease; but one of them was accidentally killed, and another Rat was introduced in its place. Disagreements between the fresh arrival and the other led to fighting and biting, and in four or five days after its entrance the new Rat had a favus commencing at its ear, while its companion soon after showed favic cups on the head and nose.'

As tinea favosa may be transmitted from an animal of one species to an individual of another species, and even to Man, contagion is here of special importance. It must at first be remarked that, in cases in which the origin of the disease could be followed in the domesticated

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\(^1\) Saint-Cyr. Recueil de Méd. Vétérinaire, 1869, p. 649.

animals, it has been ascribed to the Mouse or Rat. These rodents are, in fact, often affected with tinea, and, since the time of Bennett, corroborative testimony has been furnished by Draper, Friedreich, R. Tripier, Mollière, etc.¹ Favic Mice appear to be particularly frequent at Lyons, and the disease—which usually begins at the ear with them—often causes death. It is difficult to arrive at a definite conclusion as to whether the favus of Mice is derived from that of Man, in consequence of the peregrinations of these little rodents among the clothing and head apparel of the diseased; but it is certain that they can convey the malady to mankind.

Anderson has reported a case of favus on a little girl who had touched Mice caught in a trap, and who conveyed the disease to the majority of the members of her family. A few days after this occurrence five Mice were captured, and Anderson found a favic cup on the back of one of them, near the tail, while another had the sides of the head and the ears ulcerated by the malady. Dr. Tripier, of Lyons, successfully inoculated himself from a Mouse; and Horand, of Lyons, has given the case of a woman who had contracted favus by introducing her hand into a rat-trap containing a favic Rat.²

In general, the transmission of favus from the Mouse or Rat to Man is effected through the medium of the domesticated animals. It is, in fact, from the Mouse that the Dog and Cat acquire the malady in cases the origin of which can be ascertained. Such was the case of the Cat mentioned by Draper, and probably also in all those in which the disease was observed. Trasbot's favic bitch was a terrier, which brought to its puppies the Rats it caught. Anderson has observed—as also has Buchanana—a Dog with a favic cup on one of its forepaws; this animal was in the habit of killing the Mice which swarmed in the house, and several of these creatures, on being caught and examined, were found to be favic. The primary localization of the malady on the paws and nose of the domesticated carnivora is easily explained.

The study that Busquet³ has made of the Fungus of Mouse favus shows, however, that cultures of it present different characters to those of the Achorion Schönleinii; and in giving it the name of Achorion Arloïni, he considered it a special form—a different generation of the same Fungus—of a higher organization. This cryptogam, abandoning


its true medium and passing on to the Mouse, there produces a phase of the Achorion Arloini. In its passage from the Mouse to other animals and to Man, this Achorion arrives at the form A. Schönleinii.

The domesticated animals affected with favus may communicate their malady to Man. Draper's Cat transmitted its disease to two children who played with it. Saint-Cyr, Horand, Anderson, and W. G. Smith¹ have cited similar instances; and Saint-Cyr himself contracted the affection through handling the Dogs he was experimenting upon.

Inversely, the malady may be conveyed from Man to the Cat. 'From 1847,' says Jacquetant in the thesis already mentioned, 'I have seen, in the ward for children affected with tinea in the Antiquaille, two Cats with which the little patients played contract the favus, and a favus in every way similar to that with which they were, for the most part, affected.' Kobner² has succeeded in producing favus in guinea-pigs, by inoculating them with favic crust obtained from a human patient.

Saint-Cyr and Mégnin say nothing as to the origin of the favus on the Rabbits they observed; but we may suppose that favic Rats or Mice have frequented their hutches—though this is only a mere hypothesis, which has nothing to support it except its plausibility. However, Saint-Cyr's Rabbits communicated their disease to a student who watched them; and, besides, the malady has been transferred from the Rabbit to the Dog, on which it did not show itself until ten days after the contagious matter had been deposited; while Saint-Cyr has realized its experimental transmission from Cat to Cat, and to the Dog. We have succeeded in our attempts to communicate the favus from Man to the Dog and Rabbit.

With regard to Poultry, Gerlach tried in vain to transfer their favus to the domesticated Mammalia, though he affirms that he succeeded on Man. On the other side, if Schütz has been able to cultivate the parasite of this tinea on different substances, and especially on a decoction of bread previously well sterilized, and if he continued to do so up to the seventh culture, he has nevertheless failed in his efforts to transfer the malady to a white mouse, a field-mouse, a guinea-pig, a rabbit, and a pigeon. Fowls alone offered him a favourable soil for the evolution of the malady; and this brings us to the supposition that the favus of Poultry is different to that of the mammalia. But our experiments are opposed to this conclusion, and affirm the identity of the disease in both; for we have been able to infect the Rabbit from the Fowl, and the symptoms have been absolutely like those of favus in the Rabbit when transferred from Man. Reciprocally, we have obtained

¹ W. G. Smith. Cases of Favus; Specimens of Favus from the Cat, etc. The Dublin Journ. of Medical Science, 1879, p. 450.
on the Fowl a favus in every way similar to the natural favus of this species, by depositing on its crest the human favus mixed up in water. Success appears to have depended upon the crest being previously abraded—disintegration of the epidermis, so as to permit of implantation of the parasite, being evidently an indispensable condition.

It therefore results, that the favus of Mammalia and that of Birds constitute a unique affection, more or less modified in its physiognomy by the soil on which the parasite develops—that is, by the animal species, and perhaps also by the special forms of this parasite, which adapts itself—as a race—to the medium that receives it.

This conclusion is not supported by the culture experiments to which Duclaux—according to Mégnin—has submitted the Fungus of Poultry tinea; for while the cultures of Achorion Schönlcinii 'are amber-yellow, with the formation—even in the culture tubes—of the characteristic favic cups,' those of the tinea of Fowls are 'remarkable for the gooseberry-juice fluid that escapes, when the snowy layer of the culture is pricked with a needle.' As a principal objection to the signification of these cultures, we¹ have remarked that they have not been tested by inoculation; for no attempt has been made to develop tinea on Fowls by their means. Notwithstanding the scientific authority of Duclaux, there is nothing to prove that the gooseberry-juice colour of the culture is characteristic of the Fungus in question; and, besides, cultivations we have made with the same material have not given the results obtained by Duclaux. The Fungus has grown in white tufts, flocculent on the surface, yellow in the deeper circular layers; but there has been reddish fluid—they resembled, in fact, cultures of the Achorion Schönlcinii. But as our attempts at inoculation of Fowls and a Rabbit yielded only negative results, we cannot affirm the authenticity of these cultures. The question of identity of these two kinds of favus must, therefore, be considered as still undecided.

Another question raised in studying the etiology of favus, is that of the legitimacy of the genus Achorion; that is to say, does the Achorion Schönlcinii constitute a genuine species, or is it merely a particular phase of a proteiform Fungus—higher, and capable of assuming different aspects in accordance with the conditions in which it is developed? It is with regard to the favus of Man that the question has been raised; but if the identity of this affection in him and the smaller domesticated Mammifers at least be admitted, it is clear that the same considerations are applicable to all the forms.

As has been said, Lowe was the first, in 1857, who sought to establish the identity of all the vegetable parasites that grow on the body of Man, and especially between the Achorion and the Trichophyton of tinea tonsurans; and he concluded that they were all inferior states of the same mould—the Aspergillus glaucus. In 1859, Hogg expressed the same opinion, which has also been professed more especially by Tilbury Fox and Hebra. 'The diversity of forms, and of symptoms

¹ Revue Vétérinaire, 1890, p. 368.
presented in parasitic diseases,' says Bazin,¹ 'are difficult to reconcile with the hypothesis of a single origin; it is explained, according to Tilbury Fox, by the seat of the Fungus, which occupies the bottom of the hair-follicle in favus and the superficialies of the skin in tinea tonsurans and pityriasis versicolor; but the English physician neglects to inform us as to the cause which determines—in each particular case—the seat of the parasite, and what it is that keeps it confined to the locality it has chosen. In forcing the hypothesis, we cannot see, for example, why pityriasis versicolor should not be transformed into favus by the migration of the parasite towards the hair-follicle. Tilbury Fox relies on the difficulty—sometimes very great—in distinguishing favus from ringworm; but in order to appreciate the value of this argument, it is sufficient to point out that this ringworm of the English is nothing else, in the majority of cases, than the variety of favus described by us under the name of scutiform; and otherwise we might ask, why the difficulty in establishing a diagnosis between the two affections should be a proof of their identity in nature? Lastly—and this is more important—the English doctor invokes, in support of his thesis, instances of favus transmitted by patients affected with herpes or any other parasitic disorder, and gives some examples of favus being transformed on patients into herpes tonsurans. But these instances and examples are at once explained and refuted by the fact brought forward by Tilbury Fox himself—that the differential diagnosis of favus and ringworm sometimes offers very great difficulties; and there is reason to believe that these difficulties were great in the cases cited by Fox and Hebra, for they cannot be explained by errors in diagnosis; and it is also possible that—as Hardy has well remarked—the doctors in question had to deal with cases of real coincidence of two parasitic affections on the same head, only one of which was transmitted, while the other alone was perceived. . . . This hypothesis—of identity of various dermatophytes—has opposed to it everyday experience, which shows the permanence of invariability of morbidity parasitic species, whether seen in their oftentimes very long duration on the same individual, or whether followed in the indefinite series of their successive generations. Favus remains favus, whatever may be done to make it anything else, and will only produce favus, no matter what the source of the germs may have been, nor what may be the conditions of the soil or the media which it encounters at its birth; we only see the Achorion thrive or fade, according as these conditions are favourable or the reverse. And the same statements may be rigorously repeated with regard to tinea, tonsurans, or, more generally, of all the parasitic cutaneous affections.'

We may, with Horand, add to these considerations that the Rat, which contracts favus, is refractory to trichophytis; for on sowing on its skin a mixture of favic and trichophytic matters, favus alone is developed. Horand relates that, on several occasions, on the head of the same child he has witnessed the simultaneous existence of these two tinea, each of which retained its own special characteristics; and he has inoculated favus in the centre of a patch of herpes tonsurans, with the result that magnificent favic cups have appeared. He has seen favus develop in the centre of herpes; and what better proof could be offered of the essential difference between the Achorion and the Trichophyton? A similar occurrence has been observed on the Cat by

Conche;¹ while Fernbach, Duclaux, Veruijki, Quincke, and others, have made a comparison in pure cultures of the Fungus of favus with that of tinea tonsurans, and have always found important and constant differences.

**Treatment.**—The favus of animals does not offer much resistance to appropriate treatment, and in this respect it is very different to the disease in children. This is due, no doubt—as Saint-Cyr has remarked—to the fact that the skin of the Dog and Cat is finer and more supple than the scalp of Man, into which the hairs are deeply implanted.

Saint-Cyr gives the following treatment: Remove the crusts with a spatula or the blunt end of curved scissors, taking care not to make the skin bleed. Then daily dress the exposed skin with a more or less concentrated solution of corrosive sublimate—2 to 10 per cent.

Sometimes the favus re-forms, and it is then necessary, at the second application of the lotion, to remove the crust as before. Usually, five or six applications of the lotion are sufficient to effect a cure; though when the disease is situated at the root of the claws, more are needed; but the malady is always overcome in a short time.

Corrosive sublimate may occasion poisoning, and it is perhaps preferable—as Saint-Cyr advises, and as Trasbot, following his advice, has successfully employed—to apply an ointment of 1 or even 5 per cent. nitrate of silver. This ought to be carefully rubbed in to assure its penetration.

When the favus of Poultry is still confined to the nude parts of the head, it should be treated either with benzine or carbolic acid incorporated with soft soap, in the proportion of 1 to 20, one application being made every day; or calomel ointment—1 to 8; the corrosive sublimate solution; Fowler’s solution of arsenic; an ointment of red oxide of mercury—1 to 8 of lard; or one of ammoniacal oxychloride of mercury—sel Alembroth—1 to 4 of lard (Zürn).

It is needless to add that, whatever the species of the animal may be, the healthy should be separated from the diseased, the places which the latter have inhabited ought to be disinfected, and the necessary precautions adopted to prevent the transmission of the affection to the people who carry out the medical treatment.

**Favus of the Horse and Ox.**—Zürn states that—on Horses affected with tinea tonsurans—there are often seen, along with the alterations peculiar to that disease, crusts that belong to favus, and in which, by means of the microscope, the Achorion can be found; while in the neighbouring lesions only the Trichophyton can be detected. But it would be more logical to consider these particular crusts as a special manifestation of trichophytis; and all the more so, as a microscopical examination is insufficient to permit a distinction to be made, with cer-

tainty, between the two kinds of dermatophytes; transmission experiments would alone authorize one to affirm the duality of the disease in these complex cases.

In 1863, Méggin published, under the name of *tinea diffusa*, an observation on a dermatomycosis of the Horse, which was reproduced with some variations at a later period. This affection was very pruriginous—at least during the night—and consisted of dry, yellow crusts, each of which agglutinated a few hairs, was of the size of a hempseed, and was composed—exclusively¹ or in great part²—of spores having all the characters that Bazin has given for the *Achorion Schönleinii*. These spores were only found at the roots of the hairs, and were dry and dis-associated in elements parallel to the axis. The dermatosis first showed itself on the upper parts of the trunk, then it invaded the shoulders, sides, flanks and thighs. After having resisted 'all the known antipsoric and internal derivatives,' it yielded to the employment of the special parasiticide Bazin uses for the Achorion—sulphate of protoxide of mercury 1 part, lard 10 parts. But this affection is singularly different from favus; there is remarked the complete absence of mycelian or sporiferous filaments in the parasite described, as well as of cups or favi; there is also the non-confluence of the crusts; and the non-contagiousness of the malady, which, during the six months of its duration, was not transmitted to the man who groomed the Horse, nor yet to another Horse which was constantly cleaned with the same implements. Besides, Méggin himself appears to have considered his observation in 1863 as of no value; for in his subsequent writings—in 1876 and 1878—he makes no allusion to it, and says in proper terms: 'Thus, the animal species on which tinea favosa has been observed up to the present time are five in number—Mice, Rats, Cats, Dogs, and Rabbits.'

W. Williams³ describes an instance in which tinea favosa was communicated to three Horses and about twenty Cattle, living in the same stable, by diseased Cats which were in the habit of sitting on the backs of these animals. But this observation—which of its kind is unique—loses its interest because of the absence of details as to the symptoms of this pretended favus of the Cat.

G. Gigard⁴ mentions a dermatosis which he believed to be tinea favosa, and which was transmitted from the Cow to Man. Sixteen of twenty-seven cows belonging to nine owners were infected—the malady appearing in the form of large striated patches of a reddish-fawn colour, and not well defined, which were seated on the neck and eyelids; on the muffle were also convex crusts, 'analogous in appearance to spots of yellow wax.' One man and four children were attacked with it, in consequence of their having been in contact with these cows; on their scalp they had patches of a greenish-yellow matter, 'resembling in appearance—though not in colour—the eczema impétiginex of young children.' But in this instance, also, the diagnosis 'favus' seems insufficiently established; the existence of the parasite is not indicated, the lesions in the cows and children were not those

of favus, and in the Cows the malady occupied a region absolutely glabrous—the muffle.  

**Article III.—Onichomycosis of the Equidæ.**

In 1855, Virchow described, under the name of *Onychomycosis*, certain affections of the nails of Man which produce alterations in these parts, and are accompanied by the presence of varied parasitic organisms. From the studies subsequently made, it appears that the Fungus of onychomycosis of Man is very analogous to, if not identical with, either the *Achorion Schöneinii* or the *Trichophyton tonsurans*; in fact, this somewhat rare malady coincides most frequently with favus or tinea tonsurans.

In 1876, Ercolani applied the same designation to the affection of the hoof of Equidæ—more frequent in the Ass and Mule than in the Horse—known for a long time as *fournilère* (English *vulgo*, 'seedy-toe'), which usually appears as a complication of laminitis, and consists in a cavity at the front (toe) of the hoof, between the wall and keraphyllæ. In the powdery horn occupying this space, Ercolani always found a Fungus constituted by a mycelium, receptacles and spores, which he considered the cause of this disease, and which he regarded as different from that of favus or tinea tonsurans, because he could not produce any manifestation of tinea favosa or trichophytis on the skin of two Asses which had been sprinkled with conidia and filaments obtained from the diseased foot of another Ass—the skin having been previously prepared by a blister. This Fungus should be a particular kind, and Ercolani has given it the name of *Achorion keratophagus*.

Before accepting as definitive the parasitic theory of 'seedy-toe,' several things should be explained. The author does not state to how many animals he extended his observations, and on how many of them the *Achorion keratophagus* was found; and it might be supposed that he was dealing with an inferior vegetable organism allied to the moulds—such as are found in quantities on dead animal matter, like the powdery horn of this condition. What supports this view is that, in one of his cases, Ercolani found—along with the Fungus—a certain number of living Acarina which he has figured, and which appear to us remarkably like *Tyrolyphus echinopus* Robin—*Capophagus echinopus* Ménin—a species that lives on dead organic substances. On the other hand, it is necessary to ascertain if the *Achorion keratophagus* is not met with in other affections—such as the so-called 'canker' and 'thrush' of the foot, in the dust of the lateral lacune, or even in the hoofs from dead animals placed in conditions favourable to mouldiness.

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1 We may mention here an observation of Frank, who found at the upper part of the shoulder of a horse, a granular, pediculated, polypoid tumour, which incessantly reformed after being rubbed off by the collar. It was composed altogether of a somewhat large mycelium, and globular conidia situated at the periphery, resembling the mould Fungus known as *Mucor racemosus*. Frank admitted that the spores were carried accidentally to an accessible point which had been wounded by the collar, and, becoming developed there, gave rise to the apparent tumour (Deutsche Zeitschrift f. Thiermed. u. Vergl. Pathologic, XVI., 1890, p. 297).

Lastly, the essential proof required in such a matter is absent—that is, the experimental transmission of 'seedy-toe' from the diseased foot of an Ass to the healthy one of a Horse, through the medium of the supposed parasite.

If it be desired to admit that the condition is parasitic, there is no need to conclude as to the autonomy of the parasite. The Equidae are capable of contracting tinea tonsurans, and the two checks on attempts at transmission may be regarded as demonstrative, so far as the Trichophyton is concerned; though it will not be the same for the Achorion Schönleinii, as it has been stated above that care has to be observed in deciding as to the existence of favus on the Equidae, and experiments should therefore be made on young Dogs or Cats.
BOOK II.

PARASITES OF THE DIGESTIVE APPARATUS.

The digestive apparatus affords an asylum for the largest number of parasites, and it is predisposed to their invasion by its relations with the external world. An infinity of germs enter it along with the food and drink—either as ova or larvae, or in a special and somewhat advanced phase of development. The drink plays, in this respect, the most important part; as water is, in fact, the vehicle for an endless multitude of microscopic organisms, which it more or less preserves. In dry food, on the contrary, the germs have generally lost their vital properties, along with the water that was inherent in them. The special study that we shall make of each parasite in its pathogenic rôle, will show distinctly the part nearly always played by water in the etiology of parasitic diseases.

Of the germs introduced into the digestive apparatus, a large number perish there, either because—having arrived too early or too late—they have not yet attained, or have exceeded, the phase of development that would permit their profiting from this conjuncture; because they cannot find there the conditions required for their evolution; or because some individual and indeterminable circumstance places them in this condition of inferiority. They are then dissolved by the gastric juice. Those which ingestion by one of the higher vertebrates has not destroyed, and in which they realize a condition necessary—in some way provided for and ready—to their development, experience a modification that enables them to make the most of their good fortune. Each is arrested in the section or compartment that suits it, by the action of natural laws; this may be the mouth or pharynx, or the oesophagus, stomach, intestine, etc. If the germs are introduced therein in small quantity, most frequently they do not occasion any appreciable trouble; but this is not so when they are numerous, and in this respect also distinctions must be made according to the kinds of parasites—for many can multiply in the digestive canal, without betraying their presence by any derangement in the health of their host.

In general, the number of the parasites is exactly that of the germs
introduced, and which have profited by their congenial situation; they are rarely more than this, for the species capable of multiplying in such a location are very few in number—at least among the Helminths.

The vegetable parasites of the digestive apparatus which do not belong to the Schizomyeetes, are little varied, and with the exception of the Saccharomyeetes albicans—the parasitic element of thrush (of children and young animals)—they are of little importance. There is, therefore, no need to include them in these general considerations.

It is not the same with regard to the animal parasites. Very numerous and very diverse, these belong to the Sporozoa, Infusoria, Cestodes, Trematodes, Acanthocephales, Nematodes, Annelides, and Insects (see p. 3 et seq.).

Of these diverse groups, there are some the representatives of which are localized almost absolutely in a particular compartment of the digestive apparatus. These are the Cestodes, which—as parasites of this apparatus—only develop in the intestine; the Acanthocephales are also intestinal parasites; while the Annelides—represented by the Hæmopis—live in the mouth and pharynx (also the nasal cavities); and the Insects—represented by the larvæ of the C’strides—more particularly fix themselves in the stomach. The special study of these four groups will more appropriately find its place in the chapters devoted to the parasitism of their particular habitat.

A. The Sporozoa that may be found in the digestive organs, belong to the order of Coccidia or Psorospermia oviformes. The majority are parasites in the interior of the epithelial cells of the liver, intestine, etc. We have already characterized them when treating of cutaneous psorospermosis of Poultry (see p. 269).

B. The Infusoria which live in the digestive apparatus are included in the two sub-classes of Flagellata and Ciliata (see p. 4).

The Flagellata are divided into four orders in the following manner:

<table>
<thead>
<tr>
<th>Non-reticulated sarcod.</th>
<th>The flagella raised on the surface of the body.</th>
<th>No infundibuliform collarate.</th>
<th>An infundibuliform collarate at the base of the single flagellum.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reticulated sarcod.</td>
<td>A flagellum in the form of a girdle.</td>
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The order of Euflagellata—the most extensive and important—has only representatives in the digestive organs of the domesticated animals. These belong to the genera Monocercomonas, Trichomonas, and Lamblia.

a. Monocercomonas (Grassi).—Four anterior flagella, three of which are directed forward, and a long one thrown backward, beyond the posterior extremity of the body; no posterior flagellum.

b. Trichomonas (Donné).—Four or five anterior flagella directed forward, with the exception of one, which extends backward, and is longer than the body, to which it is fixed for the greater part of its length by a very thin membrane; no posterior flagellum; a single longitudinal rod in the interior of the body.

c. Lamblia (R. Blanchard).—A large anterior depression in the form of a sucker; two flagella at the posterior extremity.
The Ciliated Infusoria, or Infusoria properly so called, are usually divided into four orders, according to Stein’s classification:

Cilia covering the entire surface of the body.  
A row of long and strong cilia around the mouth.  
Cilia occupying only the ventral surface.  
Cilia arranged in a crown around the mouth, and often also in the form of a girdle.

The Holotriches, Heterotriches, and Peritriches are met with in the digestive canal of the domesticated Mammalia.

C. The TREMATODE parasites of the digestive tube are all the Distomata (see p. 5). Their suckers—which are always situated on the ventral surface—are almost hemispherical, salient cups, comprising a complex system of muscular fibres, the contraction of which tends to produce a vacuum in the cavity of the apparatus, whence results a close adhesion between the parasite and the mucous membrane of the host.

The nervous system—which, up to the present time, has only been examined in a small number of species—comprises two sub-oesophageal ganglia united by a transverse commissure, and sometimes a single sub-oesophageal ganglion joined to the others by two lateral commissures and some nerve filaments. The digestive tube is represented by a nearly always bifurcated cavity, with simple or ramifying branches, and constantly terminates in a cul-de-sac; there is, therefore, only one opening—the mouth—situated usually at one of the poles of the body, at the bottom of a sucker, which is, for this reason, named the oral sucker; this mouth acts as an anus. The circulation is lacunary. The excretory apparatus consists of a network of fine canaliculi, which converge into canals that become gradually larger, and finally end in one or several longitudinal vessels that, in their turn, unite near their termination at the posterior extremity of the body, and are sometimes dilated into a single pulsatile vesicle—the vesicle of Laurer; the entire system opens externally by an excretory pore—the caudal foramen.

With rare exceptions, the Trematodes are hermaphrodite. The male
organs usually consist of two tubular or mammillated testicles, the
different canals of which unite into a cirrus or penis, which is enclosed
in a sheath (pouch of the cirrus) opening externally by an orifice that
has a variable situation. The female organs comprise an ovary, or
germigen, the ova from which are evacuated by the germiduct. To
the ovary are added the albuminiferous or vitellogenous glands—very
numerous glandular culs-de-sac secreting a granular fluid, and joining
to form two longitudinal canals—the albuminiferouscanals or vitelloducts,
which are in their turn joined by a transverse canal into which opens
the germiduct, and from this reunion results the oviduct. This con-
fluence of vessels is enveloped by the shell gland. The oviduct is con-
tinued by a flexuous irregular tube (the uterus), the terminal portion of
which (the vagina) opens at a short distance from the male orifice.

The Distomian Trematodes are oviparous, their development being
related to their metamorphoses and migrations, which have been well
studied in some species, and to which we shall have to refer when
making a particular examination of these creatures.

In the uterus the ova undergo segmentation, and not unfrequently
the embryo is even formed there. When they are laid, or have arrived
in a moist medium—which is generally water—they continue their
development, and at the end of a certain time there issue from them
embryos, which are sometimes nude, sometimes ciliated (infusiform
embryos). After a sojourn more or less prolonged in water, these
embryos have to enter the body of an aquatic creature—usually a
mollusc—and there they lose their cilia, and are transformed into a
more or less complex organism—a kind of sac generally furnished with
a sucker (the germinative or cercariigerous sac), which may be destitute
of mouth and digestive tube (the Sporocyst of Van Beneden), or may
possess one or other of these (the Redia of Filippi). These germinative
sacs may engender others, by fission or by budding. They represent
the second phase of external development.

Each Sporocyst, or Redia, produces new organisms in its interior-
named Cercaria, which in their organization resemble the adult Disto-
mians; they have suckers like them, but they differ from them in
having no genital organs, and in the presence—at the posterior end
of their oval bodies—of a very movable simple or bifid tail.

At the end of a certain time they escape from the germinative sac,
leave the body of their host, swim or crawl in the water, waiting for
the advent of another aquatic animal—mollusc, worm, larva of an
insect, more rarely a fish or batrachian. Ercolani has found them in
terrestrial molluses; and they may sometimes fix themselves on certain
plants or inorganic bodies, in the vicinity of their liquid medium.
Arrived in their new abode, they lose their caudal appendage, become
encysted, show traces sometimes of their sexual organs, and—as agamous
Distomians—they now await the chance that will carry them into the
stomach of a third host, after being nourished by the second. The
latter is digested, the cyst is dissolved, and the parasite being set free,
reaches the organ which is to be its definite abode—intestine, biliary
canals, urinary bladder, respiratory apparatus, sub-orbital sinus of
birds, etc. There the Trematode, acquiring its genital organs, attains
the adult state.

Such is a general description of the evolution of the Distomians.
According to the species, it is more or less complex, and varies also
according to the media in which development occurs (Ercolani), as well
as climatic conditions (Pagenstecher). *Mutabile*, the embryos already carry the germinative sac in their body, and that in certain cases these sacs are seen producing cercaria without tails—that is, agamous Distomians, etc.

The important part water plays in the succession of the various phases of development, explains why the Trematodes are more particularly met within the aquatic vertebrata, and—amongst the terrestrial animals—those which frequent humid places.

The parasitic species infesting the domestic animals may be divided into two families: *Monostomidae* and *Distomidae*.

1. **Monostomidae**.—These have only one sucker, which is situated at the anterior part of the body. The genera are *Monostoma*, *Holostoma*, *Hemistoma*.

   a. **Monostome** (*Monostoma* Rad.).—The sucker is only slightly developed, and the mouth is situated at the bottom of it. This genus has representatives in the intestine of Poultry.

   b. **Holostome** (*Holostoma* Nitzsch).—The anterior part of the body—which is separated from the other part by a constriction—is dilated into a large cupule that plays the part of a sucker, and opens directly in front. The posterior part is narrow and more or less rounded. One species has been found in the intestine of the Duck.

   c. **Hemistome** (*Hemistoma* Dies).—This differs from the preceding more particularly in its anterior cupule, which is truncated in such a manner as to open obliquely in front, and has the mouth at the summit. One species is sometimes met with in the Dog.

2. **Distomidae**.—These have two suckers—an anterior, oral; a second, ventral, with variable situation according to the genera. These are *Distoma*, *Mesogonimus*, *Hystero*.

Thus it is that, in the *Monostoma*...
Amphistoma, Gastrodiscus, and Bilharzia. The latter is not a parasite of the digestive system, but of the circulatory apparatus.

a. Distome (Distoma Retzius).—This genus is characterized by its anterior sucker, which is destitute of protractile tentacula; by two portions or arms of the intestine that are separated throughout their length; and by its genital openings situated in front of the posterior sucker. In consequence of the large number of species it contains, this genus has been divided into nine sections, or sub-genera: Koel- likeria, Apohlema, Cladocelium, Brachylaimus, Brachycelium, Dicrocelium, Podocotyle, Echinosoma, and Crossodera. The parasitic species of the domesticated animals belong to the sub-genera Cladocelium and Dicrocelium, both of which are hermaphrodites, with their anterior sucker destitute of prickers, and the body non-appendiculated posteriorly. The Cladocelium has the intestine bifid and branching. The Dicrocelium
has the intestine also bifid, but not ramous, and with very long arms; the mouth is succeeded by an oesophagus, and the posterior sucker is sessile. A species of Distome has been found in the intestine of the Dog; others live in that of Fowls. But the most interesting species are met with in the biliary canals of various animals.

b. Mesogonim (Mesogonimus Monticelli).—This genus is the result of division of the genus Distoma, and is distinguished by its genital openings being situated behind the posterior sucker, which is sessile, and larger or smaller than the anterior, which is orbicular. A species lives in the intestine of the Fowl.

c. Cephalogonim (Cephalogonimus Poirier).—The Cephalogonimæ have also been separated from the Distomes, by reason of the genital openings being situated above and to the side of the oral sucker. A species has been found in the oesophagus of the Fowl.

d. Amphistome (Amphistoma Rud.).—The body is thick, muscular; somewhat dense; ovoid, cylindroid, or conoid; often curved, and two or three times longer than it is broad. The anterior sucker is small, and has the mouth at the bottom. The second sucker—relatively very large—is placed at the posterior extremity, which is truncated obliquely on the ventral surface. The branches of the intestine are not ramiﬁed. Several species live in the rumen of Ruminants; one is found in the intestine of the Ox, and another in that of the Horse.

e. Gastrodisc (Gastrodiscus Leuck).—The ventral sucker is situated at the posterior border of the body, as in the Amphistomes; but the ventral surface is studded with numerous papilla-suckers. An exotic species lives in the digestive tube of the Horse and Mule.

D. The NEMATOIDES (Figs. 117 to 121) may be white, yellow, brown, red or marbled. The surface of the body is smooth or transversely striated, though sometimes it is longitudinally so; it is formed of a chitinous cuticle, which is transparent, ﬁrm, and elastic, divisible into several layers, and sometimes showing tubercles, spines, hairs, etc., or forming expansions or wings. Beneath the cuticle is the hypoderma or sub-cuticular layer, which is soft, granular, and nuleated, and in relation—by its inferior surface—to the musculo-cutaneous or muscular layer, formed of contractile cells, the majority of which are longitudinal and often grouped in series. It is nearly always interrupted by four longitudinal lines—two on the right and two on the left, on the lateral borders—which sometimes acquire the same width as the muscular borders. The latter are thickenings of the hypoderma, in which run sometimes two or three excretory canals—aquiferous vessels—which unite into a single, short canal that opens externally by a ventral excretory pore, at the termination of the oesophagus. The other two lines are intermediate to the preceding, and are narrower: they are the middle or dorsal, and ventral lines.

The cephalic extremity—which may or may not be distinct from the rest of the body, and armed or not armed, winged or not winged—has at its summit the orbicular or elliptical mouth, ordinarily provided with three or six soft or horny lips, which are nearly always garnished with papillæ. The digestive canal extends from one extremity of the body to the other. The mouth sometimes opens in an infundibulum—buccal capsule—which is continued by the oesophagus. The latter is often the first digestive compartment; it is a narrow tube, with thick, muscular walls that are at times constricted posteriorly to form a dilatation—the ventricle. The intestine—that succeeds the oesophagus—is simple, has

21—2
thin walls, and is scarcely, if at all, flexuous; it terminates in the 
rectum, which is narrower and slightly muscular, and this, again, ends 
in the anus, which is always ventral, and terminal or nearly so. To 
this digestive tube, and principally in its anterior part, are often 
annexed glandular organs.

The respiration is exclusively cutaneous. The circulation is lacunary 
—a plasmatic fluid that fills the visceral cavity, and bathes the vis-
cera, is thrown into irregular oscillations by the contractions of the 
musculo-cutaneous envelope. There is usually a nervous system consti-
tuted by an oesophageal collar, from which arise a ventral, a dorsal, and 
lateral nerves. There are tactile papillæ, and sometimes ocular spots.

The sexes are always separate—

Fig. 120.—Caudal extremity of the male of
the Ascaride of the Pig, lateral view;
the spicule are a little too thick.—
Delafond.

Fig. 121.—Spicule of Megalocephalous 
Ascaride, with their retractor muscles,
m.—Delafond.

at least, in the species that interest us. The male—which is 
habitually smaller than the female—is usually recognised by its 
tail, this being more curved. Its genital apparatus is generally 
composed of a single testicle—a flexuous tube continued by a deferent 
channel that ends, along with the digestive canal, in a cloaca. The 
latter generally contains, in its posterior part, one or two elongated 
chitinous pieces—spicula—which serve to fix the female during copula-
tion. In certain cases, copulation is aided by the presence of a caudal 
pouch—a campanuliform expansion that keeps the male closely united 
to the female. The females have one or two filiform ovarian tubes 
aranged in more or less numerous convolutions, and continued by a 
wider portion—the uterus—that opens into a vagina terminating in a 
vulva, the situation of which is always ventral, and near one or other 
extremity of the body. The Nematodes are oviparous or ovoviviparous. 
Those which are parasites pass through their varied phases to accom-
plish their development—sometimes the ova may become evolved in 
the definitive host; at other times, the embryos—and even the indi-
vidual adults—pass a portion of their life in the external world; and, 
again, at other times they require an intermediate host before reaching 
the one in which they assume their adult form. Each of these modes
includes several types, an examination of which will be made when dealing with each parasite.

The Nematodes have been divided into a great number of families, seven of which furnish the parasites of the digestive apparatus in the domesticated animals. These are: Ascarides, Oxyurides, Strongylides, Trichotracelides, Filarides, Gnathostomides, Anquillulides.

1. Ascarides.—The Ascarides have the body cylindroid. The mouth is usually surrounded by three lips which are often papilliferous—cephalic or buccal valves, one of which is dorsal and the other two are ventral. These lips have powerful muscular masses, which can be distinguished by their dark tint seen through the cuticle. The oesophagus is long, muscular, and bulging in its posterior part. The males are provided with two spicula. The females have a double ovary, and the vulva is situated in front of the middle of the body (Railliet). The genera are Ascaris and Heterakis. All the Ascarides live in the intestines—and especially in the small intestine—of various vertebrata.

2. Oxyurides.—The body is cylindroid. The mouth is nude, or surrounded by three slightly salient lips. The oesophagus is long, with a very distinct bulb or ventricle. The males have one spicule, and two pairs of pre-anal papillae, one of which generally occupies the side of the anus. The females, the caudal extremity of which is elongated and subulated, have always two ovaries, and the vulva ordinarily opens towards the anterior part of the body. Oviparous. Ova ovoid, with a very resisting shell' (Railliet). Genus Oxyuris, a parasite of the intestines—and especially of the large intestine—of the domesticated Manimalia.

3. Strongylides.—The body is cylindroid, and rarely filiform. The mouth is sometimes nude, sometimes furnished with papille, and at times provided with a chitinous armature. The oesophagus is more or less enlarged posteriorly. The males possess an entire or divided caudal pouch, with one or two spicula of equal length. The females have one or two ovaries; the vulva is situated sometimes in front of, at other times behind, the middle of the body. The Strongylides are oviparous or ovoviviparous' (Railliet).

This family comprises numerous genera that Railliet has divided into three tribes, basing the division chiefly on the presence or absence of the buccal armature, and on the form of the caudal pouch of the male. These are: 1. Eustrongylines, with mouth destitute of chitinous armature, and caudal pouch without ribs or bands—genus Eustrongylus; 2. Strongylines, the mouth likewise unarmed, and the caudal pouch sustained by ribs or bands—Strongylus; 3. Sclerostomines, the mouth furnished with a more or less complex chitinous armature, and the caudal pouch provided with ribs—O'Sophagostoma, Syngamus, Globocephalus, Sclerostoma, Stephanurus, Uncinaria, Ollulanus, Physaloptera. Only the genera Eustrongylus, Stephanurus, and Syngamus are not parasites in the digestive canal.

4. Trichotracelides.—Worms of medium size, body very tapering, and lengthily attenuated in the anterior portion, which only contains the oesophagus—the posterior part lodging the intestine and genital organs. The mouth is rounded and nude; the oesophagus is very long. The males have a single spicule, which is envaginated, or presents two caudal papillae. The females have a single ovary; the vulva is carried to the anterior quarter of the body, or to the origin of the enlarged
part. These Worms are oviparous—*Trichocephalus* and *Trichosoma*—or ovoviviparous—*Trichina*. All the Trichocephales live in the intestine; the majority of the species of Trichosomes are met with in the digestive tube; the Trichine is an intestinal parasite in the adult state.

5. Filariades.—The body is long and filiform. The mouth is of variable shape, sometimes encircled by lips, and even succeeded by a buccal capsule; it is often provided with papillæ. The oesophagus is slender, and does not form a distinct ventricle. The males—the tail of which is generally rolled up—have a single spicule or two unequal spicules. The females have a double ovary; the vulva is usually situated towards the anterior part of the body. A great number of these Helminths are ovoviviparous' (Railliet). Genera *Filaria*, *Spiroptera*, *Disparagas*, *Hystrichis*, and *Tropisurus*. The first two alone furnish intestinal parasites. The other three are met with among the Helminths of the oesophagus or stomach of Birds.

6. Gnathostomides.—This family is established by the only genus *Gnathostome* (Gnathostoma Owen, *Cheiracanthus* Dies), represented by polymyairous Worms, the cylindroid body of which is covered in front by chitinous leaves or plates that have their posterior border notched into spinules—ἐκεῖνη, hand, ἀκώνθη, spine; in the middle region, the leaves are simple and conical; the posterior part of the body is unarmed. Head distinct, globular, and studded with simple spines. Mouth with two lips—one dorsal, the other ventral. *Males* have a spiral tail garnished with papillæ below. *Females* have a straight tail; ovary double; vulva posterior. Oviparous' (Railliet). The Gnathostomes are parasites of the stomach, either of the Pig, or of the Dog and wild Cat.

7. Anguillulides.—This family—not well characterized—comprises the Nematodes with filiform bodies, their mouth being small, and succeeded by an oesophagus that nearly always shows a double enlargement. The males have two equal spiculae' (Railliet). Genus *Rhabdonema*, of which the species live as parasites in the intestine of Man, the Sheep, Pig and Rabbit.

In the following chapters, we shall take advantage of the tendency to localization, which is general in these parasites, and study them by passing in successive review each part of the digestive apparatus and its appendages.
CHAPTER I.

PARASITES OF THE MOUTH AND PHARYNX.

The parasites which may be met with at the entrance to the digestive passages are somewhat numerous. There are usually found in the fluids of the mouth and pharynx various Fungi and Schizomycetes—such as the Leptomitus, Leptothrix buccalis, Vibrios, Spirillum, Micrococcus, etc. But we cannot recognise their pathogenic rôle, as they are nearly always present in these fluids; and when they appear to be abnormally abundant, this would seem to be due to inherent pathological conditions in their host. We have no occasion, therefore, to notice them. The only vegetable parasite of the mouth that induces morbid phenomena is the Saccharomyces (Oidium) albicans, which we shall study under the name of the affection to which it belongs—thrush (magenet).

With regard to the animal parasites, we can scarcely cite more than the Spirozoa, the larvæ of the Gastrophilus, the Hæmopis, and the Spiroptera scutata—found in the lingual and pharyngeal mucous membrane of the Pig, and which will be alluded to when dealing with the parasites of the stomach of Ruminants. The Hæmopis usually has its abode in the mouth and pharynx, and its study should naturally be made here. The little that has to be said about the larvæ of the Gastrophilus will be more advantageously treated à propos of the parasites of the stomach of Equidae. Regarding the Spirozoa, the Psorospermosis they determine in Birds will be limited to a few necessary words, in view of the uncertainty still prevailing as to their real nature.

1 R. W. Burke has described under the name of stomatitis pustulosa acarosa, an affection that he observed on several Horses, and which consisted in the presence—at different points of the buccal mucous membrane—of epithelial tumours the size of a pea or haricot bean, more or less confluent, and having a tendency to ulcerate. In these tumours he often found Acari, three at the most in each, and which, by several of their characters, he thought belonged to the acarus of flour (Tyroglyphus siro Lat.). He attributed the origin of the affection to damaged bran which had been given to the Horses, and he considered this stomatitis to be the same as the stomatitis pustulosa contagiosa, described by Eggeling and Ellenberger, and regarded by them as of microbic origin (Archiv. f. wiss. u. Prakt. Thierheilkunde, 1878). But what he says is insufficient to allow a serious conclusion to be arrived at (The Veterinary Journal, XV., 1882, p. 3; XXIX., 1889, p. 229; The Veterinarian, October, 1886, p. 692).
TREATISE ON PARASITIC DISEASES.

**Article I.—Hæmopis.**

The **Hæmopis** or Horse-leeches (*Hæmopis sanguisuga* Bergmann) also named *Vorans*—are Annelides belonging, in the sub-class of *Hirudine*, to the family of *Gnathobdellides*, in which are also found the Leeches proper (*Hirudo* Linn).

The Hæmopis or Leeches have an elongated body, gradually contracted in front, widest in the middle, obtuse behind, flat on the inferior surface, semi-depressed on the upper surface, somewhat soft and viscid, very retractile and extensible, and composed of 95 to 97 rings (or segments). Each of the extremities is terminated by a sucker turned towards the ventral surface. The anterior, or oral sucker is slightly concave, and shaped like the beak of a flute. At its centre is the mouth, an opening in the form of a three-rayed star, an anterior median, the other two lateral. Each of these slits permits the passage of a jaw—a semi-lenticular body with an adherent rectilinear border, which is continued by a kind of handle fixed in the musculo-cutaneous envelope, and a free convex border that carries a series of denticules in the form of transverse chevrons, by means of which the Leeches perforate the integuments. The eyes are ten in number, and are scarcely visible; they form a curved line at the anterior border of the dorsal surface. The posterior, or anal sucker, is twice as large as the oral one, and on its upper surface is a small opening—the anus.

The Leeches are androgynous. The sexual organs appear towards the anterior third of the ventral surface. The vulva is a transverse slit, situated five rings behind the male orifice, or between the twenty-ninth and thirtieth rings of the Hæmopis. The Leeches are reproduced by reciprocal fecundation; two individuals approach each other by their ventral surfaces and in opposite directions, each playing at once the part of male and female. After fecundation—and during the twenty-five to forty days that precede ovulation—there is formed around the part of the body where the sexual organs are situated, an olivary enlargement that has received the name of girdle. At the moment of ovulation, the Leeches leave the water and bury themselves in damp ground. The glands in the girdle secrete a viscid substance, that soon becomes a membranous capsule in the form of a funnel. The Leech crawls backwards out of this covering, after having laid an average of ten to eighteen eggs. The two openings in the capsule then close, and this, in drying, becomes brown, and assumes the appearance of a spongy cocoon. Each
Leech produces one or two cocoons, rarely three; incubation occupies from twenty-five to twenty-eight days, and at the end of this period the young filiform leeches traverse the cocoon, leaving it at different points, though taking refuge in it again when any danger threatens them.

With the _Haemopis sanguisuga_, the back appears of a greenish-brown tint, inclining sometimes towards reddish or Sienna earth, at other times to olive or green; and generally there are longitudinal rows of dark, close-set, small points, more or less effaced—the rows being six in number, sometimes four, more rarely two. In some specimens these rows are replaced by one or two bands of a bright-red colour, darker on the borders; and in other individuals—much rarer—the back is altogether unicoloured. The borders are slightly prominent, and have a narrow band—orange, yellow, or reddish-brown in colour, rarely that of the back. The ventral surface is smooth, of a dark-slate colour, usually deeper than the back, sometimes slightly red or olive-tinted, and at other times dead-black; and in some specimens it is marked by faint, isolated, irregularly-shaped points (Moquin-Tandon).

The variations of colour that the body may present, have been utilized by Moquin-Tandon to establish twelve varieties of the Leech.1

blood, besides what flows from the wound afterwards. When its many-pouched intestine is gorged with that fluid, the creature falls off. A secretion from the pharynx seems to prevent the blood coagulating, and after a full meal the Leech can fast and digest for a year. The growth of the young Leech is slow, and may continue for four or five years; while the total duration of life may extend to twenty years.)

The Horse-leech has often been mistaken for the medicinal Leech (Hirudo medicinalis Linn.); but it is easy, nevertheless, to distinguish them from each other.

While the medicinal Leech has well-marked rings, somewhat salient cutaneous glands, and possesses a certain rigidity—especially during its contractions, when it takes the shape of an olive—the Horse-leech is a little larger, is always very soft, and especially when the creature is elongated; its skin-rings are also less marked, less coriaceous, and during contraction form less apparent ridges; while its cutaneous glands are smaller and less prominent. Besides, the medicinal Leech has the dorsal surface darker than the ventral, and is generally marked by six longitudinal, reddish bands, regularly or irregularly speckled with dark-brown spots; the ventral surface is yellow or olive-green, unicoloured or dark-spotted, with a wide black band on each side.

A very important characteristic is deduced from the form of the jaws. In the ordinary Leeches they are large—2 mm. or 3 mm. in diameter—and their denticules are very sharp, and about sixty in number. Those of the Hæmopis are scarcely 1 mm. in diameter, and are furnished with only about thirty not very sharp teeth. This difference in the jaws and teeth explains what Huard the younger had already remarked—why the Horse-leech attacks only the mucous membrane, and not the skin, as the medicinal Leech does.

The Hæmopis sanguisuga has also been confounded with the black Leech, or voracious Aulastoma (Aulastomum Gulo Braun).

The latter—which is often wrongly designated the Horse-leech in the neighbourhood of Paris—is smaller and less flattened than the Hæmopis. It is generally of a deep olive hue, almost black above, unicoloured, velvety, very rarely marked here and there with some small, irregular, and scarcely appreciable points; and sometimes shows on the margins of the body small black, close-set points, but not a yellow or orange hem. The jaws are scarcely more than half a millimetre in diameter, and have only about fourteen very blunt teeth.

The Hæmopis lives in ponds, ditches, and small springs, and the adult usually lies at the bottom in mud. The young seem to prefer running water, keeping near the surface, and ready to throw themselves into the slightest current.

The Hæmopis sanguisuga is met with in nearly every part of Europe; it has been found in Sweden, but more especially in the South of Europe, in Portugal, and in Turkey. It is very common in North Africa—principally on the littoral, from Tunis to Syria. (It is certainly

very common in Syria, according to my experience, and most troublesome to animals.) In Algeria, it has been seen by the French troops at every place they have reached—even in their most advanced marches into the desert; and is observed at all seasons, though it abounds most in water during the summer.

In consequence of the feebleness of its jaws, the Hæmopis—not being able to seize the skin—seeks to penetrate the natural openings, and fix itself on the mucous membrane. Man and the domesticated animals are exposed to its attacks.

It is found in Mankind in the mouth, pharynx, nasal fossæ, larynx, trachea, vagina, and on the conjunctivæ.

The domesticated animals it most frequently attacks are the Horse, Mule, Ox, and Camel; but there can be no doubt that all warm-blooded vertebrata are liable to its visitations, if they drink in places infested by it. Blaise has seen a Dog die from the action of eight Leeches, which fixed themselves in its pharynx; four of them belonged to the Hírudíno troctína. Dr. Guyon—cited by A. Moquin-Tandon—introduced Leeches into the cesophagus and oviduct of several Fowls, and into the nasal fossæ and rectum of some Rabbits. The Fowls died from exhaustion in about thirty days, and the Rabbits in about forty days. Moquin-Tandon placed two large Horse-leeches in the pharynx of two young Rabbits; they entered the trachea, and caused death from asphyxia—one in three-quarters of an hour, the other in an hour and a half.

If the Hæmopis occupies a very extensive geographical area, the information relative to its action on the domesticated animals has been almost exclusively gathered in Spain and Algeria, and has been furnished by Fernando Calvo, Blavette, Rodet, Forthomme, Lemichel, and Blaise.¹

The Hæmopis enters the mouth along with the water animals drink, and they are usually young ones which are so taken by the domesticated animals—being filiform, and rarely longer than 2 mm. to 3 mm. They fix themselves inside the cheeks and lips, on the frænum of the tongue, on the palate, soft palate, and pharynx, and thence may reach the posterior nares, or enter the nasal cavities direct by the nostrils when the animals are drinking. They lacerate the mucous membrane by the denticules of their jaws (holding firmly to it by means of their oral and caudal suckers), become gorged with blood, and in doing so acquire a considerable size.

Their presence is easily recognised when once experience has shown the accidents they occasion; but to the inexperienced, these may remain for some time unobserved.

The signs of the action of the Leeches on some selected point of their habitat, are those of anaemia and slow internal hemorrhage. The Horses become emaciated, gradually lose their appetite, and are soft, weak, and incapable of working; their hair is erect, the visible mucous membranes are pale, the limbs vacillate, and, notwithstanding every care, death supervenes if the cause of the trouble is not recognised. But this is often perceived by a more or less abundant flow of blood from the mouth or nostrils, and more especially during work. The Leeches, in fact, disgorge a portion of the blood they imbibe, and the wound they have produced also bleeds considerably when they quit it to fix themselves on another spot. When the Horse, Mule, or Ox is at rest it swallows the blood; but when at work, the bit in the mouth of the Horse hinders deglutition and often keeps that aperture open, allowing the blood to appear at the commissures, and to escape in a somewhat abundant stream at times.

The mouth is then explored, and the Leeches, if fixed in that cavity, can be seen. They are sometimes concealed behind the soft palate. (If they are in the nasal cavities, blood will be noticed trickling from these, and the animal occasionally snorts, as if to expel the Leeches. Exploring the cavities by sunlight or a lamp will generally discover them.) But as such accidents are rarely isolated, diagnosis is rendered easy by the analogy of the symptoms.

When the Leeches are in the pharynx or at the entrance of the larynx, they induce such intense dyspnœa that death may ensue from asphyxia.

The number of Hæmopis that may be found in one animal—during life or on post-mortem inspection—is extremely variable, and to it their obnoxious action is subordinate. Androvande states that nine of these Leeches are sufficient to kill a Horse; but observation proves this to be an exaggeration. Blaise reports that when he was at Constantine, Algeria, in the Bardo quarter, there was not a Horse or Mule which had less than nine adult Leeches hidden away in its nostrils, mouth, or pharynx, and he mentions two instances in which, at autopsies, he found 185 and 192 in two animals.

They are extremely tenacious, for Guyon has seen 27 still attached to the mucous membrane twelve hours after the death of the Ox which they had made their host; and Mégnin¹ found, at Vincennes, some in an Ox from Algeria, which consequently must have harboured them for about eight days.

At the autopsy, in addition to the Leeches, there are usually remarked all the evidences of profound anaemia or asphyxia.

mucous membranes are oedematous, and more or less congested, as well as showing ecchymoses, which are red at their circumference, dark in the centre, and are traces of the bites.

It will be seen, then, that in certain countries—and particularly in Algeria—the Hämopis are a veritable scourge. They cause a serious loss among Cattle, produce much debility among Dromedaries, and by their multiplication in the springs that supply the watering-places of several garrisons, they cause much trouble to the military authorities—rendering inefficient at the same time a number of Horses and Mules, and probably terminating the existence of some of them.

According to the observations of Blaise, the Hämopis sanguisuga is not the only species that is to be dreaded as a parasite. In Algeria are to be found, under the same conditions, various kinds of Leeches that live in watering-places—such as the gray Leech (Hirudo medicinalis Linn.), the green Leech (H. officinalis Sav.), the trout or dragon Leech (H. troctina Johnson), etc. (Communicated note.)

(In addition to the parasitic water or amphibious Leeches alluded to, there are the numerous Land-leeches which attack the Horse, Ox, and other animals, besides Man. Among these, one of the most troublesome, perhaps, is the Hämadipsa Ceylonica, Hirudo tagalla or Ceylonica, which, as its name implies, is found in the island of Ceylon. It is only about an inch long, and is as thin as a knitting-needle; but it is very active and bloodthirsty, pursuing its victim with rapidity, fastening itself on man or beast, and attaining double its dimension when satiated. It is entirely terrestrial, living amongst damp leaves and in the jungles during the dry season, and remaining more or less quiescent; in the rainy season, however, it resumes its activity, attacking Men, Horses, Dogs, and other animals when they are passing through the woods and jungles, and even venturing out into the open ground, issuing from the grass and the dead leaves in troops. These cause much irritation and debility, from the numerous bites they inflict and the blood they extract, as well as the subsequent haemorrhage. 'Horses are driven wild by them, and stamp the ground in fury to shake them from their fetlocks, to which they hang in bloody tassels. The bare legs of the palanquin-bearers and coolies are a favourite resort. As their hands are too much engaged to be spared to pull them off, the Leeches hang like bunches of grapes round their ankles; and I have seen the blood literally flowing over the edge of a European's shoe, from their innumerable bites.'

A similar form, and with like propensities, occurs at an elevation of 4,000 feet in the Philippine Islands, and others in Java and Sumatra; and they have been met with at a height of 11,000 feet in the Himalayas. Land-leeches, with similar attributes, exist in Australia, Japan, and Chili. So abundant are they in some warm and moist parts of

the East, that people and domesticated animals are sometimes fatally debilitated by the minute, but persistent blood-lettings.)

To detach Leeches from the mucous membranes, several measures are employed. When the creatures are accessible, they may be removed by means of forceps, or with the hand wrapped in a towel (Abou Bekr) to prevent them slipping through the fingers. Some people recommend their being clipped in two with scissors. A more general procedure consists of repeated applications of gargles of vinegar or salts—common salt, sulphate of soda, alum, etc.—or merely fresh water allowed the victims to drink; but, unfortunately, it is not always easy to throw these liquids into the pharynx, where the Leeches so often domicile themselves. Blaise has successfully employed fumigations of tar, tobacco, or juniper berries—repeated twice a day; the fits of coughing they provoke dislodge the Leeches, which are only slightly attached to the mucous membrane. Souvigny—cited by Blaise—employed an indiarubber sound, one end of which had a piece of sponge attached; the latter was impregnated with ether, and pushed into the pharynx. (Wine or brandy will suffice; but a solution of salt is the readiest, perhaps, at all times, and may be used for the pharynx, nasal fossae, or any other parts with safety.

For Land-leeches, the same applications may be employed for their removal from the skin; while their attacks on the limbs may be prevented by bandaging these with cotton, calico, or any other cheap and convenient material.

When asphyxia is imminent, tracheotomy must be resorted to.

The anæmia consequent to the action of the Leeches requires its special and appropriate treatment.

Animals should not be allowed to drink at places infested by Leeches; and when watered at a river or stream, in addition to being safe from their attack, if already invaded by them they are soon relieved, as the parasites when gorged with blood relinquish their hold of the mucous membrane as soon as they can resume their aquatic life. The Arab hippiatrist, Abou Bekr, recommends attaching a bag to the Horse’s head, through which the water will be filtered when the animal is drinking, and through which the Leeches cannot pass. (A piece of thick muslin or fine calico made into a nose-bag, and placed over the nostrils and mouth when the horse is about to drink, should answer the purpose.) But the best course is to clear the watering-places of these pests, and to prevent their reintroduction.

Lemichel got rid of all the Leeches in the garrison reservoirs of Mustapha, by turning eels into them; these soon devoured the Suctoriæ. Many other kinds of fish would fulfill the same office.

Perforated metal filters placed where the water enters, can only keep away the larger Leeches, as the smaller ones—owing to their tenuity—can pass through the openings, however small they may be. Blaise
has obtained encouraging results with a filter made of powdered charcoal, packed and compressed, which arrested the Leeches; but the expense of this method has to be considered. Cauvet\(^1\) advises the use of a syphon-tube filled with fine sand, through which the water should be made to pass before it enters the troughs. This appears to be the most practical method of any.

**ARTICLE II.—Thrush.**

In human medicine\(^1\) this name has been given to a special affection of the buccal cavity, characterized by the production of a white caseous substance, composed of the elements of a vegetable parasite—the *Oidium albicans*—and an epithelial proliferation, the development of which is dependent on certain particular conditions.\(^2\) The French name given to the affection—*muguet*—is probably due to the resemblance of the whiteness of the deposits to the flower of lily of the valley.

Impressed by the analogy of situation and other symptomatic resemblances, veterinary surgeons have applied the name to several diseases of the buccal cavity observed on Calves, Foals, Lambs, Kids, and Birds, and characterized—in their evolution—by the production of a white or yellowish deposit on various points in that cavity.

Notwithstanding the identity in name, however, there are—in the nature of these affections—great differences. We have shown\(^3\) that, from this point of view, the thrust of Lambs and Kids cannot be assimilated with that of Man. With regard to the thrust of Birds, this is only a local manifestation of psorospermosis, except in some rare cases which—altogether different—are due to the *Oidium albicans*. We can, therefore, only deal here with thrust of Calves and Foals, on the one part, and that of Birds on the other.

**Thrush of Calves and Foals.**—German authorities—and particularly Zürn\(^4\)—describe a disease that attacks Foals, and especially Calves, either during the suckling period or immediately after weaning, and to which they give the name of *Soor, Kahlm, Maulschwämchen*. In France, this affection has not been the object of any particular publication, and it is scarcely more than superficially referred to in general treatises. We will, therefore, borrow from Zürn the following symptomatology.

**Symptoms.**—On the buccal mucous membrane—which is more or less inflamed—are seen some vesicles which soon rupture, and, after

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discharging their contents, leave excoriated surfaces, on which forms a miliary or lenticular membranous covering. This deposit—which gradually extends—is soft, 1 mm. or 2 mm. thick, and is at first white, then gray or grayish-yellow. It can be separated from the mucous membrane without injury to this, as it does not adhere to it. The vesicles and deposit that succeed them, may be propagated to the mucous membrane of the pharynx and esophagus. The affection is often an obstacle to suction and deglutition in the young animals, and it is not rare to see them fall into a state of extreme emaciation that may lead to marasmus, and eventually to death. An analogous disease—but accompanied by obstinate ulcerations—is also observed on Oxen and Horses.

Pathological Anatomy.—Writers attribute this malady to the same parasite that produces in Man—and particularly children—the malady bearing this name—that is, the Saccharomyces albicans Reiss (Oidium albicans Robin); and it is the elements of this parasite that constitute the greater part of the characteristic deposit in thrush.

This parasite was discovered on children by Berg, of Stockholm, in 1844. A short time afterwards Gruby confirmed the discovery, which was not long in becoming a definitive acquisition to the pathology of childhood. In 1853, Ch. Robin, in his Histoire Naturelle des Végétaux Parasites (p. 488), gave a complete description of this Fungus, and placed it in the genus Oidium Linck, by the name of O. albicans.

The designation Syringospora Robini, proposed in 1868 by Quinquaud, has not been adopted, and that of Oidium albicans is giving place to Saccharomyces albicans suggested by Reiss, from the analogies in development between this Fungus and those clearly belonging to the genus Saccharomyces—order of Saccharomycetes. Nevertheless, the researches of G. Linossier and G. Roux into alcoholic fermentation and the transformation of alcohol into aldehyde, produced by the Fungus of thrush, as well as the morphology of the same parasite, have induced them to remove it from the Saccharomyces group, and to ally it to Mucor.¹

The German authorities only furnish summary information on the structure of the parasite they have observed on calves, and recognise in it the characters attributed to the Fungus of thrush in children, with the exception of its dimensions, which are less. We will, then, borrow from the work of Ch. Robin referred to the classical description he has given on this subject.

The deposits or patches of thrush are composed of a mass of interwoven filaments and of spores.

The filaments are cylindrical tubes, straight or curved in different directions. Their average breadth is 3 μ to 4 μ, rarely less, though sometimes 5 μ; and their length varies from .05 mm. to .50 mm., .60 mm. and even more, according to the period of their development. Their borders are parallel, and their interior transparent. They are

formed of elongated cells, articulated end to end, and generally 20 $\mu$ long. They are longest near the adherent extremity, shortest near the free or sporiferous end.

The adult filaments have one or more ramifications, which are also composed of cells equal in size to those of the filaments, or longer or shorter. At the point of junction of two contiguous cells is seen a slight constriction or septum, and it is at this point, or near it, that the ramifications are inserted.

In the cavity of each cell there are usually some molecular granules, from 1$\mu$ to 2$\mu$, endowed with Brownian movements. Certain filaments which do not have these granules have, instead, two, three, or four oval cells with transparent, homogeneous contents that Seynes considers as simple vacuoles in the protoplasm.

The originating or adherent end of the filaments, is generally concealed in the centre of a mass of isolated spores, or mixed with epithelial cells. Nevertheless, it can be separated, and it is then observed that the first cell is the prolongation of a spore, and that there is free communication between their cavities. Whether the filament be multicellular and already ramified, or whether it is represented by only one or two cells, the spore is always recognisable. It usually contains two or three spherical granules, similar to those of the cells. In addition to the adherent germinal spores, there are often other spores.

The free extremity of the filaments or their ramifications is simply rounded, or expanded and formed by a spherical or ovoid cell, larger than the preceding ones—from which it is distinctly separated by a constriction—and measuring 5$\mu$ to 7$\mu$. It is sometimes prolonged by one or two very minute cells. Frequently those which precede it are ovoid and short, and give to the filament a varicose aspect. The expanded terminal cells are evidently spores about to be detached.

The spores are spherical or slightly ovoid, very refrangent, and contain a fine dust possessing Brownian movements, and have often one or two granules similar to those of the filament cells. Rarely they form a short chaplet of two to four elements. A certain number of them float freely, but the majority adhere firmly to the epithelium of the buccal mucous membrane—completely covering it in a close mass, and in such a manner that isolated cells can only be recognised by their outline. If they are imbricated into large patches, their margins are sometimes visible, the spores being less abundant.

We need not stay to discuss the interesting questions that arise with regard to the Saccharomyces albicans and its relations to the yeasts on the one hand (Reess), and to the Penicillium on the other (Gravitz). Suffice it to say that the last-named authority has been moved by an exaggerated appreciation of the pleiomorphism of the Fungi, and that the investigations of Declaux have amply demonstrated the complete anatomy of the parasite of thrush.

Diagnosis.—The diagnosis of thrush does not offer great difficulties. There might be danger—from a sanitary police point of view—in confounding it with aphthous fever; but this error may be easily avoided by an attentive examination. The vesicles of thrush are not numerous, and are rapidly replaced by the characteristic deposit; while contagion
—never very active—only operates on young animals, never involves adults; and there is no lameness, as the feet are unaffected. It is true that Hadinger has affirmed the existence of a Fungus, very similar to that of thrush, in the aphthous fever of Bovines; he found the parasite not only in the mouth, but also between the claws and on the udder. Fleming has also met with it in the pustules, and Spinola likewise signals the presence of the Saccharomyces albicans in the epithelial layers of the buccal mucous membranes in aphthous fever. But the assertions of these authorities remain unsupported, and the attempted verifications have only yielded negative results. Hadinger, Fleming, and Spinola must have mistaken for the Saccharomyces albicans, some one of those inferior Fungi so commonly met with on damp surfaces exposed to the air.

With calves more or less sickly, there sometimes remain little clots of milk at the base of the tongue or molar teeth; but these should not be taken for the products of thrush, as they are removed with the greatest readiness, and the mucous membrane beneath them is healthy, and not irritated, shining, and red as in thrush.

Lenglen has described a disease in calves which he calls 'gangrene of the mouth,' and which is a variety of stomatitis. The age and seat of the disease could alone occasion a mistake, as there is no analogy between the morbid processes in the two maladies; and here, also, the characteristic deposit of thrush is always absent.

Prognosis.—Thrush usually disappears spontaneously, or by simple treatment. Nevertheless, if it is complicated with general internal disturbance, or if any derangement intervenes beyond that it may produce, the young animal may succumb to these repeated attacks.

Etiology.—The acidity of the fluids in the mouth is one of the most favourable conditions for the development of the parasite. This fact has been established by experiment, as well as by observation in human medicine.

According to Zürn, the thrush of calves is due to small quantities of milk remaining in the mouth, in consequence of incomplete deglutition. This milk, in becoming altered, is invaded by the fresh Oidium lactis, which gradually accommodates itself to this medium, and is finally transformed into the Oidium albicans. In other instances, gastric derangement returns into the mouth milk already swallowed, and which has become acid—consequently fitted for the development of the spores of the Fungus of thrush; and if it remains for some time in the mouth, the parasite may establish itself there. Lastly, during or after weaning, the use of acid milk, or of sour or altered gruels, may prove one of the conditions for the appearance of the malady.

This rational etiology is, however, altogether hypothetical. It is inexact, also, so far as the transformation of the *Oidium lactis* into *Oidium albicans* is concerned; for the observations of Seynes\(^1\) show that these two species are separated by a number of constant differential characters. It is probable that contagion plays here its part in the thrush of children, the two affections having the same parasite as their efficient cause.

**TREATMENT.**—Great cleanliness of dwellings is clearly indicated when thrush affects several animals.

With regard to the complications that may arise in the general nutrition, or in the deeper-seated portions of the digestive apparatus, the ordinary therapeutical indications must serve as a guide.

In the treatment of the mouth, that cavity should be well cleansed morning and evening; by means of the finger, covered with a fine piece of linen, the patch of thrush should be removed as gently as possible. The mouth is to be washed out by injections of marshmellow water, and the diseased parts dressed with an appropriate medicine—such as diluted vinegar, solution of permanganate of potass, chlorate of potass, or sulphate of copper—1 or 2 per cent. (Borax forms an excellent non-irritating application for thrush.)

**The Thrush of Poultry.**—We know of only two observations concerning true thrush in Fowls—that is, due to the *Saccharomyces albicans*; as what is ordinarily designated thrush is diphtheria or psorospermia.

Of these two observations, one is by Eberth,\(^2\) and is also reported by Zürn.\(^3\) At the autopsy of a very emaciated Fowl—which had died after violent convulsions—Eberth found on the oesophageal mucous membrane, from the middle of that tube to the crop, several white, but not extensive, deposits, firmly adhering to its surface. The internal surface of the crop was covered by a white layer, two-thirds of a millimetre thick, and similar to the deposit of thrush. Behind the crop, the oesophagus had also some more isolated patches of a brownish-yellow colour. The examination of the layer similar to that of thrush, proved it to be composed of the spores and filaments of the *Saccharomyces albicans*. The spores were round and 4 \(\mu\) or 5 \(\mu\) in diameter, or oval and 5 \(\mu\) or 6 \(\mu\) in their largest diameter. The filaments, which were equally arborescent, were 2 \(\mu\) to 4 \(\mu\) broad.

The second observation is due to P. Martin.\(^4\) It is relative to a young Turkey, at the autopsy of which was found, at the posterior part of the oesophagus, as far as the proventriculus, a layer of thrush, showing—to the naked eye and by the microscope—characters almost identical with those seen by Eberth. There were, besides, pulmonary lesions, which had no evident relation with the parasite. Martin unsuccessfuly attempted to transmit the disease to two strong, healthy

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\(^2\) Eberth. Virch-w's Archiv, III., p. 528.


Fowls, by depositing on their beak the specific products taken from the Turkey that had died of thrush.

Zürn supposes that, in cases of this kind, there is contagion from the child to the Fowl by the soup or any other alimentary preparation which—after having been contaminated by the patient—has been given to the Poultry; and the information acquired by Martin would seem to prove that it was in this way the Turkey he observed was infected.

We have vainly endeavoured to realize this transmission, by depositing in the recesses of the buccal cavity of two Fowls, relatively massive doses of thrush material from a child; and we have also spread it on their combs, which had been previously scraped until they were nearly raw; but nothing transpired to demonstrate that the parasite had been implanted.

It is necessary, therefore, to admit a predisposition to the disease, due to a previous sickly condition of the Bird. This was the case with the Turkey in the second observation.

The diagnosis of this thrush of Fowls is impossible when the malady is located in the oesophagus and crop; but if it occupies the buccal cavity and pharynx, then it is easily recognised by the white deposit that characterizes it, and particularly if a microscopical examination be made of that deposit.

The treatment consists in sponging the cavity with a ten per cent. solution of sodium borate.

**ARTICLE III.**—*Gutturomycosis of Equidae.*

Rivolta has given the designation of *gutturomycosis* to an ulcerative affection of the gullet pouches, which, he asserts, is caused by a parasitic Fungus that he has named *Gutturomyces equi.* This disease, which he observed on two Horses, has since been seen in a Horse and Mule by Bassi, who entirely adopts the views of Rivolta with regard to it.

In the three Horses, the symptoms were those of a paralytic dysphagia. At the autopsy, there was found pulmonary hepatization and gangrenous pneumonia, due to the passive introduction of food into the trachea. The ulcer occupied the bottom of the gullet pouch—that is, the portion situated in the stylo-condyloid space, as far as the point where the mucous membrane is doubled. The irritation, in extending to the ninth pair of nerves, had led to paralysis of the pharyngeal muscles. The ulcer had the characters of a glander lesion, and on the crusts on its surface were found numerous elements—mycelia, conidia, and spores—of a Fungus closely related to the *Aspergilus,* if not identical with these moulds.

The Mule had been suffering from epistaxis, and succumbed at last to a violent nasal hemorrhage. The ulcer—situated in the right gullet pouch—had involved the internal carotid artery. It showed the same cryptogamic elements as were found in the three preceding cases.

These four observations are insufficient to establish the parasitic nature of such ulcers. As Railliet has remarked, there is reason to believe that the development of the parasite is only a secondary and

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altogether accessory phenomenon. The essential fact is the ulceration, and certain details given excite a suspicion as to its glandery nature, which, in fact, in one case can scarcely be doubtful. Test inoculations should have been practised, in order to establish whether these were really cases of gutturoscopy, properly speaking, or a glandery localization in the guttural pouches.

**Article IV.—Diphtheria of Fowls.**

We have already seen (p. 268) that the cutaneous psorospermosis of Fowls—the *epithelioma contagiosum* of the comb, wattles, or other parts of the head, which prevails principally among Poultry and Pigeons—may reach the commissures of the mouth, and enter the buccal cavity, localizing itself chiefly in the lingual canal. These psorospermic nodules are more especially noted in young Birds. The beak of the Bird attacked is sometimes very much deformed by the malady, and the prehension of food is consequently rendered difficult. Recovery may occur spontaneously, if the parasitic nodules are few in number and are wide apart. In the contrary cases, the malady progresses, obstructs the nostrils and mouth, and more or less rapidly induces fatal marasmus.

This affection is often complicated with white, firm or defluent patches, which invade the whole of the buccal cavity; at the same time the mouth is fetid and slimy. Depression, emaciation, and inappetence bring on death within a variable period. It is, then, a kind of diphtheria, the nature of which is the subject of very diverse opinions. It is probable that, under the name of *diphtheria*, three or four affections—differing in their causes, but having the closest symptomatic analogies—have been included. Not long ago, in fact, it was a microbial affection which was assimilated with the diphtheria of Man; but it is due to a different microbe, as numerous investigations—and especially those of Colin, Roux and Yersin, etc.—have demonstrated.

Rivolta and Delprato¹ class the parasites that produce this diphtheritic affection with the Coccidia. They are developed in the epithelial cells, and when mature their shell ruptures, and the spores—*pseudo-navicella*—become the embryonic Coccidia: protoplasmic masses which, owing to their amœboïd movements, are capable of passing through the layers of epithelium. On arriving in the young cells, they install themselves in the midst of their protoplasm, grow there, and assume the form of granules—at first discoid, then globular, shining and homogeneous. In their interior are developed the new spores, which—by the same mode of propagation—continue the extension of the disease.

The same authorities have described another form of croupous

¹ Rivolta and Delprato. *L'Ornitzjatria*. Pisa, 1881, pp. 25, 32.
angina observed in pullets and young Pigeons, and which is due to flagellate Infusoria. These Infusoria—Monocercomonas gallinae Riv.—are round or discoid homogeneous bodies, of a pale tint, from 14 μ to 25 μ in length and 5 μ to 7 μ in breadth. One of their extremities is obtuse, and bears a flagellum as long as the body; the other extremity—which is acute—is furnished with three flagelli united at their base. They move in every direction, from the action of these flagelli.

The presence of these Flagellata coincides with white or yellowish-white, lumpy, punctiform or irregularly elongated spots, having sometimes the dimensions of a grain of millet or vetch, which are disseminated on the mucous membrane of the pharynx, oesophagus, crop, and at times on the palate, the base of the tongue and the lingual canal. They are formed of epithelial cells, leucocytes, haematinies, and a granular matter; and among these elements there move thousands of these Infusorium. Beneath the spot or patch, the mucous membrane is hyperaemic.

This affection may cause death by inappetence and inanition. It is distinguished from diphtheria by the fact that the exudate is only slightly adherent to the mucous membrane, and is therefore easily detached from it; and it is also diffused in the mouth, pharynx, oesophagus, etc.

Pfeiffer has made analogous observations. He allies these Flagellata with the Trichomas, and allows them only two flagelli—one at each pole. He states that in the pathological tissues in which they are retained, they may lose their mobility, assume an amoeboid condition, the encysted form, and even that of round cells. They may then be mistaken for the Coccidia of epithelioma contagiosum. Pfeiffer thinks that, in diphtheria, the presence of a bacillus is secondary, and is only manifested when the epithelium has been dispersed by the previous action of the Flagellata.

Cornil and Babes are of the contrary opinion. They consider the part played by the Flagellata as problematical, as the life of these parasites is ephemeral; they die after being multiplied for a few days in culture broth, at the temperature of the body. In the false membranes of diphtheria, they are always accompanied by the bacilli described by Löffler in this affection of Birds, and are not discovered in the Rabbits to which the malady has been conveyed by inoculation. These authorities describe the Flagellata as scarcely distinct from leucocytes when they are examined at rest or dead; they are not coloured by picro-carminate of ammonia, and after staining by methyl-violet appear as round or irregular hyaline bodies, having sometimes fine striæ a little coloured on their surface. They are provided with

2 Cornil and Babes. Les Bactéries, 3rd edition, II., 1890, p. 84.
two, three, or four flagelli at one pole, and only one—which is not constant—at the other pole.

The various diphtheritic affections of Birds often extend farther, reaching the other parts of the digestive and respiratory canals. They usually cause death, and generally appear in an epizootic form in poultry-yards and pigeon-houses.

Treatment\(^1\) has no chance of success, unless the disease has not got beyond the first section of the digestive canal. Then the false membrane should be delicately removed, and the diseased surfaces touched with one of the numerous caustics at our disposal. The employment of the oil of turpentine has been warmly recommended. Thomassen advises washing the exposed sores with a 2 per cent. solution of boric acid, and then to powder them three or four times—at intervals of forty-eight hours—with a thick layer of flowers of sulphur. Cadiot and Mauri have obtained good results with Van Swieten’s fluid. Disinfection of the invaded dwellings, and isolation of the affected creatures, are measures of the first necessity.

It is necessary to include with the preceding affections, another malady of mycosic origin that attacks young Pigeons, and may co-exist with diphtheria. Its importance has been indicated by Dieulafoy, Chantemesse and Widal, at the International Congress of Medical Science at Berlin in 1890.\(^2\) The creatures attacked by this mycosis offer lesions which sometimes remain localized in the buccal cavity, but most frequently become generalized in the lungs, liver, and more rarely in the oesophagus, intestine, and kidneys. The localized lesion in the floor of the mouth takes the form of a white nodule, apparently caseous, from the size of a pea to that of a small nut. In the lungs it appears as milliary tubercles, sometimes transparent, sometimes opaque—isolated, disseminated, or agglomerated in caseous masses like the tubercles of Laënnec. These tumours do not contain the bacilli of tuberculosis, but in their centre is the mycelium of a Fungus, which cultivations demonstrate to be the \textit{Aspergillus fumigatus} Fresenius.

This mycosis is related to those which have been so often observed in Birds, and of which we will treat \textit{à propos} of the diseases of the air-passages. It has been already seen—in the buccal form—in the Fowl, by Rivolta and Delprato; and its localization about the beak of the Pigeon gives it special importance. According to Dieulafoy, Chantemesse and Widal, the ‘crammers of pigeons’ probably owe to contagion the chronic disease of the lungs with which they are for a long time affected. In certain establishments in Paris, these men feed


daily several thousands of Pigeons, filling their mouths with a mixture of water and grains, then applying their own lips to the open bill of the creatures, in order to blow down a portion of this mixture. It is probable that they in this way derive the germs of the Aspergillus, either from the surface of the grains with which they fill their mouths, or from direct contact with the buccal tumour of the Pigeons. Culture and inoculation experiments made with the expectorations of the diseased 'crammers' confirm this explanation.
CHAPTER II.

PARASITES OF THE ŒSOPHAGUS AND STOMACH.

In the stomach of the different domesticated animals, Worms may be found which come into it from the intestine—their ordinary habitat, and where they are agglomerated. These are more particularly the Ascarides and the Tæniae.

Various Infusoria are more especially located in the œsophagus and stomach, as well as Trematodes—Distoma, Cephalogonimus, and Amphistoma, Nematodes, and the larvæ of the Cestridæ; the latter are special to the Equidae. The Nematodes—the majority of which are lodged in sub-mucous tumours in the œsophagus, stomach, or intestines—belong to four families only: Strongylides, Trichotrachelides, Filariades, and Gnathostomides (see p. 325). There are: 1. In the Strongylides, various species of Strongylus, Ollulanus, Physaloptera. 2. In the Trichotrachelides, the Trichosoma. 3. In the Filariades, the Spiroptera, Dispharagus, Hystrichis, and Tropisurus. 4. In the Gnathostomides, the Gnathostoma.

Of these diverse genera, only two—Strongylus and Spiroptera—have representatives in the œsophagus of a large number of Mammalia and Birds; the diagnoses of them may advantageously be dealt with here. The others being found in limited groups, it will be preferable to examine them when treating of the hosts in which they are found.

The Strongles (Strongylus Müller) have the mouth nude or encircled by papillæ, and the œsophagus more or less abruptly dilated in its posterior part. The males have a caudal sac usually bi-, tri-, or multi-lobular, and sustained by the ribs; there are two equal-sized spiculae. The vulva is situated in the posterior moiety of the body.

The Spiropteres (Spiroptera Rud.) have an elongated body, though it is much less so than that of the Filariæ, from which, otherwise, they differ but little except in their habitat; the tail of the males is rolled up in a spiral manner, and furnished with membraneous wings; there are two straight spiculae; and the vulva is more or less distant from the mouth.
Article I.—Parasites of the Oesophagus and Stomach of Equidæ.

The only parasites which belong almost exclusively to the stomach of the Equidæ are the Nematodes and the larvæ of the Oestræides.

A. Nematodes.—Four species have been described: two Strongles and two Spiropteres.

1. *Strongle of Axe* (*Strongylus Axei* Cobbold).—A small filiform worm, gradually enlarging posteriorly, mouth nude; the male is furnished with three (?) unequal spiculae, and is 6 mm. long, the female being 8 mm. The tail of the latter is abruptly contracted to a narrow point, and is conical. This Worm was found at the Royal Veterinary College, London, in tumours on the gastric mucous membrane of an Ass. Its presence does not give rise to any appreciable symptom.

2. *Strongle minusculus* (*Strongylus tenuisсинus* Mazzanti).—Mouth nude, and behind it four papillæ. Male: body gradually thicker behind, 2-5 mm. long; caudal pouch bilobate, the ribs being joined for the greater part of their length, each terminating in two short branches, the external posterior of which is divided; two equal spiculae. Female: body filiform, and 3 mm. to 5 mm. long; vulva situated towards the posterior sixth. Ova ovoid, and 70 μ long, 30 μ broad. This worm has been found by Mazzanti in the mucous membrane of the right sac of the stomach of an old Horse. It might be mistaken for the preceding.1

3. *Spiroptera megastoma* (Rud.).—Body white, and equally attenuated at both extremities. The cephalic portion is separated from the remainder of the body by a constriction, and is provided with four thick, horny lips, the two lateral of which are small, one dorsal and another ventral being broader, the latter bearing a papilla on the lateral border. The mouth is continued by an infundibuliform pharynx. Male: 7 mm. to 9 mm. long; tail obtuse, rolled in a spiral manner, and bearing two lateral wings, each sustained by four pre-anal and one post-anal papilla; two unequal spiculae. Female: 11 mm. or 12 mm. long; tail straight and obtuse; vulva situated towards the anterior third of the body. Ova oblong, almost linear, and hatched in the body of the female.

The Spiropteræl tumours are usually found in the right sac of the stomach of the Horse. They form round prominences, the volume of which varies from that of a small nut to a fowl’s egg. Their colour does not differ from that of the adjacent parts, and they are firm in consistence. They have on their summit one or more perforations that communicate with the irregular cavities into which they are hollowed. By pressure on these tumours, a grayish matter, as well as the worms they contain, is extruded.

These tumours are situated between the mucous and muscular layers of the stomach, and are the product of the irritation set up in the sub-

mucous connective tissue by the worms. Andral considered them as due to a pathological dilatation of the glands of the stomach, the orifices of which correspond to their perforations, and have served for the entrance of the Spiropteres; while Ercolani more correctly imagined that these perforate the mucous membrane, in order to introduce themselves beneath it.

When the tumours are old their contents are concrete, their walls are fibrous, and they have the consistency of cartilage. In them are found dead worms or their débris, or purulent matter if the worms have evacuated them for a long time.

Valenciennes found these verminous tumours in 11 Horses out of 25. They were most frequent in the month of June; and Ercolani made the same remark. The mode of introduction of these Spiropteres is not known, nor yet whether they multiply in the tumours or submit to migrations.

The presence of these tumours does not seem to cause any disturbance in the functions of the stomach, but they might hinder the passage of the alimentary matters if they were in large numbers in the vicinity of the pylorus (Railliet).

4. Spiroptera microstoma (Schn.).—This differs from the preceding species by its greater size—male, 10 mm. to 12 mm.; female, 12 mm. to 17 mm.—by the absence of the constriction behind the cephalic

extremity; only two lateral lips in the form of a hatchet; two un-
symmetrical post-anal papillae on each side of the male. The ova are
hatched in the uterus of the female.

C. Baillet\(^1\) has often found these Worms, in somewhat large numbers,
in the stomach of the Equidæ. When that organ is examined im-
mediately after death, its contents appear to be affected by a very
pronounced undulatory movement, due to the action of these entozoa
in every direction. They sometimes have the head engaged in the
glands of the mucous membrane in the right sac. Railliet has on several

occasions, in summer, observed extensive ulcers on the gastric mucous
membrane of Asses killed at the Alfort Veterinary School, and which
were the hosts of large numbers of these parasites.

Müller has found in an old Horse, scutated Spiropteres \((Spiroptera
cutata)\) lodged in the epithelium of the esophagus. This parasite
will be noticed when dealing with those of the esophagus of the Ox
and Pig.

B. Larvæ of the \(\text{Œstrus gastricoles}.—\) The most common para-
sites of the stomach of the Horse are the larvæ of the \(\text{Œstrides}\) (see
p. 44). By reason of their \textit{habitat}, they constitute the \(\text{Œstrus gastricoles}—\text{Chylivorous of Bracy-Clark}—\) and all belong to the genus \textit{Gastro-
philus} (Leach), the result of doubling the genus \(\text{Œstrus}\) of Latreille.

The Gastrophiles are included, according to Brauer,\(^2\) in the group

Vétérinaires, VIII., 1866, p. 561.

\(^2\) Fr. Brauer. \textit{Monographie der Œstriden.} Vienna, 1863.
whose wings have not a transverse terminal nervure, the fourth longitudinal nervure extending to the posterior border. In the perfect state the body is woolly; the abdomen is not pediculated; the style of the antennae is nude; the buccal organs are rudimentary; the palpi—lying in the buccal fossette—are small and globular; the proboscis is non-protractile, and little distinct; the calytera are small, have long cilia, and do not cover the balancers. Examined in their third stage of development, the larvae are found to have two pairs of jaws; curved mandibuli, called buccal hooks, and, between these, straight horny maxillae. The posterior extremity of the body is broader than the anterior, and is straight and truncated. The stigmates—carried on the last segment—are concealed in a cavity that opens externally by a transverse slit, situated between the chitinous arcades. The anterior stigmates are imbedded, and invisible externally. The antennae only carry one ocelliform point.

Brauer has described eight species of Gastrophiles, the majority of which have been found in the larval condition in the stomach of the Equidae:

3. *G. pecorum* Fabr., common to Europe.
4. *G. nasalis* Linn., found also in Europe and in Nova Scotia.
5. *G. flavipes* Oliv., the larvae of which inhabit the stomach of the Ass in Southern Europe and North Africa.
6. *G. inermis* Brauer, an Austrian species, the larva of which is unknown.
7. *G. lativentris* Löw, found in Russia; its larval life has not been ascertained.


We have only to consider the first five species.

1. **Gastrophilus of the Horse** (*G. equi* Fabr., *Gastrus* or *Estrus equi*, the Breeze or Horse-bee of Britain).—A woolly insect with a fawn-coloured face, covered with a white silky down; forehead fawn-coloured, the posterior part having black hairs; antennae rust-coloured; thorax sometimes entirely covered with reddish hairs, and most frequently having a black transversal band. The abdomen is of a yellowish-brown or ferruginous tint, with irregular, denticulated, brownish-gray, and more or less dark spots. The wings are transparent, and have in their middle a transverse smoky band, their posterior extremities having two points of the same tint. The posterior extremity of the male is obtuse; but the abdomen of the female is, on the contrary, extended as a long oviscapt, which is doubled under that region when at rest. Length—not including the oviscapt of the female—12 mm. to 14 mm.

![Fig. 130.—*Gastrophilus equi*, natural size.](image)

A, female, dorsal view; B, the same in profile; C, male, dorsal view.

This species is the most important of those we have to describe. It is found throughout Europe, and also in Africa—Egypt, Nubia, Cape of Good Hope—in Asia, and in North America. Macquart states that it is likewise found in the Canary Islands. (It is less common in Britain than on the Continent of Europe.)

It exists in the perfect state from June until October, but particularly in August. During the warmest hours of the day, the female flies buzzing about Horses, Asses, and Mules, balancing itself with the oviscapt directed downwards and forwards; it hovers for a few seconds over the place where it seeks to deposit its eggs, drops an egg upon it and immediately flies away; but it soon returns, lays a second egg, and repeats the operation so often that hundreds of eggs may be found on the same Horse, which does not appear to be disturbed by the performance. The ova are observed on various regions, but the insect prefers the anterior limbs—particularly the fore-arms—and the knees and shanks (parts most accessible to the Horse's tongue).

The ova of the *Gastrophilus* of the Horse are yellowish-white in colour and conical in shape, being 1.25 mm. long; they are transversely striated, and provided at the larger extremity with an operculum,
which is obliquely truncated. They adhere to the hairs by their narrow end, in the same manner as the ‘nits’ of the Louse, by means of a viscid matter that is deposited with them; their wide end remains pendent. They are hatched in a few days—4 or 5 according to Bracy-Clark, 20 to 25 according to the observations of Joly; the operculum becomes detached, being pushed up by the larva, which is very vivacious, and begins to crawl on the skin, causing a slight itching which impels the Horse to lick the place. The larvae in this way are introduced into the digestive apparatus, and the majority fix themselves on the mucous membrane of the stomach by means of their buccal hooks, the head plunged deeper and deeper into an alveolus, that is formed under the influence of the irritation due to their presence. They subsist on the inflammatory products secreted by this small wound in the mucous membrane.

On its exit from the egg, the larva (or ‘bot’) is very long and fusiform, and has thirteen rings or segments, the first of which are difficult to distinguish. The cephalic segment has two antennæ, two buccal hooks, a circle and a fasiculus of movable spines—directed backwards like the hooks—and situated immediately in front of the second ring. Similar spines are present on the posterior border of the nine segments succeeding the first; but the last two segments are destitute of spines. The thirteenth segment has at its free extremity two lips, between which are projected—from time to time—two retractile tracheæ.

After the second moulting—the third stage—the larvae are not so thick at their anterior extremity as behind, where the body is perpendicularly truncated. The integument is smooth and rigid, and does not readily wrinkle. There are only eleven segments, which are more convex on the dorsal than the ventral surface. The cephalic ring has—behind the antennæ and the buccal organs—several series of spinous prominences which are very small and curved. From the second to the eighth inclusively, each ring has—towards the anterior border—a double row of spines, also directed backwards, those of the first row being much stronger than those of the second. The ninth has some smaller ones, but only on the sides, and the tenth has none at all, or only one or two. The inferior surface of each ring, from the second to the tenth included, presents at its anterior border a double row of spinescent tubercles. A short longitudinal ridge runs along each side of the body. The eleventh ring, posteriorly, has the respiratory slit, which is limited by two narrow but salient lips, the bottom being formed by the stigmatic plates, which are united into one by a common chitinous frame. Each plate is reniform, and constituted

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by three concentric arches, each having a longitudinal groove on which open small apertures arranged in pairs, and which are the means of communication between the respiratory apparatus and the atmosphere. When the larva has reached maturity, these stigmatic plates are black; the spines are brown at the base and black at the points; the colour of the body—which was originally red—passes gradually to yellow; and the total length is from 18 mm. to 20 mm.

Maturity is attained after a sojourn of about ten months in the stomach of the Horse. From May to August, the larvae become detached voluntarily, and pass along with the alimentary matters, to be finally expelled from the body of their host along with the faeces. According to the remark of Numan, although the larvae are expelled at all hours of the day, yet the majority are evacuated during the night or towards the morning. At first very lively, they penetrate the ground or remain concealed in the excrements; then their movements cease, and they soon become rigid and motionless. After twenty-four to forty-eight hours they assume a bright-brown tint, then a dark-brown, almost black colour; the skin becomes hardened, and forms a shining shell.
(pupa-case) in which the nympha is enclosed. This case or shell has a slight curvature from before to behind, the concavity of which is ventral.

The duration of the nymphosis is—as for the other Cestridae—from about thirty to forty days, and the perfect insect (or imago) emerges according to the mode already indicated for all the forms of the family. Copulation takes place, and the females, in their turn, deposit their ova on the bodies of Horses.

2. *Gastrophilus haemorrhoidalis* (Linn.).—Dark-brown colour; face covered with light-yellow hairs, forehead with fawn-tinted hairs; antennae ferruginous. Thorax covered with olive-gray hairs in front of the suture, and showing a transverse black band behind it. Abdomen woolly, the hairs being white in front, black in the middle, and of an orange hue behind. Wings hyaline, without spots. Oviscapt as in the *G. equi*. Length, 9 mm. to 11 mm., without the oviscapt.

This species is, with the *G. equi*, the most wide-spread in France. It is found throughout the whole of Europe and in North America; its habits are analogous to those of *G. equi*, though the female prefers to lay its eggs on the lips of the Horse, and the long hairs covering them. This gives rise to a kind of irritating tickling, which induces the Horse to rub its lips against the ground, the fore-limbs, or trees; or it seeks to evade attack by galloping away, and even plunging into water to escape from its enemy (Bracy-Clark).

The ova of the *G. haemorrhoidalis* differ from those of *G. equi*, chiefly by their dark colour. The larvae, at their exit, cause titillations, which compel the Horse to pass its tongue around its lips, and so the parasite is carried into the mouth, and thence into the digestive canal.

At the third stage, these larvae (known in Britain as the red-tailed Horse-bot)—mixed with those of *G. equi*—are distinguished by their slightly smaller size, their deeper-red colour, the spines of the first row of each anterior ring being scarcely so strong as those of the second,
the presence of a denuded dorsal spot in the middle of the ninth ring, and the entire absence of dorsal spines on the tenth, as also on the eleventh ring.

They are also distinguished by their habitat, the sojourn they make in the rectum before returning to the external world, the greenish colour they assume, and certain other peculiarities in their parasitic existence which will be alluded to hereafter.

3. *Gastrophilus pecorum* (Fabr.).—The male is brown, and covered with coppery-yellow hair, which is black in places. The segments of the body are short and spheroidal; the thorax has, behind, a transverse band of black hairs, often interrupted in the middle by yellow hairs. The wings are small, of a fuliginous, grayish-yellow hue, and frequently showing a large smoky band in the middle, and a spot at the point. Length, 12.5 mm. The female is black or dark-brown, and covered with black or dirty-yellow hairs. The wings are shorter than the body, and are similar to those of the males, or entirely fuliginous. Length, 15 mm.

The eggs differ little from those of *G. hemorhoidalis*. The larva, when mature, is 13 mm. or 14 mm. long, and is of a dark-red, blood tint; the spines are brown—bright at the base, and dark at the point. Their arrangement on the dorsal surface constitutes a distinctive character, they being disposed in two rows on the anterior border of each ring, from the second to the fifth; at the sixth there is an interruption in the middle, which is still more marked in the seventh, and greater in the eighth, where it occupies the middle third of the ring. The succeeding rings are nearly always completely unarmed.

This species exists throughout Europe, and is very frequent—in the larval condition—among Hungarian Horses; it is very rare in Sweden, according to Boheman. Mégnin\(^1\) has seen perfect insects hatched from larvae procured from Russian ponies sent to Paris.

Like those of the preceding species, the larvae are fixed for some time to the rectum before being evacuated.

4. *Gastrophilus nasalis* (Linn.).—Insect covered with fine down. Upper surface of the thorax covered with dark hairs, intermixed with others of a golden hue. Dorsal scutellum shining, of a dark-brown, often of a fine, bright-brown, or golden chestnut colour. The abdomen is variable in colour, always garnished with long, fine, and close-set hairs, which are usually white on the second ring, black on the third, and orange on the succeeding ones; in others the latter are grayish, and in others, again, they are orange from the second ring. The wings are somewhat small, broad, and hyaline. Length, 12 mm. or 13 mm.

The ova are white, elliptical, truncated in front, and have on one side two longitudinal lines. An altogether distinctive feature of the larvae is their only having one row of spines at the anterior border of their rings. On the upper surface the median interruption commences at the eighth ring; the tenth is unarmed. In a state of maturity, these larvae are 13 mm. to 15 mm. in length, and are of a light-yellow colour; the spines are white at the base, and dark-brown at the point.

This species appears to be spread throughout Europe, but is most common in Austria and Prussia. It owes its name to the circumstance that the female deposits its eggs on the alæ of the nostrils and lips of the Horse. It has also been described by the name of G. salutaris Meig., G. salutiferus B. Clark, in order to signify the beneficial influence the larvae are supposed to exert on the digestive functions.

They exclusively inhabit the pyloric region of the duodenum, and do not fix themselves to the margin of the anus while they are being evacuated.¹

5. *Gastrophilus flavipes* (Oliv.).—This is 11 mm. long, with pale-yellow legs and hyaline wings; the dorsal scutellum is black, with yellow lateral patches; abdomen of a shining brownish-yellow colour, with a darker longitudinal line; when pubescent, it is white. The larvae are more especially parasitic in the Ass. The species is wide-spread in Dalmatia, Spain, Northern Africa, and Asia Minor; it is also found in the Pyrenees. Its history is still incomplete.

(The larvae of the *Gastrophilus elephantis* is found in the stomach of both the African and Asiatic Elephant, and is stated to be specifically different to that of the Horse, being sometimes one inch in length. 'I found that when these bots were removed from the membrane of the stomach they struggled violently, and several grasped my finger firmly with their hooklets.' Cobbold thinks it not improbable that these larvae are derived from the ova that have been deposited by the mature *Gastrophilus elephantis*, on the tusks of the Elephant. Another 'bot'—the *Pharyngobolus africanus*—has been found in the pharynx of the African Elephant. No clinical importance has been attached to these larvae.)

The larvae of the Gastrophiluses are found in Horses which frequent pastures or live much in the open air, and which do not receive much grooming. The age, state of health or disease, and mode of feeding, have no influence upon them. According to the observations of Numan, these larvæ are much more abundant after dry, hot summers than after rainy seasons.

When taken into the mouth of the horse by licking, the young larvæ do not all pass directly into the stomach; for it sometimes happens that some of them are arrested at the soft palate, on the epiglottis, and in the pharynx. This more especially, if not exclusively, occurs with those of the *G. haemorrhoidalis*. Their presence is not altogether without danger.³ Vitry reports the case of a Horse which succumbed in


23—2
two months to an affection characterized by a violent dry cough, and increasing dyspnoea that terminated in asphyxia. At the necropsy nothing could be discovered, except five larvae of the Gastrophilus, attached to the margin of the epiglottis, their bodies floating in the larynx. Crepin has seen a Horse that presented analogous symptoms to the preceding, and which was cured by a farrier, who, thinking a feather had got fixed about the larynx, introduced a rod with a piece of cloth at the end into the oesophagus. On withdrawing it he found several larvae of the Gastrophilus, and repeating the manœuvre several times, the Horse was cured. Gunther relates a similar case to the first, but there was more 'roaring'; and Renner, Professor of Veterinary Medicine in the University of Moscow, states that the Russian empirics employ a brush fixed to a handle, with which to detach the larvae that are fixed in the 'gullet.' Pigeaire has often witnessed similar instances among the Camargue Horses, several dying from asphyxia. The treatment adopted also consisted in introducing into the pharynx a stick enveloped in a towel impregnated with olive-oil, or, better, empyreumatic oil.

Mather has described the case of a foal in which mastication and deglutition became altogether impossible, and at the autopsy there were found in different parts of the mouth, pharynx and larynx quantities of these larvae in a not very advanced stage of development.

Dieckerhoff contests, theoretically, the value of the preceding observations, in relying on the slight sensitiveness of the pharyngeal and laryngeal mucous membrane at the points occupied by the larvae.

In general, the larvae of the Gastrophilus equi fix themselves on the gastric mucous membrane, and almost exclusively in the left sac—occupying, by preference, the region adjoining the velvety mucous membrane in the right sac—and some stop in the oesophagus, above the cardiac opening, where the membrane offers the same characters as in the left sac of the stomach. When the stomach of a Horse is opened, the larvae are found in variable numbers—10, 15, 20, or more, sometimes even hundreds; Daubenton has counted more than 600, Vallisnieri 700, and Numan more than 1,000, in one stomach. They are collected in one or more groups, one of which is always larger than the other. There may be a mixture of several kinds of larvae, though in our country those of the G. equi predominate. They are more especially located in the left sac of the stomach, but those of G. haemorrhoidalis—besides their possible arrest in the pharyngeal region—may also be found in the right sac and in the duodenum. They remain some time in the latter portions of the rectum before leaving the body, and there they assume a characteristic green tint. They can be seen at the time of defecation, when the rectum is everted; and it is this

which gave rise to the error—pointed out by Bracy-Clark—that the larvae of the *G. haemorrhoidalis* are developed in this region: the eggs having been deposited there in the springtime by the female, which took advantage of the protrusion of the mucous membrane when the faces were being expelled. The larvae of the *G. pecorum* have also the same temporary lodgment in the rectum before emerging to undergo their nymphosis; but this does not occur with the *G. equi* nor *G. nasalis*, the larvae of the latter having the duodenum for the principal habitat.

With regard to the effects that the larvae of the Gastrophiles may have on the health, very divergent opinions have been given. Certain authorities have attributed the most serious consequences to them, and Numan cites a number who have asserted that the larvae erode the tissues of the stomach, perforate it, and in this way cause death; or they bring on emaciation, or induce cough, colics, cerebral symptoms, or inflammation of different viscera, and especially the lungs. Chabert lays the most varied maladies to their account; while Vallisneri ascribes an epizooty, which killed a great number of Horses in 1713, at Verona and Mantua, to the enormous quantities of larvae generally found in the stomach (Numan). From a careful examination of the majority of the cases reported, Numan concludes that the perforations observed were produced after death, and that they were easily effected because of the ante and post mortem softening of the tissues of the stomach.

It is true that, when we reflect on the extreme frequency of the gastric larvae, the multitudes of Horses which are infested with them, their frequently being present in enormous quantities in a stomach, and the impossibility of even suspecting their presence there during life, owing to the absence of any apparent disturbance, we might be led to consider these parasites are altogether inoffensive. What is more, some authorities have ascribed a stimulant action to them, which is of advantage to the digestive functions; but in this there is manifest exaggeration. We cannot admit that the numerous ulcers produced on the surface of the oesophageal and gastric mucous membrane are a matter of absolute indifference, and, indeed, they must have some effect on the function of these organs, which ought to be revealed when other pathological conditions intervene. In any case, a considerable number of observations are recorded of fatal troubles having been due to the larvae of the Gastrophiles; and we have quoted some of a relatively recent date, and altogether independent of any preconceived ideas which Numan’s observers may have entertained.

The latter reports having once found the duodenum pierced by four or five holes, evidently due to the larvae of the *C*estrus, one of which had passed through a hole and was attached to the peritoneum; another was firmly fixed in a second perforation, and several had
bored through the mucous and muscular tunics, leaving the serous membrane intact. There was inflammation and manifest softening of this portion of the intestine. The Horse had suffered for a long time from a disease of the foot, and died from exhaustion. The larvæ were those of the Gastrophilus nasalis. Numan also states that the Royal Veterinary College of London has the stomach of a two-year-old Colt, which presents at its larger curvature and inferior surface a considerable thickening, in the centre of which are six perforations through all the gastric tunics, and in which are as many larvæ of the Estrus; while three or four perforations have no larvæ, and about fifty of the parasites are still adherent to the internal surface of the stomach. The inflamed state of the organ should be noted, as this could not have been without influence on the exceptional action of the larvæ.

Hertwig—quoted by Verheyen—relates a case of death of a Horse from hæmorrhage of the stomach. At the autopsy, this viscus contained about two gallons of blood, which had come from two ulcers in the gastro-omental artery—these ulcers being attributed to larvæ of the Estrus, a certain number of which were found on the mucous membrane. It is true, at these ulcers was found a sub-mucous purulent centre, and it might be asked if this was not really the cause of the arterial lesion.

In a Horse killed because of sudden general paralysis, Schliesse found between the cardia and vertebra a pouch communicating with the stomach, and which contained about a dozen larvæ of Estrus.

At the autopsy of an aged Mule, which had shown all the symptoms of chronic gastro-enteritis, Delamotte discovered four perforations of the stomach—which were attributed to these larvæ—that led to a large diverticulum formed by the peritoneum, which was separated from the organ, and in which alimentary matters had accumulated.

The presence of larvæ of the G. hæmorrhoidalis and G. pecorum in the folds of the rectal mucous membrane, has sometimes occasioned troubles that have not always been without gravity.

Hertwig reports having observed a Horse which, in consequence of the presence of some thirty larvæ in the rectum and anus, made such violent efforts at defecation that there occurred an eversion of the rectum, which required a surgical operation to cure it. Bracy-Clark had already directed attention to the irritation produced by the larvæ arrested at the margin of the anus, which may result in a kind of temporary mania, or provoke symptoms that might lead to the belief that serious colic was present (Elettì).

Other observations might be cited, which place beyond doubt the sometimes fatal action of the larvæ of the Gastrophiles. And alongside these exceptional cases must be placed those in which there is merely derangement in digestion, a capricious, irregular appetite, emaciation, and symptoms of gastritis. This is particularly remarked

PARASITES OF THE GESOPHAGUS AND STOMACH.

in foals; and the observations of Lessona, Cambron and others, leave no doubt as to the fact. They show that, in many instances, obscure pathological conditions affecting the digestive apparatus should be ascribed to the presence of the larvae.

The lesions caused by the larvæ of the Gastrophilus equi—other than the perforations just discussed—are those of a gastritis, ordinarily very slight, and even inappreciable. What are constant, are the ulcerations involving the mucous membrane of the left sac, and distributed as are the larvæ themselves, of which they in reality indicate the points of fixation. They are in the form of circular sores, from 4 mm. to 5 mm. in diameter, rose-coloured in the centre, borders salient, and several of them sometimes running into each other. In a two-years-old colt, Lafosse found a larva lodged in the connective tissue beneath the parietal layer of the peritoneum. We need not now speak of those sometimes observed in the cranium, as they will be referred to when treating of the parasites of the brain.

The prophylaxis consists in preventing animals being reached by the winged Insect, by adopting the measures already indicated (p. 37), and more especially having them frequently and attentively groomed.

In the treatment, the object must be to kill the insects in the stomach, without injuring the health of the host. Lessona says he has obtained the greatest success with bryonia-root—15 to 25 grammes—powdered and given in half a pint of water. Cambron gives the preference to tar—in doses of 8 to 40 grammes—in an aromatic infusion; it may be useful to repeat it. Benzine may also be recommended.

But an easy cure must not be relied upon, as the majority of authorities confess to having failed in the employment of diverse parasiticides. From all the serious attempts made before him and by him, and numerous experiments—which consisted in plunging the larvæ in toxical fluids or in irrespirable gases—Numan arrived at the conclusion 'that agents endowed with great energy, and which arrive in the stomach without undergoing any modification, act upon that viscus, but scarcely produce any effect on the larvæ. No medication can therefore be recommended for their destruction or expulsion.' It is fortunate that their sojourn is only temporary, and that they are eliminated spontaneously when the summer returns. Therefore, as a cure should occur spontaneously, without any medication, there is no necessity to intervene unless the health is seriously compromised. Should this happen, then mucilaginous fluids may be given to allay the irritation in the stomach; a substantial alimentation ought also to be enjoined, to compensate for the loss of nutriment incurred by the presence of the 'bots.'


2 Lafosse. Traité de Pathologie Vétérinaire, III., 1867, p. 296.
It is, nevertheless, advantageous to remove by the hand the larvae of the \textit{G. \textit{haemorrhoidalis}} and \textit{G. \textit{pecorum}} which appear on the rectal mucous membrane and at the margin of the anus, and so relieve the Horse from an annoyance that is sometimes dangerous. It may also be advisable, in certain cases, to introduce the hand and arm into the rectum in order to ascertain whether any have arrived there, or to administer enemas of soapy water, a weak emulsion of petroleum or benzine, or a dilute solution of creosote. We have seen above, how the larvae fixed in the pharynx and larynx should be removed.

\textbf{Article II.—Parasites of the \textit{Oesophagus and Stomach of Ruminants.}}

There may be found in the \textit{oesophagus} and stomach of Ruminants numerous Infusoria, Trematodes, and Nematodes.\(^1\)

\textbf{Infusoria.}—The rumen and reticulum of Ruminants contain—suspended, and swimming in the midst of the semi-fluid mass of food—inferior vegetable or animal organisms. The first do not offer anything particular for comment, as they are found in all liquids in which vegetable matter is macerating, and the majority of them belong to the great group of Schizomycetes. The second are more special, by their forms and their localization. These are the \textit{Ciliated Infusoria} (see p. 4), of which Gruby and Delafond had already described four forms, and Colin has figured a great number; but the study of these was very incomplete until it was undertaken, successively, by Stein, Schuberg, Certes, and Fiorentini.\(^2\) They are divided between the \textit{Holotrichæ} and the \textit{Peritrichæ} (see p. 319).

Among the \textit{Holotrichous Infusoria} are the \textit{Isotrichæ} and \textit{Dystrichæ.}

The \textit{Isotrichæ} (Stein) have an oval body, covered with long and close-set cilia, the surface being traced with longitudinal striae that unite along a line passing from the mouth to the posterior extremity; there are several contractile vacuoles in the anterior region of the body; also a nucleus containing an adherent nucleolus, surrounded by a kind of capsule which is united to the external layer of the protoplasm—ectoplasm—by what Schuberg calls the ‘nuclear peduncles.’

Two species are met with in great quantity in the rumen of Ruminants: 1. \textit{Isotricha proemina} Stein, the mouth of which is situated at the anterior extremity, and somewhat towards the ventral surface; its length is 80 \(\mu\) to 160 \(\mu\), and breadth 53 \(\mu\) to 120 \(\mu\); 2. \textit{I. intestinalis}

\(^1\) The Sarcoспорidia of the \textit{oesophagus} will be spoken of when dealing with muscular p\textit{orospermosis.}

Stein, with its mouth farther removed from the anterior extremity, and situated in a keel-shaped depression on the ventral surface: length 97 μ to 131 μ, and width 68 μ to 87 μ.

The Dasytrichæ (Schub.) differs from the Isotrichæ by the striae on the surface running in a spiral manner, and joining each other at the anterior and posterior extremities; by the presence of a single contractile vacuole, situated near the pharynx; and by the absence of the peri-nuclear capsule and nuclear peduncles. A single species—D. ruminantium Schub.—measuring from 50 μ to 100 μ long, and 25 μ to 66 μ broad.

The Cologoidea are Holotrichæ which are often found in infusions of hay. List and Balbiani say they have seen them in the stomach of Ruminants; but Schuberg thinks this fact is at least doubtful, and is at most purely accidental.

The Peritrichous Infusoria existing in the stomach of Ruminants belong to the genera Butschlia, Ophryoscolex, Entodinion and Diplodinion.

The Butschlia (Büttschlia Schub.) have the body ovoid, truncated at the anterior extremity, and bearing close-set cilia only in front, but appearing to present other ciliary zones; a vesicle containing crystalline concretions; a large nucleus without a nucleolus; and no alimentary masses in the central protoplasm—endoplasm. There are three kinds, which are rarely found in the rumen of the Ox.

Butschlia parva Schub.—Body short and ovoid or nearly globular. Length, 30 μ to 53 μ; breadth, 26 μ to 38 μ.

B. neglecta Schub.—Differs more particularly from the preceding species by the presence of four deep notches at the posterior pole, and small transverse ciliary zones at various points on the surface. Length, 57 μ; breadth, 42 μ.

B. lanceolata Fior.—Body lanceolated, and showing at its anterior fifth a constriction in the form of a neck, surmounted by very fine cilia. Length, 48 μ; breadth, 20 μ.

The other three genera of Peritriches constitute the family of the Ophryoscolecidae, which is characterized by an ovoid or elongated body, a terminal mouth surrounded by spiral cilia, and the posterior extremity usually furnished with one or more styliiform appendages.

The Ophryoscolex (Stein) has the body squat, rigid, truncated in front, and rounded behind; the dorsal surface is convex, and the ventral surface traced by two granular striae limiting a narrow sole. At the anterior extremity is an undulatory organ in the form of a frill, with powerful cilia; at the posterior extremity—above two caudal stylets when they are present—is the anus. In front of the middle of the body is an equatorial girdle of thick cilia, interrupted at the ventral surface. There is a nucleus with a nucleolus, and some contractile vesicles. Two species, which are found more particularly in the rumen of the Sheep.

O. Purkynjei Stein.—Three whorls of stylets, curved at the posterior extremity.
O. inermis Stein.—No caudal stylets.

The Entodinions (Entodinium Stein) have the body ovoid, nude, flattened in the dorso-ventral sense, and truncated in front. The buccal opening is very large, and surrounded by a spiral of thick cilia descending into the pharynx. There is no equatorial girdle; but there is a nucleus with a nucleolus, and a contractile vesicle. Four species, found in small quantity in the rumen of the Ox and Sheep.

E. minimum Schub.—Elongated body, drawn to an obtuse point. Length, 38 μ; breadth, 23 μ.

E. Bursa Stein.—Somewhat broad body, rounded and notched at the posterior extremity. Length, 55 μ to 114 μ; breadth, 37 μ to 78 μ.

E. caudatum Stein.—Body ovoid, terminating in three prolongations, one of which is equal to the length of the body. Length, 53 μ; breadth, 26 μ.

E. rostratum Fior.—Diffs from the preceding by the presence of a single caudal prolongation in the form of a hook. Length, 60 μ; breadth, 24 μ.

The Diplodinions (Diplodinium Schub.) differ from the Entodinions by the presence of a posterior crown of cilia, more or less incomplete, an equatorial girdle resembling that of the Ophryoscolex. Several contractile vacuoles. Eight species, found in the rumen of the Ox.

D. vortex Fior.—The body is as if formed of two oblique trunks, joined at the equatorial girdle; a single spiral of cilia around the mouth; the posterior extremity divided into three superposed crowns imbedded in indentations, the inner crown much exceeding the others posteriorly. Length, 200 μ; breadth, 80 μ.

D. Maggii Fior.—Body cordiform, truncated in front, where it has two circles of cilia placed beside each other, the largest of which limits the peristome; an anal notch in front of the posterior summit; and an incomplete and inconstant anal girdle. Length, 180 μ; breadth, 120 μ.

D. Bursa Fior.—Body cordiform, flattened, the anterior extremity truncated, with a single coronet of cilia; posterior extremity bilobate; equatorial girdle very short. Length 100 μ; breadth, 60 μ.

D. mammosum Raill.—Diffs from the preceding chiefly by its posterior extremity, which is divided into three lobes. Length, 100 μ; breadth, 45 μ.

D. dentatum Stein.—Body truncated at both ends; the anterior end has two contiguous coronae of cilia, the posterior extremity having six curved denticulations. Same dimensions as the preceding.

D. caudatum Fior.—Body elongated; anterior extremity truncated, with a single coronet of cilia; the posterior extremity prolonged into a curved tail, at the base of which is the anal slit; equatorial girdle somewhat large. Length, 160 μ; breadth, 44 μ. Fiorentini names D. caudatum as a rarer form than this, from which it only differs by the absence of the tail, and of which it is doubtless only a transitory phase of development.

D. rostratum Fior.—Resembles the preceding species, differing from it chiefly by its relatively larger size. Length, 80 μ; breadth, 40 μ.

D. Cattanei Fior.—Body elongated, and especially characterized by...
its very spiral ciliary coronet, and the posterior extremity divided into fine caudiform prolongations, one of which is the longest. Length, 180 µ; breadth, 64 µ.

The very diverse Infusoria met with in the two first gastric compartments of Ruminants, only live a short time in their host, because of the chilling and the alterations taking place in their liquid medium. Fior-entini says they only appear after suckling, when the Ruminants are fed exclusively on vegetable matters. They are digested, and pass into the true stomach and intestines. Their number is so great that Gruby and Delafond estimated the total weight of those found in the first two compartments of the stomach of a Sheep at 600 to 1,000 grammes. They are certainly not parasites, but only commensals; and it is possible that they have a share in the digestive process of Ruminants, as Certes has noticed the presence of glycogen in the protoplasm of these animalcules.

**Trematodes.**—Two kinds of Amphistomes have been described (see p. 323) as living in the rumen of the domestic Ruminants. One is the *Amphistoma crumeniferum* (Creplin), found in the Zebu (*Bos Indicus*); the other is the *Amphistoma conicum* (Zeder), which lives in the Ox, Sheep, and Goat, and possesses some interest.

*Amphistoma conicum* is ovoid, thin in front, gradually thickening to the posterior part, which is obtuse and a little curved on the ventral surface. The colour of the body is rosy, irregular, and more or less dark. Length, 10 mm. to 13 mm.; breadth posteriorly, 2 mm. to 3 mm.

Daubenton was the first to find this worm in the rumen and reticulum of the Ox. It has since been met with in the Sheep (Treutler), Goat (Creplin), and a considerable number of wild Ruminants. It fixes itself—by means of its posterior sucker—between the papillae of the rumen, and more especially to the borders of the oesophageal furrow. It appears to be most frequently present in the month of April, and has been considered inoffensive; but Zürn states that a deadly disease of cattle has been attributed to it in Australia, though doubtless this is only a coincidence.

This parasite is very common in Egypt. To this species may belong the cercaria of the Amphistome found at Cairo, by Sonsino, on a Gasteropod (*Physa Alexandrina*). This is a cercaria which forms cysts and fixes itself everywhere—on aquatic plants, stones, shells of Molluscs, etc.\(^1\)


\(^2\) Sonsino. Archives Italiennes de Biologie, VI., 1884, p. 57.
NEMATODES.—Three Strongles and a Spiroptera (see p. 346) are, in different degrees, parasites of the stomach or esophagus of Ruminants.

**Strongylus contortus** (Rud.).—Body red or white—according as its intestine is full or empty of blood sucked from the mucous membrane—filiform or attenuated at the extremities. At a short distance from the anterior extremity are two small lateral papillae, in the form of teeth directed backwards. Integument finely striated transversely, and showing, besides, from 40 to 50 longitudinal ridges. Mouth nude. Male, 10 mm. to 20 mm. long; caudal pouch bilobate, each lobe being sustained by four ribs, the middle and anterior being doubled; the right lobe has an accessory lobe supported by the two posterior ribs, which are short and slightly divided at their extremity. Female, 20 mm. to 30 mm. long, the body terminating in a pointed tail; vulva situated towards the posterior fifth of the body, at the bottom of a depression surmounted by a powerful linguiform appendage directed backwards. Eggs ovoid, from 70 μ to 97 μ long, and 43 μ to 54 μ broad.¹

The *Strongylus contortus* lives in the abomasum of the Sheep, Goat, Argali, and Chamois. Railliet and Lucet have found it in the abomasum of a heifer, and ourselves in that of a Cow. It subsists on the blood it abstracts from the mucous membrane, and to this it owes its brown colour. Its name is justified by the arrangement of its ovarian tubes, which are rolled around the intestine to form regular loops, the white colour of which contrasts with the dark tint of the digestive tube.

According to the investigations of C. Baillet,² the *Strongylus contortus* is ovoviviparous, and the rhabditiform embryos it produces will not develop in pure water, but die in the course of a few weeks. Leuckart has seen them grow rapidly in muddy water, however, and after several moltings reach a state of development in which they were capable of being completely perfected in Ruminants. It is therefore probable, that Sheep are infested by drinking water soiled by the excrements of animals which are bearers of the Strongles.

This worm has only once been reported in France as a dangerous parasite;³ but in Germany, on the contrary, it has been considered by Gurlt, Gerlach, Röll, Zürm, etc., as causing an epizoötic disease—*Magenwurmsuche*—that often attacks more especially lambs and year-old Sheep, is often complicated with verminous bronchitis, and generally appears during the spring and summer, in certain countries with sandy soils where there is stagnant water. Similar observations have been made in England and Scotland.⁴ (In the United States of America it also causes serious damage, to lambs and yearling sheep more especially. Stiles mentions an epizoöty in Pennsylvania, in which the parasites were so numerous that they completely concealed the mucous membrane of the abomasum.—*Note in an inedited communication.)*

¹ Railliet. *Le Strongle Contourné.* Le Naturaliste, December 1, 1890.
³ Railliet. *L’Acclimatation,* 1887.
It is a kind of \textit{pernicious anæmia}, the symptoms of which are not very characteristic, and scarcely permit a precise diagnosis to be established; there are dulness, languor, inappetence, pica, intense thirst, emaciation, hydæmia, sub-acute colics, and black diarrhoea. The disease usually terminates in death. Wernicke indicates—as an \textit{ante mortem} sign—a peculiar alteration in the blood (\textit{poikilocytosis}), which shows, mixed with the red corpuscles, reddish-yellow, isolated cells, larger than the normal globules, of which some are spherical, and others foliaceous, seutilform, pyriform, or claviform.\

At the autopsy of animals which have been killed or have died, there are found in the abomasum hundreds, even thousands, of the \textit{Strongylus contortus} lying close together on the mucous membrane, which is paler than usual, and may be also somewhat thickened; though in some instances it may be sanguinoient, and show numerous ulcerations where the worms are yet attached. The abomasum is more or less dilated, and contains reddish matters, also tinted by effused blood.\

This 'strongylosis of the abomasum' is only serious because of its epizootic form, or if it is at an advanced stage, or the animals have not been submitted to suitable treatment.

Tonic and strengthening food is recommended. The medicines employed are Chabert's empyreumatic oil—a teaspoonful per head every day; or a mixture of equal parts of empyreumatic oil and oil of turpentine, diluted with treble its weight of brandy—the dose being two teaspoonfuls a day; or kamala—3 or 4 grammes per day, Zürn, after Rabe, prefers, as less irritant and as active for the patients, the picrate of potass given daily in doses of .15 to .30 gramme to lambs, and 1.25 grammes to adults; a cure is effected in about three days.

\textbf{Strongylus filicollis} (Rud).—This Strongle may be found in the abomasum of the Sheep and Goat, alone or in company with the preceding. It is capable of causing grave damage; but as it usually inhabits more particularly the small intestine, it will be noticed when speaking of the parasites of that organ.

\textbf{Strongylus convolutus} (Ostertag).—Body brownish-yellow—darker in the female—filiform, and attenuated at the extremities. Mouth nude; oesophagus separated from the intestine by a small bulb. The \textit{male} is 7 mm. to 9 mm. long, and has the caudal pouch bilobate, each lobe being sustained by four ribs, the middle and anterior of which are doubled; the posterior ribs are short, a little divided at their extremity, and fused at their base, and join the two lobes of the pouch. The \textit{female} is 10 mm. to 13 mm. long, and terminates in a short tail; the vulva is situated towards the posterior tenth of the body—that is, near the anus, and occupies the bottom of a depression above which is a kind of membranous bell.

This worm has been found by Ostertag\(^1\) in the abomasum of the Ox, and according to the incomplete description he has given of it, it appears to resemble greatly the \textit{St. contortus}, of which it is perhaps only a variety or special phase of development. Ostertag has met with it in variable quantity, in 90 per cent. of the cattle slaughtered in the Berlin abattoirs. It was only in limited number in animals in good condition, but was abundant in those which were emaciated or otherwise in a low state. It was lodged beneath the epithelium of the abomasum at very varied points, but never at the pylorus; and it occupied a small depressed nodule, the size of a pin’s head to that of a lentil—the smallest of the nodules being grayish, and the others surrounded by brownish-yellow areola. The centre of the nodule was pierced by a small punctiform orifice, and its cavity contained a Strongle rolled up on itself. Some time after slaughter, the worms left these nodules and many were found on the surface of the epithelium, a larger number projecting in various lengths from the orifices of the small tumours. (Stiles has found it in Cattle and \textit{Sheep} in America.)

This Strongle appears to be the cause of a pernicious anaemia, accompanied by catarrh of the abomasum, young animals being more particularly its victims.

The \textit{Spiroptera scutata} (Müller) is yellow; the mouth is round and nude; the cephalic extremity is truncated, and surrounded for the length of a millimetre by chitinous plates of various thicknesses, in the form of a shield. The \textit{male} is 4 cm. to 5 cm. long, has the tail rolled up, and is furnished with two wings and two spiculae. The \textit{female} is 8 cm. to 10 cm. long, and has the vulva situated in front of the anus; it is ovoviviparous.

This Spiroptera has been found by Müller, of Vienna, in the epithelium of the oesophagus—and more especially in its thoracic portion—in five Polish and Hungarian Oxen\(^2\); he described it under the name of \textit{Spiroptera scutata oesophagea bovis}. There were only a few in each Ox. Harms has seen the same worms in the oesophagus of Sheep; they were parallel to the longitudinal axis of the organ, and rolled up in a spiral manner, like the wool-fibre of merino Sheep. Zürn found them to be identical with the \textit{Sp. scutata} of the Ox.\(^3\) Müller has also observed them in the epithelium of the oesophagus of an old Horse. Lastly, Korzil has seen them in the mouth and pharynx of Pigs, as will be mentioned immediately. (Stiles has found them in abundance in American Cattle and Sheep.)

Curtice says he has found in the walls of the oesophagus of the Ox, larvae which he considers as those of the \textit{H. bovis} in the first stage (see p. 51).


ARTICLE III.—Parasites of the Stomach of the Pig.

Gruby and Delafond have found in the stomach of the Pig a flagellate infusorium belonging to the Order Euflagellata (see p. 318), which may be included with the Trichomonades (Trichomonas Donne). It is the Tr. suis Davaine. The authorities who have seen it, have described it as having an oval, depressed body, 20 μ long and 10 μ broad, with a flagellum (?) at one pole and a crown of cilia (?) at the other.

The other parasites met with in the stomach of the Pig are Nematodes.

1. Spiroptera strongylina (Rud.).—Body white, thin, and often curved in a semicircle. Head not distinct from the rest of the body. Mouth without lips and papillae, and continued by a pharynx. A very narrow lateral wing on one side. Male 10 mm. to 13 mm. long; tail furnished with two broad, unequal wings; six papillae on each side asymmetrically arranged, two of them being post-anal; spicule long and thin. Female 12 mm. to 20 mm., vulva situated immediately in front of the anus.

The Spiroptera strongylina—which appears to be rare—has been found in Germany in small sub-mucous tumours in the stomach. No trouble has been ascribed to it. It has been observed most frequently in the wild Boar.

2. Spiroptera scutata (Müller).—This worm is mentioned above as being found in the Horse, Ox, and Sheep. Korzil has also often seen it in the mouth and pharynx of the Pig, implanted in the epithelium, and more or less free on the surface of the mucous membrane. It does not seem to have produced any appreciable pathological effect.

3. Gnathostoma hispidum (Fedtsch.).—The anterior extremity is provided with twelve rows of chitinous plates, the summits of which are garnished with sharp hooks directed backwards. The male is 25 mm. long; its tail forms a kind of rounded pouch. The female measures 31 mm.; its body gradually tapers towards the end, where it terminates in a conical point (Railliet).

This Nematode was found by the Russian traveller, Fedtschenko, in the walls of the stomach of a Pig. Csokor has seen it in Vienna, where it is known to the pork-butchers as the tricoloured worm. It fixes itself in the mucous membrane by means of its hooks, and lives on the blood it extracts. The points it occupies are marked on the exterior of the stomach by distinct injection, involving the peritoneal serous membrane, and dark spots the size of a poppy-seed. Internally, the mucous membrane is inflamed, particularly at the fundus of the organ; while between the ruge more especially, it is mammillated, reddened and thickened, and there the worms are observed to be implanted in it by their cephalic extremity. The stomach is more or less distended and disturbed in its functions, and there is often marked cachexia.

4. Cobbold has described, as the type of a new genus, a singular parasite—the Simondsia paradoxa. The genus Simondsia (Cobbold) is, in fact, represented by endo-parasitic Nematodes, the females of

which have a very developed external uterus, from which spring several branches that end in a cul-de-sac. These females are encysted; the males are free.

The *Simondsia paradoxa* (Cobbold) has a cylindroid body, attenuated towards the anterior extremity, which has two narrow lateral wings. The mouth has two prominent papille. The male measures 12 mm., it has a spiral tail, and two long, thin spicule. The female is 15 mm. long, and towards the posterior part of the body has a considerably-developed, rosette-shaped organ, formed by the everted uterus; the tail is twice as thick as the body, is conical, and has three spinules along the base, immediately above the anus. It is probable that the vulva opens at the base of the rosette.

This remarkable parasite was discovered in March, 1852, by Professor Simonds, in the walls of the stomach of a German Pig belonging to the Zoological Society of London. The males were free, and the females were enclosed in small tumours or cysts, from which they protruded their head by a narrow opening in the cavity of the stomach. In the first description Cobbold gave of this worm, he mistook its head for its tail (Raillet).

![Figure 141: Simondsia paradoxa, after Cobbold](image)

**Figure 141: Simondsia paradoxa, after Cobbold.**

A, female extracted from its cyst, magnified five diameters; a, cephalic extremity; b b, lateral wings; c, posterior end of the oesophagus; d d, intestine; e e e, ceca of the uterine rosette; f, tail. B, male, magnified five diameters; a, cephalic extremity; f, caudal extremity. C, group of ova extracted from the uterine cornua; magnified 250 diameters.

**ARTICLE IV.—Parasites of the Oesophagus and Stomach of the Dog.**

Independently of the two forms of Infusoria found by Gruby and Delafond in the stomach of the Dog, the parasite most frequently found there is the *Spiroptera sanguinolenta*. We have also on two occasions seen the larvae of the Gastrophilus of the Horse in it, and also wandering Ascarides from the intestine. *Taenia* may likewise find their way into the stomach, and Wolpert has even found them in the oesophagus.¹

**Infusoria.**—One has a pyriform body terminated by a flagellum; the upper surface of the cell is convex, the lower flattened; movements very active; length 10 μ, breadth 20 μ; it may be included (?) in the genus *Monocercomonas* (*Euflagellata*), by the name of *Mon. canis*

Davaine. The other species is filiform, and is slow in movement; length, 10 \( \mu \); it appears to belong to the vegetable kingdom (Bacteriacea) rather than to the Infusoria. These two forms extend into the duodenum and the first moiety of the small intestine. They are independent of the state of health.

**Spiroptera sanguinolenta** (Rud.).—This Nematode is readily recognised by its blood-red colour. The *male* is from 3 cm. to 5 cm. long, the tail spiral and provided with two lateral wings, each of these being sustained by six papille, of which two are post-anal; two unequal spicule. The *female* is 6 cm. to 8 cm. long; the tail is slightly curved, and the vulva is 4 mm. or 5 mm. behind the mouth.

This worm has been met with in the Wolf and Fox, and more particularly in the Dog. It is sometimes found in the aorta, lungs, and lymphatic glands; but it is lodged almost exclusively in tumours in the stomach and oesophagus. These tumours are never numerous, being only one, two, or three; their volume varies in size from that of a hazel-nut to a pigeon's egg; their shape being ovoid and their consistence hard. The mucous membrane covering them offers no other alteration than a regular circular opening on their summit, but which may—in very exceptional instances—be absent. They are limited, outwardly, by the muscular coat of the oesophagus and stomach, and are composed of indurated tissue chambered into cavities, in which the rolled-up worms are imbedded in a purulent fluid that pressure causes to issue from the opening, and which also follows extrusion of the Spiroptera. This orifice is in communication with all the cavities

![Fig. 142.—Spiroptera sanguinolenta.](image)

A, male and female, natural size; B, cephalic extremity, showing the interior of the buccal capsule, magnified fifty diameters; C, caudal extremity of the male, lateral view; magnified twenty-five diameters.—Railliet.
in the tumour. The number of worms in each tumour is very variable, generally from 2 to 20.

Silva Aranjo has found five Spiroptera sanguinolenta free in the oesophageal cavity of a Dog.¹

Morgagni and Ercolani have imagined that the Spiropteres—being introduced into the stomach in the larval condition—perforate the mucous membrane and develop in the submucous connective tissue. Davaine² is of the contrary opinion, and thinks that—owing to their tenuity in the first stage—they find their way into the duct of an oesophageal or gastric gland, causing its dilatation and inflammation, and ultimate conversion into a verminous tumour. He bases his opinion on the form of the opening, which does not appear to be eroded or ulcerated. In the larger proportion of cases, the duct of the gland remains permeable; but in others it becomes obliterated, perhaps by the compression of the tumour itself upon it, even when it is permeable; so that there goes on a transformation analogous to that so frequently observed in the sebaceous follicles, in the glands of the lips, etc. But the histological study of these tumours can alone solve this undecided question.

The Spiroptera sanguinolenta—which is common in China and Brazil—appears to be more frequent in Italy than in France, where it is somewhat exceptional. We need only refer to its most characteristic symptoms. According to Manson, its presence in the oesophagus is manifested by repeated vomittings, which may terminate in death from inanition; the tumours may open into the peritoneum, and—as a consequence of their rupture—occasion a fatal pleurisy. Littlewood has also remarked frequent vomiting in a Dog, the stomach of which con-

tained numerous nests of Spiropteres. The Spiropteres of the stomach have been sometimes considered as the cause of a voracious appetite with which several of the animals attacked appeared to be affected. A relatively large proportion of the observations with regard to this parasite have been of Dogs dead from rabies; but this may be explained by the circumstance that the autopsy of rabid Dogs demands a careful examination of their stomach. And it may also be the case that this Nematode at times induces rabiform symptoms, which have led to mistakes, and caused Dogs presenting them to be sacrificed as rabid.

The recent investigations by Grassi have made known the evolutive cycle of the Spiroptera sanguinolenta. This worm has for its intermediate host the Eastern Cockroach (Periplaneta orientalis Linn.), one of the insects commonly known in France as Cafard and Canerelat (American Cockroach). In the abdominal cavity of this creature, Grassi, at Catania, has often found relatively large cysts containing young Nematodes, the colour of which resembled that of the Spiroptera in question; and Dogs to which he had administered a large quantity of these cysts have—at their autopsies—shown young Spiropteres which, at the end of fifteen days, had already imbedded themselves in the oesophageal mucus membrane. It is probable that this Cockroach finds its parasites in the excrements of Dogs which are bearers of the Spiropteres, and that the Dogs in their turn are infested in eating these Insects; for Grassi affirms that many Dogs like chasing Cockroaches.

Seeing the relative rarity of the helminthiasis caused by the Spiropteres, and the absence of precise symptoms indicative of its existence, nothing can be said with regard to the treatment of the affection.

Larvae of the Oestræae.—Larvae of the Gastrophilus equi have been found in the stomach of carnivorous animals, such as the striped Hyæna and the Badger. G. Colin has met with one once in a four or five months old Newfoundland Dog, pupped at the beginning of winter, and on which no Oestrus could have deposited its eggs. But as it had been fed upon the débris of Horses, a larva, no doubt, had been swallowed with that food, and had been arrested in the stomach, where it had hooked itself on to the mucus membrane, in which it had made a depression to lodge the posterior extremity (sic) of its body. Schliepe, at the autopsy of a rabid Dog, found in the cardiac diverticulum of the stomach three larve of the Oestrus equi firmly implanted in the mucus membrane, and as well developed as those found at this time, December, in the stomach of the Horse.'

1 Littlewood. The Veterinarian, February, 1890.
Article V.—Parasites of the Stomach of the Cat.

Ascarides and Tæniae may be found in the stomach of the Cat, and particularly the Tænia crassicollis; but the only parasite proper to that organ is a Nematode of the family of Strongylides—the three-pointed Ollulan (Ollulanus tricuspis Leuckart). To Leuckart we owe its discovery and description.¹

The genus Ollulanus is characterized by the presence of an urn-shaped buccal capsule, a slightly muscular oesophagus, and—with the males—a caudal bilobate pouch, containing two short spiculae. In the Ollulanus tricuspis, the adult female measures at most 1 mm. long, and has three points at the caudal extremity.

In the adult state, the worm resides in the substance of the gastric mucous membrane of the Cat, where it is often found in such quantity that this membrane is softened, reddened, and ecchymosed. The female is ovoviviparous. The embryos are of colossal dimensions, compared with those of the parent—measuring, in fact, 320 μ long, and 15 μ broad; the body of the female can scarcely contain more than three of them. Nevertheless, they are found in great quantities, not only in the stomach, but also in the intestine as far as the large colon, whence they soon wander—like the Trichinæ—to various parts of the body of their host—invading more particularly the pleura, diaphragm, liver and lungs, where they form cysts measuring 15 mm. to 20 mm., in each of which are found one or several embryos rolled up on themselves. The wall of the cysts is very thick, and their cavity relatively restricted. In the lung they simulate miliary tubercles, each being surrounded by a zone of hepatization; and the inflammatory process may be so extensive as to cause the death of the animal. In serious cases, the embryos are met with in the more or less sanguinolent bronchial mucus.

The embryos of the Ollulanus tricuspis cannot continue their course of development in the Cat. The majority of them are expelled along with the faeces, or, exceptionally, with the bronchial mucus. They may then be ingested by the smaller Rodents, and—as Leuckart has experimentally demonstrated—they pass from the intestine of these into the muscles, where they become encysted, after the manner of the Trichinæ. There their development becomes more advanced than it can be in the pulmonary or other cysts in the Cat; but it is probable that it is completed in the digestive canal of the Cat that feeds upon infested Rodents. Nevertheless, Leuckart, having fed a Cat with mice experimentally infested, on killing it eight days afterwards, found the worms—not in the stomach, but in the oesæum and large intestine, and they had undergone no change. So that uncertainty still prevails with respect to the evolution of the Ollulan. We think it should be mentioned that in our numerous autopsies of Cats, we have never met with this parasite.

Lutz² says that, in Brazil, he saw in the stomach of a Cat a great number of worms—male and female—which he believed belonged to

¹ R. Leuckart. Die Menschlichen Parasiten, II., Leipzig, 1876, pp. 102, 106.
the genus *Physaloptera*, of which we shall speak hereafter when dealing with the Brazilian species found in the stomach of the Fowl. These Physalopteres are very closely related to the *Ph. digitata* Schneider, that lives in the stomach of the Cougar or Puma (*Felis concolor*).

It is possible that these worms were only Physalopteres of the Fowl which had been ingested with the entrails of that Bird. We have found in the intestines of a Cat, intact *Heterakis papillosa*, which had evidently been derived from this source.

**Article VI.—Parasites of the Stomach of the Rabbit.**

The **Striped Strongle** (*Strongylus strigosus* Dujardin) chiefly infests warren Rabbits, being found in the caecum and colon. Railliet¹ has found it in thousands in the stomach of these animals, in which it gives rise to a fatal anæmia, by abstracting blood from the gastric mucous membrane. The same worm has been found by Railliet, in small numbers, in the stomach of domesticated Rabbits at Alfort; and Perroncito has made a similar observation at Turin. But up to the present time, a real pathogenic action in domesticated Rabbits has not been attributed to this Strongle.

It is recognised by the following characters:

Body blood-red, filiform, cuticle striated transversely, and having about 50 longitudinal lines. *Male*, 8 mm. to 16 mm. in length, and provided with two long spiculae with a brush-like termination; a campaniform caudal pouch, deeply excised in front, slightly bilobate behind, its posterior ribs fused into one for the greater portion of their length, and divided into two branches at their posterior extremity; the posterior, external, and anterior are single; the middle and anterior are double. *Female*, 11 mm. to 20 mm. long; vulva distant from the caudal extremity 2·14 mm. to 3·28 mm.

Moniez has found beneath the gastric mucous membrane of the Rabbit and Hare, a particular Spiroptera which he has named the *Spiroptera leporum*.²

Article VII.—Parasites of the Æsophagus and Stomach of Birds.

When we treated of diphtheria (p. 341), mention was made of the Flagellata seen by Rivolta and Pfeiffer in the mouth, pharynx, and other parts of the digestive canal; so that we have now only to consider the Helminths that may be found in the Æsophagus and stomach of domesticated Birds.

The Fowl, Goose, Duck and Swan are the only ones that harbour Helminths in the pre-intestinal portion of that canal. With the exception of one species of Trematode found in the Fowl, these are all Nematodes belonging to seven different genera. Two—Strongyulus Müller, and Physaloptera Rud.—belong to the family of Strongylidæ; one—Trichosoma Rud.—belongs to the Trichotarachelidæ; and the other four—Spiroptera Rud., Dispharagus Duj., Hystriehis Duj., and Tropisurus Dies.—belong to the Filariæ (see pp. 326, 346).

Fowl.—In the Æsophagus of a Fowl, Von Linstow found five specimens of a Trematode, which he named Distoma pellucidum, and which—because of the situation, altogether in front of the genital openings—should be included in the genus Mesogonimus—Mes. pellucidus. It is transparent, reddish, foliaceous, attenuated in front, has two large and equal-sized suckers, is covered with spines on its posterior moiety, and measures 9 mm. long, 5 mm. broad. 1

Another parasite of the Æsophagus is the Dispharagus spiralis (Molin) 2—a name given to the genus by Dujardin, because its Æsophagus is formed of two distinct portions, and, besides, succeeds a cylindrical ventriculus. The spiral Dispharagus has three papillae around the mouth; and the anterior part of the body has a flexuous cord on each side. The male has a spiral tail with wings, a single spicule, and is 7 mm. long. The female is 9 mm. long.

These are probably embryos of the species that Rivolta and Delprato 3 described by the name of Trichina papillosa. They found them in the fowl, encysted in the connective tissue around the Æsophagus, crop, and proventriculus, as well as in the wall of the intestine, and in the mesentery near its visceral insertion. To the same species may also belong the worms previously found in nodules in the wall of the Fowl’s gizzard, and which were considered as belonging to the genus Spiroptera (p. 346).

Another species of Dispharagus—D. nasutus Rud., Filaria nasuta Rud.—has been found in the wall of the Fowl’s and Sparrow’s gizzard. The male was closely rolled up in a spiral manner, and measured 5 mm. long; the female was from 5 mm. to 7 mm. long. It received the name of nasutus, from the two long terminal papillæ on each side of the mouth, from which start two double, flexuous folds of integument that pass to a distance 6 mm., then curve forward without joining.

2 Zürn (Die Krankheiten des Hausgeltürgels, p. 43) indicates as having been found by Molin, beneath the Æsophageal epithelium of the Fowl, the Trichosoma annulatum, which will be described hereafter, among the parasites of the intestine.
Legros\(^1\) has reported an epizooty due to this species, among the poultry in a yard where several breeds of Fowls were kept, and of which the Crèvecœur breed suffered most severely. The Birds became emaciated, were dejected, and died exhausted without having lost their appetite; on the contrary, during their last days they were unusually voracious. The gizzards was studded with the *Dispharagus nasutus*—some being entirely hidden in the substance of the mucous membrane, and others fixed in it by one extremity, the other floating freely in the cavity of the organ. They were packed so close together in certain places, that they formed a kind of tissue.

The *Spiroptera hamulosa* Dies. was discovered by Natterer in small tumours on the surface of the gizzard of a Brazilian Fowl. The *male* is 10 mm. to 12 mm. long; the *female*, 24 mm. to 26 mm.

The genus *Physalopterus* is characterized by its mouth, which has two greatly developed lips, each provided with three papillæ externally, and having teeth internally at the extremity. The caudal pouch of the male is closed, and embraces the base of the tail. The female is oviparous. The truncated *Physalopterus* (*Phys. truncata* Schn.) measures, for the *male*, 25 mm., and for the *female* 33 mm. long. It has also been found in Brazil, in the proventriculus of the Fowl.

Bakody\(^2\) believed he had found Trichinæ encysted in the walls of the ventriculus and intestine of Fowls which had succumbed to a small outbreak of disease. But, as Leuckart has observed, they were evidently not Trichine, but the larvae of some Filaria capable of encystment, which is not rare in various species of animals.

**Duck.**—Railliet and Lucet have attributed to a Nematode—the *Trichosoma contortum*—a most serious disease affecting a lot of young Ducks of Pekin breed.\(^3\)

The *Trichosomes* (*Trichosoma Rud.*) belong to the family of Trichotelides. The body is filiform, very attenuated in its anterior part, moderately and progressively expanded in its posterior part. The *male* has the caudal extremity rolled up, and terminated by a small caudal copulatory pouch that forms around the genital orifice a kind of ring; the sheath of the spicula is transversely striated or ridged. This genus has its chief representatives in Birds.

The *Trichosoma contortum* (*Creplin*) is slightly attenuated near the posterior extremity. The anterior has a terminal projection like a button. The *male* is 12 mm. to 17 mm. long, and 7 \(\mu\) to 9 \(\mu\) broad near the head, and 75 \(\mu\) to 80 \(\mu\) in the posterior region; it has a very fine spicula, the sheath of which is covered with very small spines directed forwards. The *female* is 31 mm. to 38 mm. long, and 9 \(\mu\) or 10 \(\mu\) broad at the head, 120 \(\mu\) to 150 \(\mu\) behind; it has the vulva opening about the anterior sixth of the body. Ova from 48 \(\mu\) to 56 \(\mu\) long, and 21 \(\mu\) to 24 \(\mu\) broad.

This Nematode has been found in various kinds of Passeres, Grallatrices, Palmipedes, and Raptatores. According to the observations of Railliet and Lucet, it causes in Pekin Ducks an engorgement—by food

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—of the cervical dilatation of the œsophagus, altogether analogous to dilatation of the crop in the Gallinæ and Pigeons. This *ingluvial indigestion*—so named by Dupont of Plazac—has been attributed to various causes—such as the food being too dry, too abundant, swallowed too hurriedly, or undigested. But the above authorities have shown that perhaps the chief factor is parasitism by the *Trichosoma contortum*; for at the autopsy of Birds that have died from this affection, they have only found alterations in the œsophagus, which was enormously distended in its cervical portion, and full of food; while its walls were extremely thin and very congested. To the naked eye, or through the hand-lens, the mucous membrane at that part shows white or light-yellow lines, sometimes slightly in relief. The microscope proves that these streaks are submucous galleries partly occupied by the Trichosomes, which have formed them in their movements and turnings around the œsophageal glands. The majority of the galleries contain the ova of the parasite. One œsophagus may contain more than thirty worms.

These Nematodes act, no doubt, mechanically in causing obstruction of the œsophagus, that first leads to its inertia, then its engorgement and extreme dilatation, that causes pressure on the pneumatic nerve, producing the phenomena of asphyxia.

The symptoms of this affection consist at first in an arrest of growth, and emaciation and weakness, with sometimes epileptiform crises. In about five to ten days engorgement of the œsophagus commences, and it rapidly increases until death ensues in one or two days.

The conditions prevailing at the appearance of this affection are not known. It is only recognised that youth and breed predispose to it; for ordinary young Ducks reared in the same conditions as those of the Pekin breed, pay but an insignificant tribute to this ingluvial indigestion. From what is known of the evolution of the Trichocephales and hepatic Trichosomes of the Muridae (Railliet), it is probable that the Trichosoma contortum has a direct development. Otherwise, its sub-mucous sojourn—notwithstanding its frequency—is, doubtless, only accidental; for in the other Birds in which it has been observed, it is nearly always found free in the œsophagus.

With regard to treatment, all that can be advised is the employment of anthelmintics best suited for destroying entozoa in the intestinal canal.

The *hooked Spiroptera* (*Spiroptera uncinata* Rud.) is another parasite of the Duck's œsophagus, where it has been found by Zürn.1 The mouth is furnished with six papillæ and two teeth; the latter arise from a flexuous cord that descends to 2 mm. from the anterior extremity. On each side of the body is a double longitudinal series of small spines, with their points inclining backwards—a series that extends to nearly the caudal extremity. In front, the two series are

on the dorsal surface, between the two cords, and approach the mouth. The male is 9 mm. long, has eight papillæ on each side—four of which are post-anal—a salient caudal pouch on each side, and a long and thin spicula. The female measures 15 mm.; the vulva is 1 mm. from the caudal point. Zürn has met with these worms in large numbers in the œsophagus, the crop, and the small intestine of Ducks that had died somewhat suddenly. They had produced a severe inflammation of these parts. The precursory symptoms of death had nothing characteristic—dulness, upright feathers, dysphagia and a great appetite, were nearly all the signs that were observed.

The genus Tropisurus (Dies.) is represented by two species in the domesticated Duck. It is remarkable for sexual dimorphism. The female has a thick ovoid body; the male is filiform, and 15 to 18 times longer than it is broad, with its tail careened downwards (τρόπις, keel). The species found in the tame Duck are the Tropisurus inflatus Mehlis, and the Tr. fissispinus Dies. They inhabit sub-mucous cysts in the succentric ventricle and the œsophagus, and sometimes set up a fatal inflammation of these parts (Zürn).

The genus Hystrichis (Duj.) is composed of filiform worms, the anterior portion of their body being studded with prickles (τρόπτης, a whip armed with thorns). They are lodged between the mucous and the muscular coats of the digestive canal of Birds. Two species are sometimes found in the tame Duck: 1. Hystrichis tricolor, Duj.—so named because the female, which is 27 mm. long, is white externally, black in the centre or intestine, and bright-red in the intermediate layer and the whole of the œsophageal region. It has been found in the succentric ventricle of the tame Duck, and so firmly implanted in the mucous membrane that it has been found very difficult to remove it therefrom without breaking it. 2. H. tubifex Nitzsch, found at Geneva by Jurin, in nodules from the œsophagus of the tame Duck. Body white, thick, filiform, and 9 cm. long.

Goose.—The Spiroptera uncinata, which Zürn found in the Duck, has been met with several times in the domesticated Goose, in nodules in the œsophageal mucous membrane.

The Strongylus nodularis (Rud.) is sometimes found in the tame Goose, in the substance of the mucous and muscular coats of the succentric ventricle and duodenum. It is attenuated in front; the mouth has, laterally, two vesiculous wings in the form of nodules, and at the posterior part the pharyngeal bulb carries three teeth which can be projected externally. The male is 10 mm. to 12 mm. long, and has a caudal pouch with radiating sides. The female is 10 mm. to 18 mm. long, and has the vulva situated 1·5 mm. from the caudal point.

Swan.—In the succentric ventricle of the Cygnus olor—domesticated or wild—there has been found on several occasions a kind of Hystrichis—the H. puckyocephalus Molin—implanted in nodules in the mucous membrane.
CHAPTER III.

PARASITES OF THE INTESTINES.

Of the several portions of the digestive canal, the intestines are those in which nearly the greatest number of parasites are found. Their rapid passage into the mouth, pharynx and oesophagus scarcely allow them time to fix themselves there; besides, in these three cavities they do not find the abundant liquid medium the intestines afford them, and in them they would be continually disturbed by their energetic contractions. The stomach is scarcely more favourable for their lodgment, as the acidity of the gastric juice drives them out of it, those which remain being generally refugees beneath the mucous membrane. By their alimentary contents, their extent, and the slowness and smoothness of their movements, the intestines are the most suitable for the development and sojourn of the numerous parasites, the germs of which are carried therein by the food and water. The majority of these parasites infest the small intestines, others the cecum, the minority the colon; and each species has generally its particular sojourn, and its exclusive location in the same compartment.

With the exception of some inferior Fungi, the parasites of the intestines belong to the animal kingdom. They are the Coccidia, Infusoria, Flagellata or Ciliata, Cestodes, Trematodes, Acanthocephales, and Nematodes. The other groups have been already sufficiently studied (p. 318), so that it is needless to refer to them again in this place.

Cestodes.—The Cestodes (see p. 5), or Tape-worms, are Plathelminths, the body of which is in the form of a narrow band divided into more or less distinct segments. One of the extremities—termed the head, and generally expanded—has a fixation apparatus formed of suckers, and also frequently of hooks. The head is often succeeded by a thin, non-annulated constriction, named the neck. The mass of the body is constituted by a connective network of cells, with anastomosing prolongations. From these cells all the organs are derived; they may be covered with carbonate of lime, and form calcareous concretions, which are frequently present in the body of these worms. The integument comprises—from without to within—an apparently homogeneous
cuticle, lying on a sub-cuticular layer formed of large contractile cells, beneath which is found the muscular layer; this layer is double, the superficial portion being composed of longitudinal, and the deep of transverse, fibres.

The nervous system consists of two longitudinal cords united by a transverse commissure at the head. There is no digestive apparatus, the nutritive materials in the intestinal canal of the host of the Cestode passing into its body by fine canaliculi that traverse the cuticle. Nor are there circulatory or respiratory apparatuses—the integuments serving for the exchange of gases. The excretory apparatus is represented by what are termed (erroneously) aquiferous vessels—longitudinal canals, generally four in number, two on each side—a dorsal and a ventral—which intercommunicate by transversal anastomoses. They open on the posterior surface of the body by an orifice—the caudal foramen—which is formed in the last segment, after shedding of the one behind it.

Each segment is hermaphrodite; but the male organs appear before the female ones—the younger rings or segments, situated near the head, being at first exclusively masculine. The male apparatus is formed of numerous testicular, pyriform vesicles situated at the extremity of the deferent canals, which open into a common excretory canal—the spermiduct. The sinuous extremity of the latter ends in a muscular pouch—the cirrhus-pouch, that opens at the summit of a more or less salient mamelon, situated on the lateral border or the ventral surface of the segment, and which is named the genital pore. The extremity of the spermiduct may, on becoming everted, protrude beyond the sexual orifice to constitute a copulatory organ—the cirrus or penis.

The female apparatus comprises one or more ovaries. The ova—gathered together in a pavilion—pass into the oviduct, and thence into the uterus, which is an irregular tube that becomes distended by the accumulation of ova, and develops into numerous lateral cæca in gradually effacing the other organs; sometimes the distended walls rupture, and the ova are then dispersed in the central zone. The integuments of the segment may even give way under the internal pressure, and the ova escape externally. In the Bothriocephales, the uterus has a natural opening on the external surface. The vulva—situated near the male orifice—is continued by a vagina that terminates in the oviduct, near its origin, to convey the spermatozoa that the

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**Fig. 145.**—Diagram of the structure of a Cestode segment.—After Van Beneden.

tt, testicles; sp, vas deferens or spermiduct; pp, sac of the cirrhus or penial pouch; p, cirrhus or penis; ov, germigen or ovary; do, germiduct or oviduct; vt, vitelloduct; vv, uterus, showing the mode of formation of the lateral cæca; rs, seminal reservoirs; vv, vagina; vu, vulva; v, excretory vessels; c, integumentary envelope.
cirrhus throws into it. In one part of its course, the vagina has often a dilatation that serves to retain the semen; this is the seminal receptacle. There is also, besides, a vitellogen (yolk-glands)—a mass of glands that secrete the vitellus, which is conveyed into the oviduct by a vitelloduct.

When the ova are laid, they usually contain an embryo provided with hooks, generally six in number—hexacanthus embryo. This embryo does not become an adult Cestode until after a series of migrations. It exists in a larval, agamous form, in the tissues of a transitory host; then, with it, it passes into the intestine of a second animal, in which it fixes itself and acquires—along with the sexual organs—its adult form.

Of the small number of families in the Cestodes, only two furnish parasites to Mammalia and Birds. These are the Taenidiae and Bothriocephalida.

1. Taenidae.—The family of Taenidae is almost reduced to the genus Taenia Linn., which comprises more than four hundred species.

The Taenid—typical of the Tapeworms—are characterized by their head, which is always furnished with four suckers (oscula suctoria)—the structure of which is analogous to those of the Trematodes (see p. 319)—between which is sometimes found a more or less marked depression, at other times a prominence named the proboscis or rostellum, which may or may not be contractile, nude, or armed with hooks. Besides, the segments or joints have nearly always their genital openings on their margin.
The phases of development are known for only a small number of species, which undergo a series of complex metamorphoses. At its exit from the ovum into a suitable medium, the embryo—always provided with six hooks (hexacanthus)—receives the name of proscoclex or proscolcx. It is at first a larva, which penetrates the organism of a primary host—a vertebrate or invertebrate; there it loses its hooks, often becomes enveloped in a cyst produced in the body of the host, and is transformed into a vesicle—caudal vesicle (or bladder)—which has fluid contents and a contractile wall (Cystis). This Cystis develops by budding, at one or more points, a second larval form—dento-scoles, scolex—which has the same conformation as the anterior extremity of the Tænia, except that the head is invaginated. The tissues which contain it being introduced into the digestive canal of a suitable host—a Vertebrate—the scolex separates from the vesicle, the head is evaginated and becomes fixed on the intestinal mucous membrane, and by proliferation produces a linear series of rings (segments or joints)—thus constituting a Tænia. In the adopted nomenclature, the chain takes the name of strobila, and the sexually mature segments that of proglottis—previously designated cucurbitans.

The numerous species of Tæniae are distinguished from each other by their dimensions, the form of their segments, the arrangement of the genital organs, and the presence or absence of the cephalic armature. The number, size, shape, and arrangement of the hooks are very important characters, but they are, nevertheless, liable to limited variation in each species. A useful distinction, from a practical point of view, is that of dividing the Tænia into armed and unarmed—according as the head has hooks or no hooks; though this distinction is not really scientific, and does not take into account the true affinities indicated by the mode of development, on which alone the classification should rest. Unfortunately, only a very small number of species are so identified, and the classification of these has been established principally by the researches of Abilgaard, Von Siebold, Van Beneden, Küchenmeister, Haubner, Baillet, Redon, Moniez, Villot, etc.

We shall have occasion to refer to several in detail, in dealing with some of those which are parasitic in the domesticated Mammalia. For the present, we will give a summary description of the classification of the Tæniae of the domesticated animals, such as has been made by Railliet, according to the memoirs of Villot.¹

The Tæniae referred to are divided into three groups: Cystotænians, Cystoidotænians, and Anoplotænians.

A. Cystotænians (Cystotænia).—'They are characterized by Cysticeri, which have the caudal vesicle proceeding from the proscolex by simple increase and modification of structure, without the production—properly speaking—of a new part' (Villot).

The head is nearly always armed with hooks like small daggers, arranged in a double crown, and the genital pores of the strobila—single in each segment—are irregularly alternate. Their Cystici form

three secondary groups, Cysticerci, Cœnuri, and Edinococi, which are found in the tissues or closed cavities of the Herbivora, Omnivora, and exceptionally in the Carnivora; while the strobiles live in the digestive canal of the latter. The Cystici are always enveloped in a cystic membrane, furnished by the organism of their host.

The Cysticerci (Cysticercus Zed.) are monosomatic and monocephalic Cystici—that is, their caudal vesicle gives rise to a single body having only one head.

The Cœnuri (Cœnurus Rud.) are polysomatic and monocephalic Cystici, their caudal vesicle giving origin to multiple bodies, each of which only possesses a single head (Fig. 149).

The Echinococi (Echinococcus Rud.) are polysomatic and polycephalic Cystici; their highly cuticularized caudal vesicle produces numerous bodies (proligerous vesicles), each of which bears several heads.

The diverse forms of Cystici will be specially studied with regard to the organs in which they are found. The strobile derived from them are the cause of intestinal helminthiasis in the domesticated Carnivora.

B. Cystoidotaenians.—The Cystoidotaenians (Cystoidotaenia) have Cystici, the caudal vesicle of which is formed by budding of the proscolex—that is, by the addition of a new part' (Villot).

The Cystici of Tænia of this group have—like those of the preceding group—a caudal vesicle, a body, and a head; but they also have a fourth part which Villot names a blastogene. The head, in itself, represents the future scolex. The body and caudal vesicle are the parts proper to the Cystici. With regard to the blastogene, it represents the proscolex, which here preserves its autonomy and all its embryonic characteristics. The caudal vesicle is very small, and does not contain any fluid; hence the name of Cysticercoïdes given by Leuckart to this group of Cystici. They are all parasites of Invertebrata, and are lodged in the tissues or cavities in the body of their host; they are not surrounded by a cyst, like the preceding group.

Villot divides this group into two sections, according as the formation of the caudal vesicle takes place by endogenous or exogenous budding. The second section alone contains a cystic form related to the parasitic Tæniae of Mammalia. This form is that of the Cryptocystes (Cryptocystis Villot), which are distinct from the other Cysticercoïdes by their relative simplicity of organization, by their separation from the blastogene as soon as they arrive at maturity, and by the fact that they are not proliferous. The only representative of this genus is the cystic form of an armed Tænia of the Dog, Tænia canina or T. cuenmerina.

C. Anoplotænia. — The Anoplotænia (Anoplotænia) are true unwormed Tænia, the evolution of which is absolutely unknown; their head has neither rostellum nor hooks, the segments are much wider than they are long, and the embryos are surrounded by a pyriform apparatus (Railliet).

All the Tæniae of this very artificial group belong to the Herbivora, and their history—still very incomplete—scarcely embraces more than generalities. The majority are Diplidians (Diphyllidia); that is, those
which have two genital pores on each border of each segment. The pyriform apparatus surrounding the embryo—and which is given as a characteristic of the group—has not been seen in all the forms enumerated. Nothing is known as to their migrations.

Lastly, an unarmed Tænia is found in the Dog—T. litterata—which, in all its characters, is absolutely outside the preceding groups, and remains isolated in a crowd of numerous species of Tænia.

With regard to the Tæniae of Birds, their diversity, and the ignorance that exists as to their migrations, permits their being assigned to a distinct group to which the preceding taxonomic considerations do not apply.

2. Bothriocephalides.—This family has for its type the genus Bothriocephalus (Brems). They are Tape-worms, the head of which

![Diagram](image)

Fig. 149.—Diagrammatic section of the Coenurus.—Railliet.

a, scolex in its normal arrangement; b, c, d, e, increasingly diagrammatic, in order to show the conformity of the Coenuri and Cysticerci.

is destitute of hooks, and provided with only two suckers in the form of elongated slits (bothria, or 'suctorial grooves'). The genital orifices are situated on the ventral surface of the segments. The majority of the numerous species of Bothriocephales live in fishes, though some are found in the Carnivora and domesticated Birds, as well as in Man.

Acanthocephales. — The Acanthocephales or Echinorhynchæ (Echinorhynchus O. F. Müller) have a proboscis armed with curved hooks, by which they fix themselves to the intestinal wall of their host. This proboscis may be doubled up in a special sheath, fixed—by its posterior extremity—to the side of the body by a ligament and retractor muscles. The nervous system consists of a ganglion at the bottom of the sheath, which sends off some filaments. There are no sensory organs; neither is there a digestive apparatus, the absorption of nutrient fluids being effected by endosmosis through the integuments.

The sexes are separate. The males have two ovoid testicles, the excretory canals of which unite in a common vas deferens, which is often
furnished with accessory glandular sacs. At the posterior extremity of the body, this common canal opens into a conical penis situated at the bottom of a campanuliform pouch, which can become everted and serve as a copulatory organ. The female organs comprise an ovary, the produce of which falls into the visceral cavity; the ova are collected in a belt-shaped uterus, continued by a short vagina that opens at the posterior end of the body. The embryos developed in these ova have to undergo somewhat complex metamorphoses and migrations, before reaching their adult state. In the larval condition, the Echinorhynches inhabit the visceral cavity of various Crustacea or Insects, where they become encysted. The sexual and adult condition is only realized when this primary host is introduced into the digestive tube of a Vertebrate—Fish, Bird, or Mammal.

**NEMATODES.**—The intestinal Nematodes belong to the following families (see p. 322) and genera:

1. Ascarides: genera *Ascaris* and *Heterakis*;
2. Oxyurides: genus *Oxyuris*;
3. Strongylides: genera *Strongylus*, *Gisophagostoma*, *Globocephalus*, *Sclerostoma*, *Uncinaria* and *Ollulanus*;
4. Trichotrichelides: genera *Tricocephalus*, *Trichosoma*, *Trichina*;
5. Filariades: genera *Filaria* and *Spiroptera*;
6. Anguillulides: genera *Anguillula* and *Rhabdonema*.

These various genera, besides the characteristics of families or tribes, are also recognised as follows:

**Ascaride** (*Ascaris* Linn.).—The borders of the lips are generally denticulated. The males have two equal spiculae, and about the anus numerous papille, which—according to Schneider—constitute one of the best specific characters. The ova are globular or ellipsoid. This genus contains numerous species, commonly—but wrongly—
named *lumbrici*, which inhabit the small intestine. Almost every species of the domesticated Mammalia has a corresponding species of Ascaride, subordinate—with regard to dimensions—to the size of the host. The vitellus does not become segmented in the intestinal canal of the host in which the eggs are deposited, but after their expulsion from its body, if they find the necessary conditions of warmth and moisture. However, if their development does not occur in a moist situation, the ova of the Ascarides—according to the observations of Leuckart—may resist complete desiccation for weeks, or even months, and also alternations of damp and drought. The embryo, when once formed, is set at liberty in the intestine of another host of the same species as the first, on its shell being dissolved by the digestive fluids (Davaine, Baillet). It may, nevertheless, be hatched externally on grass or damp soil, but not in water (P. Hallez).

Leuckart and Von Linstow had supposed that the passage of the ova of the Ascarides through an intermediate host—an Invertebrate—was necessary; but the experiments of Grassi demonstrate that the embryos may directly undergo their ulterior development in the definitive host; and Laboubène confirms these observations.

**Heterakis** (Duj.).—This genus is distinguished from the preceding by the presence, in the *male*, of a pre-anal sucker and of two unequal spicule, as well as by at least three pre-anal papillae on each side, larger than the others.

Among the domesticated animals, Poultry alone harbour the Heterakis.

**Oxyuris** (Rud.).—This offers the characters of the family (see p. 323).

**Strongle** (*Strongylus* Müller—see p. 346). The most interesting species in this genus infests the air-passages. Some are found in the intestines of Ruminants and the Rabbit. All have, probably, a direct development.

**Esophageostome** (*Esophageostoma* Mol.).—The mouth is not succeeded by a buccal cavity or capsule, but opens directly into the oesophagus. The species is parasitic in the intestine of Ruminants and the Pig.

**Globocephalus** (Mol.).—Head spheroidal and diaphanous; buccal capsule sustained by two horny rings parallel to each other—one at the opening, the other at the back—both united by four horns intermediate cornua; buccal orifice terminal and orbicular, the annular limb being entire and not dentated (Railliet). A species found in the intestine of the Pig.

**Sclerostome** (*Sclerostoma* Blainv.).—Head truncated and straight, or slightly curved towards the ventral surface; mouth surrounded by sharp teeth—which are often numerous—and succeeded by a buccal capsule of variable shape. *Males* provided with two spicula, and a caudal pouch, which is frequently trilobate. *Females* have a double ovary, and the vulva is situated in the posterior part of the body (Railliet). The species is parasitic in the intestine of the Horse, and of small Ruminants.
Uncinaria (Frölich, Anchyllostoma Dubini, Dochmius Duj.).—Head curved towards the dorsal surface. Buccal capsule horny; the dorsal wall being shorter than the ventral, is sustained by a conical line or rib, which sometimes projects by its point into the interior of the cavity. At the bottom of the capsule—on the ventral wall—are two sharp teeth or lancets; and towards its free border, on each side of the middle line, are chitinous plates or teeth, which are often curved in a hook-like fashion at their extremity; the dorsal border may be also dentated (Railliet). Several species infest the domesticated Ruminants and Carnivora.

Ollulanus (Leuck.—see p. 372).—One species in the Cat.

Trichocephalus (Goeze).—Anterior portion of the body capillary and very thin; posterior portion suddenly expanded, and somewhat thick and cylindroid. In the males the caudal extremity is coiled up. There are no lateral spaces, only the middle lines; and there is a longitudinal papillary band on the ventral surface of the anterior region (Railliet). There are several species found in Ruminants, the Pig, Dog, and Rabbit.

Trichosome (Trichosoma R.—see p. 375).—One species infests the intestine of the Sheep, and several others are found in domesticated Birds.

Trichina (Owen).—This genus only offers one interesting species—the Trichina spiralis Owen—which will be studied when the parasitic affections of the muscles are considered (see Trichinosis).

Filaria (Müller—see p. 259).—The Filaria are more particularly parasites of the serous membranes and the subcutaneous connective tissue. They belong to the Worms that are very rarely met with in the intestine of the Horse and Dog.

Spiroptera (Rud.—see p. 346).—The Spiroptera sanguinolenta—
the natural habitat of which is in the oesophagus of the Canina—has been on one occasion found in the intestine of a Cat (Railliet).

**Anguillulidæ.**—Grassi and Leuckart have allotted to the genus *Rhabdonema*, very small Nematodes found in the intestine of Man, the Sheep, Pig, and Rabbit, which constitute so many different species. They are particularly interesting because of their series of metamorphoses, which have been more particularly studied on the species that is parasitic in Man.

Bavay has described—by the name of *Anguillula intestinalis* and *A. stercoralis*—two forms of Nematodes, the first of these is found in the small intestine, the second in the faeces of individuals affected with 'Cochin China diarrhoea.' Perroncito, Grassi, Parona, Leuckart, etc., have more recently met with them in other forms of pernicious diarrhoea. The intestinal *Anguillula* (or Thread-worm) is 2.2 mm. long and 34 μ thick; the female alone is known. The faecal *Anguillula* is smaller, the male measuring 7 mm. long and 35 μ thick; and the female 1 mm. long and 50 μ thick.

Grassi was one of the first—in 1883—to maintain that these two forms were one and the same species—the *Rhabdonema strongyloides*—and that the second is merely the free state of the first, which represents the veritable parasitic generation. Leuckart expressed the same opinion about the same time, and Golgi and Monti have confirmed it. In a recent work, Grassi and Calandruccio have made known new peculiarities relative to these Nematodes.

The intestine of the living Man harbours only the form named

Anguillula intestinalis—a Worm of female habits—and the embryos that come from it, probably by parthogenesis. It is oviparous and ovoviviparous, the ova promptly yielding the young larvae, which are expelled from the intestine along with the faces. These larvae—which are non-sexual, and very different from their mother parent—may have two widely diverse destinations; they assume the characters of the intestinal Anguillula, or those of the faecal Anguillula—a more advanced stage. In the latter case, after copu-

Fig. 159.—Intestinal Anguillula, adult female.—Grassi and Parona.

Fig. 160.—Fecal Anguillula.—Perroncito.

lation, the females bring forth a new generation of larvae which are free, and being produced by sexualized parents, external to the human intestine, do not attain maturity. They exactly resemble those mentioned above, comport themselves in the same manner, and after being ingested by Man are transformed into intestinal Anguillulae. Grassi has demonstrated that the larvae produced by the
latter also undergo this transformation, which brings them into the condition of the individuals from which they have issued. But they do not acquire maturity unless they are placed in a favourable temperature. This is what has been observed in employing a stove, for instance, and not relying on the ordinary— even the summer— temperature.

Etiology of Intestinal Helminthiasis.—The presence of Helminths in the intestines of various domesticated animals is of extreme frequency, and, in fact, may be said to be almost a normal condition in the Dog, Cat, Sheep, Horse, and Pig. The Ass and Mule are less infested, and less still are the Ox and Goat. Helminths are very often found in Poultry.

The ancients, who did not suspect the origin of these Worms, formed the strangest hypotheses as to their formation. An examination of these ideas is full of teaching for the philosophy of science, but we do not propose to discuss this, and refer our readers to the works in which this information is to be found. It is now well established by observation and experiment, that the Helminths—or intestinal Worms—are always produced from ova, embryos, or larval forms, which have been derived by the host from without, and especially by means of the animal's food and water. It is entirely a chance meeting, but it becomes frequent and easy from the multitudes of germs that these Worms can furnish. The eggs are, in fact, often produced in millions by only one of these parasites. Von Siebold estimated at a million, at least, those of a single Tænia solium; Dujardin, at 25 millions those of a Tænia serrata; Eschricht, those of the Ascaris lumbricoides at several millions. This is a compensation for the innumerable chances of destruction that threaten these germs. Besides, the shells of the eggs 'are so impermeable and resisting, that they can only be affected by very energetic chemical agents; and in the majority of cases this shell is sufficient to protect the contents of the egg against everything that, in ordinary circumstances, might alter them' (Baillet). To this may be added the remarkable vitality with which the embryos are endowed. Verloren—cited by Baillet—kept, for more than a year, ova of the Ascaris marginata, in which the embryos—formed from the fifteenth day—remained alive, although they had been exposed to all the variations of temperature during summer and winter. Baillet has made similar observations on the eggs of another species of Ascarides; and he has also remarked that in these species the transformation of the vitellus into an embryo has sometimes not been perfected until after six, seven, and eleven months. He has seen embryos of the Tænia remain full of life in the

eggs, when the segments containing them had been twenty-four hours in a thick layer of ice.

Independently of the conditions essential to the penetration of the germ into the organism, there may be others of a secondary kind which predispose individuals to intestinal helminthiasis. In general, everything that causes debility contributes to facilitate the installation of the parasites in the intestinal canal; and perhaps this may be due to the feeblcr peristaltic and antiperistaltic contractions of the intestines. In any case, the Helminths are met with much more frequently, and in greater numbers, in anæmic animals than in those which are vigorous, in young or very old individuals than in those which are vigorous, and in those which are turned out to pasture rather than in those permanently kept in their habitations. Humidity has also, at all times, been considered as one of the most predisposing causes to the invasion of the economy by Worms. Rainy years are marked by the extension of various forms of helminthiasis in animals which graze; and these affections are also more marked among animals that frequent inundated pastures and swampy places, and the borders of lakes and ponds. This is explained by the ova being preserved in water, and by their destruction under the influence of prolonged drought, as well as by the necessity for a damp medium for the succession of evolutive phases of certain species. With regard to heredity, to which the ancients attributed so important a share in this etiology, all that can be accepted is that there may be transmitted—along with the lymphatic temperament—a certain predisposition to helminthiases.

Contagion is rarely evident. It often takes place through the medium of a host specifically different from that in which the adult parasitic form is found. At other times it is masked by the more or less unknown phases which the worm must pass through externally, in order to progress from the embryonic condition to the definitive form. In dealing with each species, we shall give the details that are known with regard to this evolution, which scarcely gives its general indications.

Symptoms.—The intestinal Worms are generally nourished by the chymous matters contained in the digestive canal. But there are also those that attack the mucous membrane and abstract its blood, while others are lodged in its substance and there cause the formation of pus, on which they appear to subsist. Nevertheless, accidents attributable to these Worms are somewhat rare; and it is only when they have accumulated in great quantity that they excite the development of morbid phenomena of various kinds. It is necessary, also, to take into serious consideration the zoological species and habits of the parasite, rather than its size.

Sometimes the course of the food is hindered and obstructed; at other times the digestion is disturbed and the appetite altered; an
intestinal catarrh of varied gravity may supervene; in some cases there is a pernicious anaemia by hæmorrhagic exhaustion, mal-nutrition, or there may be—though rarely—perforation of the intestinal membranes. Certain invaginations found at the autopsies of animals which have died apparently from colic, may be attributed to Worms.¹

Chabert² gave a singularly exaggerated picture of the symptoms by which helminthiasis of the intestine is manifested; but, generally, they have no precise signification. Those which seem to really pertain to it are an irregular appetite—sometimes voracious, sometimes indolent—depraved tastes, dulness, and emaciation, notwithstanding an abundant alimentation; the skin is dry and adherent, and the hair erect; the flanks are sometimes tympanitic, sometimes retracted, or the abdomen is enlarged though there is general wasting; there may be constipation or diarrhoea; yawning, nausea, or vomiting; the breath foetid, tongue furred and foul; sub-acute colics; spasmodic movements of the upper lip; nasal pruritus in the Dog, and anal pruritus in this animal and the Pig, manifested by their rubbing that part against hard bodies, or drawing it along the ground by means of their fore-feet only; sudden cries without any apparent motive, convulsions, rabiform symptoms, etc. With regard to epilepsy and vertigo—sometimes attributed to intestinal Helminths—there is nothing to prove that they are other than a mere coincidence; and this remark applies to the singular theory of Stanley, who ascribes to worms the existence of ‘stringhalt’ among Australian Horses.³

The numerous symptoms described as indicating enterohelminthiasis are scarcely ever seen altogether in one individual, and the diagnosis of this affection is generally difficult. But the presence of parasites in the excrements often renders this certain, and for several species of Helminths a microscopical examination of the evacuations may lead to the recognition of the somewhat characteristic ova and embryos. Finally, there are symptomatic manifestations that properly belong to each kind of domesticated animal and to each species of parasite; these will be described à propos of the particular forms of helminthiasis.

Treatment.—The prophylaxis of intestinal helminthiasis is necessarily vague, as we do not know the conditions upon which the development of the intestinal entozoa depend. The purity of food and of drink, the use of dry pastures, and the exhibition of a tonic nourishment, are almost the only general measures that can be recommended here.

Treatment consists in the employment of those medicaments named vermifuges, vermicides, and anthelmintics (and tanaifuges). Their action

¹ Mégnin. Du rôle des Helminthes dans certains cas d'Oclusion Intestinale. Comp. Rend. Soc. de Biologie, 1883, p. 582.
may be assisted by a special regimen. 'We advise giving to the Herbi-
vora green food—in winter, carrots—frequently seasoned with salt; to
Horses, roasted oats; to Dogs, as much flesh as possible, and a deco-
tion of milk or of onions; to Pigs, clotted milk, skimmed milk, green
fruit, and acorns' (Roll).1

When debility is pronounced, it is well to add a regimen of tonic
substances, such as bitter plants and common salt.

When there is colic or convulsions, we commence by giving appro-
priate medicines to allay them—sweet oil, ether, opium, assafoetida,
and extract of hyoscyamus.

The anthelmintic treatment should be preceded by half-diet for some
days, and sometimes by slight purgation. A purgative may be added
to the vermifuge, in order to expel the Worms which are dead or stupe-
fied by the special drug; but it is preferable not to exhibit an
evacuant until some hours after the administration of the anthelmintic.
Recourse is generally had to drastics, especially to aloes, and some-
times also to calomel or castor-oil.

A very large number of substances have been recommended for free-
ing the intestinal canal from its parasites; but many of them have an
unwarrantable reputation, and it is best to employ those the efficacy
of which is well established. Those most frequently used are arsenious
acid, tartar emetic, santonine, the root of male shield-fern—especially
in the form of ethereal extract—tansy, benzine, empyreumatic oil, oil of
turpentine, kousso, kamala, and bark of the root of pomegranate.

Their indications, doses, and modes of employment will be given in
the following articles, in which intestinal helminthiasis is studied suc-
cessively in the various species of domesticated animals.

A.—DOMESTICATED MAMMALIA.

ARTICLE I.—Parasites of the Intestines of the Equidae.

Protozoa.2—In the large intestine of the Equidae—and especially in
the caecum and anterior parts of the double colon—are Infusoria, of
which Gruby and Delafond very incompletely described seven forms.
G. Colin has figured a dozen. Their study has been resumed by Fior-
etini, who has described six species belonging to the Peritriches Infu-
soria, which are divided into the genera Entodinium Stein, Diplodinium
Schub., Spirodinium Fior., and Triadinium Fior. The first two genera
have representatives in the rumen of Ruminants (see p. 361).

1 Roll. Manuel de Pathologie et de Thérapeutique des Animaux Domestiques.
2 Gruby and Delafond. Rech. sur les Animalcules se développant dans l'Estomac et
dans les Intestins. Comp. Rend. de l'Acad. des Sciences, XVII., 1843, p. 1054; and
Comp. des Animaux, 2nd edition, I., 1871, p. 837. — A. Fiorentini. Intorno ai Pro-
tisti del l'Intestino degli Equini. Boll. Scientifico de Maggi et Zoja, XII., 1890, p. 7;
Ann. de Micrographie, III., 1891, p. 187. — Max Flesch. Sur un Parasite de la
Entodinium valvatum Fior.—Body conical. Peristome placed at the base of the cone, and succeeded by a large pharynx. Length 600 μ.

E. bipalatum Fior.—Body more or less rectangular. Peristome anterior, garnished with a ciliary crown, and followed by a very wide, saciform pharynx. Posterior part provided with two articulated pedicles, carrying tufts of cilia. Length 214 μ.

Diplodinium uncinatum Fior.—Characterized by a hollow prolongation which is raised at the bottom of the pharynx to above the anterior extremity. Anus posterior, surrounded by a tuft of cilia. Length 900 μ.

D. unifasciatum Fior.—Three crowns of cilia, of which the two anterior surround the pharynx, and a posterior. Length 230 μ.

The Spirodinium are characterized by their spiral ciliary crown, and their irregular, elongated nucleus. One species—Sp. equi Fior., the ciliary crown of which descends in spiral to the posterior extremity. Length 230 μ.

The Triadinium have three ciliary crowns. One species—T. caudatum Fior. Very broad in front; three ciliary crowns—an anterior, and two lateral directed downwards; that of the left constitutes the peristome. Posterior extremity conical, terminated by two filaments. Length 300 μ.

These Infusoria—still insufficiently studied—are not parasitic, but are developed in the intestinal fluids, like those of hay infusion. They perish in the latter portions of the intestine, and only the remains of their carapaces are found in the faeces (G. Colin).

Globidium of Leuckart.—In the wall of the small intestine of a Horse killed for dissection, Max Flesch found, in considerable number, a microscopic parasite, which he named Globidium Leuckarti. Its presence had caused slight and irregular inflammations of the organ. Its special location was the sustaining connective tissue of the intestinal villi, generally towards their middle portion, and immediately beneath the epithelium. A villus sometimes contained two or three of them.

Most frequently the Globidium had the appearance of an elliptical or spherical capsule with a well-marked outline, and 80 μ long and 70 μ broad. In it were very refrangible spherical globules, averaging 13 μ in diameter; sometimes these were numerous and occupied the whole of its cavity, at other times they were exclusively parietal, and margined a central space filled with a mass of protoplasm. In the majority of the organisms, the wall was thickest at this point, and had a special cavity — fusiform or semilunar — filled with granular bodies, and separated from the shining spheres just mentioned by a thin septum. Sometimes the internal cavity of the Globidium was exclusively occupied by another pyriform capsule, provided at its thin pole by a micropyle opening into the general enveloping cavity.

Larger specimens—160 μ long, and 150 μ broad—and certainly older, showed that in increasing in size the parasite became deformed and bulged, and was separated into two chambers, one of which was occupied by an intra-parietal accessory body, and the other—which was
the original cavity in the *Globidium*—had its protoplasm hollowed out into numerous vacuoles increasingly larger, in the middle of a network similar to that seen in young vegetable cells. These vacuoles at last become fused into a single diverticulated cavity. The parasite might then attain 340 μ in length, and 260 μ in breadth.

Max Flesch could not determine the course followed by the *Globidium* in reaching its seat of election, nor yet the zoological group to which it should be allotted. It appeared, nevertheless, to have analogies with the Sarcosporides which Blanchard found in the submucous layer of the intestine of a rock Kangaroo, and which he had named *Balbiania mucosa*.

Moniez considers the bodies found by Flesch as the embryos of a Taenia of the Horse, encysted in the papillae, like those of the *Taenia murina* of the brown Rat. This is the only analogy in support of the hypothesis, which would require, in addition—in order to be acceptable—the presence of the hexacanthus hooks on some at least of these bodies, and several other peculiarities of organization.

Fig. 162.—*Taenia perfoliata*; natural size, but incomplete.—Railliet.

Fig. 163.—Cephalic extremity of the *Taenia perfoliata*; magnified twelve diameters.—Railliet.

**Cestodes.**—Three species of *Taenia* have been found in the digestive canal of the Equidae; all three are unarmed, and belong to the group of Anoplostrongylus. Nothing whatever is known of their cystic form. The three species have in common—besides the absence of hooks and neck—a single genital pore in each segment, situated on the same side in all of the segments.

1. *Taenia perfoliata* (Goeze).—The length generally is 26 mm. to 28 mm.; but according to Rudolphi, it may reach 80 mm.; breadth 3 mm. to 15 mm. Head somewhat large—2 mm.—tetragonous and rounded, and also prolonged behind by four rounded lobes; suckers cupuliform and directed forwards. Segments thick, but very short, and becoming wider to about the middle of the length of the body; they succeed each other like leaves, one overlapping the succeeding one, to which it only adheres at a middle transverse line; the last segments are always sterile. Ova polyhedral by reciprocal pressure;

they measure about 80 μ broad; the embryo—which is 20 μ in diameter—has its shell prolonged by an elongated blunt point, that represents the pyriform apparatus of the other Anoplopteniens.

2. *Taenia mamillana* (Mehlis).—Length 1 cm. to 3 cm., breadth 4 mm. to 6 mm. Head tetragonous, obtuse, 5 mm. long, and 8 mm. broad; suckers lateral, elongated, opening in a longitudinal slit. The segments are 30 to 40, sometimes 50 in number; the first are curved in half-circles, and embrace the base of the head; those which succeed these widen rapidly, and soon acquire their maximum breadth; their length increases, on the contrary, to the posterior extremity, where—in the last segments—they may exceed the half of their breadth. Ova oblong, and 88 μ in length, 50 μ to 66 μ in breadth; the embryo of the same dimensions and appearance as that of the preceding species.

3. *Taenia plicata* (Rud.).—Length 1½ cm. to 8 cm., breadth 8 mm. to 18 mm. Head very thick, short and wide—4 mm.—slightly depressed on each surface of the Worm; suckers cupuliform and directed forward. Segments regularly increasing in length and breadth to the last, which may be 1½ mm. long. Ova round or polyhedral.

The *Taenia perfoliata* more especially infests the cæcum, and is but
rarely found in the colon or small intestine. The *T. mamillana* is met with in the small intestine, less often in the duodenum than in the ileum and jejunum. The *T. plicata* lives in the small intestine, and is sometimes seen in the stomach.

None of these three species is common in France, but the last two—and particularly the *Tænia plicata*—are altogether rare. We have only once met with *Tænia* in the Horse. They belonged to *T. perfoliata*, and were found—to the number of 104—in the last portion of the small intestine of a Horse that came from the mountainous parts of the Hautes-Pyrénées. The *Tæniae* of the Horse are more common in Germany, and still more in Russia. In the latter country, according to Blumberg, they are encountered—on the average—in one of every ten Horses. Greve says he has seen thousands of *Tænia* in the small intestine of the Horse. In about 100 Horses, Krabbe, of Copenhagen, has found *Tænia perfoliata* in 28, and *T. mamillana* in 8; but in none of them did he see *T. plicata*. The *T. perfoliata* averaged 25 in number; in two animals they were between 200 and 300, and in one 400. The *T. mamillana* numbered, on the average, 25; 72 was the maximum. The observations of Hering, made at Stuttgart, fairly agree with those of Krabbe, except that the *Tæniae* in the Horse are much less frequent, and the *T. plicata* is less rare. Sareiron has found hundreds of *T. plicata* in an Ass's foal in Senegal; Beugnot—quoted by Railliet—has also met with them in a Mule at Gabès, Tunis. Krabbe, in his description of the Cestodes collected by Fedschenko during his travels in Central Asia, remarked that *T. mamillana* of the Horse was more rare than *T. perfoliata* (Zschokke).1

The existence of *Tænia* in the Horse generally remains unperceived during life, though sometimes it coincides with the general symptoms of intestinal helminthiasis, or rather with anæmia. At the autopsy of a Mare which had died suddenly, Poulton found numerous *Tæniae* in the duodenum, and in large pouches formed in the wall of other parts of the small intestine. Mégnin also reports two observations relating to Horses which died of peritonitis caused by the rupture of intestinal dilatations, in the interior of which were found *T. perfoliata*. Perroncito gives an analogous instance. At the autopsy of a Horse that was killed because of anæmia after paralysis, Hürlimann found such a quantity of *T. perfoliata* (?) that they filled a large basket.2

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Trematodes.—Two species of Trematodes—strangers to our country—have been met with in the Equidae—the Amphistome of Collins, and the Gastrodiscus of Sonsino.

Amphistome of Collins (Amphistoma Collinsi, Cobbold).—Worms of a brick-red colour, known for a long time to the natives of India by the name of Masuri, which live in thousands in the large intestine of the Horse, where they are capable of producing serious intestinal irritation. Besides this form, Cobbold has described another—A. Collinsi, var. Stanleyi.—Railliet.

Gastrodiscus of Sonsino (Gastrodiscus Sonsinoi Cobbold; G. polymastos Leuck.).—Body flattened into an elliptical disc, the dorsal surface being convex and smooth, and the ventral surface concave and covered with about 200 papillary suckers. The buccal sucker—smaller than the posterior sucker—is situated at the end of a cylindro-conical neck, and is salient on the dorsal surface, with which it forms a wide obtuse angle behind. This neck is about 2 mm. or 3 mm. long. The body is discoidal, about 10 mm. to 12 mm. in transverse diameter. Most frequently the antero-posterior diameter is about 1 mm. more than the other. The colour is rosy in the fresh state, and pure white after immersion in alcohol. Like the Amphistomes, this parasite fixes itself on the mucous membrane by its posterior sucker.

It was discovered in Egypt, in 1876, by Sonsino, at Zagazig, near Suez, in two Horses of fifteen which had succumbed to an enzootic affection. In one horse he found six specimens in the small intestine; in the other, about 100 in the large intestine. The study of these worms was made by Cobbold and by Lejtényi—a pupil of Leuckart. The Gastrodiscus has since been found several times in Egypt, notably by Burlazzi and Zuchinetti; and in Senegal by Sarciron. Another country afflicted with this parasite is Guadeloupe, where it has been discovered on three occasions by Guyot—at Pointe-à-Pitre, in 1880; and twice by Veterinary Surgeon Couzin, who has sent us numerous specimens from Moule.

Egypt, Senegal, and Guadeloupe are, then, the only countries in which the Gastrodiscus is at present known. In Egypt it is found in Horses; in Senegal it is met with in Ass foals; and at Guadeloupe it is observed in Mules. In the first cases, the autopsies did not reveal any lesion which could be attributed to it. At Guadeloupe, death occurred suddenly (Guyot), or after a long period of anaemia (Couzin). A remarkable feature in the history of this parasite, is that its habitat is not particularly localized. In the Mules at Guadeloupe it is found in thousands, from the pharynx to the anus, and even in the

nasal fossæ (Guyot); or in the stomach, æcum, or second section of the large colon (Couzin). The Mules had been fed on green forage and treacle, and it is probable that they had taken the larvae of the Gastrodiseus along with this aliment, in the form of germinal sacs or cercaria.

Nematodes.—The Ascaris megaloecephala (Cloq.) is special to the Equidae. It is the largest species in the genus.

Its body is yellowish-white and rigid. The head is distinct, and has three lips, which are constricted in their middle, and have comparatively large teeth on their free margin. The male is 15 cm. to 28 cm. long; its tail is bordered by two small membranous wings, and has on each side 79 to 105 papillæ, 7 of which are post-anal; the fourth and fifth of these, as well as the sixth and seventh, are joined to form one; there is a single papilla in front of the anus, the other pre-anal papillæ are arranged in a single, then in several rows. The female is 18 cm. to 37 cm. long; the vulva is situated towards the anterior quarter of the body. The ova are nearly globular, and have a diameter of 90 μ to 100 μ.

The Ascarides megaloecephales are common in the small intestine of the Horse, Ass, and Mule; but their presence does not usually affect the health of their host, though in young animals they may give rise to various troubles in digestion. Beyond the symptoms common to the various intestinal helminthiases, there is often remarked a chronic catarrh of the intestines—a slight but obstinate diarrhoea—the expulsion of the faeces being immediately preceded by a discharge of fluid from the intestine. In France, Horses so affected are called 'vidards,' and sometimes they pass these worms along with the excrements. Colic is often a consequence of an obstruction of the intestines, which may persist and eventually cause death. Symptoms of vertigo, epilepsy, and tetanus have also been observed. Dieckerhoff relates the case of a Horse that gave indications of attacks of intermittent tetanus, which were repeated several times a day, and lasted for about a minute each time. It was a kind of emprosthotonos, involving the head—jaws, lips, eyes—neck, and the upper parts of the anterior limbs, while the head was strongly flexed downwards. These symptoms disappeared after the administration of a suitable dose of tartar emetic and aloes, and the consequent evacuation of 21 Ascarides. Damitz has observed a kind of paraplegia that yielded to the administration of anthelmintics.1

Ascarides are found in the small intestines of Horses which, during

life, gave no indication of their presence. Krabbe,\(^1\) of Copenhagen, has met with them 16 times in 100 Horses he examined. The number of living individuals in the same host is very variable—there may be only a few, but often they are counted by hundreds. At the Brussels Veterinary School, in one Horse there were more than 1,800;\(^2\) and Delamotte has found 1,215—weighing collectively 3·250 kilogrammes—at the autopsy of a Mare which died of sclerosis of the heart.\(^3\) They are often massed in bundles, and rarely rolled up on themselves. They infest various parts of the small intestine, and particularly the duodenum; but when they are numerous they may also pass into the stomach—Röll has even, on one occasion, found them in the bile-duct. In a Horse which had died from pneumonia, Generali\(^4\) came upon an Ascaride that had found its way into the anterior part of the pancreatic duct, which was very dilated and its walls thickened—proving that the worm must have been there a considerable time before death.

At the autopsy of animals which have died of verminous colic, there are often observed all the signs of anaemia, and always those of more or less severe intestinal congestion in various parts of the small intestine infested by the Worms; it is not even rare to meet with ruptures of the intestine, undoubtedly due to obstruction and softening brought about by its congested condition, and the violent struggles of the animal when suffering from the colicky pains. The contents of the viscus escape into the peritoneal cavity, and among them are seen floating some Ascarides which have passed through the rent; peritonitis has precipitated the fatal issue.

Gavard was probably mistaken when he asserted he had found numerous Ascarides in the peritoneal cavity, without any rupture of the intestine.\(^5\) The consequences of such a rupture are sometimes delayed, when it happens at the lesser curvature of the small intestine, and the Ascarides pass through it to between the two layers of the mesentery, where they form a large pouch that becomes inflamed, and finally opens into the peritoneal sac. Wira has reported an instance of this; and Zorn has described two analogous cases, in which the communication of the intestine with the mesenteric pouch took place through small openings with callous, thickened borders.\(^6\) But it cannot be affirmed that in these two instances the perforations were directly produced by the Ascarides. Generally it is only a question of old or recent rup-

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2 Annales de Méd. Vétérinaire, 1854, p. 96.
3 Delamotte. Un nouveau cas de Sclérose du Cœur chez le Cheval. Revue Vétérinaire, 1890, p. 301.
ture; but in some published observations the characters of the accidental opening—its circular shape, small diameter, and an Ascaride sometimes fixed in it—are so many circumstances which ought to lead to the belief that it is in reality a perforation. It is possible that the Ascarides attack the mucous membrane with their dentated lips, and induce a local inflammation in it, which ends in ulceration.

The conditions under which animals receive the germs of their Ascarides are not known. The persistency of the latent vitality of the ova, the resistance of the embryos to causes of destruction, and the influence of humidity in the development of these embryos, render it very probable that the Worms are introduced into the digestive canal with the food or water the animals partake of. It is therefore indicated, as a preventive measure, to allow only water as pure as possible to be drunk, and to destroy by fire the Worms which are evacuated. If they are permitted to find their way to the manure-pit, of the millions of eggs they contain some may meet with the conditions favourable to their evolution, and so infest other Horses, Asses or Mules. In any case, helminthiasis by Ascarides ought never to be neglected, but should always be combated by an appropriate vermifuge.

Arsenious acid answers well. It is given in the food in increasing doses of 1 to 3 grammes a day, for ten days. Tartar emetic has also been highly recommended, in doses of 15 to 20 grammes per day, in four doses at three or four hours' interval, either in bolus or electuary, along with gentian powder, or mixed with assafoetida and empyreumatic oil. On the following day an aloetic purge is given. Zundel has been very successful with juniper berries and cream of tartar—given in a little damp bran—for fifteen days, after which a dose of aloeis is administered. The oil of turpentine may also be employed—80 to 150 grammes made into an emulsion with ground-nut oil; santonine 100 to 150 grammes, empyreumatic oil 20 to 30 grammes; or benzine 50 to 100 grammes. (Ferric chloride and sulphate of copper are often successfully employed.)

It ought to be stated that, in many cases, all these remedies are insufficient, and that a specific against the Ascarides of the Horse has yet to be found.

Curved Oxyuris (Oxyuris curvula Rud.).—The female of this Worm (commonly known in England as the 'maw worm') is almost exclusively met with. It is 40 mm. to 50 mm. long, is arched in its anterior portion, more or less subulated behind. The vulva is situated about 10 mm. from the mouth. The eggs are ovoid, from 89 μ to 95 μ long, and 41 μ to 45 μ broad, asymmetrical, and carrying at one of their ends—which is truncated—a kind of operculum. In this species, the

head has no lateral wings; the mouth presents three great rounded lips, each of which envelops two mamelons; there are six papillae in two opposite groups. The male is very rare, and has been described by Railliet. It is 9 mm. to 12 mm. long; the posterior end is obtuse and has several papillae, the longest of which sustains a kind of very developed caudal pouch; the spicule is straight, thin, and very sharp.

The curved Oxyuris is met with throughout the length of the large intestine of the Equidae; but, according to Colin, its usual habitat is the diaphragmatic flexure of the large colon. It is sometimes seen partly projecting from the anus, to the margin of which it is fixed; or it may be observed in the faeces. Effects analogous to those of the *Oxyuris vermicularis* of Man have been attributed to this worm — burning sensation, anal pruritus, and tenesmus; the margin of the anus is red and swollen, and the animal's tail often agitated. But, on the whole, the worm appears to be very inoffensive; though we have mentioned (p. 260, note) that Pflug attributed a very pruriginous eruption observed on a Horse to embryos of the curved Oxyuris. Nothing is known of its migrations, nor yet whether it has to undergo any.

**Long-tailed Oxyuris** (*O. mastigodes* Nitzsch).—This form—which had been already seen by Delafond—was first described by Nitzsch, then by Friedberger, each of whom found it in the faeces of a Horse. Blaise in Algeria and Condamine in France have also observed it in the same conditions. The description is applicable to the females, which are distinguished from those of the *Oxyuris curvula* by their length—13 cm.

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to 15 cm. The tail is long, thin, and smooth, and from three to four times longer than the body. The mouth is round and nude. The integument is finely striated transversely; the colour is brown, due to the ova which fill the dilated anterior part. The vulva is situated in front of the middle of this part of the body. The eggs are ovoid and elongated, and sometimes contain embryos already developed. According to Railliet, the long-tailed Oxyuris is only an abnormal form of the *O. curvula*—a simple case of dimorphism of the females. Intermediate forms are found (Figs. 174, 175).

In Friedberger's case, this was a mare which, for two years, showed obscure symptoms of helminthiasis.

![Fig. 171.—Oxyuris of the Horse, female.—Delafond.](image)

A, anterior extremity, with the point laid open longitudinally; B, caudal extremity; b, mouth with the lips spread out; a, anterior part of the oesophagus or anterior bulb; v, ventricle or posterior bulb; i, intestine; a, anus; u, uterus; vu, vulva.

![Fig. 172.—Oxyuris of the Horse, male.—Railliet.](image)

A, natural size; B, magnified: d, anterior bulb; v, posterior bulb or ventricle; g, the so-called salivary glands; i, intestine; t, testicle; cd, deferent canal.
Every morning about nine o'clock, during the time it was under treatment, it passed bundles of 10 to 25 worms, all held together by a very viscid substance to the surface of the pellets—never in their interior—and always empty of their eggs.

**Viviparous Oxyuris** (*O. vivipara* Probstm.).—This worm should belong to the genus *Rhabdonema* (see p. 399).

**Sclerostomes.**—Two species of Sclerostomes inhabit the large intestine of the Horse—the armed Sclerostome and the tetracanthus Sclerostome.

**Armed Sclerostome** (*Sclerostoma equinum* Müller, *Strongylus armatus* Rud.).—Body gray, or brown shaded with red; straight, rigid, the

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**Fig. 173.**—Caudal extremity of the male Oxyuris of the Horse.—*Railliet.*

A, ventral surface; B, left side; i, intestine; g, rectal glands; cd, deferent canal; s, spicula; pa, anterior papilla; pp, posterior papilla; pl, intermediate or cloacal papilla.

The anterior part being broader than that which immediately follows. Mouth orbicular, widely open, and rendered tense by several chitinous concentric rings, the innermost of which are garnished with fine teeth, while the outermost carry six papillae symmetrically divided. The buccal capsule is sustained by a dorsal longitudinal line or rib, and has at the bottom two round sharp plates. The caudal pouch of the *male* is almost trilobate, the posterior ribs being trifurcated, the middle double, and the anterior cleft. *The female* has the tail obtuse, and the vulva situated in the posterior moiety of the body. Eggs ovoid, and 92 µ long, 54 µ broad. The dimensions are variable; sometimes the males are 18 mm. to 20 mm. long, and the females 20 mm. to 26 mm., and at other times it is respectively 26 mm. to 35 mm. and 35 mm. to 55 mm.
The armed Sclerostoma—which is also often named the *armed Strongle* (and *palisade worm*)—infests the cæcum and commencement of the large colon, and—with the *Ascaris megacephala*—is the worm most commonly found in the Equidae. ‘They are easily procured in Paris,’ says Dujardin, ‘and I have seen them at Toulouse and at Rennes in the intestines of all the Horses I examined; nevertheless, in the Vienna Museum only 17 Horses of 92 had them. Rudolphi found them very plenteously at all seasons.’ At Copenhagen, of 100 Horses examined by Krabbe, 86 had this worm, and in some of these the large intestine was studded with them. Chabert counted more than 1,000 on a surface of two inches, and he estimated the total in one Horse at more than a million. Blumberg, at Kazan (Russia), only found them once in 93 Horses; and Duncan, at Toronto (Canada), met with them only once in 50 Horses.¹

The armed Sclerostomes hold firmly by their buccal armature to the

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mucous membrane, which forms at the point of adherence a small dark prominence. They are frequently met with in couples—the two individuals forming an almost right angle, and adhering so intimately that they may be preserved in this condition in alcohol. Notwithstanding their sometimes considerable numbers, and the irritation they should produce in the mucous membrane, their presence in the Horse is rarely betrayed by any appreciable symptom. They have sometimes been accused of causing death by anaemia, diarrhoea, colic, etc. (See Parasites of the Circulatory Apparatus.)

It is not only on the internal surface of the large intestine that they are met with, for they are found in aneurisms of the mesenteric artery, and in the hepatic, renal, spermatic, occipital, and other arteries; in

![Fig. 176.](image)

Anterior extremity of the *Sclerostoma equinum*.—Delafond.

![Fig. 177.](image)

Dorsal moiety of the buccal capsule of the *Sclerostoma equinum*; internal surface.—Delafond.

![Fig. 178.](image)

*Sclerostoma equinum*, an agamous individual from the pancreas; magnified three diameters.—Delafond.

A, male; B, female; b, mouth; a, anus; vu, vulva; bc, caudal pouch.

the muscles, pancreas (Goubaux, Montané), ligaments of the liver, and in submucous cysts of the cæcum, and sometimes of the duodenum. In all these instances they are in an agamous state, and represent one of

the phases in the development of the species. When we are discoursing of the parasitism of these various organs, and especially of the circulatory apparatus, this feature will be more particularly examined; so that we shall only refer here to what is necessary to be known with regard to the migrations of these Helminths.

With regard to the intestinal tumours, their volume varies from that of the head of a pin to that of a hazel or small almond-nut, according to the development attained by the worm inside each tumour. The latter also contains altered blood or pus, and there is more or less hyperæmia around the circumference. The worm within is rolled upon itself, and is, of course, of variable dimensions, —sometimes extremely fine, and never so large as in the adult state; it is always destitute of reproductive organs. Occasionally there is no worm in the tumour, and then there is seen a small opening at the summit, by which it has escaped. The worms found in the organs mentioned above are also agamous; they represent the primary phase of development, as they do not become sexualized except in the caecum and colon.

Colin\(^1\) states that the armed Sclerostomes are worms which migrate internally, and that their development is effected almost in one place. The ova are deposited in the substance of the intestinal mucous membrane—perhaps in the punctures produced by the mouth of the female, or perhaps merely in the orifices of the glands—and they are hatched there, the embryos becoming encysted at the points where they are hatched, in the cyst developed by their presence.

After being developed and having undergone several moltings, they make their exit from the cyst, and fix themselves on the surface of the mucous membrane; though a certain number remain in their cyst, grow there, have the genital organs partly formed, but nevertheless always remain agamous. Those found in aneurisms and in the peri-intestinal

organisms, must have entered the bloodvessels on their leaving the cyst, and in this way be carried—by a centrifugal migration—to the parts where they are found.

Baillet has shown that this is not the ordinary mode of reproduction and development of the Sclerostomes. The ova are expelled along with the faeces, and become hatched in a few days if they are in a damp place. The embryos that issue from them are cylindroid, a third or a fourth of a millimetre long, somewhat obtuse in front, and have a filiform tail. If the conditions of humidity continue to be favourable, they gradually grow, their integument becomes folded and forms a kind of sheath in which the worm moults in an evident manner. Baillet has been able to keep them several months in this state, or after complete moulting. It is at this period that they enter the body of the Horse in the water the animal drinks (or perhaps on green forage), undergo moulting if they have not already done so, and penetrate the substance of the mucous membrane. Leuckart asserts that the embryos should pass through an intermediate host before entering the intestine of the Horse. But however this may be, it is possible that after they have lodged themselves in the mucous membrane, a small number of embryos

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stay to fix themselves in the cysts which they cause to be formed. The majority reach the circulatory system, and install themselves in the abdominal arteries—principally at the origin of the great mesenteric; there they form aneurismatic dilatations, filled with a ragged clot that adheres to the inner surface of the vessel, and in this the Helminths are located. There they acquire a length of 3 cm. or 4 cm., and commence to be sexually differentiated, but remain agamous. These verminous aneurisms play an important part in the etiology of colics (see Parasites of the Circulatory Apparatus).

After a more or less prolonged sojourn in the aneurism, the worms leave it by allowing themselves to be carried by the blood, and in the course of time reach the caecum, where they form the majority, if not the whole, of the submucous cysts. Their last migration is, therefore, in reality, centripetal.

Finally, after remaining a more or less considerable time in the tumour they had caused the formation of, and having grown, the Sclerostomes forsake it, attach themselves to the mucous membrane, become sexualized, and copulate.

An interesting observation of Railliet\(^1\) gives support to this theory as to the development of the Sclerostomes. He found in a Horse a considerable quantity of these worms in the caecum, verminous cysts and walls of that viscus, and a smaller number in the duodenum and other parts of the small intestine.

The cysts in the duodenum—which are rare—were grouped on the small curvature of the intestine, and some were even observed disseminated in the mesentery. All of the latter contained Sclerostomes still agamous; but several of those in the small intestines—like those of the caecum—had an opening in their centre and were vacant, the Helminths having left them. This would seem to prove that the worms had reached the intestines by way of the arteries.

We ought at least to mention the opinion given by Willach\(^2\), on the phases of development of the Sclerostomes. He found in the intestine of the Horse—indeed independently of armed Sclerostomes having the usual dimensions—small worms 7 mm. to 12 mm. long, which he believed were of the same species, by reason of the shape of their cephalic extremity. Some were manifestly females, and contained numerous eggs having a thin shell, and measuring 80 \(\mu\) long and 40 \(\mu\) broad. Others had a caudal pouch similar to that of the adult armed Sclerostome, and had, in addition, eggs like those of the females just described, but less numerous. Therefore these worms were hermaphrodites; one even showed, alongside the mature eggs, embryos \(\approx 5\) mm. long. Willach consequently admits that the armed Sclerostome has a phase of development—a rhabditiform generation, issuing on the spot in the

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intestine of the Horse, from the well-known normal worms. The female rhabditiform Sclerostomes also deposit their eggs on the same place; but with the hermaphrodites—which have no vulva—the embryos are hatched in the body of the parent, and they only escape therefrom by the destruction of the internal organs, caused by their movements. These embryos, expelled outwards or continuing their development in their first host, become eventually the normal Sclerostomes.

In all this there is a phenomenon of heterogenesis, analogous to that presented by the *Rhabdonema nigrovenosum* of the lung of the Frog and Toad—a worm of which all the individuals are females, but which have spermatozoa developed in their genital tubes before the appearance of the ova. These ova—hatched in the uterus—are thrown out, grow in damp soil, and assume the form of *Rhabditis nigrovenosum*—some being males, the others females. The embryos produced by the latter, when ingested by the Batrachians, pass into the lungs of these and become *Rhabdonema*.

This theory of Willach requires further observations before it can be adopted; and all the more is this necessary when the theory is extended to the *Sclerostoma tetracanthum* and to several species of Strongylides.

**Sclerostoma tetracanthum** (Dies).—This worm is distinguished from the preceding species by its smaller dimensions—the *males* being sometimes 8 mm. to 10 mm., and at others 12 mm. to 15 mm. long; while the *females* are 10 mm. to 12 mm. or 14 mm. to 17 mm. in length. Their colour is white, and the body is slightly tapering anteriorly. Mouth circular, with a salient rim that has a crown of triangular teeth, and outwardly six papillae—two lateral, small, and on each side of them two others, conical and very prominent. Buccal capsule cylindrical; two long lateral papillae a little in front of the termination of the oesophagus. The caudal pouch of the *male* is simply excised on the ventral surface, the posterior lines or ribs are trifurcated, the middle doubled, and the anterior cleft. The *female* has the tail terminating in a point, and the vulva very near the anus. The eggs are very ovoid, and 100 μ long by 48 μ broad.

The Sclerostoma tetracanthus also inhabits the caecum and colon of the Equidae, often in company with the preceding species, with which it is often confounded. It is usually free among the intestinal contents, and is frequently found coupled. The ova—like those of the Sclerostoma—are segmented in the uterus; they are laid in the intestine of the host. The external phases in their development are, according to Baillet, very analogous to those of the armed Sclerostome. The embryos are thicker, the tail is longer, and their movements less active. They are introduced into the intestine with the water the host drinks, and it is probable that they encyst themselves directly in the mucous membrane, without penetrating the circulatory apparatus—at least, no wandering parasites of this kind have ever been observed. The tumours they form beneath the mucous membrane are of the same character as those of the other species. Probstmayer, Leuckart, and Cobbold have exclusively allotted to the *Sclerostoma tetracanthum* the agamous worms.
found beneath the mucous membrane of the caecum. They are generally considered inoffensive, but some observations\(^1\) show that, by their great numbers, the verminous tumours of the intestine may induce a serious, even fatal, anaemia; and that the tetracanthus Selerostomes, when free and numbering several thousands in the intestines, are capable of producing a hemorrhagic enteritis and fatal colics.

Other Nematodes.—We here and there find mention made of other Nematodes that have been met with in the intestines of the Equidae. Thus, Rudolphi speaks of having seen there, in the Horse, the *Filaria papillosa* Rud., which is almost exclusively a parasite of the splanchnic serous cavities.\(^2\)

Cobbold mentions *Trichonema arcuata* as being found in the large intestine of the Horse; but at a later period he recognised it as the larval form of the *Slerostoma tetracanthus*,\(^3\) and considered it as identical with the *Nematoides equi caballi* Diesing, which has the same habitat.\(^4\)

Probstmayer and Perroncito have described, under the name of *Oxyuris vivipara*, worms found in abundance—by millions, Perroncito says—in the caecum and large colon of the Horse; but according to Railliet, these are only *Rhabdonema*.\(^5\) They are small female worms, much resembling *Oxyures*, 2·5 mm. long, and 4·10 mm. to 80 mm. broad, the uterus of which shows only a few ova containing embryos at various stages of development.

Lastly, in 1859, Schlotthauber has designated by the name of *Piguris (?) reticulata* a worm he found in the caecum of the Horse and Mule.\(^6\)

We have no further information concerning these worms, the authenticity of which is at least doubtful, and the importance of which is surely small.

Larvae of the Diptera.—According to Cobbold, on several occasions larvæ of the hanging Helophilus (*Helophilus pendulinus* Még.) have been discovered in the digestive canal of the Horse.

The larvæ of the Gastrophilus, in process of evacuation, have also been observed in the intestines of the Equidae (see p. 353). It has been stated above, that those of the hemorrhoidal Gastrophilus stay in the

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\(^3\) Rudolphi. *Entozoorum Historia Naturalis, Amsterdam, 1809, II., part I., p. 63.


\(^5\) Diesing. *Systema Helminthum, II., p. 322.


\(^6\) Schlotthauber, quoted by Von Linstow. *Compendium der Helminthologie, Hanover, 1878, p. 56.*
last portions of the large intestine, attaching themselves to the mucous membrane; while those of the nasal Gastrophilus prefer to develop in the pyloric region of the duodenum, and are, therefore, likely to hinder the passage of the alimentary matters and give rise to colics.

Observation.—The various parasites which have been passed in review may be combined in more or less large numbers, and occasion a complex helminthiasis. The most remarkable instance of this kind is that which Krause has reported. In a horse were found 519 Ascaris megaloecephala, 191 Oxyuris curvula, 214 Sclerostoma armatum, several thousands of Sclerostoma tetracanthum, 69 Taenia perfoliata, 287 Filaria papillosa, and 6 Cysticercus fistularis.¹

**ARTICLE II.—Parasites of the Intestines of the Ox.**

Fungi.—The Ox is one of the number of Herbivora in which Remak—and after him Purkinje, Böhm, and Mitscherlich—found, in the normal intestinal mucus, the Saccharomyces (Cryptococcus) guttulatus Robin. It is a very simple vegetable in the form of ellipsoid or ovoid elongated cells, from 15 μ to 24 μ long, and 5 μ to 8 μ broad, dark brown and opaque, and containing two to four bright, transparent droplets. These cells are sometimes united in a confused mass by mucus; but they are usually isolated, arranged in twos—end to end—or one of the largest has at one of its poles two or three smaller cells which have been derived from it by gemmation. This mould appears to have no action on the animals in which it is found.²

The Aspergillus fumigatus—a mould already noticed as growing on the beak and other parts of the digestive apparatus of Pigeons (see p. 343), and which is developed more frequently in the respiratory passages of Birds—has been found several times by Franck in the wall of the small intestine, and in the mesenteric glands of cattle killed for food. It had caused the formation of caseous or calcified centres, which were distinguished from those of tuberculosis by their greenish colour, which extended to the peri-glandular connective tissue. These tubercles were miliary, and attained the volume of a pea; they were filled with pus containing the filaments of a mycelium that inoculation experiments and cultures demonstrated to belong to the Aspergillus fumigatus Fresenius.³

Sporozoa.—Pröger and Zürn have reported an observation of intestinal coccidiosis in calves analogous to that of the Rabbit. The disease manifested itself as a fastid diarrhoea, accompanied by slight fever and catarrhal phenomena in the upper air passages. Three calves—aged from 5 to 6 weeks—succumbed to the malady in 15 to 20 days. At the autopsy they were noted thickening, redness, and epithelial desquamation of the mucous membrane of the abomasum, near the pylorus, and in that of the intestine. In the small intestine there were somewhat extensive superficial ulcerations, and in the colon the mucous membrane was at certain points swollen and softened, and at others studded with miliary ulcers filled with a yellowish mass. The mesenteric glands,  

liver, and spleen were enlarged, soft, and ecchymosed. Numerous Coccidia were found in the intestine, liver, and glands. Rivolta classed these parasites, without any plausible motive, in his genus *Cytospermium*, by the designation of *Cytospermium Zurnii*.

**Cestodes.**—Like the Equidae, Cattle harbour three species of unarmed *Taenia*. These are typical Anoplo-taeniens, the genital pores of which are double on each segment, and the ova of which are irregularly polyhedral or cuboid, showing the embryo surrounded by a pyriform apparatus (Fig. 182). These three *Taenia* are altogether unknown in their cystic form.

1. *Taenia denticulata* (Rud.).—Length variable, but usually between 25 and 28 cm., though it may reach 1:70 metre. 2 Head powerful, 1:125 mm. broad—sometimes only 0·65 mm.—and divided into four globular lobes or suckers, which have a narrow orifice directed forwards. No neck. Segments very short and close together, especially in the anterior two-thirds of the strobila, where they are twelve to twenty times as broad as they are long; their posterior border is undulated and wider than the anterior, whence results the dentated borders of the chain. The last segments are as thick as they are long, and may be 25 mm. broad. The ova are 65 μ to 80 μ broad.

2. *Taenia expansa* (Rud.).—Length variable—from some decimetres to 4, 5, and 6 metres, and even more than 100 feet, according to Rudolphi. Head generally small—from 5 mm. to 8 mm.—slightly expanded; suckers a little salient, oval, opening elongated and turned outwards. Neck very short or *nul*. Anterior part of the strobila filiform. First segments very short; the others, longer, are always broader than they are long, their breadth attaining in the last segments of large worms 2½ cm. All the strobila are thin and translucent. The ova are 50 μ to 70 μ broad.

3. *Taenia alba* (Perr.).—This species was distinguished from the preceding by Perroncito. It is 60 in. to 2·50 m. long. Head larger,

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2 Humboldt says he has met with one measuring 45 metres (about 50 yards) in the intestine of a lean Cow, five years old.—*Berlin Thierärztl. Wochenschrift*. 
measuring 1.15 mm. to 1.40 mm. broad; suckers hemispherical, and opening obliquely forwards and outwards. Neck short, but distinct. Segments thicker, longer, and narrower than in *T. expansa*, and sometimes longer than they are broad, though rarely attaining more than 10 mm. to 12 mm. in breadth. The ova are 48 μ to 58 μ broad.

These three species are easily distinguished from each other; for *T. expansa* is semi-

transparent and very broad; *T. denticulata* has very short, broad, and thick segments;

while *T. alba* has comparatively narrow, long segments.

The *T. denticulata* is only met with in bovine animals, in which it appears to be more common than the other two species. *T. expansa*
appears to be more frequent in Sheep than in Bovines, and is also found in the Goat and some wild Ruminants. The *T. alba* is common in the Ox in Italy, where it has also been found in Sheep by Perroncito; Moniez has observed it at Lille, and Railliet at Alfort, in the Ox; while Blaise has sent us several specimens from an Ox in Algeria.

These three *Tænîci* inhabit the small intestine, and no trouble in the digestive functions of cattle has been ascribed to them; but Villars has mentioned the case of a Cow in which *T. expansa* appears to have induced serious colics; 1 and Sheep are reported to have suffered from the presence of this worm.

**Trematodes.**—A single species of Trematode has only been found in the intestine of the Ox. This is the *Amphistoma tuberculatum* Cobb., met with in cattle in India along with the Amphistomes of the rumen. There is no occasion to allude to the *Bilharzîa*, the ova of which may be found in the substance of the more or less altered intestinal mucous membrane (see *Helmetoza*).

**Nematodes.**—The Calf *Ascaride* (*Ascaris vituli* Gæze) 2 is of a reddish-white colour, and has a transparent integument when in the fresh state. The head is small and distinct, and has the lips enlarged at the base, constricted in their anterior two-thirds, their free margin being markedly denticulated. The posterior extremity is terminated by a kind of conical point. The *male* is 15 cm. to 20 cm. long, exceptionally 26 cm. The caudal papillæ form two irregular rows—very lateral—of 10 to 15 each, all pre-anal. The *female* is 22 cm. to 30 cm. long; the vulva is situated towards the anterior sixth of the body. The ova are 75 μ to 80 μ in diameter.

The *Ascaris vituli* is rare in adult animals, but quite common in the calf—especially in the South of France. In 1712, Vallisneri ascribed an epizoöty among calves in the neighbourhood of Padua, and to which many succumbed, to this worm; their flesh, it appears, acquired a very bad odour. 3 The parasite is very frequently seen in calves killed in the slaughter-houses in Toulouse, and sometimes it is counted by hundreds, and even thousands, in the intestine, being also met with occasionally in the abomasum. Local inflammations of the intestinal mucous membrane are noted in these cases, and they may give rise during life to colics, and exceptionally to rupture of the organ. Descomps has reported an instance of this accident, in which the intestine contained 15 litres of Ascarides. 4

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1 S. Villar. *The Veterinarian*, October, 1886.
3 Vallisneri. *Nuove Osservat. et Esperienze intorno all' Ovaja Scoperta ne' vermi tondi dell'Uomo e de' Vitelli*, Padua, 1713.
To expel the Ascarides of the calf, Guittard recommends the administration, in the evening after feeding, of 8 to 12 grammes of rectified empyreumatic oil in a mucilaginous emulsion, and next morning a purgative of sulphate of soda. The worms will be expelled in bundles in the course of the day.\(^1\)

**Strongylus ventricosus** (Rud.).
—Body filiform. Head small and slightly winged; no buccal papillae. Integument streaked by 14 longitudinal ridges, five of the largest being on each of the dorsal and ventral surfaces, and two smaller on each side. *Male* 6 mm. to 8 mm. long; caudal pouch wide, and obscurely trilobate. *Female* 11 mm. to 12 mm. long; vulva situated behind the middle of the body, and surrounded by a cutaneous enlargement, from which it derives its specific name. This worm inhabits the small intestine of Cattle and the European Deer. No morbid influence is attributed to it. In consequence of its smallness, it often escapes notice.

**Esophagostoma inflatum** (Sch.).—Mouth circular, with a prominent ring having six papillae. Anterior extremity provided with an ample cutaneous transparent enlargement, immediately followed by two lateral membraneous wings, which are traversed by two papillae. *Male*, 14 mm. to 15 mm. long, with caudal pouch faintly trilobate. *Female*, 16 mm. to 20 mm. long; vulva situated a little in front of the anus, and surrounded by a ring (Railliet). This species, which inhabits the large intestine of the Ox, has been separated from the genus *Strongyulus*, and placed in the *Esophagostoma* by Railliet.

**Uncinaria radiata** (Rud.). — This worm was found by Rudolphi in the duodenum of a calf. The *male* measures about 15 mm., and the *female* 25 mm.

**Trichocephalis affinis** (Rud.). — So called by reason of its resemblance to the Trichocephalus of Man (*Tr. dispar* Rud.—Fig. 158), this species has the head sometimes furnished with two transparent vesicular enlargements in the form of wings. The marginal papillae of the longitudinal band are larger than the

\(^1\) Guittard. *Le Progrès Vétérinaire*, 1890, p. 144.
others. The male and female measure, each, 6 cm. to 8 cm. long. The spicula of the male is very long, and its sheath, which is very long also, is studded with triangular spines, the points of which are posterior (Fig. 191).

The Tricocephales affinis inhabit the large intestine—and particularly the caecum—of the Ox; but they are more rare than in the Goat, and especially the Sheep. In general, they attach themselves very firmly to the mucous membrane; but they do not cause any trouble. Leuckart has remarked that the ova of this species, when kept in a damp place, develop their embryos in a variable period, according to the season; but it may be several months in cold weather. When these ova are swallowed by Sheep, they are transformed into Trichocephales, which are adults in about sixteen days. The investigations of Grassi have placed beyond doubt the fact, that this development does not require an intermediate host.¹

Other Nematodes.—Von Linstow² again mentions—no doubt follow-

ing Leidy—the *Filaria papillosa* Rud., and *Trichina spiralis* Owen, as found in the intestines of Bovines; but there is certainly an error with regard to the first parasite, and the second could only be found after infestation experiments on cattle with trichinous flesh.

Drechsler has found beneath the intact mucous membrane of the intestines of an Ox—the other organs of which were healthy—about 450 nodules the size of a pin's head to that of a pea, the majority of which had undergone caseous degeneration. Spherical in shape and well defined, they were composed of strong fibrous tissue, and each contained an undetermined Nematode—or, rather, a larva—about 1 mm. long, and which had two conical cephalic papillae. These were probably the larvae of *Strongyloides*.

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*Fig. 191.* *Trichocephalus affinis*; largely magnified specimens.—Delafond.

A, male; B, female; c, cephalic extremity; i, intestine; a, anus; t, testicle; vs, seminal vesicle; g, sheath of the spicula; ov, ovary; v, vulva; C, ovum; magnified 200 diameters.

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ARTICLE III.—Parasites in the Intestines of the Sheep.

FUNGI.—The Saccharomyces guttulatus Robin has been found by Remak in the intestinal mucus of the Sheep, as in the Ox.

INFUSORIA.—Grassi has discovered in the intestine of the Sheep a Flagellate (Euflagellata)—the Lamblia intestinalis Blanchard (see p. 318), which has been very often seen in Man, and which is very common in the Muridæ—Rats, Mice, Meadow-Mice. This Infusorium is 9 µ to 16 long, and 4 µ to 7 µ broad; it is pyriform, the base being anterior. One of the surfaces shows a depression or deep reniform sucker—the hilus of which is behind—that occupies the anterior two-fifths. It has four pairs of flagelli directed backwards, three of which are fixed on the borders of the depression; the fourth continues the body posteriorly. The body itself is transparent and colourless, and covered by a very fine cuticle. There are two nuclei at the bottom of the sucker.1

SPOROZOA.—Leuckart includes the Sheep among the Mammalia which have Coccidia in the intestines, more or less like those found in the liver of the Rabbit, and in the intestines of the Dog, Cat, etc.

CESTODES.2—The sheep is—after the Dog—the domesticated animal which most frequently harbours the largest number of Tænia in its intestine. These Cestodes belong to eight distinct species, all of which are unarméd, and all of which are unknown in their cystic form. Four of them are diphyliANS (see p. 382): Tænia expansa, T. alba, T. Benedeni, T. fimbriata—the first two being common to the Ox and Sheep. The others—T. Vogti, T. ovilla, T. centripunctata, T. globipunctata—have the genital pores single in each segment and irregularly alternated; they are only found in the Sheep.

1. Tænia expansa (Rud.).—This is easily recognised by the characters already described (p. 412), and in particular by its yellow, thin, and translucent segments, the breadth of which is always greater than the length; it is at least 1 cm. in the ripe segments, and may attain $2\frac{1}{2}$ cm.

2. Tænia alba (Perr.) is distinguished from the preceding by its thicker segments, which are sometimes longer than they are wide, but rarely exceed 10 mm. to 12 mm. in breadth (p. 412).

3. Tænia Benedeni (Moniez).3—A worm 4 metres long, and even more. Head globular and small—6 mm. to 9 mm. in diameter—and succeeded by a filiform portion 4 cm. to 5 cm. long, in which the segments are already marked. The segments are all very thick, and much wider than they are long—their breadth may exceed a centimètre, and their length be not more than 2 mm. The muscular layer of one surface is

less than that of the other. There are two genital pores in each segment, Ova are rounded polyhedrals in shape, from 75 μ to 80 μ in diameter, and distinctly show the pyriform apparatus surrounding the embryo.

These three species are very closely related to each other.

4. **Taenia fimbriata** (Dies.) 1—A worm measuring 15 cm. to 30 cm.; head tetragonal and 1 mm. to 1.5 mm. broad. The last segments are a little narrower than those preceding them, and the chain is therefore somewhat attenuated at both ends; the greatest width is 7 mm. to 8 mm. There are two genital pores in each segment.

The most remarkable feature in this Taenia is the fringe on the posterior border of each segment, which gives the strobila an exceptional appearance.

5. **Taenia Vogti**. 2—This species is only known by a headless fragment, measuring about 50 cm. long. It is a very thin, flat worm, remarkable for the general shape of the segments, which are longer than are usually seen in unarmed worms; those which have mature ova are nearly 5 mm. long, which is much more than their width—2.5 mm. The ova are 29 μ in diameter; and the embryo, with its pyriform apparatus, measures to its point 21.5 μ long; without this apparatus it is 14.5 μ in diameter.

6. **Taenia of the Sheep** (T. ovilla Rivolta, T. Giardi Moniez, T. aculeata Perroncito). 3—Two or more metres long. Head tetragonal, and a little more than 1 mm. broad; it is succeeded by a long neck, one-half the width of the head. The segments are always very short, but gradually increase in width and length to the last, which are 5 mm. to 10 mm. in breadth, and 1 mm. to 1.5 mm. in length. The testicles are situated laterally, between the marginal border of the segments and the longitudinal canals. The genital pores are single on each segment, and irregularly alternated. At a metre from the head, the penis in every segment is sometimes quite salient, and this gives to the strobila a peculiar aspect—*T. aculeata*. Grouped in lots of six to ten in the numerous globular diverticuli of the uterus—kinds of fibrillated shells that render the broken segments finely granular in appearance—the ova are spherical or ovoid, and measure 16 μ to 25 μ in diameter; their embryos have no pyriform apparatus.

7. **Taenia centripunctata** (Rivolta). 4—Head 1.5 mm. to 2 mm. broad. Length of the strobila 2.75 m. to 2.85 m. The head is suc-

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ceed by a narrower portion, in which the segments are faintly marked by fine transverse striations. At a decimètre from the head —where their width varies from 2 mm. to 4 mm.—the segments are remarkable for their relative dimensions, being the more narrow and thick as they are posterior—the last are scarcely more than 1 mm. broad, but they are very thick. Their length is always inconsiderable, but increases from before to behind—varying from $\frac{1}{10}$ to $\frac{1}{3}$ of a millimètre. The genital pores are single in each segment and irregularly alternated; they are little apparent, and open in the middle of one of

![Fig. 193. Segments of the anterior region of the *Tania fimbriata*; magnified ten diameters.—Railliet (inedited).](image1)

![Fig. 194. Lateral portion of the last segments of the *Tania fimbriata*; magnified ten diameters.—Railliet (inedited).](image2)

![Fig. 195. Two segments of *Tania ovilla*; magnified twenty diameters.—Rivolta.](image3)

![Fig. 196. Transverse section of a segment of the *Tania ovilla*, showing the arrangement of the ovigerous capsules; magnified forty diameters.](image4)

the sides. The testicles are symmetrical, and situated within the longitudinal canals. In the centre of each segment in the posterior moiety of the strobila, the naked eye can detect a slightly prominent white spot formed by the uterus. Ova few in number in each segment, globular, from 21 $\mu$ to 24 $\mu$ in diameter, and without the pyriform apparatus.

8. *Taenia globipunctata* (Riv., *T. ovipunctata* Riv.).—A very

1 Rivolta. *Sopra Alcune Specie, etc. (loc. cit.)*—We place in a single species the *T. globipunctata* and *T. ovipunctata* of Rivolta, as the descriptions he gives under both names do not furnish any really differential character. We have to acknowledge our obligation to this authority for a labelled specimen, *T. ovoglobipunctata*, which proves the impossibility of separating the two supposed types.
PARASITES OF THE INTESTINES.

421
delicate diaphanous worm, 45 cm. to 60 cm. long. Head ·5 mm. to 1 mm. broad; suckers directed forward. No neck. The mature segments are 2 mm. broad, and ½ to ½ millimètre long. Testicles lateral, and external to the longitudinal canals. Genital pores single in each segment, and irregularly alternated. Each segment has a double uterus, which appear to the naked eye or hand-lens as two longitudinal series of opaque points, doubled outwardly—in the anterior part of the strobila—by the spermidiucts, the middle line of the strobila remaining transparent. Ova globular, from 15 μ to 21 μ in diameter, and destitute of pyriform apparatus.

These eight species of Tæniae of the Sheep are easily distinguished from each other by referring to the following table:

<table>
<thead>
<tr>
<th>Two genital pores in each segment</th>
<th>Broad segments—10 mm. to 25 mm., transparent, always wider than long</th>
<th>T. expansa.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Posterior border slightly undulated.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Thick segments, opaque, becoming longer than they are wide—10 mm.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>in width at most</td>
<td></td>
</tr>
<tr>
<td></td>
<td>T. alba.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Posterior border of the segments fringed.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Thick segments, opaque, always broader than they are long</td>
<td></td>
</tr>
<tr>
<td></td>
<td>T. Benedini.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>One genital pore in each segment</th>
<th>Mature segments longer than they are wide.</th>
<th>T. Vogti.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Segment always broader than they are long.</td>
<td>T. orilla.</td>
</tr>
<tr>
<td></td>
<td>Mature segments 5 mm. to 10 mm. broad</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Opaque in the middle line.</td>
<td>T. centripunctata.</td>
</tr>
<tr>
<td></td>
<td>Transparent in the middle line.</td>
<td>T. globipunctata.</td>
</tr>
<tr>
<td></td>
<td>1 mm. to 2 mm. broad.</td>
<td></td>
</tr>
</tbody>
</table>

These various Tæniae are far from having the same importance. Thus, Moniez has only seen one individual of T. Vogti; and Rivolta has only once met with his T. ovilla, of which Perroncito has received two specimens—T. aculeata. It is true that, according to Moniez, this species—T. Giardi—is very common at Lille, but it is not believed to cause any harm to the Sheep.

T. centripunctata has been found by Rivolta in the small intestine of an anæmic Sheep. At the point they occupied, the mucous membrane was partly red in consequence of the hyperæmia of the villi, and partly pale or grayish, because of their pigmentary degeneration. Matozzi has met with the same entozoa, but he only noted catarrh of the mucous membrane. Blaise, who has sent us several examples from Algeria, does not make any remark as to lesions.

With regard to the T. globipunctata, those that Rivolta has described had their head deeply buried in the intestinal mucous membrane. Their presence had brought about degeneration in a large number of villi, irritation of Lieberkühn’s glands, and the formation of isolated or confluent inflammatory nodules, from the size of a pea to that of a lentil.

The diphylidian species are broader and more voluminous, and have a more important pathological rôle.
The *T. fimbriata*—first found by Natterer in various kinds of South American Deer—is very abundant in the western plains of the United States, and its presence does not induce a very characteristic *taeniasis*—being merely a pernicious anaemia, the same as is so often observed in flocks of Sheep. It has great analogies with that attributed, in Europe, to *T. expansa*, and in the etiology of which other species—at least *T. alba*, and doubtless also *T. Benedeni* (which appears to us to be very frequent)—may have a large share.

When these *T. expansa* are not numerous, they do not produce any appreciable disorder in the digestive functions. But it is otherwise in some instances—rare in France, but more common in Germany—in which, by their number or by their length, these worms are the cause of a serious epizooty among the lambs and year-old Sheep—the disease being known to the Germans as the *Bandwurmseuche.*

The commencement of the disease is obscure. There is paleness of the skin and visible mucous membranes, the fleece is brittle and poor in fine wool; then follows emaciation and an arrest of development, although the animals eat and drink more than usual. Soon various disturbances in the digestive functions are manifested, rumination is irregular, breath unpleasant and nauseous; there are colics, constipation, distension of the abdomen, either because of the retention of the accumulated faecal matters, and which can be felt on pressing the abdominal walls, or by the gas that inflates the intestines. When the defecatory efforts are successful, the faeces are noticed to be soft, mixed with a yellowish mucus, and there are often some segments of *T. expansa*. The Sheep become more and more emaciated and feeble; they can scarcely move, and follow the flock with great difficulty. They are at times seized with convulsions, and at last colliquative diarrhoea brings them to the final stage of debility and cachexia, in which—unable to rise—they lie stretched out on the ground, and quickly perish from exhaustion.

(Many outbreaks of fatal diarrhoea due to *Taenia expansa* are on record. In 1855, Cox described one; in 1877, an enzoöty occurred in Central Park, New York, in which the intestines of lambs were filled with *Taenia* fifteen feet long, and which would fill a twelve-ounce measure glass. The animals were for two or three days unwell; they then became affected with convulsions, would turn round in a circle, and drop dead. Cross, of Shrewsbury, in 1877, dealt with 'scouring' in lambs, in the semi-fluid faeces of which were innumerable segments


(3 American Veterinary Journal; *The Veterinarian*, August, 1877.)
PARASITES OF THE INTESTINES.

423

with double sexual organs and unarmed heads. Cobbold\(^1\) mentions being consulted concerning loss from worms of 1,200 out of 8,000 Sheep, on a farm to the north-west of Sydney, New South Wales. Tænie several fathoms in length were said to have been discovered in the intestines, together with certain Nematodes. And Gamgee mentions that in Australia, especially on overstocked land, Tænie infest lambs, and give rise to an enzooity that kills many. The tapeworm segments may often be seen on the washed soil, after a heavy fall of rain. The parasites cause pain and emaciation, and predispose the animals to other disorders. They cause loss not only by fatalities, but by reduction in value and amount of fat. Curtice\(^2\) observed young and adult Tapeworms in immense numbers, in 87 per cent. of Western Sheep and lambs examined in Colorado, United States of America, in 1887. The Sheep were diseased in direct relation to the prevalence of the parasites, which he thought were new, and similar in species to that found in the Brazilian Deer; but which were probably \textit{T. expansa}. The outbreak prevailed from Oregon and Wyoming on the south, to Nebraska and Kansas on the west, the parasites being present from May to January, chiefly in the duodenum.

The diagnosis, embarrassing at first, is decided by the appearance of the proglottides thrown out along with the faeces. In any case, if there is difficulty in deciding as to the nature of the malady, the doubt can be dispelled by killing a sick lamb and examining it, when numerous Tænie will be found obstructing the intestine. The other animals can then be treated with certainty.

Although this tæniasis may manifest itself among Sheep kept in the fold, yet it is most prevalent among the young animals grazing, and it is quite probable that they take up the \textit{T. expansa} in its cystic or larval form, with the grass when at pasture. The disease, in fact, shows itself in wet years, and in damp marshy regions, as there are in these conditions favourable to the preservation of the germs of Tænie. Although lambs with the ewe are often affected—and in those of four weeks Spinola has found worms 10 mètres long—yet it cannot be admitted that the germs of the Tænie reach them during foetal life, or through the milk of the dam, as has been hypothetically stated. It is more likely that these young animals infested themselves in picking up, here and there, some stalks of herbage in the pastures, or directly in some other way not yet ascertained.

It is obvious that flocks should be kept away from suspected pastures. (If possible, infested pastures should be ploughed up, or top-dressed with sodium chloride, sodium nitrate, lime, gas lime, or any other substance likely to destroy the germs at a period when these are on

\(^1\) Cobbold. \textit{The Veterinarian}, 1876, p. 675.)

\(^2\) Veterinary Record, I., p. 59.)
the ground. More especially should the faces, with ova and worms, be destroyed by burning or other means.)

Treatment is only likely to be of avail before cachexia has set in. Each animal should receive a teaspoonful of Chabert's empyreumatic oil (oil 1 part, oil of turpentine 3 parts), with 25 to 35 centigrammes of tartar emetic; later, every day there should be given 15 grammes of tansy-root for six or seven days. Zürn recommends picrate of potass in doses of 0.6 to 1.25 grammes in pill every day, a purgative being given afterwards.

The comparative experiments of Hartmann show that kamala is an excellent tænifuge for the Sheep. He prescribes it in doses of 3.50 grammes, suspended in water, and repeated once at four hours' interval. Philippi has made trial of picrate of potass, areca-nut, the ethereal extract of male shield-fern, and kamala, and gives preference to the two latter remedies. He administered the first in 3 and 4 gramme doses, and the second in 5 and 6 gramme doses, giving a dose of castor-oil three hours afterwards. Mojkowski considers naphthaline superior to kamala as a tænifuge; he gives it in 1 gramme doses twice a day for a week, terminating the treatment with a sulphate of soda purge.¹

**Nematodes.**—Ascaride of the Sheep (*Ascaris ovis* M. C. V.).² This is yellowish-white in colour, and somewhat attenuated at both


² Museum Cæsareum Vindebonense—Imperial Museum of Vienna.
extremities. The head is small; each lip has finely denticulated borders, the superior lip having two papillae, and each of the others only one. The male measures 7 cm. to 10 cm. long, and 2 mm. thick; its caudal extremity has—on the ventral surface—two rows of 45 to 50 papillae each, three of which are post-anal, and one single at the very end of the body. The female is 7 cm. to 12 cm. long, and of the same thickness as the male; the vulva opens towards the anterior third of the body.

This species was only known by one female specimen seen in the Vienna Museum by Diesing, and already mentioned by Rudolphi in 1819, until we gave a description of it. It is therefore very rare. R. von Drasche\(^2\) considers as belonging to a different species two females found in a Sheep by Kölbl, but in a bad state of preservation.

Strongylus filicollis (Rud.).—A white or rosy-white filiform worm. The integument is marked by eighteen longitudinal ridges. Head very small, and margined by two little membranous wings. Male, 8 mm. to 15 mm. long, with bilobate caudal pouch. Female, 16 mm. to 24 mm. long, with the anterior portion very thin, and its posterior part short and somewhat expanded (hence the specific name); vulva situated behind the middle of the body.

The Strongylus filicollis inhabits the small intestine, particularly the duodenum of the Sheep and Goat. Railliet has found it in the abomasum of the Sheep, in company with the Strongylus contortus, with which it appeared to play the same part. The small intestine may contain myriads of this parasite, as Railliet, and probably Chéd-homme, has remarked. By its presence it may set up irritation in the mucous membrane, and by the blood it abstracts will induce pernicious anaemia. Curtice says it is frequent in autumn and winter in the United States of America; but it does not appear to be blamed for any serious damage.

Wedl has described, by the name of Trichosoma papillosum, a Nematode that he has found in considerable numbers in the intestine of a Sheep; but Curtice remarks that these were very probably young of the Strongylus filicollis.¹

Strongylus ventricosus (Rud.).—This parasite of the Ox's intestine has also been found in that of the Sheep by Curtice.

Œsophagostoma venulosum (Rud.).—Mouth circular, and surrounded by a raised ring that has six papillae. The neck is marked by an ovoid enlargement; and a little behind this are two lateral papillae, and behind these, again, is the commencement of two membranous wings. Male, 15 mm. to 16 mm. long; caudal pouch slightly trilobate, and broader than it is long. Female, 23 mm. to 24 mm., vulva situated a little in front of the anus. This Nematode has been more especially found in the Goat, in which it is rare, however. Railliet has discovered it in the Sheep, Chabin (long-woollen Sheep of Berry, France), and Roe-deer, and he considers it as belonging to the same species as two female Nematodes that Carita found in the intestine of a Sheep, along with Sclerostoma hypostomum and Uncinia cernua.²

Œsophagostome of Columbia (Œs. Columbianum Curtice).³—Body a little attenuated before and behind. Mouth circular, sustained by a horny ring, armed with two crowns of teeth—of which the internal are the smallest—and surrounded by a cutaneous ring on which are six pointed papillae. This ring is succeeded by a slight elongated constriction, terminated by another ring at the ventral transverse slit. Towards the anterior fourth of the œsophagus are two opposed papillæ, and at the anterior quarter of the body are two narrow wings on each side. Male, 12 mm. to 15 mm. long; caudal pouch slightly sinuous and shallow, with its ribs arranged as in Œsophagostoma dentatum (Fig. 209). Female, 14 mm. to 18 mm. long; vulva situated a little in front of the anus. Eggs ovoid, and 90 μ long by 50 μ broad.

This species—which is closely related to the Œs. dentatum of the

³ C. Curtice. The Animal Parasites of Sheep, 1890, p. 165.
Pig—is, according to Curtice, frequent in adult Sheep in the South of the United States, and is more particularly observed in the autumn and winter; it does not cause any trouble except when in great numbers. The symptoms have nothing characteristic, and are those of insidious anaemia slowly leading to marasmus. This Esophagostome is found in the adult state in the cecum and first portions of the large colon. But it appears more frequently in the larval condition—3 mm. to 4 mm. long, and lodged beneath the mucous membrane in tumours varying in size from that of the head of a pin to that of a hazel-nut, each of them containing a worm. The mucous membrane is sometimes so studded with these tumours that great inconvenience is experienced in preparing the intestines for sausage-making.

**Sclerostoma hypostomum** (Duj.). — Body white, filiform, cylindrical, and rigid. Head globular, slightly curved and obliquely truncated towards the ventral surface; mouth furnished with a double row of narrow, sharp teeth, and surrounded by six papillae. Male, 10 mm. to 20 mm. long; caudal pouch short, obliquely cut, and campanuliform. Female, 13 mm. to 23 mm. long; tail often encrusted with a dark yellow substance, and terminating in a sharp point curving upwards; vulva situated a little in front of the anus. This worm is common in the large intestine of the Sheep and Goat. Carita accuses it— as well as the next species—of causing fatal anaemia in a Sheep he had under observation, and the intestinal mucous membrane of which was covered with red punctures. Friedberger and Fröhner also state that the *Sclerostoma hypostomum* may induce slight colics, and that at the autopsy they have seen the small intestine full of minute punctiform haemorrhagic spots—the intestinal contents being the colour of chocolate. According to the observations of Baillet, the ova undergo, externally, a series of modifications the same as those through which the Sclerostomes of the Equidae pass. There is, therefore, reason to believe that the *Scl. hypostomum* is also ingested as an embryo, in the water drunk by Sheep and Goats.¹

**Uncinaria cernua** (Crep., *Monodontus Wedli* Molin).—Body yellow or reddish, rigid, and attenuated at the extremities. Head thin and raised behind. Mouth circular and opening into an ovoid buccal capsule armed with four teeth—two on each side, the base of which is imbedded in the capsule, and the free extremity is curved hook-like towards the interior of the cavity; the two ventral teeth are strong, raised behind the head, and frequently not visible externally.

the dorsal ones narrow; the dorsal rib also buries its conical point in the capsule; lastly, the armature is completed by the two deep ventral lancets. Male, 15 mm. to 18 mm. long; caudal pouch deep and infundibuliform. Female, 20 mm. to 28 mm. long; vulva placed a little in front of the middle of the body (Railliet). This species lives in the small intestine, and sometimes in the large intestine, of the Sheep and Goat. Nothing precise is known as to its morbid effects, nor as to its migrations.

**Trichocephalus affinis**.—This parasite has been already described (p. 415) among the entozoa of the Ox, in which it is much more rare than in the Sheep. Its pathological effects are unknown, but very probably they are insignificant. (Simonds states that when a number

of Sheep suffer at the same time from diarrhoea with much mucus, and their appetite is increased, the disease is generally due to these worms.)

**Rhabdonema longus** (Grassi).—Grassi has discovered in the intestine of a Sheep, an Anguillule nearly identical with the intestinal Anguillule of Man (see p. 387), but of larger size. The female measures 6 mm. long. The body is a little attenuated in front, and terminates behind by a round conical tail, which may be even a little dilated at its extremity. The triangular mouth has three small lips, and opens into an almost cylindrical, long oesophagus, which is continued by the intestine without any marked transition. The vulva is situated in the posterior third of the body.

This Anguillule may have—like that of Man—a free generation if the larvæ are kept at a temperature above 25° (Cent.). But while

among the worms which have reached maturity there are—with the *Rhabdonema strongyloides*—about one male to eight females, nearly all here are females, which rarely show ova in process of segmentation, and larvae resulting from free generation have not yet been seen. In addition, the mature *Anguillula stercoralis* of the Sheep are much smaller than those of Man. The chief difference between the two species is that, in the *Rhabd. strongyloides*, the intestinal form is derived indifferently either from the larvae of the Anguillula transformed external to the human body, or from larvae emanating from a free generation; while in the *Rhabd. longus* this second mode of reproduction is doubtful, or at least very rare. This latter species does not cause any particular trouble in Sheep.

**Article IV.**—*Parasites of the Intestines of the Goat.*

**Cestodes.**—Rudolphi gave the provisional name of *Taenia caprae* to fragments of tape-worms without a head which had been found in the ileum of a Goat, and was led to consider this as a species intermediate to the *T. expansa* and *T. denticulata*. Apart from this exceptional mention, all the *Taeniae* met with in the Goat have been classed with *T. expansa*, which has already been described among those of the Ox and Sheep. In some exceptional instances, this worm may, by its accumulation, cause accidents similar to those we have seen it produce in the Sheep. The same remarks and treatment will therefore apply to it.

**Nematodes.**—Five species of Nematodes have been noted in the intestines of the Goat: they have also been seen in the Sheep, and are: *Strongylus filicollis*, *Oesophagostoma venulosum*, *Sclerostoma hypostomum*, *Uncinaria cernua*, and *Trichocephalus affinis*. There is nothing to add to what has been said about these parasites in the Sheep.

**Article V.**—*Parasites of the Intestines of the Pig.***

The Pig affords asylum to a large number of intestinal parasites—a circumstance readily explained by the diversity and frequent impurity of its food. But it offers the remarkable and inexplicable peculiarity that, up to the present time, no adult form of Cestode has been discovered in it.

Tardieu¹ has, however, observed in a Pig symptoms of epilepsy which disappeared on the adoption of an anthelmintic treatment. The animal passed 'a considerable quantity of worms, which appeared in pellets at the anus, and amongst them,' says that authority, 'I recognised portions of the solitary worm (*taenia*), which I suspected to be the principal cause of the disease.'

The majority of the intestinal parasites of the Pig are Nematodes, though it is possible there may also be present Distomes—*Distoma hepaticum* and *D. lanceolatum*—which have escaped from the bile ducts into the digestive canal.

Protozoa.—Independently of a Trichomonas that Künstler has met with in the intestine of the Pig, there is very often found in the rectum of this animal a ciliated Infusorium of the order of Herotriches—the Balantidium coli (Stein).  

This is an ovoid animalcule, 70 μ to 100 μ long, and 50 μ to 70 μ broad. The body is enveloped in a thin cuticle, which is longitudinally striated from one pole to the other, with very short, vibratile cilia between them, which form a covering to the whole of the surface. The body is composed of a fine granular matter, surrounded by a kind of cortical layer of bright and transparent protoplasm, in which are seen the nucleus and contractile vesicles. The nucleus is situated in the anterior moiety, and is large and elliptical, or slightly curved; it has no nucleolus. The contractile vesicles are usually two in number, and are unequal in size, the largest and most constant being placed near the posterior extremity, the other near the middle of the body; they execute slow and feeble contractions. At the anterior pole is an indfundibulum depression, somewhat on the ventral surface; this is the peristome. Its anterior border is nude; the posterior border has a row of long stiff cilia (adoral cilia), which have an active rotatory vibration. The peristome ends in the mouth, which is continued by a short canal embedded in the peripheral protoplasmic zone, and terminates in a cul-de-sac at the internal granular mass. The anus is situated at the posterior pole, and is with difficulty recognised except for the expulsion of the remains of the digestive materials. Reproduction may take place by the conjugation of two individuals, and is usually accomplished by transverse division.

The Balantidium coli was observed in Man for the first time, by Malmsten, in 1856, and since then (1863) by Leuckart, as being always present in large numbers in the colon and rectum of Pigs in Saxony. In order to find and observe it, it is sufficient to introduce a sound into the rectum, and among the mucus and feculent matter brought out with that instrument, the Infusoria may be seen by means of the hand-lens, in the form of small white points moving about. This observation of Leuckart has been confirmed in many localities in Germany and Sweden by Stein, Ekeckrantz, and Wising; in Italy by Grassi; in St. Petersburg by Raptchewsky, who has found the Balantidium in large quantity in three Pigs out of eighteen; and Railliet has met with it

in all the Pigs he examined at Alfort. We have also seen it at Toulouse.

The Balantidium coli move about in every direction in the water in which the rectal matters have been placed; but after a certain time they become motionless, contract, lose their short cilia, then the adoral ones, and each appears as a minute ball 80 $\mu$ to 100 $\mu$ in diameter, from around which the cuticle finally separates. In the half-dried excrements of the Pig, similar cysts are found; they have a great power of resisting destructive influences, and it is admitted that these Infusoria are introduced in this condition into the digestive canal of the animal, after having soiled its food.

The Balantidium is indifferent to the intestines of the Pig; but in Man—in whom it has been found in Russia, Sweden, Italy, Cochin-China, and China—its presence coincides with violent digestive disturbance, which is more especially betrayed by profuse and obstinate diarrhoea. In this centres our interest in it, for the Pig—it's natural host—probably transmits the parasite to Man as a consequence of the dispersion of the cysts. Calandruccio and Grassi are nevertheless convinced that there is a specific difference between the two species, basing their opinion on the circumstance that they have not been able to develop this parasite in Man by the ingestion of cysts derived from the Pig. And, on the other hand, Wising had already remarked that the Balantidium of Man is much smaller than that of the Pig.

Acanthoccephales.—The Pig and wild Boar are the natural hosts of the best known species of this order—the Echinorhynchus gigas (Goeze)—which is also found in the collared Pecari (Dicotyles torquatus or Taja9u) and striped Hyæna.

The giant Echinorhynchus is a cylindroid worm, often expanded at several points in its length, of a milky-white tint, sometimes shaded with green or violet, irregularly wrinkled transversely, and attenuated behind. The anterior extremity consists of an almost globular proboscis, garnished with five or six transverse rows of hooks curved backwards, and irregularly arranged in quincunx (like a chess-board). The male is 6 cm. to 9 cm. long, and 3 mm. to 5 mm. broad; it has a campanuliform canald pouch. The female is 20 cm. to 35 cm. long, and the posterior part of the body is obtuse. The ova are oblong, almost cylindrical, and provided with three envelopes, in which the embryo appears several days after the eggs have been laid. It has the shape of a truncated cone, and being longer than the egg, its tapering extremity is folded up in the shell; the anterior part has four hooks similar to those of the armed Tænia, and several other smaller ones.

In the adult state, this worm infests the small intestine, and particularly the duodenum—rarely the large intestine. It is found floating in the fluid contents of the canal, or more frequently it is fixed to the
mucous membrane by its proboscis, the anterior part being turned towards the stomach.

Its presence causes a variable degree of irritation at the points where it attaches itself. It may bury itself more or less deeply in the mucous membrane, penetrating as far as the muscular, and even the serous, coat, or entirely perforating the wall of the intestine and opening the peritoneal sac, thereby setting up fatal peritonitis. Most frequently, however, the lesions are limited to a number of small tumefied wounds, the size of a pin's head; or there are salient cicatrices, which would indicate that the worm often changes its hold.

According to Kocoureck, the intestine which harbours the Echinorhynchus looks pearly white externally, but its walls contain abscesses the size of a hempseed, encircled by a red areola, in the centre of which is the proboscis of the Worm. At other points the mucous membrane is of a slaty-gray colour, thickened, and covered with exudate. The more or less complete perforations in the wall of the intestines are often so numerous as to render them useless in the manufacture of sausages.

When the worms are numerous in the intestines, they cause marked disturbance in nutrition. Hurtrel d'Arboval\(^2\) says the Pig is wasted, 'there is weakness of the loins, and the hind-quarters are stiff. While feeding in the morning and evening it continually groans, and if it eats with others it bites them; but as it is so weak, when they resent the attack it falls. Its eyes are sunken and pale; the excrement is hard and highly coloured; the debility goes on increasing, and at last the animal can neither rise nor stand.' This picture—precise though it is—

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PARASITES OF THE INTESTINES.

appears to be rather inductive than really observed. Friedberger and Fröhner give the following symptoms: 'Loss of appetite, constipation, restlessness; the animals paw and burrow, and apply the snout or teeth against the abdomen; emaciation increases; there are convulsions and epileptiform spasms; with young Pigs death may ensue in three or four days. Frequently the malady assumes an epizootic form.' A diagnostic element might be found in a microscopic examination of the feaces, which should show the ova of the worm, in which the embryo is not yet present.

The giant Echinorhynchus is common in France and Germany; according to Dujardin, it has been found in Vienna in about one of every four Pigs. Cloquet\(^1\) says that the Limousin Pigs killed in Paris are more affected than those of the other provinces. Köhler\(^2\) asserts that these worms are now more rare than formerly. Wyman and Leidy have found them in Hogs in the United States of America. According to Cloquet, they are more frequent towards the end of winter than at any other time. We have never met with them at Toulouse. (Cobbold\(^3\) says that, fortunately, it is not of frequent occurrence in England.)

Schneider\(^4\) states that the development of the worm requires an intermediate host, and that this is the White Worm—the larva of the ordinary May-bug (Melolontha vulgaris). The ova of the intestinal

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\(^1\) Cloquet. Anatomie des Vers Intestinaux. Paris, 1824, p. 64.
\(^3\) Cobbold. The Internal Parasites of our Domesticated Animals, p. 23.)
Echinorhynchus are eliminated with the faces, spread over the ground or carried into the dung-pit, and in these conditions are eaten by the White Worms, and hatched in their intestines; the embryos bore through the walls of these by means of their hooked proboscis, and making their way into the abdominal cavity, become encysted there. In this state they remain during the existence of the larva, and even after its metamorphosis into the perfect insect. If the Pig devours these White Worms or the May-beetles, the cyst-membrane is dissolved in its intestines, the young Echinorhynchus is set free, attaches itself to the mucous membrane, and gradually acquires its complete development. The researches of Leespé had long before revealed the necessity for an intermediate host; he had caused the ovum of Echin. gigas to be hatched in the intestine of several species of gastropod mollusces—Helix pomatia, H. hortensis, Limax maximus, Arion rufus; and had found a larva in the liver of a helix. What militates against Schneider's opinion, is the fact that the larva of the May-beetle is essentially phytophagous—it only lives on roots, and is not found in manure-pits. Perhaps Kaiser has indicated the real intermediate host; for, according to him, the ovum of Ech. gigas thrown out on the ground with the excrement of the Pig, is swallowed by the larva of the common rose chafer (Cetonia aurata); the embryo then bores through the shell, which has been softened by the gastric juice, passes through the cuticle, and stops at the subjacent muscular layer, where it pursues its evolution (Blanchard).

As there is little information with regard to the pathological effects of the Echinorhynchus, we are still less advanced as to the medicaments to be employed against it; but it would be useful to try experiments with those drugs prescribed for the other entozoa.

(It may be mentioned that Leuckart states that Echinorhynchus gigas only appears in those swine which have been fed in the open air.)

NEMATODES.—The Ascaride of the Pig (Ascaris suilla Duj.—Figs. 117, 120) bears such a close resemblance to the Ascaride of Man (A. lumbricoides Linn.—Figs. 153 to 155) that several authorities—Leuckart, Schneider—consider they both belong to the same species, the first being, at most, only a variety.

Like the other, this has a milky-white, firm, elastic body; the head is small; the three lips denticulated, the upper having a papilla at each of its inferior angles, the two others only one at the middle of their base. The male is 15 cm. to 17 cm. long, and about 3 mm. thick; the caudal end has 68 to 75 papilla, 7 of which are post-anal. The female is 20 cm. to 25 cm. long, and about 5 mm. in diameter; the vulva is situated towards the anterior third, in the middle of an annular constriction. The ova are 66 μ long, with a foveolated shell. According to Dujardin, Walter, and Baillet, this species is distinguished from

A. lumbricoides by being thinner, the longitudinal strie closer, spiculae less sharp and flatter, longer uterus more doubled, and smaller ova.

This worm infests the small intestine of the Pig, and is not very common; though it is sometimes in sufficiently large number to cause obstructions and colics.

**Esophagostoma dentatum** (Rud., *Es. subulatum* Molin).—Body white or grayish-brown, straight, and attenuated at both extremities. Mouth circular, placed in the centre of a horny ring furnished with a crown of bristles, and surrounded by a transparent cutaneous ridge on which are six sharp papille. This circular ridge is succeeded by a constriction, which is followed by an ovoid cutaneous enlargement—well defined posteriorly—at a slit that occupies the whole length of the ventral surface. Two papille opposite each other are seen in the posterior quarter of the oesophagus. *Male,* 8 mm. to 12 mm. long; caudal pouch campaniform and rounded, with a small, faintly marked middle lobe. *Female,* 12 mm. to 15 mm. long; caudal extremity subulated; vulva situated a little in front of the anus, and surrounded by a raised ring. This species inhabits the intestine of the Pig, Wild Boar, and white-lipped Pecari. In the Pig it is most frequently found in the cæcum and colon; Baillet has met with it several times in the small intestine. Little is known of its pathogenic action.

**Globocephalus longemucronatus** (Mol.).—*Male,* 7 mm. long; caudal pouch slightly trilobate; posterior ribs tridigitated, middle and anterior ones doubled. Two spicule. *Female,* 8 mm. long; caudal extremity a conical point ending in an elongated mucrone. Found by Wedl in the small intestine of the Pig' (Railliet).

**Trichocephalus crenatus** (Rud.).—This species has often been confounded with the Trichocephalus of Man—*Tr. dispar* Rud. But it is more especially distinguished from it by the special features in the sheath of the spicule, which is garnished with short blunt spines, thinly scattered, especially behind, where they disappear; the point of the spicule is rounded. The *male* is 40 mm., and the *female* 45 mm. long. This worm inhabits the large intestine of the Pig. An experiment made by Leuckart¹ shows that—as with the *Tr. affinis*—if the ova of the *Tr. crenatus* containing well-formed embryos are introduced into the digestive canal of the Pig, they are developed directly, and become individuals which have acquired the adult form in about four weeks. It is probable that infestation usually takes place through drinking water. The *Tr. crenatus* does not induce any appreciable derangement in digestion.

Trichina spiralis (Owen).—To attain the adult state, this species has to pass through the digestive canal of warm-blooded animals, and of these the Pig is the most important. This parasite will be dealt with in detail when we come to treat of trichinosis, in studying parasitism of the muscles.

Rhabdonema of the Pig (Rhabdonema suis Lutz).—This representative of the family of Anguillulides—already observed by Leuckart and Grassi—has been more recently studied—though still in a very incomplete manner—by Lutz. According to him, the Rhabdonema of the Pig is a distinct species to that of Man and the Sheep. While the size is different, the ova of the intestinal generation of the Rhabdonema of the Pig cannot be hatched except outside—a considerable difference, and which should be verified. Otherwise, in localities where the Rhabdonema of Man is very common—as in Brazil—Lutz has remarked that this of the Hog is very rare, notwithstanding the chances of infestation to which that animal is exposed, from the absence of latrines, its free life, etc.

Independently of the few details given above with regard to each of the species of intestinal Nematodes of the Pig, it may here be stated, in a general manner, that they have been accused of keeping their host in a state of great emaciation, inducing a violent cough, and a vague restlessness, that betrays itself by wandering here and there without any apparent motive, as well as by cries, convulsions, etc., symptoms of the colicky pains it experiences. The Ascarides have been more especially blamed for provoking this morbid condition.

Pigs affected with intestinal helminthiasis are treated with the various medicaments already indicated for the other species, and particularly with decorticated castor-oil seeds. The dose of this for the adult Pig is 8 grammes, mixed with the food, and is most suitable for the Ascarides. Benzine, 10 to 20 grammes, mixed in the food or in pills; or picrate of potass, 20 to 25 centigrammes, given in a mucilaginous decoction or meal and water, are recommended by Zürn against the Esophagostoma dentata. To expel the giant Echinorhynchus, Kocourek has obtained good results from the administration of the oil of turpentine—a teaspoonful for a dose; then a purgative of sulphate of magnesia 10 grammes, aloes 5 grammes.

Article VI.—Parasites of the Intestine of the Dog.

Infusoria.—The Lamblia intestinalis Blanch., a Flagellate already noticed as found by Grassi in the intestine of the Sheep, has also been discovered by him in the intestine of the Dog.

Coccidia.—When studying the diseases of the liver, we shall have

2 Rivolta. Delle Cellule oviformi che trovansi nei vili intestinali del Cane e del Gatto, 1874. — Idem. Della Gregarinosi dei Polli e dell’ Ordinamento delle Gregarine
to enter into more precise details with regard to a Coccidium—Coccidium oviforme—which is often encountered in the Rabbit. Leuckart has given the name of Coccidium perforans to a species that Virchow and Rivolta had already found in the intestine of the Dog, and other observers in that of the Rabbit, Cat, and Man, and also in the domesticated Gallinaceae (Fig. 249). The Coccidium perforans inhabits the epithelial cells of the intestine, while the C. oviforme occupies those of the bile-ducts. According to Leuckart, they are also distinguished by the duration of their evolution external to the animal body, the period being longer for the C. oviforme than for C. perforans. Rieck, however, thinks the last difference is very slight, and it is formally contested by Bambiani, who attributes it simply to the more or less considerable thickness of the layer of water covering the cysts.

The specific name of Coccidium perforans, indicates that it is in the intestinal epithelium that is first observed the perforation of the cells at the moment the Psorospermia leave them to fall into the body of the organ as cysts. The alteration in these epithelial cells, their deformation, and their shedding, are accompanied by local inflammatory phenomena, tumefaction of the mucous membrane, and sometimes the production of small tumours; most frequently there is only seen a white point on the surface of the membrane, or swelling of Lieberkühn’s glands. There may be disturbance of digestion—loss of appetite, emaciation, colics, diarrhoea, and even rabiform symptoms.

Rivolta has given the designation of Cytozpermium villorum intestinalum canis, to ovoid bodies he found in the villi of the small intestine, and particularly in the duodenum, of the Dog and Cat. These Coccidia are ovoid or round, are 8 μ to 16 μ long, and 7 μ to 9 μ broad, and are enclosed in a double-contoured membrane, the contents of which—elongated, attenuated at the extremities, and curved like a bow—resemble the embryo of a Nematode; it shows towards the middle of its length a kind of granular nucleus. They are not within the epithelial cells, but beneath them, in the proper tissue of the villi, in which they generally occupy the summit. Railliet and Lucet have also discovered these Coccidia of the Dog, and have noticed the division of their protoplasm into four fusiform spores; in consequence of this observation they class them with the tetrasporous Coccidia of Schneider. They have a geminal arrangement, which would appear to indicate a

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*Fig. 210. — Coccidium bigeminum, from the intestinal villi of the Dog; magnified 650 diameters.—Railliet. A, B, C, D, E, the coccidia, showing progressive division of the central nucleus; F, G, H, I, isolated coccidia; G, with granular protoplasm; I, seen at one of the poles; H, with four fusiform spores; J, two coccidia in the same envelope.*
longitudinal division, as the globular mass they contain is often at the same level as its congener, and nearly in contact with it on the plane of union of the two bodies. Raillet and Lucet think that—by its ultimate division—this mass gives rise to spores. Stiles, because of their usual arrangement, names them *Coccidium bigeminum*.

The influence of these parasites on health appears to be insignificant, as they are found in healthy Dogs, or those which have succumbed to very diverse maladies.

Cestodes.—Of all the domesticated animals, the Dog is by far the most frequently infested with intestinal parasites. Of 500 Dogs examined by Krabbe¹ at Copenhagen, 336—or 67 per cent.—had intestinal entozoa. Schöne² has also published interesting information as to the frequency and the distribution of Helminths in the Dog. He has found them in 53 per cent. of sporting Dogs; in 67 per cent. of butchers’ Dogs; in 40 per cent. of watch Dogs; in 72 per cent. of harness Dogs; in 57 per cent. of Sheep Dogs; and in 70 per cent. of pet Dogs. The number of them is sometimes considerable, and they may belong to extremely varied species; but the most frequent are the *Taenia*.

The Dog is, in fact, the favourite host of Tape-worms; for in two-thirds of those which we have examined after death, we found these parasites in more or less considerable numbers—sometimes, indeed, in such quantities as to excite wonder at the persistent good health of the animals. Zürn relates having found 137 Tape-worms in the intestines of a Dog; they belonged to three distinct species, and weighed altogether 375 grammes. The researches of Krabbe prove how frequent these entozoa are in this creature. What is of most interest, is the fact that these Cestodes require an intermediate host in order to effect their evolution, and that for the majority of them this host is one of the domesticated herbivora—Sheep, Ox, Goat, Horse, and Rabbit, or the Pig, or even Man. In their cystic form, and when developing in organs, they sometimes cause very grave maladies, such as ‘gid’ in Sheep, echinococcosis in the other species or in Man—only to mention the most important. It is this which makes the Dog an obnoxious animal, and one that yields us troublesome compensation for his services. Therefore it is that those administrative measures which are directed towards pleasure Dogs, with a view to limit their number, should be favourably received.

Eight species of *Taenia*, and five or six species of Bothriocephales of the Dog, have been described. But they are far from having the same frequency and importance, and they may all be found in the intestines of the same animal. The *Taenia* are infinitely more frequent than the Bothriocephales.


Tænias.\(^1\)—Of the eight species of Tænia, six belong to the group of Cystotænians (see p. 381); they are: Tænia serrata Goeze, T. marginata Batsch, T. Krabbei Moniez, T. coenurus Küch., T. serialis Baillet, and T. echinococcus Siebold. One—T. cucuvierina Goeze—forms part of the Cystoidotænians; and another—the T. litterata Batsch—is separated from all the other species of the genera by very special characters, with reference to the arrangement of the sexual organs.

The Cystotænians which infest the Dog always have the head provided with a proboscis or rostellum, which is itself armed with hooks. The latter comprise a free portion or blade in the form of a sickle, the convexity being antero-external and the point turned outwards and backwards; so that when implanted in the intestinal mucous membrane it concurs in fixing the Tænia. This blade is prolonged by a handle directed forwards and inwards, and to which are attached the contractile fibres of the rostellum. The point of union of blade and handle is marked on the concave side by an apophysis—guard, tooth, heel or hypomochlion—that also serves for the insertion of muscular fibres. These hooks are arranged in two crowns or concentric rows, the central area of which is occupied by the summit of the rostellum. They are unequal in size, and are distinguished as large and small; these are alternate, and in this manner form two rows, disposed in such a fashion that the small hooks stand slightly higher than the large ones—the points of both being pretty well on the same circular level. The cephalic expansion is always succeeded by a constricted portion or neck, the first rings—joints or segments—of which only appear at some millimetres from the head.

1. Tænia serrata (Goeze).—From 50 m. to 2 m., but generally 1 metre long. Head a little broader than the neck; 34 to 38 hooks, the largest of which are from 230 \(\mu\) to 260 \(\mu\), with the handle cylindrical, thick, and longer than the blade—which is short and wide—

while the small books are 125 μ to 160 μ, and have a short handle with bifid guard. Segments at first narrow and much shorter than they are broad, becoming square or somewhat longer than broad, and showing their genital organs well developed about the 175th segment, or 25 cm. to 30 cm. from the head. Genital pore very prominent, causing the border in which it is placed to be convex, and the proglottis to be wider in its middle than at its ends; posterior border straight and angles salient, which gives the strobila its saw-like appearance; mature segments from 10 mm. to 17 mm. long, and 4 mm. to 6 mm. broad;

![Diagram of T. serrata](image)

**Fig. 214.**—A mature segment or joint of *Taenia serrata*; magnified three diameters. —Railliet.

c, vas deferens or coiled spermiduct; v, vagina; m, body of the uterus; bm, branches of the uterus.

**Fig. 213.**— *Taenia serrata*; natural size.

**Fig. 215.**—Ova of *Taenia serrata*.—Railliet.*

* A, ovum surrounded by the vitelline membrane, and still containing the vitelline masses; B, ovum freed from its accessory parts.

The cystic form of this worm is the *Cysticercus pisiformes* Zeder, which is frequent in the peritoneal cavity of Hares and domesticated or wild Rabbits. It was with it that Küchenmeister made his first experiments, in which he demonstrated the migrations and metamorphoses of the *Taenia*. The Dog becomes infested with *Taenia serrata* in eating the viscera of Rabbits or Hares containing these Cysticerci. When these have reached the intestine of the Dog, their caudal vesicle
PARASITES OF THE INTESTINES.

contracts and becomes detached; the same occurs with the body. The scolex fixes itself on the mucous membrane, and its posterior part produces—by incessant germination—new segments. Twelve days after their introduction into the digestive canal of the Dog, the Tæniae are one to three centimètres long, and in about two months their development is so advanced that the last segments are mature and commence to be detached. The ripe ova given to Rabbits become Cysticerci. It is, then, by the proglottides that are expelled with the fæces, and the ova which escape from this and are scattered over the grass or carried by water, that the Dog is the cause of the introduction of this parasite into the organism of the Leporides.

The Cysticercus pisiformis, which becomes the Tænia serrata, maintains its vitality for a long time. In the omentum and mesentery of the Rabbit, and which have been exposed to the open air—along with the intestines—for more than eight days, there are found Cysticerci that are apparently dead and withered, but which will promptly become reanimated if plunged for a few minutes into water at a temperature of 40° or 50° C. (Bailleit).

2. Tænia marginata (Batsch, T. cysticerci tenuicollis Leuck.).—This is the largest Tænia found in the Dog. It is 1·50 m. to 2 m. long. The head is scarcely wider than the neck. There are 30 to 44 hooks, the largest of which are 180 μ to 220 μ, the handle having undulated, thin borders, and being longer than the blade, which is narrow; the smallest are 110 μ to 160 μ, with an elongated handle curved in the
contrary direction to the blade, and have the guard entire. The segments are broader, and relatively shorter, than in the preceding species, becoming nearly square, and having the genital organs well developed at the 275th to the 300th, or about 50 cm. from the head; genital pore slightly salient; posterior border wavy, or a little crenellated, and received into the succeeding segment. Mature segments 14 mm. to 16 mm. long, and 5 mm. to 7 mm. broad; uterus formed by a short median trunk, having on each side five or six—sometimes eight—branches deeply divided and ramified. Ova almost spherical, and from 31 μ to 36 μ in diameter.

This worm—which is less common than Taenia serrata, comes from the Cysticercus tenuicollis Rud., which is found in the peritoneal, more rarely in the pleural sac, and even in the pericardium of various animals, and especially in the domesticated Ruminants. The experiments of Baillet show that the development of this Taenia is slower than that of T. serrata. Two months after the ingestion of Cysticercus tenuicollis by a Dog, its parasite is no more than 55 cm. to 85 cm. long, and does not yet show well-formed genital organs; it is only towards the fourth or fifth month that the last segments contain mature ova, and begin to be detached. Ingested by Lambs, they develop into the Cysticercus tenuicollis, which, again, will become transformed into the Tape-worm in the intestine of the Dog more than twenty-four hours after the death of its host (Baillet).

3. Krabbe's Taenia (T. Krabbei Moniez).—This species does not belong to our country. It was obtained experimentally by Moniez,1 in Dogs which had received Cysticerci found abundantly in the muscles of several Reindeer that had died in the Lille Zoological Gardens. The head is larger than that of T. marginata; it has 26 to 34 hooks. Neck thin and short; segments broader than those of T. marginata, and all—except the last—much wider than long. Genital pore very developed, and occupying the entire length of the border of the segment; the latter is short, and is sometimes 1 mm. in diameter.

4. Taenia coenurus (Kich.).—This is a worm attaining, and sometimes exceeding—though rarely—1 m. in length. Head small, and sensibly wider than the neck; 22 to 32 hooks, the largest of which are 150 μ to 170 μ long, with the handle a little wavy on its borders and slender, and as long as the blade, which is short and wide, and the guard cordiform; the small hooks are 90 μ to 130 μ, with the handle attenuated behind and the guard entire. Segments narrower than in the preceding species, becoming square, or a little longer than they are wide, with the genital organs well developed towards the 125th, or from 15 cm. to 20 cm. from the head; posterior border straight, angles salient. Mature segments 10 mm. to 12 mm. long, and 3 mm. to 4 mm. broad; uterus formed by a median trunk of average length, having 18 to 26 slightly ramifying branches. Ova nearly spherical, and 31 μ to 36 μ in diameter.

The cystic form of this Taenia is the Cœnurus cerebralis Rud., which

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is developed in the cerebro-spinal cavity of the Sheep—more rarely in other domesticated herbivora—and causes the disease popularly known as 'gid,' 'turnsick,' etc. (Fr. *tournis*). The experiments of Küchenmeister first, and those of Haubner, Leuckhart, Baillat, etc., afterwards, demonstrated this relationship. 'Gid' appears in lambs which have ingested the ripe segments of the *Taenia coenuros*. Inversely, the *Taenia* is found in Dogs which have swallowed one or more of the *Cenurus cerebralis*, and they are always numerous, the parasite being provided with multiple heads. The 'gid' has, therefore, for its immediate cause, the ova disseminated by the proglottides expelled along with the excrement on pastures on which Sheep are grazed. The Dog becomes infested with the *Taenia* in eating the heads of Sheep affected with 'gid.' The scoleces appear to require two or two and a half months' sojourn in the intestine of the Dog, before their posterior segments have attained complete maturity.

5. *Taenia serialis* (Baillet).—A worm 45 cm. to 75 cm. long. Head a little wider than the neck, and having 26 to 32 hooks, the larger of which is 135 μ to 157 μ long, with the handle wavy on its borders, and of the same length—or a little longer—than the blade; the smaller hooks are 85 μ to 112 μ long, with the handle short and the guard bilobate. Segments similar to those of the *T. coenuros*, as well in their form as in that of the uterus; the last of them are 8 mm. to 16 mm. long, and 3 mm. to 4 mm. broad, the posterior border being straight. Eggs ovoid, and 34 μ long, by 27 μ wide.

This *Taenia*—which is closely related to *T. coenuros*, has been
obtained by Baillet, who caused Dogs to ingest the Coenurus serialis, which he found in the connective tissue of various parts of the bodies of some Rodents, and especially of warren Rabbits. That authority and ourselves have met with it several times in Dogs which had not been experimented upon. The Coenurus is developed into a Taenia in eighteen to twenty-four hours after the death of his host.

6. **Tænia echinococcus** (Sieb.). — This species is distinctly separated from all the others, more particularly by its diminutiveness. The entire chain does not exceed 4 mm. or 5 mm. in length, and only comprises 3 or 4 segments, the last of which contains the mature ova. The head has a double crown of 28 to 50 hooks, which differ but little in size in the two rows, and are all remarkable for the great development of the guard; the larger hooks are 22 μ to 30 μ long, according to Leuckart; while the small ones are—after the same authority—30 μ to 38 μ, though they are given by others as 18 μ to 22 μ. Eggs ovoid, 32 μ to 36 μ long, by 25 μ to 26 μ broad.

This worm often escapes observation, in consequence of its small dimensions; but by close attention it can be distinguished in the form of small yellow filaments expanded at one end, floating in the fluid contents of the intestines, and readily made visible by opening the viscus and immersing it in water. Its hydatid form is the Echino-

coccus veterinorum, which is found in most of the organs of Herbivora, and even of Man; but it is more particularly met with in the liver and lungs of Ruminants and the Pig. The experiments of Von Siebold, Leuckart, Küchenmeister and others, have proved that the mature
protoglottides, ingested by a herbivorous animal, cause it to become infested with Echinococci in various organs, and that numbers of *T. echinococcus* are found in the intestines of Dogs that have eaten viscera containing this Cystic. In two or three weeks these *Tæniae* have already two segments; in about a month the *Tæniae* are fully formed—the last segment containing ripe ova; though Baillet has not been able to find mature eggs in worms 54 days old.

7. *Tænia canina* (Linn., *T. cucumerina* Goeze).—A worm 10 cm. to 40 cm. long, and 3 mm. at its greatest breadth. The head is provided with a club-shaped, very protractile rostellum, which is retracted into a pouch in the centre of the head, between four suckers, and is furnished with four rows of very small hooks in the form of thorns of a rose-bush. Neck long and narrow. The first segments are narrow and trapezoidal in shape, the others longer than they are wide, and like melon-seeds in form (*cucumis*). Genital orifices double, and opening towards the middle of each side of the segments on a slightly raised prominence. Ova globular, from 37 μ to 46 μ in diameter, and massed in small groups, in round, special, and contiguous capsules.

For a long time the host of the *T. canina* in the larval state was unknown, until one of Leuckart's pupils—Melnikow, 1 in 1869, discovered this larva—*Cryptocystis trichodectis* Villot—in a cavity in the body of the Trichodect—*Trichodectes latus*—of the Dog. It appears as a pyriform

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body, 3 mm. long, dark-gray colour, enveloped in a thin membrane, and almost entirely destitute of a bladder. In its middle is seen the retracted rostellum, and on each side the invaginated suckers. Melnikow has succeeded in infesting the Trichodectes by sprinkling on the skin of a Dog—at a part invaded by these insects—the paste obtained by crushing ripe proglottides. In hunting for these parasites the Dog swallows the Cryptocysts which they themselves harbour, and which are transformed into Taeniae in its intestine. They are rapidly developed there; for in puppies ten days old they are found already measuring 25 mm. long, and in those four or five weeks old the last segments of the worm are filled with ripe ova. The Trichodectes are infested by gnawing the débris of the Taenia attached to the hairs.

But the Trichodect is certainly not the ordinary intermediate host of the *T. canina*, which is infinitely more frequent in the Dog than the skin parasite; and this fact has led Grassi to the discovery of the first normal host of this Cestode. It is the Dog Flea (*Pulex serraticeps*) which plays this part; for the Cryptocysts are found in a free state in the abdominal cavity of this insect, which may contain fifty of them. In giving Dogs infested Fleas, the development of the *T. canina* constantly follows, its dimensions being related to the time that has elapsed since ingestion of the Fleas. The experimental precautions adopted by Grassi give every guarantee for the soundness of his conclusions. The number of infested Fleas is not always proportionate to that of the *Taenia cucumerina* in the Dog, as the insects pass very readily from one host to another, and in this way contagion comes into operation. The Flea that lives on Man (*Pulex irritans*) may also serve as the intermediary of the same Taenia.

It may be mentioned that the discovery of Grassi has been confirmed by Sonsino.  

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8. *Tænia litterata* (Batsch).—This Cestode has a certain resemblance to *T. canina* by the form of its segments, which are wider in the middle than at the ends. It is slightly transparent, and has a faint reddish tint along the middle line. But it is entirely different in its organization to the *T. canina*. Its average length is 30 m. to 50 m., though it may exceed 2·50 m. The head is ·9 mm. broad, and is destitute of rostellum and hooks; its four suckers are large, with a very wide longitudinal slit. The genital pores are not lateral, and are represented by two small openings, situated nearly at the middle of the ventral surface, and the vulva is a little in front of the male orifice.¹ The genital organs appear on the middle line as a small opaque spot, very visible to the naked eye, and which—in the mature segments, measuring 3 mm. long, and 2 mm. broad—is constituted by a pyriform vesicle, situated near the posterior border; this is the uterus, filled with ovoid eggs having a very thin double envelope, and 40 μ to 60 μ long, by 35 μ to 45 μ broad.

This *Tænia* is common in the intestine of the Fox, in which it was first discovered, and described under the name of *T. litterata*. Rudolphi gave the designation of *T. canis lagopodis* to a closely allied form, found by Abilgaard in the *Isatis*—*Canis lagopus*.

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should not rather be designated *T. lineata*, so intimately allied are these forms—*T. canis lagopodis, T. litterata, T. lineata*; but they should nevertheless be considered as distinct, because of certain peculiarities in their reproductive organs, which have been so carefully studied by Zschokke and Hamann. The presence of four suckers brings these worms towards the *Tænia*; but the situation of the genital openings allies them, on the contrary, to the Bothriocephales. It is quite natural to associate them in one special group, and Batsch has done so, naming them *Tænia margaritifera*, in consequence of the uterus being flask- or pearl-shaped. Hamann has proposed to form a genus of them—*Pychophysa*—a name based on the aggregation of the ova in one shell. But that of *Mesocestoides litteratus*, employed by Vaillant, has the preference. All these Cestodes are unknown in their cystic form.

The eight species of *Tænia*, a summary description of which has just been given, are sometimes difficult to distinguish from each other—the first five especially. If *T. Krabbei* be excepted—because it is not likely to be observed in our country, as it has its origin in the Reindeer—an exact distinction may easily be arrived at by referring to the following table:

<table>
<thead>
<tr>
<th>Description</th>
<th>Measurements</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head armed.</td>
<td><em>T. serrata</em></td>
<td>230 μ to 260 μ long; genital pore very salient</td>
</tr>
<tr>
<td>Genital pore marginal,</td>
<td><em>T. serialis</em></td>
<td>136 μ to 157 μ long; genital pore not very salient</td>
</tr>
<tr>
<td></td>
<td><em>T. marginata</em></td>
<td>180 μ to 220 μ; length of the mature segments double that of their width</td>
</tr>
<tr>
<td></td>
<td><em>T. caninus</em></td>
<td>150 μ to 170 μ; length of the mature segments treble their width</td>
</tr>
<tr>
<td></td>
<td><em>T. canina</em></td>
<td>3 or 4 segments; some millimètres long</td>
</tr>
<tr>
<td></td>
<td><em>T. echinococcus</em></td>
<td>double and bilateral</td>
</tr>
</tbody>
</table>

Head unarmed; sexual orifices on the ventral surface.

The *Tæniae* are extremely frequent in Dogs, and autopsies which do not furnish some are almost rare. Of 84 Dogs examined by Berthold and Chauveau,¹ with the object of ascertaining this frequency, only two had no traces of Tape-worm.

But the various species are far from being equally distributed, and the variation seems to pertain to countries.

At Lyons, of 84 Dogs examined by the two authorities we have cited, 23 furnished *Tænia serrata*, 11 *T. marginata*, only one the *T. caninus*, 6 *T. echinococcus*, 75 *T. canina*, and 7 *T. litterata*.

Zschokke, at Zurich, examined the bodies of 177 Dogs, and he found 61 of them—or 34 per cent.—the host of Tænia; of these, 38 had T. canina, 9 T. marginata, 7 T. echinococcus, 4 T. serrata, and 3 T. coenurus.¹

In Schöne’s examination of an average of 100 Dogs, he noted that 43 harboured T. marginata; 40, T. canina; 24, T. serrata; 1, 6, T. coenurus. Tænia serrata was most frequent in sporting Dogs; T. marginata in butchers’ and harness Dogs; T. canina in watch Dogs; and Sheep Dogs were the hosts of T. coenurus—7 per cent.—T. marginata, T. serrata, and T. canina; while 36 per cent. of pleasure Dogs had T. marginata and T. canina, and 16 per cent. T. serrata.

At Copenhagen, of 500 Dogs of all sizes and ages which were killed or had died of disease, Krabbe found T. serrata in only 1, T. marginata in 71, T. coenurus in 5, T. echinococcus in 2, and T. canina in 240.

These figures show the generally greater frequency of T. canina, which we have also found to be the case at Toulouse; then comes—as at Lyons—T. serrata; T. marginata is more rare there, and T. coenurus is still rarer. The rarity of T. serrata is also remarked at Copenhagen, which may be explained by the fact that few Rabbits are bred there.

The frequency of Tænia is also related to that of the Cysts infecting Ruminants and Rabbits. According to Bertholus and Chauveau, the ‘gid’ of Sheep is altogether exceptional at Lyons. The T. litterata is common at Toulouse, and in certain years one-third of the Dogs examined post-mortem have it.

In Iceland, in 93 Dogs, Krabbe met with T. marginata in 75, T. coenurus in 18, T. echinococcus in 28, T. canina in 57, and T. litterata in 21. The abundance of the first three species in that island is owing to the large number of Sheep owned by the inhabitants. The frequency of T. litterata should also be remarked; but that of T. echinococcus is the most important circumstance in connection with this question. The number of Dogs in Iceland is very considerable, and as they live in the most promiscuous manner with Man, he is also frequently affected with echinococcosis. It is estimated that one-fortieth to one-fiftieth of the human population is the proportion of those who pay tribute to the disease; and certainly this proportion must be much greater for live stock.

Thomas² has also remarked on the frequency of T. echinococcus in Australia, he having found it in nearly one moiety of forty Dogs he examined; these animals had been fed on offal from slaughter-houses, or on refuse flesh. This prevalence of Tape-worm in Dogs is related to the great frequency of Echinococci in Man and the domesticated animals in that country.

² J. D. Thomas. Proceedings of the Royal Society, No. 238, June, 1885; and the Veterinary Journal, June, 1886, p. 469.
Several species of Tæniae may be found together in the intestines of
the same Dog; for it is sufficient that the animal should have eaten
flesh containing the various Cystics from which these Tape-worms are
derived.

The number of individuals by which each of these Tæniae may be
represented in the same Dog is extremely variable. Bertholus and
Chauveau have found 1 to 64 for T. serrata, 1 to 7 for T. marginata,
1 for T. canurus, 1 to several thousands for T. echinococcus, 1 to more
than 360 for T. canina, and 1 to more than 300 for T. litterata. Krabbe
has also often met with T. marginata alone, or rarely more than 2 or 3
specimens of it, or as many as 20, and in one instance 24; the number
of T. canurus was usually below 10, often above it, and as high as 30—
in two instances it was from 150 to 180; that of T. echinococcus was
always considerable—sometimes enormous; while T. canina was often
under 10, but in the majority of instances it was much more—as high
as 100, sometimes several hundreds, and once 2,000; and there were
also, ordinarily, fewer than 10 of T. litterata, though in some cases
there were more—sometimes 300 to 400.

These numbers, in general, quite agree with the conditions pertaining
to the origin of these Tæniae; for T. serrata is in variable, and usually in
small quantity, as is also the Cysticercus pisiformis of the Rabbit’s peri-
toneum, and somewhat in the same proportions; while T. marginata
can scarcely be otherwise than in small number, as but few examples
of Cysticercus tenuicollis are found in the peritoneum of one Ruminant.
The Coenurus cerebralis having numerous scoleces on the inner surface of
the bladder, T. canurus should therefore be always found in troops; and
the divergence between the induction and the reality may be explained
by the circumstance, that the majority of the scoleces are already dead
when the heads of the Sheep which had been affected with 'gid' are
given to Dogs to eat. The large number of T. echinococcus is accounted
for by the multitude of scoleces that contain the Echinococci. With
regard to T. canina, its numbers should be as large as the intestinal
colonies are old; because then the chances of infestation of the fur by
the parasites are increased, and, consequently, that of the Dog itself.
Lastly, nothing can be said as to the T. litterata, for nothing is known
as to its larval condition.

Notwithstanding their extreme frequency, the Tæniae most frequently
have no influence on the health of the Dog. Sometimes, nevertheless,
by their accumulation, and by the intestinal obstructions or invaginations
they cause, colics ensue, or symptoms of chronic intestinal catarrh are
manifested. The appetite is very capricious, and passes from extreme
voraciousness to absolute inappetence. Growth is checked and emacia-
tion becomes marked; young Dogs are often uneasy, the tail is agitated,
they change their resting-place every minute, and appear to be desirous
of biting the skin of the abdomen. Sometimes they drag the abdomen
along the ground, utter cries or howls, are restless, run here and there, and even have epileptiform seizures. After these attacks, they remain dull and taciturn, or they resume their liveliness and normal state until the appearance of another crisis; and when these are very frequent, convulsions set in, with cataleptic attacks, a gradual sinking, and death may result.

The existence of Tape-worm is readily recognised, in nearly every case, by the presence of segments or joints on the surface of the faeces; and often the only symptom accompanying this indication is pruritus, due to the presence of fragments of strobila arrested near the anus, and which compels the animal to rub this region against the ground in moving along in an attitude altogether peculiar and characteristic. Trasbot states that many taeniae of Dogs also rub their nose against the ground.

The nervous symptoms that a Dog affected with taeniasis may exhibit have sometimes a certain resemblance to those of rabies. In 1862, Pillwax considered the T. echinococcus as capable of inducing rabiform fits, by the intestinal pain it caused. He had only met with that parasite on three occasions, and then in Dogs which had been killed as rabid, and which, at their autopsy, showed the same lesions as those observed in Dogs really rabid. In the same Dog he found millions of these worms entirely covering the mucous membrane of the small intestine, into which they were implanted by their hooks, and so firmly that in attempting to pull them off the strobila was usually removed, but the head remained. Bollinger has published a similar observation; and one of Leisering's experiments appears to confirm Pillwax's opinion. He gave a Dog a large quantity of Echinococci taken from the liver of an Ox. Six weeks afterwards this animal exhibited symptoms of rabies, tendency to bite, harsh and husky voice, refusal of food and water, dulness, debility, and wasting; death occurred on the fifth day. At the autopsy, the small intestine was observed to be much congested, and every part of the mucous membrane was covered with an immense number of Tape-worms. But this experiment is not reliable, as nothing is said with regard to the antecedents of the Dog, and proof-tests of inoculation were not made—no more than in Pillwax's cases—in order to ascertain whether there was merely a coincidence.

1 Goze has drawn attention to the case of a dog infested by Tæniae, and which, for several months, ceased altogether to bark. With the expulsion of the Helminths, the voice was restored. Similar instances have been recorded in man. Lichtenstein has seen a boy, six years old, who, after having spoken quite perfectly, suddenly began to stammer, then became completely aphasic. The administration of santonin caused the expulsion of numerous Ascarides, and the return of normal speech (Revue des Sc. Médicales, XXV., 1885, p. 611).

2 Pillwax. Tidsskrift for Veterinairer, Copenhagen, 1862, 4th part; and Journ. de Méd. Vétérinaire de Lyon, 1863, p. 370.


4 Leisering. Bericht de Dresde, 1864, p. 29; and Journ. de Méd. Vété. de Lyon, 1866, p. 370.
between the worms and true rabies; because similar symptoms were not noted in the numerous experiments made by various authorities, in the development of *T. echinococcus* by the ingestion of Echinococci.

The facts collected by Cagny and Benjamin are more conclusive, and do not concern *T. echinococcus* alone, but all the large Tape-worms without distinction of species. The physiognomy, and the agitated condition of the Dogs, certainly resembled rabies, as well as the desire to bite either people, straw, or other matters; but one was cured by the administration of a vermifuge, and at the autopsies of two others the intestines were discovered full of bundles of Tape-worms. And it is well known in human medicine, as well as that of animals, that lesions of the stomach or intestines may be betrayed by different kinds of vertigo; but investigations are required in this direction to establish the reality of the relations between rabies and *taeniasis*. An observation by Cadéc—mentioned below—is very demonstrative in this respect.

Waldteufel has also published an interesting case of a Dog affected with a serious helminthiasic cachexia—due to Ascarides and the *Tænia coenurus*—the animal also being affected with a circling-round movement (*mouvement de manège*) and rabiform vertigo. The disappearance of these symptoms coincided with the evacuation of a mass of intestinal parasites.

The autopsies of Dogs attacked with *taeniasis*, generally only show the parasites lodged in the small intestine. According to the time that has elapsed since death, they may have wandered more or less beyond this, and in small numbers, into the stomach or large intestine. Krabbe has always met with the *T. coenurus*, *canina*, and *litterata* in the posterior moiety of the small intestine, and *T. echinococcus* in the anterior moiety. We have made the same observation.

Inflammation of the mucous membrane, croupal enteritis (Eberth), invaginations, and obstructions by coils of Tape-worms, may be discovered; but it is altogether exceptional to find perforation of the intestinal wall, though cases reported by Schiefferdecker, Cadéc, and Lahogue demonstrate the possibility of this lesion taking place.

The first of these authorities found a prodigious quantity of *T. canina* in the small intestine of a Dog. There was considerable hypertrophy of the papillae of the small intestine—which was very hyperemic—and more than four or five times the size of normal papillæ. In the layer of Lieberkühn's glands were kinds of tunnels running parallel to the axis of the intestine, which contained segments of *Tænia* 3 mm. to 6 mm. long, and 2 mm. to 3 mm. broad; each gallery held two or three parasites, but most frequently only one. The walls of these tunnels were formed by the normal glands of Lieberkühn, their floor

by widened and curved glands, and their roof by hypertrophied papillae fused together as a consequence of shedding of their epithelium.

At the autopsy of a Dog which had been killed after exhibiting the physiognomy of rabies, Cadéac found two *Taenia*—*T. serrata*—placed, one in the non-inflamed peritoneum, the other fixed in a perforation of the small intestine, its anterior extremity floating in the abdominal cavity—the worm being retained in the intestine by the proglottis, which could not pass through the opening. The fistulous perforation was infundibuliform at its intestinal orifice, and salient at its peritoneal opening, its walls being formed of embryonic tissue at least some days old. Inoculation of a Rabbit with the medulla oblongata of the Dog had no result, showing that it had not been a case of true rabies.

An anaemic Dog having been killed under suspicion of rabies, Lahogue found in its small intestine a considerable quantity of *T. serrata*, and in the duodenum three small perforations surrounded by an inflammatory ring, in each of which was fixed a Tape-worm, floating by its free portion in the peritoneal cavity.

Caparini attributed to the presence of numerous *T. canina*, a violent attack of enteritis in a Dog which had previously ingested Echinococci; but there is nothing here to prove the obnoxious influence of the *Taenia*.1

The Tape-worms are not, therefore, absolutely free from inconvenience to the Dog, and it is advisable to free that animal from them, in order to prevent accidents which they might occasion; and this is the more to be urged in view of the possible infestation of Man and the domesticated herbivora by the Cystics issuing from these *Taeniae*. This recommendation is particularly applicable to Sheep Dogs that go among grazing flocks, and to those which—rare in our country—live in such close companionship with Man, that the proglottides expelled along with their excrements may not contaminate the water he consumes.

The administration of a *taeniafuge* should be prepared for by a fast for twenty-four hours; enemas may also be useful.

Many *taeniafuges* have been proposed and employed.

The æthereal extract of male shield-fern is certainly one of the best, and 2 to 8 grammes in capsule or pill produce a prompt result. Trasbot states that remarkable effects are obtained by mixing the extract and the tincture—2 to 8 grammes and 18 to 40 grammes. But this preparation has the inconvenience of being very irritating to the intestine, and to require the addition of a large proportion of some excipient.

An excellent mode of administration is that practised at the Toulouse clinic; the dose varies according to the weight of the animal—about 15 grammes for a Setter—and is mixed with a quantity of castor-oil, which is also proportionate to the weight of the Dog. The evacuation of the Tape-worms is almost certain, and often takes place within an hour after the remedy has been administered.

Trasbot also recommends birch-seeds (*graine de bouleau*), given in

milk for four or five days, in doses of 10 to 50 grammes, as an excellent and perfectly safe agent.

The English more particularly employ calomel in doses of .25 to 1 grammie, in a spoonful of syrup. Delabere-Blaine recommends oil of turpentine, 2 to 4 grammes, given in yolk of egg for some days.

Kousso is particularly serviceable. It is given in doses of 10 to 30 grammes, the flowers being pulverized, and mixed with 35 grammes of sugar in some spoonful of infusion of tilleani; or the leaves are infused for a quarter of an hour in one-fourth of a litre of tepid water, and the whole is administered when the animal is fasting. An effect is produced in about two or three hours.

Pomegranate bark is also efficacious, employed in doses of 50 to 150 grammes in decoction with 750 grammes of water, reduced to 500 grammes. Three doses of this are given at intervals of an hour. The fresh root is to be preferred, as being more certain. Treatment is completed by the administration of a purgative—30 grammes of castor-oil—three hours after the last dose.

For twenty years kamala has held an important place among taeniafuges, and it is also a purgative. It is given in 5 to 10 grammes in pill, and it may be useful to repeat the dose two or three days after. The seeds or nut of areca catechu in powder are a good taeniafuge for the Dog. They should not have been gathered for more than a year. They are given in doses of 5 to 10 grammes, mixed with butter in the form of pills. The Taenia are ejected in a few hours afterwards—rarely longer than 18 hours; but if no effect is produced in about 2 hours, the action of the drug may be expedited by a dose of castor-oil. Areca-nut has the inconvenience of being often vomited by the Dog.

Delamotte has constantly obtained expulsion of Tape-worms by the employment of sulphuret of calcium, in doses of 1 to 5 grammes for young Dogs, 3 to 5 for adults. A purge of castor-oil is given an hour afterwards.

(I am not aware that calomel is much resorted to as a taeniafuge in England. Powdered areca-nut is perhaps the most employed, in doses of 15 grains to 2 drachms—about 2 grains for every pound of the Dog’s weight—mixed in soup, mucilage, the ordinary food, or, best of all, milk. Previous to the administration, the bowels should be emptied by giving a simple laxative, and then the animal should be kept without food for several hours. Sometimes the areca-nut powder is combined with 10 to 15 minims of male shield-fern extract, and this is said to be the most effectual remedy for Tape-worm in Dogs. If the parasites are not removed, a second dose of the mixture is advisable several days later, when, should the results be still unsatisfactory, the animal strong, and the bowels not much relaxed, a moderate dose of castor-oil and turpentine will sometimes bring away worms that were previously immovable.—Dun.)
Bothriocephales.—The best known of this species is the Bothriocephalus latus (Bremser—Figs. 150 to 152, 230 to 233). It is a worm usually 2 m. to 7 m. long, but it may reach 20 m. It is of a grayish tint. The head is oblong, lanceolated, and unarmed, and is furrowed for nearly its entire length by two lateral slits—or bothridia—that play the part of suckers. The neck is scarcely marked, and the first segments are barely visible, but those that follow are soon distinguished by their length, which goes on increasing—though it is always less than their breadth, which gradually attains 2 cm., while the length never exceeds 4 mm. to 5 mm.

When they have reached complete maturity, they lose their breadth, and the strobila with them; at the same time, they diminish in length—a modification which is due to atrophy of the genital organs, and their depletion by ovulation. In fact, the segments of the Bothriocephalus do not separate from the chain like those of the Tænie, to throw off their eggs by rupture of the tissues. There is a real ovulation through an opening situated near the middle of the ventral surface. In front of this is seen a small tubercle, on the summit of which is pierced the male and, immediately behind it, the female opening. The eggs are ovoid, operculated, and 68 μ to 71 μ long, by 44 μ to 45 μ broad. The embryo is only developed after the egg is laid; it is hatched in water during several months. It is globular, covered with a ciliated envelope, from which it issues by a rupture it makes, and then appears with all the characteristics of a hexacanthous embryo of the Tænie.

During its intestinal existence, the Bothriocephalus throws off, from time to time, fragments of various lengths, which are nearly empty of eggs, and are more or less shrivelled and twisted.

This species more particularly infests Man, chiefly in the lake districts of French Switzerland, in the North of Italy; on the shores of the Baltic, Finland, and Sweden; in a small portion of Poland; in Denmark; and in Greenland; and it has also been observed here and there in every European country. (Switzerland and the Baltic province-

![Fig. 230.—Portion of a Bothriocephalus latus.](image-url)
of Russia appear to be the countries in which this worm is most frequently observed in Man; and in these much fish, caught in the great freshwater lakes, is eaten. It seems to be extremely rare in the United Kingdom, and in countries beyond Europe where there are similar lakes—as on the American continent. Dr. Drivon, of Lyons, who has recently written on intestinal worms, observes that the spread of the parasite beyond its two favourite localities has been noted by several recent authorities. In 1883 and in 1890, Dr. Drivon himself observed a case in Lyons. In the first case, the patient had never been to Switzerland, and had not gone further from Lyons than Mâcon for years. A specimen of *Taenia saginata* was passed by the same patient. In Dr. Drivon's second case, the patient had never been further than Vienne on the Rhone. The Bothriocephalus has been observed within

![Diagram of a segment of the Bothriocephalus latas, seen on the ventral surface.](image1)

Fig. 231.—Diagram of a segment of the *Bothriocephalus latas*, seen on the ventral surface.

\( v \), vessel; \( n \), nerve; \( tt \), testicles; \( sp \), spermiduct or vas deferens; \( op \), orifice of the penis; \( vo \), ovary; \( pr \), pavilion; \( mt \), uterus; \( om \), opening of the uterus; \( vt \), vitellogogenous follicles; \( do \), vitelloduct; \( vg \), vagina; \( ovg \), opening of the vagina.

![Ova of the Bothriocephalus latas.](image2)

Fig. 232.—Ova of the *Bothriocephalus latas*.

![Ciliated embryo of the Laboulbène.](image3)

Fig. 233.—Ciliated embryo of the *Bothriocephalus latas*.—Leuckart.

* A, seen in glycerine; B, seen after being acted upon by sulphuric acid, which renders the operculum apparent.

the last twenty years in Paris, Vincennes, St. Malo, Utrecht, Piedmont, Milan, and Bavaria. The Lake of Starnberg, which supplies fish to Munich, seems to have become infected about 1879, by tourists who had resided for some time near the Lake of Geneva. On the other
Parasites of the Intestines.

hand, the parasite is becoming rarer in Switzerland. Not many years ago it used to be said, that no good citizen of Geneva was without his Tape-worm; and a distinguished authority was the 'host' of several samples of the Bothriocephalus, very shortly after he became the guest of that city. The same authority, revisiting Geneva a few years ago, had great difficulty in procuring a single specimen of the Bothriocephalus for purposes of experiment. The explanation of the welcome disappearance of the parasite from Geneva is by no means clear. The larva appears to choose by preference the Pike, Turbot, and Perch, but it has been found in Tench, Grayling, and other fishes. All those animals live in British waters.\(^1\)

The history of its development is still incomplete. For a long time, the opinion most general was that the Bothriocephalus must pass through an intermediate host, which was a fish. The persevering researches of Braun confirmed this opinion; for he found the Pike and Burbot to have their intestines, muscles, and different tissues infested with agamous Bothriocephales—Plerocercoides—always destitute of an adventitious capsule, with an invaginated head, and without a posterior appendage. In feeding Dogs and Cats with these larvae, and keeping them away entirely from any other cause of infection, Braun has always found the *Bothriocephalus latus* in these animals. Parona and Zschokke have, in their turn, remarked the presence of these larvae in the Pike, Burbot, Char, Grayling, common Trout, and the Fera. Parona, Ferrara, Grassi and Rovalli have experimentally demonstrated the transformation of these larvae into Bothriocephales, in the intestine of the Dog and Man.\(^2\)

The *Bothriocephalus latus* has also been found in the Dog, exclusive of experimental conditions. Linné and Pallas had already noted this, and their observation was confirmed by Von Siebold, Krabbe, Perroneito, and Braun. According to Parona, this worm is not rare in Dogs in Northern Italy, and it was doubtless two specimens of it which were described by Generali in 1878, as are also those exhibited in the Turin Museum, and which were found by Perosino; as well as that, 2 m. long, met with by Bassi of Turin, and which Ercolani named *Bothriocephalus canis*. This Cestode has also been discovered by Mégnin, at Vincennes, in a Dog.\(^3\)

Diesing considers—but probably wrongly—the Bothriocephalus found in the Dog by Von Siebold as belonging to the same species—*E. serratus*—as that discovered in Brazil by Natterer in the small intestine of the Pampas Fox (*Canis Azaré*).

*Bothriocephalus cordatus* (Leuek.).—The maximum length of this worm is 1·15 m.; but it usually has not more than about 400 segments. The head is short, broad, flattened laterally, and has a deep bothridos on each surface, dorsal and ventral. No neck. Segments rapidly widening, the mature ones being 3 cm. from the head, and 3 cm. beyond this they attain their greatest width, which is from 7 mm. to 8 mm. The calcareous corpuscles are very numerous.

This species is special to Greenland, and has been only once found

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\(^1\) Drivon. Lyon Médical, 1891; and British Medical Journal, Oct. 10, 1891.

\(^2\) Railliet. Revue de Parasitologie. Recueil de Méd. Vétérinaire, 1888, p. 341; 1889, p. 120.

\(^3\) Mégnin. De la présence d'un *Bothriocephalus latus* (Bremuer) chez un Chien de six Mois, né et élevé à Vincennes. Comp. Rend. de la Soc. de Biologie, 1883, p. 308.
in Man; but in that country it is frequent in the Dog, one animal sometimes being the host of several specimens. Olrik has collected twenty from six Dogs, and Pfaff twenty-four in three others. Pfaff has also found the worm in a Seal (*Phoca barbata*), and Zimmer has met with it in a Walrus. The presence of this Cestode in Mammalia which are essentially ichthyophagous, demonstrates that its larval stage is passed in a fish.

**Bothriocephalus fuscus** (Krabbe).—A worm measuring 1 cm. to 80 cm. long. Head compressed and lanceolated. First segments scarcely visible, and appearing at some distance from the head or immediately behind it. Their breadth increases regularly from .5 mm. to 5 mm., then it diminishes, the segments becoming longer—often longer than broad. The uterus appears in their centre as a dark-blue spot, the colour being due to the eggs it contains. There are no calcareous corpuscles.

Krabbe has found this worm in the intestine of two Dogs in Iceland. In one Dog there were 22 worms of different sizes.

The same authority has given the names of *Bothr. reticulatus* and *Bothr. dubius* to two forms that he also discovered in Dogs, and which appeared to be so closely related to *B. fuscus* that he hesitated to separate them from it.

**Trematodes.**—Two species of Trematodes—a Hemistoma and a Distoma, both very rare—have been found in the intestine of the Dog.

**Hemistoma alatum** (Goeze).—The length of this worm is 3 mm. to 6 mm., the colour is dirty-white; the anterior part is dilated in a heart-shaped manner, and formed as if it had a kind of horn on each side. It is common in the Fox and Wolf, and has been found in the Dog by Creplin and Schöne. The latter has only met with it in draught Dogs—5.5 per cent.

**Distoma echinatum** (Zeder).—Body red or rosy in colour, 4 mm. to 15 mm. long, and seven times narrower, lanceolated, flat, prolonged in front by a narrow and very short neck, terminated by a head or reniform dilatation, notched below, and surrounded by straight spines over all the remainder of its contour. Integument studded by small spines or sharp lamellæ on the anterior part, and by obtuse lamellæ on the posterior part. Ventral sucker three or four times broader than the oral one. Ova of a brownish-yellow hue, 94 μ to 110 μ long, and 75 μ broad (Dujardin).

This species, which is somewhat common in the intestine of domestic Ducks and other aquatic Birds, has been found by Generali in the duodenum of a Dog; the intestine was very inflamed, and dotted by a great number of yellowish-gray spots. This Distoma is interesting, because of the complete researches of which it has been the object on the part of several experimentalists, especially Pagenstecher, and more

1 Generali. *Le Spallanzani, Modena, 1881*; and Archives Vétérinaires, 1882, p. 70.
especially Ercolani. Railliet has given a résumé of these investigations, from which we learn the following history:

The larval forms of the *Distoma echinatum* are those most commonly observed in aquatic molluscs, and especially in the lymnaeæ, planorbes, and paludineæ. They are met with in very diverse organs, and in these conditions their characters are so variable as to lead to the belief that there are several specifically distinct forms. Such is the origin of the

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**Fig. 236.**—Phases of evolution of the *Distoma echinatum* in the intestine of the Duck.

1, redia containing free and encysted cercariae; 2, multiplication of the redia by fission; 3, *Cercaria echinata* encysted, from the heart of the viviparous Paludine; 4, the same liberated from its cyst; 5, one of the small-tailed forms of the same cercaria; 6, one of its large forms; 7, *Distoma echinatum*, developed in the intestine of the brown Rat; 8, the same developed in the intestine of the Duck.
Cercaria echinatoides Fil.—identical with C. echini/era La Val—and of C. spinifera La Val. The germinal sacs of this species are the rediae (Fig. 236, No. 1), which develop by gemmation in their interior from other rediae or cercariae, and are even sometimes reproduced by external budding or by fission (No. 2). Leuckart, however, rather suspects the correctness of this observation of Ercolani relative to the multiplication of the redia by budding or by division. The rediae vary much in their shape, as do also the cercariae that they have formed—at least, those that are free, though they resemble them as soon as they are encysted. In certain cases these cercariae quit the body of the Mollusc which harboured the redia, to become encysted in the skin or around the heart of paludines, while in other instances they encyst themselves as soon as they leave the redia, or even in its interior (No. 1). In administering these encysted cercariae to cold-blooded animals—Frogs, Toads, or Snakes—no result is obtained; on the contrary, they are transformed into Distomes when they are ingested by warm-blooded animals. The experiments of Ercolani were more particularly made on Ducks, and in these creatures the later forms of the cercariae above indicated all yielded the Distoma echinatum. With Sparrows, Mice, Rats, Moles and Dogs, the same Distoma has been obtained; but with very remarkable morphological variations (Nos. 7, 8). Van Beneden was probably in error in classing Cercaria Brunnea Dies. with the cercariae by which he had obtained the transformation into D. echinatum in the intestine of the Duck.²

**Nematodes.—Ascaris marginata** (Rud.).—This species is considered at present, by the majority of helminthologists, as a mere variety of the A. mystax of the Cat, from which it is scarcely different except in being a little larger.

The body is white or reddish; head usually curved, and provided

PARASITES OF THE INTESTINES.

with two membranous lateral wings, broader behind than in front, and which cause it to look like an arrow-head. Each of the three lips has a salient papilla. Male, 5 cm. to 10 cm. long; tail curved, having two small membranous lateral wings, and 26 papillo on each side, two of which are post-anal. Female, 9 cm. to 12 cm. long; obtuse tail, vulva situated towards the anterior quarter of the body. Ova almost globular, and 75 μ to 80 μ in diameter.

These worms are more especially frequent in young Dogs, which may be infested with them at three or four weeks old, and even earlier, according to Hering; but it is towards two or three months that they are most abundant. In 500 Dogs examined by Krabbe at Copenhagen, 122—or 24 per cent.—had them; Schöne carried this proportion to 37 per cent. They inhabit the small intestine, and frequently the stomach, causing the vomition of glairy matter, in which they are found. Their presence is indicated by the same signs as those of the Taenia—emaciation, unthrifty coat, enlarged abdomen, irregular appetite, sometimes symptoms of epilepsy or rabiform trouble, colics, and constipation or diarrhoea. In collecting in masses in the intestine, they may cause complete obstruction, arrest the course of the alimentary matters, and induce invagination and fatal colic.

At the autopsy of Dogs which have succumbed to the disorders caused by the Ascarides, the intestinal mucous membrane is tumefied and catarrhal, and shows numerous small, round, black points, in the centre of which is an ulcerous depression surrounded by a salient zone; and an intense hæmorrhagic enteritis, with fissures and excavations having ulcerated borders—the process involving all the coats of the intestine—has also been observed (Friedberger and Fröhner).

The observations and experiments of Hering and Mégnin lead to the belief that—contrary to the hypothesis of Linstow—the Ascarides, and particularly those of the Dog and Cat, have no intermediate host, and are directly developed. This conclusion is strongly fortified by the experiments of Grassi.

Against the Ascarides of the Dog, the various remedies recommended for Taenia may be employed. Areca-nut is particularly useful, though santonin is most frequently employed in 2 to 3 centigramme doses, given in milk. Zürn also recommends benzine—1 to 7 grammes—in pills or in oil. (Santonin, conjoined with extract of male shield-fern, repeated twice a week, and followed by a laxative, is the treatment generally advised in England.)

**Oxyurus vermicularis** (Brems.).—Zürn states that this parasite of the human intestine may be exceptionally found in the Dog. The male

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is 2 mm. to 3 mm. long, the female 9 mm. to 10 mm., the colour being white, and the body expanded anteriorly. Ziem's affirmation is not corroborated, and Railliet thinks that perhaps he refers to the *Oxyuris compar*, which is a parasite of the Cat.

**Uncinaria trigonocephala** (Rud., *Documus trigonocephalus* Rud.).—Body white; buccal capsule slightly expanded, the ventral wall having on each side of the middle line a complex chitinous layer or 'jaw,' the free extremity of which terminates in three hook-shaped teeth in the interior of the mouth, and which decreases in size from the dorsal to the ventral surface. On the dorsal border there are, in addition, two small straight teeth, separated by a median rounded depression. Two

![Fig. 238. — *Uncinaria* or *Documus trigonocephalus*, male and female coupled; natural size.](image)

![Fig. 239. — Cephalic extremity of the *Uncinaria* or *Documus trigonocephalus*, dorsal surface; magnified 150 diameters. —Railliet.](image)

![Fig. 240. — Caudal pouch of the *Uncinaria* or *Documus trigonocephalus*; magnified fifty diameters; semi-diagrammatic.](image)

opposite lateral papillæ at the posterior third of the ðæosphagus. *Male*, 9 mm. to 12 mm. long; caudal pouch trilobate, the middle lobe being slight. *Female*, 9 mm. to 21 mm., most frequently 15 mm. to 20 mm. long; tail obtuse, and prolonged by an acute mucron; vulva towards the posterior third of the body. Eggs ovoid, and 74 μ to 84 μ long, by 48 μ to 54 μ broad.

This species inhabits the small intestine of the Dog and Fox, in company with the worm next to be described. They fix themselves on the mucous membrane, and live on the blood they extract. In certain cases they are very numerous, and induce an affection analogous to that produced in Man by the *Uncinaria duodenalis* or 'Ankylostoma duodenalis,' and which is designated—according to the countries in which it appears—as *Egyptian chlorosis, intertropical anæmia* (America), and miner's
anæmia—a condition which has been particularly well studied by Perroncito, whose writings so inspired Railliet and Trasbot that, from 1879, they attributed to the presence of the Uncinaria trigonocephala that form of anæmia with which packs of hounds are often attacked. Mégnin has especially drawn attention to this Pernicious Anæmia of Packs of Hounds, Uncinariosis, or Ankylostomiasis, which has also been designated—because of one of its most ordinary symptoms—Bleeding at the nose of packs of Dogs. 1

Symptoms.—The symptoms are those of grave anæmia. In the first period there are only debility and wasting, always increasing, although the appetite remains unimpaired. The Dogs are less ardent in hunting, and are even dull and indifferent; the coat is staring, the skin scaly or reddened with erythematous patches—especially at the stifles and nose; the latter is tumesced, cracked, rough, and excoriated, with a muco-purulent or sanguinolent discharge from the nostrils. Later, veritable epistaxis supervenes—the blood being foamy and bright red, or merely rosy—the Dog at each time losing perhaps two-thirds of a gill. These attacks of nasal haemorrhage are separated by intervals of some days to several weeks, during which the discharge is again muco-purulent or sanguinolent. There is a diminution of the red corpuscles, and leucocytosis is marked. When the anæmia is rapidly developed, it is sometimes accompanied by convulsions.

Another important symptom is the œdematosus and indolent engorgement of the limbs; this is at first intermittent, then it becomes permanent and increases in extent. In the last stage there are ulcerations, sweatings, and gangrenous patches. A diarrhœa—which has perhaps already become confirmed—gradually grows persistent, and gives place to dysentery; the appetite, after having been capricious, disappears. The animals—feeble, emaciated and miserable, covered with red patches and excoriations—remain constantly lying, and finish by dying in a comatose condition or in convulsions. Death takes place in a few months, or even in a year. The malady is perpetuated in kennels which have once been invaded, if energetic measures are not adopted.

Lesions.—At the autopsy of Dogs which have died from Uncinariosis, or have been sacrificed in the last stage, all the alterations of cachexia are observed, and particularly hypertrophy of the mesenteric glands. There are, besides, the lesions special to the malady, localized in the mucous membrane of the small intestine and caecum. This membrane is very much thickened, and marbled by large reddish patches; its villi, quintuple their normal size and highly injected, are closely packed together. These alterations begin in the duodenum, and thence extend to the other portions of the small intestine. In the relatively healthy parts are seen a multitude of small haemorrhagic points, and in their

vicinity or centre are noticed one or more Uncinarias—often coupled; their number is all the greater the larger the extent of healthy membrane, and it is consequently larger in Dogs which have been ill for only a short time, than in those in which the malady is chronic. In the latter there may be merely a few parasites in the ileum—a circumstance which may raise a doubt as to the anaemia being due to Helminths.

The Uncinaria stenocephala is mixed with the Uncinaria trigonocepha; and the cæcum often contains, in addition, a great number of Tricocephales.

Diagnosis.—This affection is easily mistaken for essential, non-parasitic anaemia, which also attacks packs of Dogs; so that the diagnosis really depends upon the discovery of ova of the Uncinaria—which should be abundant in Uncinariosis after the exhibition of anthelmintics. These drugs, of course, would be ineffectual in ordinary anaemia; but in that due to parasitism they should cause numerous Uncinarias to be expelled, and these are readily seen in the faeces, while a beneficial change will be observed in the affected Dogs. The autopsy of one of these will often remove all doubts as to the nature of the malady. The Linguatules, by their presence in the nasal cavities, may—although rarely—cause epistaxis; but then the blood is bright-red, there are frequent fits of sneezing, and the general health is scarcely disturbed.

Etiology.—Pernicious anaemia scarcely ever attacks any but sporting Dogs, and more especially those which live in packs. It does not appear to affect any one breed more than another, but seems to attack, almost exclusively, it is said, cross-bred Dogs—French and English crosses. Dampness is one of the conditions that favour the extension of the disease, and causes it to assume an epizootic form, when it often destroys or gravely compromises the welfare of valuable packs. Leuckart has studied the evolution of the Uncinaria trigonocephala, and it appears that this parasite is analogous in its general characters to that of the Ankylostoma of Man, such as it has been described by Perroncito.¹

The vitellus of the ova of Uncinaria trigonocephala segments in the oviduct of the female until it reaches the morula stage; their evolution is not continued in the intestine of the Dog, but after their expulsion with the faeces. But on incubating in water at a suitable temperature, an embryo soon becomes visible in their interior, and hatching is completed in two or three days. The rhabditiform larvae that issue from the ova are 300 μ long and 95 μ broad; their posterior extremity is elongated into a tapering tail; in growing they moult two or three times, and they attain the adult condition in passing—with the

water—into the intestine of the Dog, without requiring an intermediate host. Eight days after this passive migration they are 0.5 mm. to 1 mm. long, and in certain details of organization they resemble the definitive form, but in all probability without having undergone another moult. On the ninth or tenth day, the old chitinous integument is shed, the buccal capsule appears, and it is only now that the group to which the parasite belongs can be recognised. It retains this form for three or four days, during which it acquires its final dimensions, and a second moult resulting in the parasite acquiring its sexual individuality. These details, and particularly the part water plays in the evolution of the *Ucinaria trigonoceplicda*, show that infestation probably takes place through the medium of the drinking water, and that Dogs contaminate each other by scattering the ova of their parasites in the water-troughs of their kennels.

**Treatment.**—When pernicious anæmia appears in a pack, extreme care should be exercised with regard to cleanliness of the kennel—flushing it out thoroughly with water to wash away the ova, and watching the animals so that they only drink pure water, and that which has not been soiled by the diseased Dogs, feeding them in buckets or troughs washed after each meal, and isolating the sick as much as possible.

Medical treatment consists in the employment of anthelmintics. Mégnin recommends kamala in doses of 3 to 4 grammes, with the addition of 0.5 grammes of calomel, and arsenic 5 to 6 milligrammes. Perroneito has obtained remarkable success in the parasitic anæmia of miners, with the extract of male shield-fern in doses of 15 to 30 grammes—which also answers perfectly well in Uncinariosis of the Dog, in doses and conditions as indicated for taeniasis. The strength of the animals should be most sedulously maintained by good and easily-digested food, such as milk, and especially raw horse-flesh, with cod-liver oil, tonics—iron, gentian, etc.

*Ucinaria stenocephala* (Rail.).—Body thinner than that of the preceding species. Head narrow; buccal capsule having on each side
of its ventral wall a chitinous layer with a sharp border, beneath which is a hook-shaped tooth. The dorsal border has a middle depression, but no salient teeth. Male, 6 mm. to 8 mm. long, caudal pouch trilobate, the middle lobe being slight. Female, 8 mm. to 10 mm. long; tail prolonged by an acute mucron; vulva placed towards the posterior third of the body. Eggs ovoid, and 63 μ to 67 μ long, by 32 μ to 38 μ broad.'—Railliet.

This species has been found by Railliet,¹ in company with the Uncinaria trigonocephala; and it appears to play as active a part as its congener in the development of anaemia in packs of sporting Dogs, so that it has its share in the preceding considerations.

Trichocephalus depressiusculus (Rud.).—This species has a great resemblance to the Tr. affinis of Ruminants and the Tr. dispar of Man. The male and female are each 45 mm. to 75 mm. long. The spicula of the male is longer than in Tr. affinis, and its tubular sheath has blunt spines only in the moiety nearest the cloaca, the remainder being smooth. The ova are 70 μ to 80 μ long, and 32 μ to 35 μ broad.

The Trichocephalus depressiusculus lives in the blind pouch of the caecum of the Dog, in which it is not rare. It is often found in animals affected with the pernicious anaemia just described, but it does not appear to have any other than a secondary part in the development of the disease. We have always found it in essential (or ordinary) anaemia. Mégnin states that, when in considerable number on the surface of the mucous membrane of the caecum, it causes an inflammatory tumefaction of that organ—a veritable typhlipis—sometimes accompanied by its invagination.

Railliet² has succeeded in obtaining experimental development of the Trichocephalus of the Dog. The ova of this species, when collected in February and placed in water, took five months to produce complete embryos; and when ingested by a Dog, these became Trichocephales, which became entirely developed in about three months. This experiment confirms those of Leuckart on the Trichocephalus affinis of Ruminants, and the Tr. crenatus of the Pig; and it shows that the Trichocephales are directly developed without any intermediate host, that their embryonic development takes place entirely outside the body of an animal, and that they must pass into the digestive tube of their

² Ibid., p. 449.
host while still enveloped in their shell. It also establishes the fact that embryonic evolution is altogether suspended by desiccation, and explains the facility with which spontaneous infestation can occur. Railliet has found in the jejunum of a Ferret a female Trichocephalus that appeared to belong to the same species as that of the Dog.

'Filaria hepatica' (Cobbold).—Cobbold gave this name to worms found by Mather, encysted in the intestinal mucous membrane and biliary ducts of a Dog. 'It was probably only a larval form.'—Railliet.

ARTICLE VII.—Parasites of the Intestines of the Cat.

Sporozoa.—Coccidia of Rivolta (Coccidium Rivolta Grassi).—The Coccidium Rivolta has close analogies with the form already alluded to as infesting the Dog—the Cocc. perforans. It also undergoes its first phases in evolution in the interior of epithelial cells. When it is encysted—that is, surrounded by an envelope or double-contoured shell—it is set free by rupture of the cell, and then appears as an oval or elliptical body, 27 μ to 30 μ long by 22 μ to 24 μ broad; and it is in this state that it is met with in the contents of the intestines or in the faeces. The ulterior phases of development are observed when the Coccidia are placed in water; then the encysted mass divides into two, afterwards into four sporoblasts, each of which appears to contain four falciform spores. The Coccidium, having now arrived at its final development, dies and then decomposes. Grassi has caused two young Cats to swallow cysts arrived at this stage, but without result.¹

Fink has attributed a preponderating share in the phenomenon of absorption of fatty substances, to corpuscles that filled the intestinal villi of a Cat, and which were nothing more than Coccidia. They differed, however, from the Coccidium Rivolta in their dimensions, which were 80 μ to 100 μ long, and 70 μ to 90 μ in width.²

Infusoria.—There is found in the Cat—though rarely—a flagellated Infusorium—the Lamblia intestinalis R. Bl., which has been already mentioned among the intestinal parasites of the Sheep and Dog (see pp. 418, 436). This Infusorium prefers the duodenum and jejunum, and often attaches itself by its sucker to the intestinal epithelial cells. It does not appear to cause any inconvenience to its host.

Cestodes.—Three species of Tenia and a Bothriocephalus live in the intestine of the Cat. Of the three Tenia, one is a Cystotænian, the second a Cystoïdotænian, and the third is confounded with the Tenia litterata of the Dog.

1. Tænia crassicollis (Rud.).—This is a worm 15 cm. to 60 cm. long, and offering the general characters of the Cystotænians of the Dog. The head is hemispherical, 1·7 mm. broad, with a powerful rostellum; the neck is as wide as, or wider than, the head, and there is no constriction between them. There is a double crown of 29 to 52 hooks—most frequently 34—the largest of which are 380 μ to 420 μ

long, and the smallest from 250 µ to 270 µ. The last segments are 8 mm. to 10 mm. long, and 5 mm. to 6 mm. wide. Ova globular, and 31 µ to 37 µ in diameter.

This Tænia is represented in the vesicular state by the *Cysticercus fasciolaris* Rud., which inhabits the liver of Rats, Mice, Norway Rats, Voles, and Water-Rats. This Cysticercus—which is always coiled up in a cyst it has itself produced—is remarkable for its elongated form and the smallness of the bladder. Its length varies between 3 cm. to 20 cm., and even more. The vesicle or bladder is globular or ovoid, and is frequently no larger than a pea; it terminates a distinctly-formed chain of segments, which are short and wide, and have not a trace of genital organs. At the anterior extremity—which is 4 mm. to 5 mm. broad—is a slit, at the bottom of which the head is invaginated. In 1844, Von Siebold saw this Cysticercus become transformed into *Tænia crassicollis* in the intestine of the Cat. According to Leuckart, all the segments disappear during this process, and the scolex is formed anew; while Baillet has demonstrated that Rats will become the hosts of *Cyst. fasciolaris*, by feeding them with the mature segments of *T. crassicollis*.

This Tænia is common in the small intestine of the Cat, and it may, when numerous, occasion serious disease. Romano¹ has published the account of an epizooty among Cats caused by this Tape-worm. The animals died after showing the following symptoms: gradual diminution, then complete loss of appetite; abdomen retracted; slight diarrhœa at the commencement, then constipation; abundant salivation; sometimes spasmodic contraction of the muscles of the upper lip; great prostration, and loss of sight. Some of the animals could not hear,

or appeared not to hear, the voice of the people to which they were accustomed; certain of them vomited, and this seemed to give them slight but temporary relief. Nervous phenomena, epileptiform convulsions, and more frequently attacks of colic, were also remarked. A similar epizooëty prevailed among Cats in the Black Forest in 1874.¹

At the autopsy of the animals which had succumbed, there were found—along with Tænia extending from the stomach to the middle of the small intestine—evidence of chronic enteritis and a violent gastric catarrh. The hooks of the worm were deeply implanted in the mucous membrane.

Perroncito was inclined to attribute a rupture of the intestinal wall he found in a Cat, to the action of T. crassicollis; and Grassi and Parona have witnessed an analogous case; while Zschokke also considered this entozoon as a frequent cause of death among Cats.²

The Cat contracts the T. crassicollis in eating Rats or Mice which harbour the Cysticercus fasciolaris in their liver. In Romano’s observation, the Cats he alludes to had to encounter swarms of Rats, which were unusually numerous that year; and it was those which were the best ‘ratters’ that succumbed to the epizooëty.

Baird has described a Tænia semiteres from the intestine of the Cat, but it appears to be only a monstrous form of T. crassicollis.

2. Tænia elliptica (Batsch).—This is a Cystoidotænian closely related to T. canina of the Dog, to which it has the greatest resemblance. It measures 10 cm. to 20 cm. long, and 3 mm. at its greatest breadth. The ova are larger than those of T. canina, being 49 µ to 54 µ in diameter.

Several authorities have considered T. canina and T. elliptica as belonging to the same species; but Leuckart separates them, because of the more rapid development and maturation of the segments of T. elliptica, and which does not allow of their becoming longer; while Krabbe supports this view by the fact that, in Iceland, he has never found T. elliptica in Cats, although T. canina is very common in Dogs. On the other hand, in Copenhagen, Krabbe discovered T. elliptica in a moiety of the Cats he examined, the entozoon being lodged in the posterior two-thirds of the small intestine. In general, there were not more than 50, though it was not rare to count them by hundreds; on one occasion there were 500, and on another 600.

Tænia litterata (Goeze).—Baillet, who was the first to observe this Tape-worm in the Cat, gave it the name of T. pseudo-elliptica, just as he had designated that which he met with in the Dog as T. pseudo-

cucumerina. These two have usually been regarded as identical, although, according to Baillet, the ova are smaller in this worm—31 μ to 36 μ. It is not rare at Toulouse; and Krabbe has seen it in more than a third of the Cats he examined in Iceland, but he never saw it in Dogs or Cats in Copenhagen. In the Cat, it sometimes measures 65 cm., and there are always several, though never more than 20.

Of these three species of Tæniae, the only one possessing much interest—from a pathological point of view—is the T. crassicollis; and it is it alone that sometimes necessitates therapeutical intervention. When this becomes necessary, recourse must then be had to the anthelmintics recommended for the Dog, giving them in about half the quantity.

Bothriocephalus Felis (Creplin).—In 1825 Creplin found two young Bothriocephales in the intestine of a Cat at Griefswald. One measured 4 mm., the other 7 mm. long. He named them Bothriocephalus Felis; but Diesing—without sufficient reasons—classed them with B. decipiens, which lives in the intestines of several wild Felidae. Ercolani described a Bothriocephalus that measured 65 mm., and Krabbe collected at Copenhagen five specimens from the small intestine of two Cats, which measured from 15 cm. to 22 cm., and which he looked on as different to the Bothriocephalus latus of Man. Bruckmüller, Alessandriti, Zschokke, and Perroncito, have also collected Bothriocephales from the Cat; but the latter of these authorities recognised a great analogy between his specimens and those found in Man. These various Bothriocephales, which—for lack of sufficient studying—have all been grouped under the name of B. Felis, much resemble the B. latus in their general features, though not in their dimensions. Their ova are smaller, being no more than 50 μ to 60 μ long. No disturbance to the Cat has been ascribed to the presence of this worm.

Nematodes.—Ascaris mystax (Zeder—Fig. 232).—This species presents all the characters of an Ascaride of the Dog, of which it is only a larger variety. This of the Cat measures 4 cm. to 6 cm. long (male), or 4 cm. to 10 cm. (female).

The Ascaris mystax is more especially found in young Cats, and is present in the small intestine, sometimes also in the stomach, when it may cause vomiting, though it rarely disturbs the health of its host. Krabbe has met with it in more than 50 per cent., of the Cats he examined; in those under three years old, 17 of 19 were affected, above that age 8 of 24; the number of worms was usually under 10, sometimes 20 to 30, and once it was 80.

Oxyuris compar Leidy.—The female only of this is known; it is 8 mm. to 15 mm. long. It was found in 1856 at Philadelphia, by Leidy, in the small intestine of a Cat, along with Tænia crassicollis.

Uncinaria trigonocephala (Rud.).—Parona and Grassi have made known a pernicious anaemia that prevails among Cats in Italy, and
which they attributed to a worm they have named Dochmius Balsami. It plays the same part in this affection that the Ankylostoma duodenalis does in miners' anaemia, and that which is ascribed to the Uncinaria trigonocephala in the pernicious anaemia of packs of sporting Dogs. But Railliet has been able to assure himself de visu, thanks to Professor Parona, that the Dochmius Balsami does not sensibly differ from the Uncinaria trigonocephala. It is also probably confounded with the Strongylus tubaeformis Zeder. It is, therefore, under the name of Uncinaria trigonocephalus that the parasite which causes the pernicious anaemia of Cats should be described.

This disease is marked by slowly progressive debility; the Cat is often ill for four months before emaciation is very noticeable. A dark-coloured diarrhoea sets in with intensity at first, then gradually diminishes; the animal's tail is constantly soiled in consequence. Inappetence is manifested, with vomiturition or vomiting, and death is brought about from exhaustion. In very serious cases, a fatal termination occurs after a month of diarrhoea. In others, there are alternations of aggravation and amelioration; and frequently the existence of the malady is only recognised some months after its commencement. At times, recovery takes place after grave exacerbations.

The diagnosis is based on recognition of the preceding symptoms, and the presence in the diarrhoeic products of the ova of the Uncinaria trigonocephala; the adult worms may also be found in these, especially if an anthelmintic has been previously administered.

With regard to prognosis, this will greatly depend on the relative quantity of ova and worms observed in the faeces.

The autopsy shows all the lesions of anaemia, and the Helminths localized in the small intestine for a distance of 20 cm. to 60 cm. from the stomach; they may be grouped in four or five zones, or, if they are numerous, be spread over one-half the length of the intestine. Sometimes as many as 200 or more are found. They are floating in the intestinal fluids, or adhering to the mucous membrane, often very tenaciously. They are white, black or red, according as they are empty or full of blood; the mucous membrane is speckled with haemorrhagic points, and the food in the colon is impregnated with blood.

The treatment should be the same as for the pernicious anaemia of Dogs, the doses of medicine being reduced to one-fourth.

Other Nematodes.—Leidy² has described a Trichosoma lineare, seven specimens of which he met with in the small intestine of a Cat. Body filiform, and almost equally attenuated at both ends. Caudal extremity of the female coiled up in a spiral manner; tail curved, obtuse, and having two conical points on the ventral surface. Caudal

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extremity of the male spiral; tail long, conical, and acute; genital opening at a great distance from the end of the tail. Length of the female 7·6 mm., and male 3·8 mm.; the breadth of the female is 3·35 mm., and the male 3·21 mm.

Railliet states that the museum of the Alfort Veterinary School contains specimens of the *Spiroptera sanguinolenta* (see p. 369), labelled as from the intestine of the Cat.

In the intestine of this animal may also be found embryos of *Oltulanus tricuspid* (see p. 372), when the adults occupy the substance of the gastric mucous membrane.

**Article VIII. — Parasites of the Intestines of the Rabbit.**

**Cryptogams.** — It is more especially in the Rabbit that the *Saccharomyces guttulatus* Robin—already mentioned as found in the Ox, Sheep and Pig—is oftenest met with. It is found in the contents of the intestine and stomach, and Remak has also observed it in Peyer’s patches in the caecum—and even in the substance of the mucous membrane of the small intestine—forming conical or bifurcated groups enveloped in a cyst membrane, and lying parallel to the glands of Lieberkühn.

**Sporozoa.** — Several observers have found *Coccidia* in the intestine of the Rabbit, independently of the *Coccidia oviformes* so often met with in the liver of this animal. They behave in the same manner as the *C. perforans* of the intestine of Man and the Dog, or the *C. Ricolla* of the Cat. Rieck, who has made a special study of them, classes them with the *C. perforans*.

The intestinal Coccidia of the Rabbit are ovoid, sometimes flattened at one pole, filled with a granular protoplasm, enveloped in a double-contoured membrane, and measure from 17 µ to 24 µ long, and 12 µ to 14 µ broad. Cultivated in broth, they pass through all their phases of development in four to six weeks. The protoplasm breaks up into four spores which surround the remains of a nucleus, and are covered by a thin membrane, then become enlarged at their ends (Rieck). It is probable that each of these enlargements corresponds to a secondary spore, as in the *Coccidium oviforme*.

The presence of these *Psorospermia oviformes* may cause somewhat serious trouble—intestinal coccidiosis. In bad cases there is profuse diarrhoea, rapid emaciation, inappetence, and death from cachexia. At the autopsy there is found catarrhal inflammation of a portion or the whole of the intestinal canal. In the large intestine, the mucous membrane is covered by a thick diphtheritic layer, and offers some

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grayish, necrosed points surrounded by a dark-red inflammatory zone. In the products of necrosis, and in the croupous layer—in the midst of particles of food, epithelial cells and pus globules—are seen numerous Coccidia. Sometimes, in benign cases, the intestinal villi are simply more or less distended by Coccidia lodged in the interior of the epithelial cells (Kölliker, Lieberkühn), a desquamation of the epithelium invaded by the parasites (Neumann), or partial, whitish, irregular thickenings, 2 mm. to 6 mm. broad, where the corium and the epithelial cells are penetrated by the Coccidia (Klebs). A single cell may contain one to six parasites.

Infusoria.—Davaine has described, under the name of Hexamita duodenalis, an Infusorium which he found in considerable numbers in mucus from the duodenum of a Rabbit recently killed, and still quite warm. Very probably this was the Lambilia intestinalis Blanch.

Cestodes.—There are sometimes met with in the small intestine of the domesticated Rabbit, and more frequently in the Hare and wild Rabbit, unarmèd Tæniae which are classed under the designation of Tænia pectinata Geæ; but they are very variable in their characters, and Riehm has grouped them into five species. Two of these have unilateral genital spores—T. rhopalioccephala of the Hare, and T. rhopalioccephala of the wild Rabbit. To these must be added the T. Wimerosa Moniez, of the wild Rabbit. The other three have bi-lateral genital spores, and consequently belong to the genus Dipylidium; they are the D. Leuckarti of the wild Rabbit, D. pectinatum of the Hare, and D. latissimum of the wild Rabbit. The distinction between these three appears to be a little forced.

The length of these Tæniae of Riehm varies with the species, but is between 40 cm. and 1 m., their width being between 5 mm. and 14 mm. The T. Wimerosa scarcely measures 1 cm. long, and 1·5 mm. broad, and its body is formed of only about a dozen segments.

We have found in the domesticated Rabbit a Tænia 35 cm. long, the largest segments in which were 20 cm. from the head, and measured 11 mm. broad; to us it appeared to belong to the Dipylidium Leuckarti.

Curtice has found 55 Tæniae in a Rabbit, none of which were more than 3 cm. long, the majority being less than 5 mm. He classed them with T. pectinata, not taking note of the distinctions made by Riehm. The youngest showed—besides the four suckers—a cupuliform cavity occupying the place of the proboscis, and which was margined by 85 to 90 hooks; older specimens offered the same cavity, but there were no hooks; while the oldest had no cavity at all. This is the only information we possess as to the primary phases in development of the Tænia of the Rabbit, and it is very incomplete and insufficient.

Acanthocephales.—Bellingham has noticed an Echinorhynchus (Echinorhynchus Bell.)—but without giving a description of it—which he found in the small intestine of the domesticated Rabbit.

Nematodes.—Oxyris ambiguus (Rud., Passalurus ambiguus Duj.).—A white fusiform worm, the male of which is 3 mm. to 5 mm. long, and the female 8 mm. to 11 mm.; the body in both sexes

2 G. Riehm. Studien an Cestoden, Halle, 1881.
terminates in a subulated or suddenly tapering tail 20 mm. in length. It infests the large intestine and caecum of the Rabbit and Hare. At Vienne, according to Dujardin, it is found in 12 of every 125 animals.

**Striped strongle** (*Strongylus strigosus* Duj.—see p. 373).—This strongle has only been noted as inhabiting the caecum and colon of the wild Rabbit. Railliet has found it at Alfort in the stomach of the domesticated Rabbit, and Perroncito has observed the same at Turin. It must not be mistaken for *Str. retortaformis* Zeder, which has thick, short and twisted spicule, and infests the small intestine of the Hare and wild Rabbit. Railliet has, however, also found this species in the small intestine of the domesticated Rabbit.

**Trichocephalus unguiculatus** (Rud.).—This species is particularly characterized by the tenuity of the spicula and its sheath, which is smooth. The male and female are 3 cm. to 4 cm. long. It is met

with in the large intestine, and more especially in the caecum, of both the wild and domesticated Rabbit, and the Hare (Schneider).

**Intestinal Anguillula of the Rabbit.**—This is a species observed by Grassi and Perroncito, in the posterior moiety of the duodenum, in the jejunum, and sometimes in the first portion of the ileum. The female only appears to be known. It is 37 mm. long on the average, the oesophagus occupying nearly one fifth. This oesophagus is triquetrous, and gradually expands posteriorly; it has no chitinous armature. Ovary double; vulva situated towards the posterior third of the body, and surrounded by papillae. Eggs ovoid, 40 μ long, and 20 μ wide.

The four species of Nematodes we have mentioned have not, up to the present time, been considered as playing any pathogenic part in the domesticated Rabbit.

**Article IX.—Parasites of the Intestine of the Guinea-pig.**

No Helminths have been observed in the intestine of the Guinea-pig, but only flagellated Infusoria, localized in the cæcum and large intestine.

a. *Monocercomonas (Monas) caviae* Davaine.1—We may provisionally—and until further information is afforded—class with the *Monocercomonas* a Flagellate that Davaine was the first to find, in considerable quantity, immediately after death in the large intestine of a Guinea-pig. By their numbers and movements, when viewed through the microscope, these Monads gave to the fluid they were in a singular boiling appearance. Davaine described this infusorium as being slightly variable in size, according to individuals; but about 20 μ long, irregularly spherical in shape, having a single flagellum in front nearly twice as long as the body, and movable throughout its whole length. It is probably the same parasite as that to which Perroncito attributed the production of an enteritis that often decimated the offspring of Guinea-pigs. He admits the existence of three species—*Cercomonas ovalis*, *C. pisiformis*, and *C. globosus*. They appear to be capable of enveloping themselves in a thin protective membrane, and in this encysted, resisting form they can be propagated. This parasite is perhaps also the Protozoön described by Künstler by the name of *Bacteriöidomonas sporifera*, and as oblong in form, 24 μ long, provided with a single very long flagellum, and which develops in its interior one to eight spores, which also are endowed with a flagellum when set free, and are capable of assuming various shapes—even that of the * Spirillum*.

b. *Trichomonas caviae* Dav. *Cimaenomonas (?) caviae* Grassi.—Body of variable form and volume, but often ovoid, and gradually becoming finer, to terminate in a flagellum at least as long as the body; rapid undulatory movement on the contour, apparently due to vibratile cilia (?) which are incessantly in motion, and which—in consequence of their base being thick—can only be seen from time to time. The largest specimens are 20 μ long, and 10 μ wide. They have been found in great numbers at Paris, by Davaine, in the large intestine of a Guinea-pig recently killed, and still warm.

Leuckart says that Coccidia have been observed in the intestine of the Guinea-pig.

**(Article X.—Parasites of the Stomach and Intestines of the Elephant.**

(Steel2 mentions that 'round worms' are found burrowing in the coats of the stomach of the Elephant, and there form for themselves 'abodes,' which occur as tumours, having burrowing channels in the mucous membrane, the larger and smaller of these being formed by different species of worms. No practical importance can yet be attributed to these parasites. One round worm occurs in both stomach and intestines, and three others have been found in the latter; they vary in length


from 9 lines to 3 inches, and an even larger form is said to be found occasionally in the bile-ducts. There is no evidence that they cause inconvenience.

Three kinds of Amphistomes are found in the intestines, but only one— *Amphistoma Hawkesii* Cobbold—is of any importance. They give rise to a diarrhoea, known in India as 'Lungen,' and which is the most frequent disease of Government Elephants—proving fatal in some cases, as when the animals are young, or are improperly fed and tended. Death results from exhaustion, which is caused by the drain on the system effected by these animal parasites in two ways; firstly, by irritation causing profuse diarrhoea; and secondly, in all probability, by direct removal of blood from the mucous membrane of the intestine, to which they adhere with the greatest tenacity, by means of their suckers. Of course, they must be present in very large numbers to produce such serious effects, and which are all the more easily and quickly induced if the Elephant they invade is already weakened. Almost every Government Elephant in India is infested with some of these Amphistomes, which in some instances become so numerous, and cause so much irritation, that purging sets in, and they are got rid of if the animal is sufficiently strong to withstand their attacks. As parasites of a closely allied species occasionally cause the death of Horses in India, Cobbold was inclined to believe that the Elephant Amphistome is derived from the Horse. The symptoms are those of ordinary diarrhoea of a severe and persistent character, preceded by a depraved appetite and a tendency to eat earth, which renders the faces muddy; while the dejections themselves contain—generally in enormous numbers—small translucent bodies of a pink colour, resembling soaked barley-grains, measuring three-eighths of an inch long, by one-fourth of an inch broad. Careful examination of these will lead to their being identified as Amphistomes—and especially the presence of a circular sucker at each extremity of their elongated bodies. After a time, oedematous swellings appear about the head and shoulders, and the animal dies from exhaustion.

If an autopsy is made immediately after death, the Amphistomes are often found in myriads, adhering by means of their suckers to the mucous membrane of the large intestine, some being also free in the intestinal canal. The intestine exhibits indications of irritation, especially in the form of gelatinous effusion between the tunics; and there are generally other parasites associated with these. The other organs of the body are anaemic, and more or less dropsical, while the blood is very deficient in colour. Infestation probably takes place by means of green forage.

An outbreak of this parasitism occurred among the Elephants of a London circus in 1878, and caused much loss.  

**B.—DOMESTICATED BIRDS.**  
**Article I.—Parasites of the Intestines of Poultry.**

**Infusoria.**—Eberth has remarked in the intestines of several Birds, and notably in the Fowl, an Infusorium in the glands of Lieberkuhn that Künstler places in the genus *Trichomonas*—Tr. *Eberthi* Sav.  

(1) Cobbold. *The Veterinarian, 1875.*  
(2) Steel. *Medical Examiner, 1878.*
Kent. It is remarkable for the presence of a very salient, plicated, undulating membrane placed along the body.

**Sporozoa.**—Rivolta, Silvestrini, Perroncito, and others, have met with Coccidia in the intestines of the Fowl, which should be classed with the *Coccidium perforans*, of which we have already spoken when treating of the intestinal parasites of the Dog and Rabbit.

By the name of *Gregarina avium intestinalis*, Rivolta has given a description of Psorospermia encysted in the submucous connective tissue of the intestine of the Gallinacea of Poultry-yards.

It is in the form of utricules—oval, elongated or globular cysts, averaging 40 μ to 48 μ in diameter. They are limited by a thin homogeneous membrane, and are filled with spores—*pseudonavicellae*—which are elongated, straight or slightly curved, and a little pointed at each end. Each of these spores has a granular contents, and is full of vacuoles. They measure 11·50 μ to 14·25 μ.

These spores, when introduced into the intestine with the food, traverse the mucous membrane, reach the connective tissue, and become developed and encysted, giving rise to white, discrete, or confluent points formed of these agglomerated 'Gregarine,' and which are found throughout the intestines; these being no longer competent to perform their function, the Poultry are attacked with diarrhoea, depression, loss of appetite, and die in a state of marasmus.

This affection most frequently appears in an epizootic form, and usually coincides with cutaneous, buccal, and pharyngeal psorospermosis, of which we have already spoken. The pathological processes that accompany it, and which may extend to the liver and lungs, have such great resemblances to the diphtheria and tuberculosis of Birds, that it is often impossible to decide as to which morbid entity they belong to; and we can therefore understand how it happened that Mégnin and Cornil, Lépinez and others, have been led to consider this collective condition as a single malady, which they designated *tuberculo-diphtheria*. But unfortunately, these authorities, while showing that they were really dealing with tuberculosis and diphtheria, did not establish the differences or relations between these affections and psorospermosis, nor the histological appearances which caused them to believe in the existence of the latter condition; so that they have not justified in a peremptory manner the opinion they arrived at. The obscurity that still reigns on this subject, explains the brevity of our notice of it.

**Cestodes.**—Ten species of Cestodes—nine *Taenia* and one *Bothriocephalus*—have been described as parasites of the Fowl. But the
numerous forms of Tape-worms mentioned as infesting this Bird are
difficult to distinguish from each other, while the majority have been
incompletely described; besides, the hooks with which the head is
armed are usually very temporary, and after they are shed the
physiognomy of the scolex is so modified that the species can scarcely
be distinguished; and, finally, many Tæniae are so seldom met with,
that there is little opportunity for establishing their natural history on
a solid basis. In certain cases the intestines contain them in such
numbers, and so many Fowls are infested, that there prevails a kind of
epizoötic tæniiasis.¹

1. Tænia infundibuliformis Gœze.—Length 20 mm. to 130 mm.,
exceptionally 230 mm.; breadth 1 mm. to 2 mm. Head oval, slightly
flattened, and .50 mm. long; long rostellum, retractile or protractile,
cylindrical or hemispherical, and bearing a single crown of 16 to 20 hooks,
according to Krabbe — 30 according to other authorities, which are
20 μ to 27 μ long; suckers small and neck very short. First segments
very short, and the succeeding ones infundibuliform, the anterior border
being narrower than the posterior. Genital pores single, and irregularly
alternated. These worms are often present in hundreds in the intestines
of the Fowl. Grassi and Rovelli state that the Cysticercus of this Tænia
has, for its intermediate host, an earth-worm—the Allobobophora fætida
Eisen.²

2. T. cuneata Linst.—Length 2 mm., breadth 1 mm. Rostellum
provided with 12 hooks, 32 μ long. Suckers oval and elongated.
Strobila cuneiform, comprising 12 segments, which increase in breadth
from the first to the last. Grassi and Rovelli assert that this Tænia
has the same intermediate host as the preceding.

3. T. exilis Duj.—Length 100 mm., breadth 1 mm. to 2 mm. Head
tetragonous and .60 mm. broad. Rostellum short, depressed, and
armed with a single crown of 60 hooks, 8 μ long. Suckers orbicular;
neck distinct and 5 mm. long. Segments wider than they are long,
and the anterior border narrower than the posterior, giving the strobila
a saw-like appearance. Genital pores unilateral.³

4. T. tetragona Molin. Length 12 mm. to 90 mm.; width 2 ·mm.
Head tetragonous and very small. Rostellum very short, conical and
unarmed (?). Suckers nearly quadrangular. Neck short. First seg-
ments very short, the last being subquadrangular, overlapping each
other, and so rendering the strobila dentated.

5. T. fasciolaris Pallas (T. malleus Gœze).—Length 40 mm. to 200
mm., breadth 4 mm. to 5 mm. Head very small and 2 mm. broad.
Rostellum short, slender, and armed with 12 hooks, 17 μ long. Suckers
.05 broad. Neck short, .80 μ broad, followed by a transverse dilatation,
formed of very numerous but little distinct articles. Ova collected in
files or series (Dujardin). Found by Crepin in the Cock; more
frequent in the Duck.

6. T. cesticillus Molin (T. infundibuliformis Duj.).—Length 9 mm.
to 45 mm. (Molin), or 110 mm. (Krabbe); breadth 1 mm. to 2 mm.

¹ J. Nessl. Die Tænia als Ursache einer Seuchenartigen Hühnerkrankheit. Mo-
natschr. des Vereines der Thierärzte in Österreich, 1887, p. 27.
Head pyriform; rostrum scarcely salient, depressed, discoïd, and surrounded at its base by a ring which is unarmed, according to Molin, but has a double crown of 208 hooks, $7\mu$ to $9\mu$ long and very temporary. Neck *null.* First segments very short, and broader than the head; the last are nearly as long as they are broad. Genital orifices single, and irregularly alternated. A common species.

7. *T. proglottina* Dav.—Length 9 mm. Head ovoid, 10 mm. long and 18 mm. broad. Rostrum replaced by an infundibulum 80 $\mu$ wide, and armed with a double crown of more than 80 hooks, $5\mu$ long. Suckers have only one-third of the infundibulum, and are armed similar to the hooks, but smaller. Strobila nearly always formed of less than four segments, the first is distinct from the head and smaller than it; the second segment is larger than the head, and the third and fourth are successively larger; the genital pore is at the anterior angle of one side of the third segment, and at the anterior angle on the opposite side of the fourth. Ova very large—50 $\mu$—and each contains a very active embryo. The segments separate as soon as they are formed; they live and are developed when free, acquiring double the total length of the *Tænia.* When largest they are 1½ mm. long, and can retract to one-half this measurement. They move about in a very lively manner. Davaine has found these proglottides—which had been already seen by Dujardin—in considerable numbers in the duodenum of all the Fowls he examined at Saint-Amand, Nord, in October, 1885. He obtained a very small number of heads by scraping the mucous membrane of the duodenum. According to Grassi and Rovelli,¹ this *Tænia* lives as a *Cysticerus* in several species of *Limax*—*L. cinerus,* *L. agrestis,* *L. variegatus.* In less than twenty days, the ova are transformed into *Cystici* in the organs of these different mollusces, which Fowls readily eat, and in them are consequently developed the *Tænia proglottina,* which is provided with four segments in eight days.

8. *T. bothrioplistis* Piana.—Length 200 mm., breadth 3 mm. Suckers armed with seven to eight crowns of hooks. Neck long and narrow. Genital pores unilateral, and situated on the middle of the marginal border of the proglottis. This worm buries its head deeply among the intestinal villi, and as far as the muscular tunic. Piana has found in the small mollusces belonging to the genus *Helis*—*H. carthusianella,* *H. maculosa*—little *Cysticeri—Cysticercus bothrioplistis*—28 mm. long, and 21 mm. broad, which might be the larval form of this *Tænia.*²

9. *T. echinobothrida* Mégnin.—Length 50 mm. to 100 mm., breadth 2 mm. Rostrum replaced by an infundibulum armed with a double crown of about 100 hooks. Suckers armed with crowns of rose-like thorns, those of the middle rows being the largest. No neck. Genital orifices irregularly alternated.³

The last three species greatly resemble each other, in having suckers armed with hooks. The *T. proglottina* appears to us to be a distinct species, and the *T. bothrioplistis* and *T. echinobothrida* are more especially distinguished by the arrangement of their genital pores. Mégnin considers *T. echinobothrida* as the complete state of *T. cesticillus,* this having lost its hooks and suckers. But there is much uncertainty with regard to this. We have found, fixed in the duodenal mucous membrane

³ Mégnin. *Journal de l’Anat. et de la Physiologie,* 1881, p. 27.
of a Fowl, some scoleces of a Tænia intermediate to T. proglottina, and the other two species with armed suckers. The head was 3 mm. to 4 mm. broad; the infundibulum had a double crown of about 200 hooks, 10 μ long; the suckers were equal in diameter to the infundibulum, and were armed with seven to eight crowns of hooks, which were nearly the same in length, but the blade of each was thicker and more curved.

10. Bothriocephalus longicollis Molin.—Length 15 mm. to 30 mm., breadth 4 mm. Head small and claviform. Suckers in the form of oval, lateral slits. Neck long and slender; body taenoid, and furrowed by two longitudinal grooves. First segments very short, the succeeding ones being almost quadrangular, and the last elliptical, transversely elongated, and having rounded borders.

This species was found in Italy by Molin, in the small intestine of a Fowl.

According to Nessl, the young Fowls which harbour numerous Tæniae lose their appetite, become emaciated, dull and feeble, isolate themselves, and hold their head under the wing. Other authorities have observed diarrhoea, sometimes epileptiform attacks, stiffness in movement, and the legs straddling.

The only indubitable sign is the presence of proglottides in the faeces.

With regard to the treatment of taeniasis in Fowls, the best method is to mix powder of the bark of pomegranate-root—a teaspoonful for every fifty head—in their food.

Trematodes.—1. Monostoma verrucosum Frölich (Notocotyle triserialis Dies.).—Body white or reddish, 2 mm. to 6 mm. long, and 7 mm to 1.5 mm. broad; oblong-oval, very depressed, narrow in front, rounded behind; 36 to 47 round, reddish papillæ, arranged in three rows on the ventral surface—sometimes absent, according to Dujardin—and constituted, as stated by Wedl, by the groups of the terminal vesicles of the vitelline sacs, which become prominent. Penis studded with small spines. Vulva situated behind, and at the base of the receptacle for the penis. Ova of special form, somewhat reddish, elliptical, 23 μ long and 11 μ broad, and furnished at each end with a filiform appendage 160 μ long. Found by Von Siebold in the caeca of the Fowl; though it is more frequent in the Duck.
2. *Distoma oxycephalum* Rud.—Body oval and depressed, 6 mm. to 8 mm. long, and 3 mm. to 2 mm. broad. Oral sucker unarmed; ventral sucker very large. Anterior part attenuated, and provided with small spines. Dujardin and Von Linstow consider this species as a mere variety of the *D. echnatum*, of which the hooks are little visible or are detached. Rare in the Fowl; more frequent in the Duck.

3. *Distoma dilatatum* Miram.—Body elongated, flattened, rounded behind, from 4 mm. to 8 mm. long, and 2 mm. broad. The anterior part is attenuated into a kind of neck, which presents in its middle a dilatation 1-2 mm. long. Found in the caeca and rectum. Rare.

4. *Distoma lineare* Zeder.—Body reddish, linear, flat, obtuse behind, 10 mm. to 15 mm. long, and 1-5 mm. broad. Oral sucker surrounded by six small papillae. Found in the caeca and rectum. Rare.

5. *Distoma armatum* Molin.—Body linear, flat, rounded behind, inferior surface a little concave, and covered with small, closely-set spines which are absent behind; prolonged in front by a conical neck carrying semi-lunar head furnished with two rows of spines; oral sucker oval; the ventral sucker much larger, and situated at the base of the neck. Total length 8 mm., width 1 mm. Found by Molin in Italy, in the caeca and rectum of a Fowl.

6. *Distoma ovatum* Rud. Body flattened, oval, narrower in front, whitish, speckled with black, 4 mm. to 7 mm. long, and from 2-5 mm. to 4 mm. broad behind. Oral sucker terminal, orbicular, prominent, and from 4 mm. to 6 mm. wide; the ventral sucker is double this in size. The integument is studded with hooks pointing backwards, very close together in the anterior region, and which are deciduous, and only visible in very young specimens.

It is found in the bursa of Fabricius of numerous Birds, among which is the Fowl, but only when it is young, as this pouch disappears with age and the advent of the generative functions (Retterer).

7. *Mesoyminimus commutatus* Sons. (*Distoma commutatum* Dies.).—Body flat, about 7-5 mm. long, and 1-5 mm. broad in front, 2 mm. behind; white except on the middle third, at the posterior sucker, where it has a dark tint from the presence of eggs in the oviduct. Orbicular suckers larger, the anterior a little more so than the posterior. Testicles rounded, and situated in the posterior part of the body, one behind the other. The genital openings are situated on the ventral surface, behind the posterior sucker and in front of the anterior testicle. The vitelligenes are lateral, occupying the anterior two-thirds. Ovary a little to the right, between the two testicles. Eggs ovoid, 27 μ long, and 14 μ broad. Found for the first time by Wagener, then by Sonsino, who has given a good description of it. It inhabits the caeca of the Fowl.

All these species of Trematodes are of no importance from a pathological point of view.

**Nematodes.**—1. *Ascaris gibbosa* Rud.—Length 13 mm. to 22 mm. A gibbous enlargement a little distance from the head. A very doubtful species which Zeder alone has found, in 1788, in the intestine of the Fowl, and which was only described from memory in 1800 (Dujardin).

2. *Heterakis papillosa* Bloch (H. vesicularis Frölich).—Mouth surrounded by three lips. Pharyngeal bulb not distinct. Male 8 mm. to 9 mm. long; two unequal spiculae; pre-anal sucker encircled by a

salient vesicular ring; posterior part fine and subulated. Female 11 mm. to 15 mm., and gradually attenuating towards the posterior part. A common species: of 190 Fowls or pullets, Dujardin at Rennes found it in 107, and exclusively in the ceca—sometimes in prodigious quantity during various seasons. At Vienne it has been met with in 41 of 127 Fowls.

3. *Heterakis differens* Sonsino.1 — A slightly larger species than the preceding. The mouth has no apparent lips. Pharyngeal bulb distinct. Two equal spicule, accompanied by an accessory piece; sucker neither salient nor winged. Posterior extremity of the female sharply acuminated. Found by Sonsino in the posterior portions of the Fowl’s intestine.

4. *Heterakis inflexa* Rud. — Body of a dirty-yellow colour, 3 cm. to 8 cm. long in the male, and 7 cm. to 12 cm. in the female. The tail ends in a sharp mucron. Infests the small intestine. At Rennes, Dujardin found it only in thirty of 195 Fowls and pullets. It was not met with at Vienna in 127 Fowls examined.

5. *Heterakis compressa* Schn. — Male 5 cm. long; female 9 cm. long. A species found by Schomburg in the intestine of the Fowl in South Australia. Finally, we have already mentioned (p. 375) the larval Nematodes found by Badoky, encysted in the walls of the stomach and intestine.

Baronio2 has described an epizootic malady that prevailed among Fowls and other domesticated Birds in Lombardy, during the summer of 1789, and which he attributed to worms in the intestines. From the dimensions he gives, these worms might be the *Heterakis inflexa*; but notwithstanding their oftentimes considerable numbers in the intestines and the sometimes salutary effects of vermifuges, judging from the symptoms and the lesions it might be affirmed that the helminthiasis was accessory, and that the cause of the mortality was probably nothing else than Fowl-cholera.

This is not the case, however, with the observations of Blavette and Rossignol.3 Death here appeared to be due to the accumulation of the *Heterakis inflexa* in the intestine. In the first case, there were about thirty in each Fowl that had died; and in the second they formed one

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or two pellets the size of a pigeon's egg, situated in the duodenum, which they obstructed. Some of the worms were isolated, and extended throughout the length of the small intestine. But what still leaves doubts—especially in Rossignol's case—is the sudden appearance of the disease, its rapid progress, and the mortality attending the epizooty, which had neither the physiognomy nor the symptoms of a verminous affection.

Mégnin\(^1\) asserts that helminthiasis due to the *Heterakis inflexa*, is manifested by diminution of appetite, emaciation, indifference, somnolency with sudden starts of wakefulness, and diarrhoea. He recommends mixing santonin with the food given to the Fowls, or incorporating it in powder in a cake, the dose being 4 or 5 grammes to every ten Birds.

In Blavette's observation, the good effects of anthelmintic treatment are demonstrative. Following Baronio's example, he employed a mixture of equal parts of the root of male shield-fern, tansy and savory, of which he made a decoction—about 300 grammes to 3 pints of water; the resulting fluid was mixed with flour, and of this pills were made, which were forcibly administered to the diseased Birds.

6. *Trichosoma longicolle* Rud. — *Male*, 16 mm. to 23 mm., *female*, 70 mm. to 80 mm. long. Posterior extremity of the body rounded, truncated in the female. The sheath of the spicula in the male is nude.

7. *Trichosoma annulatum* Molin.—Length of the *male*, 15 mm., of the *female*, 80 mm. Body white, capillary very attenuated at its anterior extremity, and elegantly marked with close annular stripes.

8. *Trichosoma collare* Linstow.—Length of the *male*, 8 mm. to 10 mm., of the *female*, 9 mm. to 12 mm. Cephalic extremity in the form of a truncated cone. The sheath of the spicule of the male is covered with fine bristles. Found by Von Linstow in great quantities in the intestine of a Fowl.

The Trichosomes are not frequent in the Fowl's intestine. In more than 180 Birds, Dujardin only found them in eight; he doubtless classed them all with *Tr. longicolle*. So far as pathology is concerned, these parasites possess no interest. They occupy various portions of the intestines, but more especially the caeca and colon; though Zürn indicates the *Tr. annulatum* as having been found by Molin, beneath the oesophageal epithelium of the Fowl.

9. *Dispharagus spiralis* Moën.—This has been already noted as parasitic in the oesophagus of the Fowl. It has been met with in the intestine of this animal by Fedoschenko, in Turkestan (Von Linstow).

Lucet\(^2\) has observed a verminous enteritis in poultry-yards, due to the association of various species of Helminths. The affection made slow progress, and the Fowls attacked preserved their appetite, but lost condition, and became dull and indifferent; later, the plumage

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1 Mégnin. L'Éleveur, 1890, p. 309.
lost its lustre and became erect; while the wings were drooping and the movements languid. A fœtid diarrhœa set in, wasting became more marked, and the appetite was diminished; soon the creatures remained immovable and huddled up, with their eyes half closed; the comb and mucous membrane lost their colour, the temperature was below normal, the appetite disappeared, and the feet were swollen. These Fowls often yawned, and their torpor and anaemia were extreme; death ensued in a tranquil manner in about one or two months. At the autopsy, in addition to the emaciation, there were observed the lesions of a chronic diarrhoeic enteritis, and the following Helminths—

_Taenia proglottina_, _T. infundibuliformis_, _T. cesticillus_, _Heterakis papillosa_, _H. inflexa_, and _Trichosoma collare_. The _Taenia proglottina_ was the principal cause of the malady, and in each case was found in thousands. The _Heterakis papillosa_ and _H. inflexa_ were less constant, though they had taken a good share in the development of the affection. The successful treatment consisted in the intermittent employment of calomel in doses of 1 to 2 centigrammes, and the heads of santonin, artemisia vulgaris, and wormwood, mixed with the ordinary grains on which they were fed. The hen-roosts were also scrupulously cleansed.

10. There has been observed, in Cochin-China Fowls, a diarrhœa caused by the _Aguillula stercorealis_, which had become developed in the walls of the intestine. This diarrhœa is very analogous to that attacking Man, and which is known under the name of 'Cochin-China diarrhœa.' Death resulted either from rapid debility, or slowly from marasmus and anaemia.1

**Article II.—Parasites of the Intestines of the Turkey, Guinea-fowl, Peacock and Pheasant.**

Intestinal parasites are not common in the Turkey. They are a _Taenia_, a _Mesogonima_, and two _Heterakis_.

The Tape-worm is the _T. cantaniana_ Pol., found by Poloni. It is 14 mm. long. Its globular head, furnished with four very large suckers, is described as unarmored, perhaps because of the deciduousness of the hooks. There is no neck, and the first segments are campaniform, the succeeding ones being more trapezoid.

_Mesogonimus commutatus_ Dies.—This parasite of the Fowl has been found once in a young Turkey by Sonsino.2

The two _Heterakis_ are the _H. papillosa_ and _H. inflexa_ ( _H. perspicillum_ Rud.), also found in the Fowl. They are but little prevalent.

The only intestinal parasite of the _Guinea-fowl_ is the _Heterakis papillosa_, found in the Vienne Museum in 6 of 12 Birds.

It is the same with regard to the _Peacock_, in which this parasite has been found in 9 of 17 Birds at the Vienne Museum.

The _Common Pheasant_ harbours in its intestine the _Heterakis papillosa_, _Trichosoma longicolle_, _Taenia infundibuliformis_, and _T. cantaniana_, the first three of which have been already met with in the

1 Repertorium der Thierheilkunde, 1877 (quoted by Zürn).

Fowl, the last in the Turkey. In addition to these, Von Linstow has described another species by the name of *Tænia Friedbergeri*, and Mégnin has classed with *T. cesticillus*—var. *Phasianorum*—a species which is distinguished from it by its unilateral genital pores, and which, for this reason, is more closely related to *T. exilis*.

*Tæniae* are sometimes so numerous in the intestines of the Pheasant, that they cause a real verminous enteritis, which is often fatal. Friedberger and Mégnin have drawn attention to this malady, which may prevail in an epizoötic form, more especially attacking young Birds. There is nothing particular in the symptoms, which are chiefly those of digestive or reflex disturbance common to all the intestinal Helminthiasis. In several Pheasants, Mégnin has found portions of the intestine literally crammed with masses of *Tæniae*, each usually composed of 15 to 20 complete individuals.

This authority has recommended treating the diseased Pheasants with kamala, mixed into a paste with hard-boiled eggs and bread, which should be given concurrently with ants' eggs. Zürn advises the employment of fresh powdered areca-nut, in doses of 2 to 3 grammes, and pumpkin-seeds.

Mégnin relates that he has witnessed an outbreak of verminous enteritis caused by the *Heterakis vesicularis*. It manifested itself by the same symptoms as that of Fowls—due to the *Heterakis inflexa*, and should be submitted to the same treatment.

**Article III.—Parasites of the Intestines of the Pigeon.**

**Infusoria.**—At the autopsy of four Pigeons, Rivolta found in the small intestine a considerable number of very mobile Infusoria—the *Trichomonas columbae* Raill. They were 6 μ to 7 μ long, and nearly 3 μ broad; were pale, oval, semilunar or constricted in their middle, more obtuse at one end than the other, and furnished with four flagella, one or two of the longest of these being situated at one end of the body. There were, besides, numerous yellow *Psorospermia*. The mucous membrane was inflamed. Rivolta attributed the death of the Pigeons to the action of these parasites.

**Cestodes.**—*Tænia crassula* Rud. Length 300 mm. to 400 mm., breadth 4 mm. Head oval; rostellum obtuse, rounded at the summit, and armed with a double crown of about 60 hooks from 10 μ to 11 μ long. Neck long and slender. First segments very short, the succeeding ones being always short, but with expanded borders; the last are nearly infundibuliform. Genital pores unilateral. Ova very large, ovoid, 28 μ long, and arranged in groups. A rare species, found first in Brazil by Olfers, in a Pigeon brought from the coast of Africa; seen at Rouen by Clouet.

**Trematodes.**—At the autopsy of a six weeks old Pigeon, Mazzanti found in its small intestine a certain number of Distomes in the midst of a sanguinolent fluid, and at this spot the mucous membrane was


congested and of a dark-red tint. He named this parasite *Distoma columbae*. From the description of it, it appears to be identical with *Mesogonimus commutatus* of the Fowl's intestine.

**Nematodes.**—*Heterakis maculosa* Rud. (*H. columbae* Gmelin).—Body white, somewhat translucent, cylindrical, and attenuated at both ends. Head with three almost equal-sized lips. **Male** 16 mm. to 25 mm. long; tail straight, conical, somewhat acute and mucronated; sucker round; ten papillae on each side; two long spiculae. **Female** 20 mm. to 35 mm. long; straight, conical or conoid mucronated tail; vulva placed in the middle of the length of the body, which is often distended by eggs. Internal vesicles, the nature of which is not well understood, are seen through the transparent walls like so many spots. Ova 80 µ to 90 µ long, and 40 µ to 50 µ broad.

This worm is often met with in enormous quantities in the intestines of Pigeons, sometimes to such a degree as to prevent their being reared. It is not rare to find 400 to 500 in the intestine of one Bird; so that it is easy to understand the amount of digestive derangement that may result. Unterberger¹ was one of the first to direct attention to the noxiousness of this Helminth. Independently of the ova of the *Heterakis*—which the microscope reveals in innumerable masses in the faeces—the malady is characterized by a group of symptoms, of which the principal are torpidity, loss of appetite, periodic mucus diarrhoea, and at last marked wasting, particularly of the pectoral muscles. Death usually occurs at this period, after general exhaustion and convulsions. At the autopsy, the worms are found closely packed together, and lying in the long axis of the intestine; the mucous membrane is distended in patches more or less large and numerous, gorged with blood, softened or ulcerated, and covered with thick mucus.

In about 7 grammes of faeces passed in twenty-four hours by a diseased Pigeon, there were on the average—according to Unterberger—12,000 eggs of the *Heterakis*. This authority placed some of these eggs on damp blotting-paper in a flask, and watched their evolution; the embryos were well formed in about 17 days. These ova were then given to perfectly healthy Pigeons, when they were—in about three weeks—transformed into adult *Heterakes*, the eggs of which were discovered in the faeces. When, on the other hand, healthy Pigeons were given the ova immediately after their expulsion with the faeces, or their discharge from the oviducts, they did not develop, and were passed with the excrements intact or slightly digested. The evolution

of the parasite, therefore, can only take place beyond the intestine, without the necessity, however, of an intermediate host. Infestation takes places from Pigeon to Pigeon, through the medium of the food soiled by the excrements of the diseased.

In order to prevent the extension of this helminthiiasis, the healthy should be rigorously separated from the diseased Pigeons; the faeces should be frequently examined by means of the microscope, so as to ascertain the condition of the Birds with regard to infestation; the places occupied by them ought to be kept scrupulously clean, the walls, floors, ceilings, perches, nests, etc., being frequently disinfected. The grain upon which they are fed should not be scattered over the ground, but placed in proper receptacles into which the faeces are not likely to be dropped. It is well to mix aniseed, salt, and other substances appetizing for Pigeons, and also coarsely powdered areca-nut, with this grain.

With regard to treatment, in benignant cases each diseased Pigeon should receive 6 centigrammes of calomel worked up with soft bread, or made in pills with butter. In more serious cases, recourse may be had to powdered areca-nut in 1 gramme doses, administered in the same manner (Zürn). Pelletan¹ recommends the vermifuge biscuits given to children, the Birds being very fond of them; two days of this treatment are said to kill the worms. A more practical course which he advises, is to distribute among them peas which have been macerated for some hours in a cold decoction of wormwood. The treatment employed by Blavette for the helminthiasis of Fowls (p. 483) may also be adopted, the dose being reduced to one-half.

*Trichosoma tenissimum* Dies. (*Tr. columba* Rud., *Calodium tenue* Duj.).—Male 10 mm. long, the slender part being 4-7 mm. broad; tail obliquely truncated; sheath of the spicula regularly ridged transversely. Female 18 mm. long, the anterior portion being 7 mm. broad; vulva provided with a salient membranous appendix. A frequent and abundant species in the small intestine. Pauly and Zurn² state that it often determines an intense intestinal catarrh, which leads to anaemia and consumption.

*Filaria clava* Weld.—This is stated by Von Liustow to inhabit the intestines of the Pigeon. We only know it as a parasite of the connective tissue.

**Article IV.—Parasites of the Intestines of the Duck.**

**Infusoria.**—Davaine has found in the caecum of a Duck examined immediately after death, flagellated Infusoria which he named *Monas—Monocermonas-anatis*. The body is oblong, transparent, 8 μ long and 4 μ broad, and has an anterior flagellum which is flexible throughout its entire length, and is longer than the body. This is perhaps only the


Trichomonas Eberthi, found by Eberth in the Fowl, and also in the glands of Lieberkühn of the Duck.

Cestodes.—Like the Fowl, the domestic Duck harbours nine species of Taenia. But they are much more frequent in it than in the Fowl, and their larval phase is probably passed in aquatic Invertebrata—no doubt Molluses, the Duck being more than any of the other domesticated Birds exposed to infestation.

1. Taenia infundibuliformis Gæze. Rudolphi says he found this parasite in the domestic Duck in December. It nevertheless appears to be exclusive to the Fowl.

2. T. fasciolaris Pallas.—This is more frequent in the Duck than the Fowl.

3. T. anatina Krabbe. This is 300 mm. long, and 3 mm. broad. The rostellum has a single crown of 10 hooks, 65 μ to 72 μ long, the handle of which is long. Genital pores unilateral. Eggs ovoid, and containing a very long embryo.

4. T. simusula Zeder.—Length, 50 mm. to 160 mm.—to 300 mm. according to Rudolphi. Capillary anteriorly, and 1 mm. to 2·25 mm. broad behind. Head nearly globular; rostellum carrying, like the preceding worm, a single crown of 10 hooks from 40 μ to 60 μ in length, the handle being long. Genital pores unilateral. Scolex marked by a line of black points—one on each segment; it is the pouch of the cirrhus (?), which is globular. Dujardin found this to be a rather common species in the Duck.

5. T. gracilis Zeder.—Length 27 mm., breadth 1·5 mm. to 2 mm. Head globular. Rostellum slender, armed with a simple crown of 8 hooks 67 μ to 80 μ long, and having a long handle like the two preceding species. Neck very short. Anterior part of the body very slender for most of its length; first segments infundibuliform, the succeeding ones being nearly square. Genital pores unilateral. Thos. Scott has found in an ostracode crustacean—Candona rostrata—a cysticeroid 200 μ long and 180 μ broad, which Blanchard has remarked to have a crown of hooks the same in number, shape, and dimensions as those of the Taenia gracilis; and he considers it to be the larval condition of this Cestode. It is the same as Von Linstow has seen in the intestine of a Perch which had, no doubt, swallowed an ostracode that harboured the cysticeroid. It remains to demonstrate, experimentally, the reciprocal filiation of the larval and the tape forms.

6. T. coromola Duj.—Length 40 mm. to 190 mm., breadth 2 mm. to 4 mm. Head nearly rhomboidal. Rostellum thick, and armed with a simple crown of 15 to 26 hooks 14 μ to 15 μ long, their guard being longer than the handle. Genital pores unilateral. Found by Dujardin at Rennes, and by Krabbe in Denmark.

7. T. megaloops Nitzsch.—Length 5 mm., breadth 1 mm. to 2 mm. Head large and nearly quadrangular, with large suckers; no hooks (?). First segments very short; the succeeding ones short and cuneiform in shape, with acute angles. Rare.

8. T. conica Molin.—Length 2 mm. to 10 mm. Head short, almost quadrangular; large suckers. Rostellum conical and very developed, expanded at the summit, and unarmed (!). No neck. First segments very large, and oval in shape, their greatest diameter being trans-

versal; the last segments are short and narrow. Found by Molin in Italy.

9. *T. imbutiformis* Polonio.—Length 10 mm. to 12 mm. Scolex very small, unarmed, sucker discoid. No neck. First segments linear, the middle ones campaniform, and the last ones quadrangular. Found in Italy by Polonio.

Taeniasis has not been mentioned as occurring in the Duck.

**Trematodes.**—Though the species of Trematodes found in the intestines of the domesticated Duck are less numerous than those of the Fowl, yet they are more frequent—a circumstance connected with the habits of the Palmipedes, which cause them to frequent so much those damp places where the Trematodes find the host necessary for the first phases of their development.

1. *Monostoma verrucosum* Frölich.—This has been already described among the intestinal parasites of the Fowl (Fig. 249), in which it is rare; it is more frequent in the Duck, but yet not common.

2. *Monostoma caryophyllinum* Rud.—Body 40 mm. long, 1·12 mm. broad, and depressed, the borders being slightly crenellated in front, a
little narrow behind, and obtuse at the posterior extremity, widened in front like a head, with a great rhomboidal mouth placed beneath (Rudolphi). Inhabits the intestine of the Stickleback, and has been found by Gurlt, at Berlin, in the intestine of a domesticated Duck, into which it had doubtless been introduced with the Fish upon which the bird fed.

3. *Holostoma erraticum* Rud.—Body white, but partly brown-coloured from the eggs it contains; length, 6 mm. to 8 mm. when completely developed. Sometimes found in the intestine of the domesticated Duck. Ercolani has seen it developed in Ducks to which he had given a larval form observed by Steenstrup in 1842, and named *Tetracotyle* by Filippi. It appears as a round or ovoid dark body, provided with a transparent, elastic envelope which properly belongs to it, and follows its contractile movements. The anterior surface has four suckers—a buccal and median; and, between these, two lateral ones which disappear in the adult. This larva has been met with—free or encysted—in the viscera of several species of Mollusces, and even of Fish; but it offers the remarkable peculiarity of living as a parasite in the sporocysts of several Distomata.

4. *Distoma echinatum* Zeder.—This is the species we have described amongst the intestinal Trematodes of the Dog (p. 458). It is much more frequent in the domesticated Duck, Dujardin having met with it in 3 of 25 he examined; and at the Vienna Museum it was found in 4 of 11 Ducks.

5. *Distoma oxycephalum* Rud.—Already described in alluding to intestinal helminthiasis of the Fowl (p. 481). It is more frequent in the Duck.

**Acanthocephales.**—Three species of Echinorhynchus live in the intestine of the Duck, without causing any perceptible disturbance in its health.

1. *Echinorhynchus polymorphus* Bremser.1—So named because of the shapes it assumes, according to its age. Its length varies between 4-12 mm. and 25 mm. The body is orange-red in colour, cylindrical, and in early age studded with thorns which are gradually shed as the worm grows; but they persist longer on the anterior than the posterior part, and are altogether absent on the adult. It has a constriction like a neck in front, supporting an ovoid proboscis capable of being retracted into a sheath that contains it; it is armed on its surface with 8—sometimes 9—rows of 8 hooks each. Ova fusiform, 10 μ long and 20 μ broad, covered by a triple envelope.

We owe to Greeff precise information as to the development of this species. When mature, the ova contain an orange-red embryo, 61 μ long and 14 μ broad. The whole of its surface is covered with thorns, which are strongest on the anterior part, at the end of which is a depression or cephalic pore. At each of the two poles of the body is a pair of large hooks. The anterior extremity is indicated by the constriction in the form of an unarmed neck, by which it is followed. Greeff has recognised the larval form of this parasite in the fresh-water Shrimp—*Gammarus pulex*; in which it has been named *Echinorhynchus miliarus* Zenker. Von Siebold has also seen it very often encysted in

the intestinal walls of the Crayfish—Astacus fluviatilis. After giving Ducks fresh-water Shrimps containing these larval Echinorhynchus, Greeff found the Echinorhynchus polymorphus in their intestine.

2. Ech. fillicollis Rud.—The female measures 13 mm. to 30 mm. long, the male 7 mm. to 8 mm. The female is yellowish-white, the male white. Rostellum provided with 216 hooks arranged in 18 radiating series of 12 hooks each. The body is similar to that of Ech. polymorphus. Ova elliptical, rounded at their poles, and 62 μ to 70 μ long by 19 μ to 23 μ broad.

3. Ech. sphærocephalus Bremser.—From 6 mm. to 17 mm. long, and 1 mm. to 3 mm. broad. Proboscis globular, and entirely studded or only partially armed with hooks, or quite smooth, and supported by a neck 1·5 mm. to 4·5 mm. and which is nude and filiform.

NEMATODES.—1. Ascaris crassa Desl.—Body a dirty reddish-white colour, and attenuated at the extremities. Male, 12 mm. long, and 5 mm. broad; tail thin, conical, and acute; two long, cylindrical spiculae, expanded at their base, and provided with two accessory layers or sheaths. Female, 49 mm. long, and 2·2 mm. broad; tail thin, conical, acute, and straight; vulva a little behind the middle. Often found at Caen by Deslongchamps, in the domesticated Duck, and in 3 of 27 by Dujardin at Rennes. Diesing considers this Helminth as being only the Heterakis inflexa Rud. of the Fowl and Turkey.

2. Heterakis papillosa Bloch.—This parasite of the Fowl has been recognised in the domesticated Duck of Turkestan by Von Linstow.

3. Heterakis lineata Schneider.—Body yellow, and 6 cm. to 7 cm. long in the male, 9 cm. to 10 cm. in the female. Pre-anal sucker little developed, with 14 papillae on each side. This species, which was observed in a Brazilian Cock by Schneider, has been seen in the Turkestan Duck by Von Linstow.

ARTICLE V.—Parasites of the Intestines of the Goose.

INFUSORIA.—The Trichomonas Eberthi lives in the intestine of the domesticated Goose, as in that of the Fowl and Duck.

CESTODES.—All the Tæniae of the domesticated Duck have a single crown of long-handled hooks, and unilateral genital pores.
1. *Taenia sinusosa* Zeder.—Already described among the *Tæniae* of the Duck. Dujardin, according to Rudolphi, is said to have found it very common in the Goose.

2. *T. lanceolata* Bloch.—From 30 mm. to 90 mm. long, and 5 mm. to 8 mm. broad; exceptionally, 130 mm by 12 mm. Head small and oval, with a crown of 8 (Krabbe) or 10 (Dujardin) hooks, 31 μ to 38 μ long. Neck null, or very thin, short and retractile, as the head is. Strobila lanceolated, the segments being short and gradually increasing in breadth. This is the Tape-worm most frequently met with in the Goose. Frisch—who discovered it in 1727—found it so often that he believed it to have been the cause of a veritable epizooty.

3. *T. fasciata* Rud.—Length 60 mm. to 100 mm., breadth 6 mm. to 1 mm. and 2 mm. Head hemispherical or subtetragonal, and often absent in well-developed individuals. Rostellum long, thick and cylindrical; crown single, with 8 or 10 hooks 40 μ to 60 μ long. Neck twice as long as the head. Segments short and wide, and all traversed by a median, longitudinal and obscure band.

4. *T. setigera* Frölich.—Length 200 mm., breadth 2 mm. to 3 mm. Head globular; rostellum long and retractile, and armed with 10 hooks from 35 μ to 40 μ long. Neck short and distinct. First segments very short, and the succeeding ones infundibuliform, with one of the posterior angles prolonged into a short, straight and truncated appendage or kind of bristle, which is nothing more than the penis.

**Trematodes.**—1. *Monostoma verrucosum* Frölich.—Found in the large intestine and caeca of the Goose, and less frequently than in the Duck, though not so rarely as in the Fowl.

2. *Monostoma attenuatum* Rud.—Body 3'4 mm. long, and 75 broad,
depressed, attenuated in front, rounded behind. Found by Creplin in the cæca of the Goose.

3. Distoma echinatum Zeder.—Less frequent than in the Duck. In the Vienne Museum it was only met with in 2 of 139 geese.

4. Distoma oxycephalum Rud.—Less frequent than in the Duck, though not so rare as in the Fowl.

5. Distoma ovatum Rud.—Already described for the Fowl (p. 481). It is sometimes found in the intestine and in the bursa of Fabricius.

Acanthocephales.—The Echinorhynchus polymorphus has been met in the intestine of the Goose, but less often than in that of the Duck.

Nematodes.—1. Heterakis dispar Schrank.—Mouth with three very small lobes. Two lateral wings on the neck, becoming narrower as they proceed to the tail. Male 12 mm. to 18 mm. long, the tail terminating in a fine long point; pre-anal sucker salient; ten papillæ.

Female 16 mm. to 23 mm. long; vulva situated at the middle of its length (Fig. 257).

This species—which is very closely related to Heterakis papillosa of the Gallinaceæ—has been seen in the cæca of fat geese by Frölich, Schrank and Zeder; it does not appear to be common. Railliet has recognised as H. papillosa, the Heterakes found by Lucet in the cæcum of the Goose.

2. Strongylus tenius Eberth.—Body dentated on the borders, in consequence of the projection of the segments from the cuticle. Three small buccal papillæ. Male 6·5 mm. long; two equal spicule; pouch ample, bilobate, with numerous ribs, one of which on each side is curved like a hook in front. Female 7·3 mm. long; tail acute; vulva situated a short distance from the posterior extremity of the body. Rare.

Lucet has observed an epizootic tæniasis which, on one farm, had killed 30 of a flock of 36 Geese. These birds had come from different parts, were about two months old, and had probably acquired the germs of their tæniasis in a pool where they drank. The disease was at first obscure, and was manifested by arrest of growth, emaciation, difficult and stumbling progression, a yellow and foetid diarrhoea, and plaintive

cries emitted from time to time. The appetite remained normal until nearly the last—death ensuing in five to seven days after the appearance of the first symptoms. The malady was due to _Taenia setigera_, the number in each Goose being always high—as many as 93. With these worms were also found 3 or 4 of _Taenia lanceolata_.

The treatment consisted in giving cakes in broth or crumb of bread, containing santonin, wormwood, absinthe, crushed garlic, and powdered male shield-fern.

3. _Trichosoma brevicolle_ Rud.—Anterior part relatively short. Male 10 mm. to 12 mm. long; female 20 mm. to 24 mm. long. Of 139 geese dissected at the Vienne Museum, only 18 had this parasite in their ceca.

**Article VI.—Parasites of the Intestines of the Swan.**

**Cestodes.—_Taenia setigera_ Frölich.—_This_ Taenia of the Goose is included by Von Linstow among the intestinal Helminths of the domesticated Swan. It is, at least, very rare. _T. aquabiliis_ Rud.—Length 160 mm. to 350 mm.; breadth 3·5 mm. to 4·5 mm. Head nearly round; rostellum pyriform, and armed with a single crown of 10 hooks, 27 μ to 32 μ long, their handle being nearly null. Neck and first segments very short, the succeeding ones being trapezoid, and much broader than they are long, with their angles very acute and salient like the teeth of a saw. Genital pores unilateral. Found by Bremser in the domesticated Swan. Rare.

**Trematodes.—_Holistoma erraticum_ Rud. (see p. 490).—Indicated by Crellin as found in the Swan.

**Acanthocephales.—_Echinorhynchus polymorphus_ Bremser.—_This_ worm—which is more frequent in the Duck—is noted by Bellingham as found in the Swan. It has also been met with in great numbers by Walley, in the small intestine of a Bird of this species.¹

**Nematodes.—_Filaria cygni_ Rud.—A species found by Redi, to the number of more than 200, in the abdominal cavity, and even in the intestine and ceca of a very emaciated Swan. These worms were very slender, and measured from 20 to 24 long.²

¹ Walley. The Veterinary Journal, XXII., 1886, p. 121.
² It should be remembered that Birds are often infested most seriously by Helminths; indeed, their infestation appears to be the rule. Leuckart points out that the Snipe, the Goose—so long as it lives in meadows—and some other Birds, have their intestines almost always filled with numerous Helminths, generally Cestodes. Bloch mentions that, in a male Bustard, he found at least a thousand specimens of _Taenia villosa_, some of which were no less than four feet in length. Goze also found the alimentary canal of a Parrot so full of Cestodes, twenty ells in length and about the thickness of a straw, 'that the intestine was almost ready to burst.' When the whole mass was placed in water, Goze was astonished at the enormous number, for there were several thousands. This same helminthologist found, on another occasion, no less than eighty-two Ligulae in the intestines of a Diver, some of which were six to eight ells long and eight lines broad. Frequently, as has been often noted above, the intestinal worms belong to several different species. Nathusins took from a single black Stork, twenty-four specimens of _Filaria labiata_ from the lungs, sixteen _Syngamus—Strongylius—trachealis_ from the trachea, more than one hundred _Spiroptera alata_ from the coats of the stomach, several hundred _Holistoma excavatum_ from the small intestine, and about a hundred _Distoma ferox_ from the intestine, twenty-two specimens of _Distoma kiens_ from the oesophagus, five _Distoma_ from between the coats of the stomach, and one _Distoma echinatum_ from the small intestine.)
CHAPTER IV.

PARASITES OF THE LIVER.

The liver is one of the organs in which parasites are most frequently found. The species are not very numerous, and only a few among them play an important pathogenic rôle; but these are very common in the liver of certain of the domesticated animals, and are present in such quantities as to occasion serious epizooties.

If the liver is one of the seats preferred by parasites, this is probably because of its proximity to the intestine; the germs introduced into the latter—with the food and water—can, after undergoing a primary evolution in the digestive canal, reach that organ in ascending from the duodenum, along the ductus communis choledochus. And it is not impossible for some to penetrate the intestinal walls, and so reach the hepatic parenchyma. But the normal route, by which the majority certainly reach the gland, is the vena portae; in traversing the wall of the intestine, they pass into some capillary that brings them to the great mesenteric vein, or into one of the radicles of the right gastro-omental vein, and thence into the portal vein—that open door to all ills, as Stahl said in a paradoxical exaggeration. The comparative slowness of the circulation in this vessel, ought also to favour the arrest of the parasites in the hepatic organ.

Many of these parasites have no influence on the health of their host; but when they are in great numbers they retard the flow of bile, and so bring about grave alterations which react upon the circulation and general nutrition, and anaemia is the consequence.

The gravity of certain parasitic affections of the liver, is owing to the fact that—with only rare exceptions—medicaments cannot reach the parasites in the depths of the organ in which they are lodged.

Among those worms which may be met with in the liver of the domesticated animals, there are some that need not be referred to at present. These are:

1. The Linguatula denticulata—a larval form of Linguatula tenioïdes of the Dog's nasal cavities, and which is found in its first stage in the mesenteric glands, and the liver and lungs of the Ox, Goat, Camel, Horse,
Cat, Rabbit, Hare, Guinea-pig, and even of Man. It will be described when dealing with the *Linguatula tenioideis*.

2. The Coccidia, and particularly the *Coccidium oviforme*, which will be soon studied with regard to its effects.

3. The Echinococci which are found in very diverse organs of the several domesticated species—particularly in the liver—and the study of which, from a pathological point of view, will follow the preceding.

4. The Distomes, the two principal species of which—*Distoma hepaticum* and *D. lanceolatum*—by their accumulation in the biliary ducts, give rise to a particular malady—*distomatosi*s—that will be treated of at the end of this chapter.

The others are of less importance, and we will, therefore, only briefly notice them. They belong to the same classes or orders which have so many representatives in the intestines.

**Fungi.**—*Saccharomyces guttulatus* Ch. Rob.—This is only found in the intestine of the Rabbit, Ox, Sheep, and Pig; but Remak has met with it in the biliary ducts of the Rabbit, forming enlargements analogous to tubercles, which has been already described by Nasse (Ch. Robin).

**Infusoria.**—*Monocercomonas hepatica* Rivolta.—A round, oval, or angular body, very mobile or non-mobile, 6 μ to 8·5 μ in diameter, provided with one or two flagella, and containing a granular, contractile protoplasm, with vacuoles, and two nuclei; it shows also a transverse internal line. Found by Rivolta in a young Pigeon, the liver of which—larger and firmer than in the normal state—was studded with yellowish nodules varying in size, from a mere point to a pea or small nut—caseous hepatitis. They were found in every part of the organ; but were confluent at its borders. The adjoining air-sacs were hyperemic, and covered with a yellow gelatinous exudate. Hepatic pulp containing living Infusoria was given to a young Pigeon. It was killed in six days, when the liver was found to be yet healthy, but the small intestine contained a large number of cellular bodies of variable form, with a granular nucleus at the periphery of each; no flagella. No conclusion could be drawn from this experiment.

**Cestodes.**—Various cystic forms of the *Tænie* of the Dog may be found in the liver of the Herbivora. A great number, in the embryo stage, must pass through that organ in order to reach the location that suits their larval condition; but there are among them those which remain in the liver, having attained their definitive form—such are the Echinococci, which will be dealt with separately; while others stay there by accident or only temporarily, and produce marked or scarcely appreciable alterations. Those which may be encountered in this way—besides the Echinococci—are the following:

1. *Cœnurus* of an undetermined species, found by Engelmayer in the liver of the Cat (Von Linstow).

2. *Cysticercus tenuicollis* Rud.—This is the cystic form of the *Tenuia marginata* of the Dog. It is met with in the peritoneum—more rarely in the pleura and pericardium—of various animals, more especially Ruminants, and sometimes the Pig. The experiments of Baillet have shown that this Cysticercus reaches the peritoneal cavity through the liver. In a Lamb and Kid which died ten days after ingesting segments of *T. marginata*, that authority found the liver traversed by numerous very sinuous channels, each of which was partially blocked by a small blood-clot, and was occupied by one, two or three transparent, globular vesicles. Before death, the animals exhibited all the symptoms of internal hæmorrhage; the abdominal viscera were bathed in blood, which the slightest pressure caused to transude from every part of the liver. Another Kid succumbed on the twenty-fifth day; it showed signs of a violent peritonitis and 'complete disorganization of the liver.' But these lesions have scarcely been observed except in experimental cases; for in natural infestation the Cysticerci are always few in number, and pass through the liver without producing any apparent disturbance to health—forming, in the peritoneum, those large vesicles that the French butchers call *boules d'eau*.

Nevertheless, Leuckart has pointed out the possibility of grave—even fatal—accidents to the Pig, when the Cysticerci are in large number. The lungs, and more especially the liver, show numerous inflammatory centres, each occupied by a Cysticercus; they are also excavated by galleries, at the end of which is lodged one of these parasites; while there may be evidences of hæmorrhage and fatal peritonitis. Boudeaud has reported such a result occurring in a young Pig, which died after showing symptoms that might have led to the supposition that the animal was suffering from pneumo-enteritis. Semmer found the liver of a Pig invaded by a great number of cysts, varying in size from that of a small nut to a hen's egg, each of them being occupied by a *Cysticercus tenuicollis*; the internal appearance of the organ resembled that observed in Echino-coccosis.1

Putz2 reports the death of a Cow from hepatitis and peritonitis, due to the presence of an enormous quantity of the *Cysticercus tenuicollis*.

3. *Cysticercus pisiformis* Zeder.—This is the cystic form of another Tape-worm of the Dog—the *Tenuia serrata*; it lives in the Rabbit, and only attains its final development in the peritoneal cavity. But in order to arrive there it must pass through the liver, and in doing so it produces very interesting alterations in that organ, which have been particularly studied by Küchenmeister, Baillet, Leuckart, Moniez and Laulanié.

When a Rabbit ingests the ova of *T. serrata*, there are seen—after


the second day—very small white nodules and fine rudimentary streaks. The tubercles or nodules rapidly increase in volume, and on the fifth day they are as large as a hemp-seed, and are somewhat hard; they cannot be enucleated without tearing away fragments of hepatic tissue. These nodules—which are little, if at all, transparent—are formed of a very thick envelope containing a refrangent ovoid body; this envelope passes insensibly into the tissue of the liver, and is produced merely by the transformation of the hepatic cells; while the central portion contains nothing of the embryo, but is only more advanced in degeneration. The contents of this nodule is often very characteristic pus, and from this it might be concluded that these productions are evidence of a local inflammation of the liver, which has been set up around a dead embryo, or one incapable of resisting an eliminatory process.

Independently of these nodules, and distributed—like them—on the surface, as well as in the substance of the liver, are observed numerous sinuous streaks running in every direction, of a transparent gray tint in the centre, and bordered by a yellow line. Laulanîé has recognised these as always branches of vessels from the sub-lobular vein; and it is here that is found the already more or less advanced embryo. It occupies the centre of a mass of coagulated blood, that adheres at some points to the wall of the vessel, which is the seat of a very abundant proliferation of embryonic cells. From this there arises within the sphere of action of the obliterated interlobular vessel, a venous cirrhosis—mono- or multi-lobular—which assumes two exceptional characters. The connective-tissue productions which fill the spaces and liver-fissures are remarkable for: 1. the multiplicity of their capillary vessels and the ectasia of which they are the seat; 2. the presence of a variable number of giant-cells, which sometimes attain an enormous volume, and in their distribution do not appear to submit to any recognised law. Piana had already recognised the presence of giant-cells in the vessels containing the young Cysticerci pisiformes; and he also observed that these giant-cells are often invaded by Bacteria, which he supposed had been brought from the intestine by the embryos.

The latter measured scarcely more than 1 mm. long and much less in breadth, and were composed of a very delicate reticulum enveloped

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2. G. Piana. La Veterinaria, 1881.
PARASITES OF THE LIVER.

in a thin cuticle. At the end of twelve days they were already 3 mm. long, and manifested obscure contractile movements. In developing, they become elongated, and their galleries are widened. At the twenty-second day they are about 1 cm. long and less than 1 mm. broad; and at this period they offer a curious phenomenon, first observed by Moniez. The Cysticercus is strangulated in the middle (Fig. 260), and divides into two portions which, attached to each other by a more or less constricted and twisted funicle that in time becomes atrophied and absorbed, leaves the moieties completely separated. One of these is probably destroyed, and the other soon forms a rudimentary Tape-worm head, by budding; consequently, it alone constitutes the definitive Cysticercus.

A month-old larva, taken from a superficial gallery in the liver of the Rabbit. It is already marked by numerous folds or papillae, $p$, and does not yet show any signs of dropsy; $a$, central portion, finely granular, which marks the point where the tissues rupture. The point marked $b$, to the rudiment of the head, $rc$, represents the future receptaculum capitis. Magnified 15 diameters.

It is in about a month after infestation—often less—that the Cysticerci quit the liver and spread over the peritoneal cavity; they are sometimes found protruding from the surface of the liver. Soon they are free, slightly dropsical, and of various degrees of development, being then most frequently lodged between the two serous surfaces, when they form their cyst and establish themselves. The galleries they have quitted disappear after a time, and leave more or less marked cicatrices on the surface of the gland.

Hepatic Cysticercosis may manifest itself beyond experimental
conditions, and produce a morbid state of a cachectic nature that sometimes terminates in death. We have observed such instances.

**Trematodes.**—Creplin has given the name of *Amphistoma explanatum* to a species found by Gurtl at Berlin, in the biliary duct and gall-bladder of a Zebu. It is a lanceolated oval, 9 mm. long and 4 mm. broad; the posterior sucker is sub-elliptical, and spread out at the sides.

The other Trematodes of the liver are Distomes—*Distoma hepaticum, D. lanceolatum, D. truncatum, and D. sinense,* the effects of which will be indicated hereafter (Art. Distomatosis of the liver).

**Nematodes.**—*Ascaris megaloccephala* Cloq., and *Ascaris suilla* Dujar. Ascarides may enter the biliary duct and give rise to serious colics, as Roll as remarked with regard to the Ascaride of the Horse. Camberoque, veterinary surgeon at Villefranche-de-Lauragais, has observed epileptiform seizures in a Pig, at the autopsy of which he found no other lesion than congestion of the duodenum and the adjoining peritoneum, and the presence of a bundle of Ascarides at the opening of the duetus choledochus: one of these bundles was entirely engaged in the duct, and another fixed there by its anterior part.

*Eosophagostoma dentatum* Rud.—Reported by Von Linstow as found not only in the intestine, but also in the liver of the Pig.

*Sclerostoma armatum* Rud.—Mégnin has found the middle lobe of the liver of a horse transformed into a real fibro-plastic tumour, dense at some points, soft in others, and studded with small blood-cysts, each of which contained a *Sclerostoma armatum*—male or female—from 2 cm. to 4 cm. long, and doubled up on itself. The females contained non-fecundated ova only. In the left lobe of the liver of a Horse, at the border of its posterior surface, Colucci discovered an inflammatory tumour to be occupied by a Sclerostome that he considered had come from the intestine and penetrated the gland by a foramen 1 mm. wide, and which was visible on the anterior surface of this left lobe.1

*Ollulanus tricuspis* Leuck.—We have seen (p. 362) that the embryos of this species—a parasite of the stomach of the Cat—may wander into the liver.

*Filaria hepatica* Cobb.—These are worms found by Mather, encysted in the intestinal tunic and biliary canals of a Dog (see p. 454).

Embryos of *Filariae.*—Colin and Reynal2 were the first to make mention of the presence, in the liver of the Horse, of white or yellow, calcified, and irregularly spherical nodules, formed of numerous concentric layers. Their volume varied from the size of a millet-seed to that of a pea, though there were some which were scarcely visible. Oreste and Ercolani were of opinion that these nodules had the ovum of a Distoma for a nucleus; but according to Mazzanti, they are produced by the embryos of Nematodes carried by the blood, as a capillary was in the centre of each nodule. He sometimes found 4 to 6 in the same tubercle. They insinuated themselves into the parenchyma, through the walls of the blood-vessels, and gave rise to irritation—either in the lobules or the interlobular connective-tissue—that ended

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in the formation of these pseudo-tubercles. They measured 40 μ to 180 μ long and 3 μ to 6 μ in diameter, and differed from those of *Filaria papillosa*—belonging, no doubt, to an undetermined species of *Filaria*.

*Eustrongylus gigas* Rud.—This parasite of the kidneys has been met in the liver of a Dog by Lissizin (see *Parasites of the Urinary Organs*).

Before passing to the description of psorospermosis, echinococcosis, and distomatosis, we here give a list of the hepatic parasites of the domesticated animals.

**Equide.**—*Ascaris megaloecephala*, *Sclerostoma armatum*, *Filaria* sp.?, *Distoma hepaticum*, *Linguatula denticulata*.

**Ox.**—*Amphistoma explanatum*, *Distoma hepaticum*, *D. lanceolatum*, *Cysticercus tenuicollis*, *Linguatula denticulata*.

**Sheep and Goat.**—*Distoma hepaticum*, *D. lanceolatum*, *Cysticercus tenuicollis*, *Linguatula denticulata*.

**Pig.**—*Esophagostoma dentatum*, *Distoma hepaticum*, *D. lanceolatum*, *Cysticercus tenuicollis*, *Cyst. cellulose* (see *Measles of the Pig*).

**Dog.**—*Filaria hepatica*, *Eustrongylus gigas*, *Distoma truncatum*, *Cysticercus cellulose* (see *Measles of the Dog*).

**Cat.**—*Ollulanus tricuspis*, *Distoma truncatum*, *D. lanceolatum*, *D. sinense*, *Cænurus* sp.?

**Rabbit.**—*Saccharomyees guttulatus*, *Eimeria* falciformis, *Coccidium oviforme*, *Cysticercus pisiformis*.

**Pigeon.**—*Monocercomonas hepatica*.

**Article I.**—*Coccidiosis of the Liver*.¹

Coccidiosis, or Psorospermosis, of the liver is a frequent parasitic affection in the domesticated Rabbit, and is caused by *Sporozoa*—the *Coccidia oviformes* (*Coccidium oviforme* Leuck.).

**History.**—This parasite appears to have been seen first in the Rabbit by Carswell, then by Hake in 1839, Nasse in 1843, Handfield Jones in 1846, etc.; but its nature was for a long time unknown. Hake mistook the Coccidia for pus corpuscles, and Lang considered them to be neo-formations; while a number of observers believed them to be the ova of Nematodes, Distomes, Taeniae, or Linguatula; or they were mistaken for the Utricles of Miescher—Sarcosporidiae. Davaine—in consequence of their great resemblances to the ova of the Helminth—named them *Corps oviformes*, by which designation they were for a long time known. However, in 1845, Remak, recognising them as parasites,

proposed to class them with the Psorospermiae of Fishes, discovered by J. Müller in 1841. This relationship—which was for a long time hypothetical, but was endorsed by Lieberkühn in 1856—was confirmed in studying their phases of development, but with the important restriction that the Psorospermia of Fishes—Myxosporidia—and the Psorospermiae oviformes—Coccidia—form two distinct orders in the class of Sporozoa.

Coccidium oviforme.—The Coccidium oviforme belongs to the order of Psorospermiae oviformes or Coccidia, class of Sporozoa (see p. 4). In the adult state it is an ovoid body, enclosed in a double-contoured shell or cyst, flattened at one of its poles, and 30 μ to 50 μ long by 14 μ to 28 μ broad.

In the Coccidia so encysted, the protoplasmic contents separate from the wall and contract into a ball-shaped mass (Fig. 261, f); this is the last phase of development observed in the liver. But if some of these cysts are put in water or damp soil—as Kauffmann did first in 1847, then Lieberkühn, Davaine, Stieda, Waldenberg, Balbiani, etc.—the ulterior stages will be promoted; but the rapidity of their evolution depends upon the conditions of temperature and oxygenation in which they are placed. Below 2 cm. or 3 cm. of water, Balbiani has seen segmentation of the central mass occur in 15 or 20 days. In less water or in damp sand, it takes place in 2 or 3 days, and at the end of 10 or 15 days in summer the complete evolution has been effected.

Segmentation divides the protoplasm into two (g), then into four round masses or sporoblasts (h); then each of these elongates (i), expands into a ball at each end (k), is enveloped in a thin membrane, and shows in its concavity the remains (m) of the granular mass of the sporoblast. At this stage each sporoblast is formed by the junction of two falciform corpuscles or spores (n, o), placed in an inverse direc-

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**Fig. 262.—Evolution of the Coccidium oviforme of the Rabbit's liver.—After Balbiani.**

a, b, c, young Coccidia contained in the epithelium of the hepatic canaliculi; a, nucleus of the epithelial cell; d, e, f, encysted adult Coccidia; g, h, i, k, l, development of the sporoblasts; m, mature sporoblast, much magnified, showing the two falciform corpuscles in their natural position, with the remains of the granular mass (nucléus de reliquat); n, compressed sporoblast, with the two corpuscles separated from each other; o, a spore; y, its nucleus.
tion, and provided with a nucleus (Balbiani). The Coccidia are thus preserved—without any appreciable modification—for an indefinite time.

If the cultivation has been made in an albuminous fluid, at the end of eight days segmentation has resulted in the production of four, sometimes five, six, or more, oval corpuscles, which quickly elongate, become cylindrical, pyriform, or fusiform, and manifest slight ameboid movements. They soon appear to reunite and form a long filament in the capsule; sometimes they form a crescent. In all these vermiform bodies appear two or three round, very refrangent corpuscles, which cannot be seen passing through the capsule, but which increase in number in the fluid surrounding them (Delepine).

Frequency.—Coccidiosis of the liver is frequent in domesticated Rabbits, especially those in certain regions—as in Paris. Delepine estimates at 92 per cent. the number in which the Coccidia oviformes may be found in England. In this, as in all other cases of parasitism, their development and propagation are favoured by the agglomeration of numerous individuals in the same locality.

Coccidiosis of the liver is distinct from that of the intestine, and most frequently they do not exist in the same animal.

The Coccidia oviformes—or others closely allied to them—have been met with in the liver of Man by Gubler, Dressler, Virchow, and Leuckart. Perhaps this was also the case with the Pig in which Johne found, on the upper border of the liver, irregular-shaped cysts containing a turbid fluid, in which numerous Coccidia floated; but they were three or four times larger than those of the Rabbit, as they measured 120 \( \mu \) long by 70 \( \mu \) broad.

Symptoms.—Rabbits affected with hepatic Coccidiosis to a marked extent, lose flesh, the appetite disappears, and the fur loses its lustre and becomes matted; they are also less lively and alert. Notwithstanding good food, they continue to waste, their mucous membranes become pale or assume an icteric tint, the hair is erect, the weight rapidly diminishes, and marasmus is accentuated by tympanitis; there is ascites, an exhausting diarrhoea, uncertain or staggering movements, etc.; in fine, all the symptoms of pernicious anaemia. Death takes place in convulsions in two or three months. Often, however, a very large number of Coccidia will be found in the liver, and yet the animals during life did not show any evidence of their presence. Claude Bernard has found that puncture of the floor of the fourth ventricle in Rabbits affected with advanced Coccidiosis, does not not produce diabetes (Davaine).

Pathological Anatomy.—At the autopsy, the liver may present its normal volume and weight if infestation is not very marked; but generally it is much larger in size and heavier—sometimes treble its normal condition, and all the lesions of cachexia and abdominal dropsy are observed. The hepatic parenchyma is studded or crammed with whitish-yellow cysts,
from the size of a millet-seed to that of a pea, or even a nut; and
globular, elongated, or lobulated, giving the surface of the liver a mam-
millated appearance. Their number is at times so great that the inter-
vening parenchyma is completely atrophied. These cysts contain a
thick, yellow, creamy, grumous or caseous matter, chiefly composed of
the encysted Coccidia, epithelial cells un-
dergoing fatty degeneration, free nuclei,
and fat-drops. The membrane limiting
these tumours is only the altered wall of
a hepatic canal, which, under the in-
fluence of irritation, has formed a thick
capsule of connective tissue, constituted
by concentric fibres and numerous nuclei.

These altered and transformed hepatic
blood-vessels have generally maintained their
communication with the neighbouring
canalici; though it may happen that a
connective-tissue formation has isolated
and encysted them, in a manner analogous to the encystment that
takes place around foreign bodies or old tubercles.

The hepatic lobules have undergone various changes. Sometimes
they are replaced by connective tissue, as in biliary cirrhosis; at other
times they are atrophied by the peripheral compression of the parasitic
cysts, or by hypertrophy of the interlobular connective tissue.

The Coccidia show themselves in two principal forms—free or
encysted. The free Coccidia are the youngest, and are met with in the
biliary canalici, which have undergone much change; they are most
frequently spherical or slightly elongated, measuring 11 \( \mu \) to 14 \( \mu \) broad,
and 17 \( \mu \) to 22 \( \mu \) long. Some are almost homogeneous, and very
PARASITES OF THE LIVER.

refrangent, with a darker central point; the others are altogether granular, without a central point, and resemble cells undergoing fatty degeneration; their volume varies from 6 μ or 8 μ to 30 μ. They exactly resemble white or red blood corpuscles, or even cellular nuclei, and are often included in epithelial cells, and solitary or grouped in small masses in the same cell. The encysted Coccidia, which correspond to the type described above, may also exist in the interior of a cell; and, like the preceding, they are sometimes lodged in large giant-cells.

It is not rare to find white particles floating in the bile, similar to the contents of the tumours, and almost exclusively formed of Coccidia. According to Rivolta, the parasites are also sometimes developed in the epithelium of the gall-bladder. He also states that he has observed in the Rabbit's liver, along with the Coccidium oviforme, other Coccidia belonging to the species Eimeria falciformis Eimer, which, until then, had only been found in the intestinal epithelium of the Mouse.

The evolution of the Coccidia oviformes in the liver of the Rabbit, may be summed up as follows. It is probable that the sporiferous cysts described above, after their evolution in a damp medium, are carried with dust, by currents of air, on to the food of healthy animals. On reaching the digestive canal, they rupture, the sporoblasts also rend their wall, and the spores are changed into small amoeboid masses; these ascend by the ductus choledochus into the bile-ducts, to invade the epithelial cells. They are there seen at first as free Coccidia, dilating the cells into which they have penetrated, and gradually pushing their nucleus to one side. By their accumulation they enlarge the bile-ducts, rendering them varicose, sometimes causing their rupture, and forming the white masses characteristic of the malady. Soon the epithelial cells are detached, along with the Coccidia they contain, and fall into the pouches formed by the dilatation of the ducts; it is now that the parasites are liberated, and becoming enveloped in a double-contoured capsule, are said to be encysted. They are gradually carried into the intestines, and on being thrown out of the body with the faeces, achieve their development in a damp situation.

Treatment.—Hepatic Coccidiosis may occasion serious losses in rabbit-hutches, and gravely compromise the rearing of Rabbits.

When it is present, it is easy to arrest its ravages by separating the healthy from the diseased animals, and in carefully carrying out disinfection by means of boiling water, in the places where the sick creatures have deposited their excrements, along with the encysted Coccidia. It is more advantageous to sacrifice the diseased or suspected Rabbits, than to undertake their medical treatment. Their viscera should not

1 The genus Eimeria Schn. comprises Coccidia, the contents of whose cysts are entirely converted into a single sporoblast that is transformed into an indefinite number of corpuscles.
be thrown on dung-heaps, nor in yards, as is usually done, but burned, or purified by prolonged boiling.

If, as Davaine remarks, psorospermosis is more frequent among Rabbits reared in dark and confined places, the indications are to have the hutches in dry, and sufficiently well-aired and lighted situations. According to Handfield Jones, English breeders attribute the development of the disease to feeding the Rabbits exclusively on green food, and this certainly may contribute to it; so that it is well to give them fortifying healthy food, with hay and corn from time to time, and water should always be accessible to them.

**Article II.—Echinococcosis of the Liver.**

**Echinococci.**—The Echinococci (*Echinococcus veterinorum* Rud., *Ech. polymorphus* Diesing) represent the cystic phase of the *Taenia echinococcus* of Von Siebold, which lives principally in the intestine of the Dog (see p. 423 et seq.). The carnivorous bearer of that Tape-worm expels, with its defecations, the mature proglottides gorged with ova; and the latter, protected by the resistance of their shell from external causes of destruction, are many of them carried into drinking water, or into the alimentary matters of Man and animals, and with them gain access to the digestive canal. The experiments of Von Siebold, Küchenmeister, Van Beneden, Leuckart, etc., have placed beyond a doubt the relationship between the Echinococci and the *Taenia echinococcus*.

The Echinococci—also called *Hydatids*—are met with in very varied hosts. They have been found in Man, various species of Monkeys, the Dog and Cat, Ichneumon, Rabbit, Squirrel, Pig, Wild Boar, Ox, Argali, Sheep, Goat, Deer, Giraffe, Camel, Dromedary, Elan, Antelope, Horse, Zebra, American Tapir, and Giant Kangaroo. They have also been observed in the Turkey. (Echinococci have likewise been seen in the Elephant.) But they are most frequent in Ruminants and the Pig.

They are met with in the most varied organs, but the liver is the favourite location; then come the lungs, and after them the kidneys, spleen, intestinal walls, serous membranes, heart, muscles, and even the bones. The same animal may be invaded in several of these organs, and instances are on record in which there was general infestation that induced pronounced cachexia. Such was the case of a sow two years old, reported by Dupuy, which had been affected with paraplegia, and was found on examination after death to have hydatids in several muscles of the loins, back and thighs, and in the liver, lungs and kidneys. Mégnin and Lemke have made known similar cases.¹

The development of the hydatid is very slow. The embryos of the *Taenia echinococcus* probably enter the liver by the portal system.

Leuckart, having succeeded in infesting sucking Pigs with ripe segments of this Tape-worm, has noticed beneath the serous covering of the liver, at the end of four weeks, small white nodules scarcely a millimetre in diameter. Each of these consisted of a cyst of connective tissue, formed at the expense of the hepatic tissue, and containing a globular body of a simple structure, which was a young Echinococcus. Two months after infestation, the Echinococci were nearly double that size, and were already dropsical; and towards the end of the fifth month the cysts were the size of a wall-nut—raising the serous membrane more or less, and each contained a hydatid. This was constituted by a spheroid tremulous vesicle with thick walls, whitish in colour, and translucent (the mother-vesicle). The wall comprises two quite distinct membranes—an external (hydatid membrane), which is a cuticle about 2 mm. thick, formed of a large number of concentric layers; and an internal one (germinal membrane), which is thin and scarcely 1.2 mm. thick. The fluid that distends the hydatid is colourless or slightly yellow, of a neutral or slightly acid reaction. It may contain very diverse substances, the majority of which are foreign to it, and enter it—by endosmosis—from the blood or adjacent organs.

Besides these accidental substances, the hydatids contain variable proportions of a leucomain—discovered by Mourson and Schlagdenhauffen—which is nutritive waste. Its abundance is in proportion to the activity of nutrition, which is very great when the heads of the Tænia are growing, and small at the resting period of the Echinococcus. To the presence of this alkaloid are attributed the urticarias and peritonites observed in Man, in cases in which the hydatid opens into the large serous cavities.

Exceptionally, the Echinococcus does not get beyond this stage, and it is then—since the days of Laennec—named an Acephalocyst. But it
usually happens that, when the mother-vesicle has sufficiently enlarged, there appear on the internal surface of the germinal membrane, small papillae arranged in more or less closely-set groups. Each of these has a cavity that gradually enlarges, and the inner surface of which soon becomes differentiated into a thin cuticle. The vesicles thus formed, and which are attached to the germinal membrane by a short pedicle, are designated *proligerous vesicles*. Their internal surface forms the heads of the *Taenia*, or scolecies; there are usually 5 to 10, or 20, or even 34, in the interior of the same proligerous vesicle, and they are not always of the same age or size. When completely developed, they are small round bodies, measuring on the average 1.9 mm. by 1.6 mm.; the pole opposite to the pedicle shows a depression formed by the invagination of the head itself, and on the sides are the suckers, at

![Fig. 267.—Echinococcus polymorphus.](image)

A, young *Taenia* detached from the proligerous vesicle, to which it was fixed by its inferior pedicle; the head is retracted inside the neck. B, the same, with the head evaginated.—After Perroncito.

the bottom a double crown of hooks. The latter are similar to those of the adult *Taenia*, though slightly longer, and at the periphery of the head are distributed a considerable number of calcareous particles or corpuscles. Evaginated, it appears as in figure 267, B. The vesicles burst, and the heads separate from them and float at liberty in the fluid for a long time after the hydatid is dead, or when it is placed in water, which enters it by osmosis.

The proligerous vesicles are not the only mode of multiplication of the *Echinococcus*; for there may form what are called *secondary vesicles* or *daughter-bladders*, which have all the characters of the *mother-vesicle*. Originating in the substance of the cuticle or hydatid membrane, they gradually distend, then rupture it, and fall external to or inside the mother-vesicle, according to the conditions in which development is effected. In the first case, there are *secondary external* or *exogenous vesicles*, and the *Echinococcus* is then called *Echinococcus scoleciparicus* Küchenmeister, or *E. simplex* or *E. granulosus* Leuckart. In the
second case, there are secondary internal or exogenous vesicles, when the parasite is termed *E. altricipariens* Küchenmeister, or *E. hydatidosus* Leuckart.

The mode of formation of these two kinds of Echinococci remains the same, and there is nothing fundamental in the distinction; it may be remarked, however, that they are not generally found in the same Echinococcus, nor yet in the same host.

The external secondary vesicles are more especially common in Ruminants and the Pig, and they are not rare in Man. They usually remain small, and may pass unperceived; they most frequently belong to medium-sized Echinococci.

The secondary internal vesicles are most frequent in Man, the Pig, and the Horse—though they have been seen by Railliet also in the Ox; they are generally much larger than the external ones.

The secondary vesicles are also capable of throwing out—by intracuticular budding—other vesicles of a tertiary order, external or internal like them, and called grand-daughter vesicles.

The secondary daughter or grand-daughter vesicles—external or internal—are capable of developing proligerous vesicles, and, consequently, the heads of *Tænia*, at least as well as the mother-vesicle; like it, also, they may remain sterile and form acephalocysts.

There is also a special form of Echinococcus that receives the name of *Echinococcus multilocularis* or *E. alveolaris*, and which is distinguished

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*Fig. 269.—*Echinococcus polymorphus*; diagram of the formation of proligerous and secondary vesicles.—Railliet.*
TREATISE ON PARASITIC DISEASES.

from the preceding by the size of the vesicles—these remaining very small, from the size of a millet-seed to that of a pea at most. These vesicles remain agglomerated in masses, which may grow as big as the head of an infant, and are attached to each other by a common connective-tissue stroma, resulting from the fusion of their adventitious capsules. The masses they form have the appearance of well-defined tumours easy to enucleate, and a section of them shows a number of alveoli, each filled with what looks like colloid matter, but which is nothing more than a vesicle with its wall collapsed and doubled-up on itself. In consequence of their appearance, these tumours originally received the designation of alveolar colloid cancer, but Virchow was the first to make known their true nature. The multilocular Echinococci are less frequently fertile than the ordinary hydatids, and the number of the heads more particularly always remains limited, their discovery sometimes requiring long and diligent search. Little is known as yet with regard to the development of these Echinococci; perhaps they result, as Meyer has said, from exogenous budding of the daughter and grand-daughter vesicles, arising from a small number of the mother-vesicles. They have been more especially observed in Man; but we possess at present 36 recorded instances1 in which they have been found in animals, 23 of these being due to Ostertag. Only four of them were cases of Pigs, all the others being observed in the Ox, and nearly all of the Echinococci were found in the liver.

The multilocular Echinococcus is distinguished not only by its appearance, from all the other Echinococci, but it has a particular geographical distribution—at least in Man. Thus it is never seen in Iceland nor Australia, where the hydatid cysts are endemic; and of 182 cases of hydatids observed in Mecklenburg, only one had this form. It is in Wurtemberg, Bavaria and Switzerland—where the hydatid cysts are relatively rare—that the alveolar Echinococcus has been most frequently encountered. The hydatids of this form observed in Oxen and Pigs, are observed chiefly in the abattoirs of Munich (Bollinger, Brinsteiner) and of Berlin (Ostertag).

Man alone furnishes important information as to the longevity of

the hydatids, and it appears that this may be very great. Court has observed a case of hydatid in the iliac region, that dated from thirty-five years. (Raynal operated on a woman, in whom the swelling had gradually spread during forty-three years over a considerable portion of the face, and attained the size of a child’s head.) Raymond has seen an Echinococcus persist for seven years in a Horse.1

In growing older, the hydatid undergoes modifications. These are sometimes limited to increase in volume and thickening of the cuticle, which may attain 1 mm. By remaining simple, the hydatid is capable of acquiring a diameter of 15 cm.; though this is exceptional, and most frequently it remains no larger than the fist. In general, the increase in size is due to the formation of secondary vesicles, which—if they are internal—cause the mother-vesicle to undergo a dilatation that is rarely regular, and is usually subordinate to the resistance that the organs of the host offer to its extension.

Pathological Anatomy.—Echinococcosis of the liver is more particularly prevalent in Ruminants and the Pig; a few instances have been observed in the Horse and Ass.2

It is often difficult to ascertain the number of Echinococci by which the liver is invaded, in consequence of the impossibility of distinguishing the external secondary vesicles from the mother-vesicles.

The hydatids sometimes cause considerable alterations in the liver of their host. There is formed, at first, a cyst for each mother-vesicle, and the external vesicles may remain in this cyst—which is amplified in proportion to their growth; or it may throw out ampullary ramifications, each having one or several secondary vesicles. These ramifications remain in communication with the primary cyst, or separate from it by the constriction of the intermediate canal, causing obstruction, and sometimes its atrophy. The walls of the cyst have a variable thickness, which may be from 5 mm. to 10 mm.; they are coriaceous, resisting, have not many vessels, are smooth on their inner surface, and in general free from adhesions with the surface of the hydatids. The latter can be extracted by careful incisions made with the scalpel, guided by the director.

A liver invaded by the Echinococci is considerably modified in its aspect. Its volume and weight are augmented—sometimes tenfold. The liver of the Ox, which, in the normal state, weighs about 5 kilogrammes, may when affected with hydatids amount to 50 kilogrammes. East has found it weigh 130 pounds, Roberts and Gregory 145 to 146 pounds, and Ringk 158 pounds. It is the same in the Pig; in health the average weight of this organ is about 2 kilogrammes

1 Raymond. The Veterinary Journal. XVI., 1883, p. 178.
(4½ pounds), but it may acquire an enormous volume—Cartwright has found it to be 50 pounds, and Girard 110 pounds.¹

The increase in volume entails modifications in the neighbouring organs, which are displaced, compressed, deranged, and hindered in their functions. The curvature of the diaphragm is increased, and the lungs are diminished in size; while the intestines sometimes show constrictions, and the peritoneum contracts adhesions.

The liver is lumpy on its surface, and instead of a uniform tint, it shows round white patches corresponding to the hydatids. The visceral peritoneum and Glisson’s capsule are notably thickened, and may form adhesions with the diaphragm, intestines, etc. The hepatic tissue is compressed, discoloured, and atrophied, and has become fibrous at points in the vicinity of the hydatids, and particularly at those which are intermediate to two or more voluminous vesicles, where it only appears as an eyot or band. A deep section of the organ lays open round, irregular, and unequal cavities, lined by the cystic membrane, from which the hydatid fluid spirits out, with the intact vesicles.

As they become older, the hydatids are modified, and are often destroyed. The walls of the cyst become more thickened; between its internal surface and that of the hydatid, are deposited layers of

apparently tubercular or seaceous semi-fluid, sometimes thick and consistent matter; sometimes, also, there is pus or blood; these concrete in concentric strata (Brückmuller). This deposited matter compresses the hydatid vesicle on all sides, or pushes it against the side of the cyst; its liquid contents diminish, its walls become shrivelled and approach each other, and the cavity finally disappears. Gradually the secreted matter becomes thicker, concretes, assumes the consistency of mastic, then that of chalk, and is at last a calcareous mass. An attentive examination may discover in it membranous shreds of the Echinococcus; but most frequently only the hooks, the chitinous nature of which preserves them from destruction. According to Ruysch, Bremser¹ and several others have made the following observation: 'Finally, the vesicle disappears, and the hydatid is transformed entirely into a calcareous mass, which may sometimes be detached as readily as the healthy hydatid, from the organ in which it is found.'

This particular appearance assumed by the old hydatids might cause them to be mistaken for tubercles. But it is always easy to distinguish them, either at first sight—by the persistency of neighbouring hydatids, and the absence of real young tubercles—or microscopically, from the presence of hooks in the contents of the tumour. Owing to this resemblance, several observers have ascribed the origin of tubercles to hydatids. Jenner was the first to promulgate this idea, and about the same time Dupuy wrote: 'These hydatids—regarded and described by zoologists as organized and living bodies—might well throw some light on the origin and formation of tubercles, or at least prove that these formations—which disorganize the lungs in the same manner—are developed under the influence of the same circumstances.'² It is superfluous to remark that these ideas are to-day exploded.

The multilocular Echinococcus is characterized by the restricted dimensions of its vesicles, by the frequent sterility of these, and by their agglomeration into colloid tumours, which have been compared by Guillebeau to a head of cauliflower. The stroma forming the framework and the envelope of the tumour does not undergo transformation by softening, which is usual in the multilocular Echinococcus of Man, and the connective matrix has not acquired the same importance. The minuteness of the parasitic elements allows of the anatomical processus assuming a resemblance to the arrangement of tubercles. The hydatid is surrounded by a layer of irregularly cubical giant-cells, from 50 μ to 60 μ in diameter, with numerous peripheral nuclei; and external to these are several rows of round epithelioid cells. These pseudo-tubercles are united into one conglomerate tubercle by a layer of connective fibrous tissue. At some points the giant-cells are replaced by

radiating fusiform cells. Sometimes there can be seen a single giant-cell, which envelops a hydatid (Guillebeau).

**Symptoms.**—The signs that indicate the presence of Echinococci in the liver of the Ox are varied and obscure. They are more perceptible if the lungs are also invaded by the same parasites, and their existence in the liver may then be suspected by some symptoms which now manifest themselves (see *Echinococcosis of the Lungs*). If the liver alone is invaded, there may be some indications of fever in the respiration, circulation and digestion; but in general these pass unperceived. When the malady is well advanced, the appetite and rumination become irregular, and all the more so as the case is serious. The animal wastes, the skin is dry, and the coat dull and staring. Pressure and percussion on the last four ribs of the right side cause pain, and produce a dead sound. Sometimes there is an icteric tint of the conjunctivæ, and obstinate diarrhœa. Rectal exploration sometimes discovers the liver enormously enlarged, and this gives rise to suspicion of the cause.

In the Sheep, the same vague symptoms accompany hydatism of the liver; there is feebleness, dulness and indifference, though these may not be very marked, except at the last stages of the malady, when the animal is altogether cachectic. There are frequent tympanites, and pruritus at various points; the wool is dry and brittle, and easily pulled out; and, in general, the symptoms are confounded with those of distomatosis which co-exists with hydatids.

No particular symptoms have been mentioned as betraying the existence of echinococcosis of the Liver in the Pig; they should be somewhat the same, however, as those observed in the Ox and Sheep.

There is no need to notice the symptoms that result from rupture of the hydatids of the liver, and discharge of their contents into the peritoneal cavity; as this eventuality, which is not exceptional in Man, does not appear to have been observed in animals.

The disease rarely terminates in death, and most frequently is only discovered after the animal has been slaughtered at the abbatoir.

**Etiology.**—The essential cause of Echinococci is evidently related to the proximity of Dogs, which harbour the *Taenia echinococcus* in their intestine; but it may be aided in its effects by secondary circumstances.

**Geographical Distribution.**—Echinococcosis appears to be cosmopolitan in the Dog itself, according to the statistics relative to Man. Similar investigations have not been made with respect to animals, but we may conclude that hydatids are much more frequent in them than in our own species. Of the whole of Continental Europe, Mecklenburg appears to be most infested by Echinococci—in some districts they are found in 26 to 50 per cent. of the Oxen, 75 per cent. of the Sheep, and
5 to 8 per cent. of the Pigs are hosts for these parasites;\(^1\) while Man pays a larger tribute to them there than elsewhere.

Bollinger states that echinococcosis is the most common endoparasitic malady of Ruminants, after tuberculosis and distomatosis; and Schmidt estimates the annual money loss it causes in Prussia at 200,000 francs (Friedberger and Fröhner).

But Iceland is beyond all other countries in this respect—a circumstance due to the considerable proportion of Dogs and Ruminants there. Krabbe\(^2\) estimates the number of Dogs at 15,000 to 20,000 to a human population of about 70,000, or 1 to 3 Dogs to every 5 people; and we have seen (p. 449) that these Dogs are infested with Tænia echinococcus in the proportion of 30 per cent. Sheep are in the proportion of 488 and Cattle 36 to every 100 people. Men, Dogs and Cattle live in close promiscuousness—at least, in winter—and reciprocal infestation is therefore assured. Echinococci are very frequent in the human species, and still more so in the domesticated herbivora. Ewes and Cows are more often infested than the males, and to such a degree does this occur that it is quite exceptional not to find them in Ewes four years old, or in Cows which have reached ten years. Finsen attributes this greater frequency to the fact that Ewes and Cows graze about the houses during summer, and are in this way continually in contact with the Dogs; while the Sheep and Oxen are driven to the mountains in the spring, and remain there until the autumn.\(^3\) (Hjaltelín states that hydatids occur in more than every fifth Sheep in Iceland; that they have been seen there in every third Sheep over three years old; and that in one district they are found in every adult Sheep. He also states that one-sixth to one-seventh of the population suffer from Echinococcus.)\(^4\) When the animals are killed to put their flesh in salt, the viscera are thrown away and not buried; on these the Dogs feed, and so become infested with the Tænia echinococcus.

Australia is infested with Echinococci to nearly as serious an extent as Iceland, according to the reports of J. D. Thomas. (Richardson\(^5\) also testifies to the prevalence of echinococcosis in Australia, both in animals and Man, the shepherds becoming infested—according to his statement—by eating raw flesh, the Dogs, no doubt, having deposited the proglottides and ova of their Tænia on it. Thomas\(^6\) reports that the disease occurs once in 18,000 of the inhabitants of Victoria, and in South Australia once in 23,000.)

\(^3\) Finsen. Les Echinocoques en Islande. Arch. Génér. de Medicine, 1869, I., p. 29.
\(^6\) Thomas. Hydatid Disease, with Special Reference to its Prevalence in Australia. Adelaide, 1884.)
In India, where Dogs are very numerous, 70 per cent. of the Cattle are affected with echinococcosis of the liver. (In other parts of Asia, the disease is probably as prevalent in animals, and proportionately so in Man. In Eastern Siberia it would appear to prevail even to a larger extent than in Iceland; for Kaschin\(^1\) asserts that in nearly all the post-mortem examinations he had made of Buratis—a Mongolian people who live there—he found hydatids in the liver and heart. The accounts which are given of the mode of life and customs of this nomadic race give a clue to this grave infestation. In unfavourable weather, for example, and particularly in winter, they live in the same tents or 'yourts' as the Cattle and Dogs, and in the most loathsome state of filth and uncleanliness; since they wash neither their dishes nor their own bodies, and wear their clothing until it falls to pieces. Like the Icelanders, they allow the Dogs to clean their wooden dishes by licking them.)

Treatment.—Owing to the difficulties attending diagnosis, and the slight disturbance to health caused by the hepatic Echinococci, this disease has not received much attention hitherto, so far as curative treatment is concerned. But prophylaxis is very important. It would be absolute if the Tænia echinococcus could be destroyed; and this would be effected if Dogs were not allowed to eat viscera containing, or suspected to contain, hydatids, and were submitted to periodic anthelmintic treatment—this is a matter for shepherds and butchers to attend to.

With regard to the prevention of the introduction of the ova of the Tænia into the digestive canal of Oxen, Sheep or Pigs, this can be effected by not permitting them to graze on pastures where Dogs have deposited their faeces, nor to give them forage suspected of having been soiled by these animals; but this is in practice almost impossible.

**Article III.—Distomatosis (or Fascioliasis) of the Liver.**

The term Distomatosis (Zundel) or Distomiasis (Wiame) designates any affection due to Distomes.\(^2\) (Fascioliasis has also been a term employed in England, the parasite being named by some authorities the *Fasciola hepatica*.)

The principal species of Distomes of the domesticated animals infest the liver, and the hepatic form is therefore the most important of the Distomatoses. In the first line is placed that which is produced in the herbivora, and especially in the Sheep, by the *Distoma hepaticum* and the *Distoma lanceolatum*.

\(^1\) Leuckart. *The Parasites of Man*. English edition of the German work, Edinburgh, 1886.)

1. The Distomatosis of the Herbivora. 1

The distomatosis of herbivora has been known for a very long time under numerous designations, which have been applied almost exclusively to the ovine species. Chabert enumerates not less than 75. The principal of these are: Cachezie aqfene, Pourriture, Bête pourrie, Mal de foie, Poie douré, Douve, Douvette, Jaunisse, Bouteille, Boule, Gamadure, Goulonmon, Ganache, Phthisie verminene du foie (Fromage de Feugrê), Cachezie iætæro-vermineuse (Röll), etc.; in Germany, Leberfâule, Egelfâule, Leberegelkrankheit, Lebergeloseuche, Anbrüchigkeit; in England, Rot, Rot-dropesy (Fascioliasis, Liver rot, Fluke disease, Cachezie aquosa verminosa); in Italy, Bisciouola, Marciaja; in Holland, Hot organs.

The Distomes of the liver have been recognised for a long time, but the first mention of them is due to Jean de Brié—1379; they were known in France by the name of douves—a designation still applied to them every day. A long time afterwards—1547—Gabucinus spoke of worms resembling pumpkin-seeds, as inhabiting the liver of Sheep and Goats, and in course of time other observers made the same remark. Davaine has given an excellent résumé of the history of these worms. (From an early period, the disease to which the Distomas give rise was known in England as 'Rot,' while the parasites themselves were and are alluded to as Flukes, from their resemblance to the fishes usually so designated.)

Etiology.—The essential agents in the production of distomatosis is the Distoma hepaticum and, secondarily, the Distoma lanceolatum.

DISTOMA HEPATICUM (Linn.).—Body flattened, foliaceous, of an irregular, pale-brown colour, and 15 mm. to 31 mm. long, by 10 mm. to 13 mm. broad, in the adult; oblong oval or lanceolated in shape, broader and rounder in front, where it suddenly contracts to form a kind of conical neck; attenuated and obtuse behind. Cuticle studded

with numerous small prickles directed backwards. Oral sucker terminal, small, and round; ventral sucker large and salient, with a triangular opening, and situated 3 mm. behind the first. Intestine with two ramifying branches—sub-genus Cladocelium—visible through the integuments, and of a dark hue. Penis salient, in front of the abdominal sucker, and always curved. Vulva very small, and situated beside the male opening or a little behind it. Ova brown or greenish-yellow, and ovoid in shape, measuring 130 μ to 145 μ long, and 70 μ to 90 μ broad.

DISTOMA LANCEOLATUM (Mehlis).—Body semi-transparent, speckled brown by the ova, and 4 mm. to 9 mm. long and 2.5 mm.

![Figure 271: Distoma hepaticum; natural size.—Railliet.](image)

![Figure 272: Digestive apparatus and nervous system of the hepatic Fluke; the nervous system is diagrammatic.](image)

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**Hosts.**—The *Distoma hepaticum* is, above all others, a parasite of Ruminants, in the liver of which it is very often met with—such are the Sheep, Goat, Camel, and a certain number of wild species. It is found, besides, in several other domestic and wild animals—the Horse, Ass (Buffalo), Pig, Elephant, Rabbit, and even in Man.

With regard to the *Distoma lanceolatum*, it is generally observed, with the preceding, in the bile-ducts of Ruminants; and it has also been noted in the Rabbit, Hare, Pig, Ass (Sonsino), Dog, Cat, and Man.

**Geographical Distribution.**—According to Leuckart, there are

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more of the Distoma lanceolatum found in the South of Europe than in the North, which may be due to differences in the mode of keeping stock, and to the nature of the pastures.

The D. hepaticum prevails in the eastern provinces of Prussia, (Gerlach), and the D. lanceolatum is universally and almost exclusively spread throughout Thuringia (Ziirn), and at Berne (Siedamgrotzky, Guillebeau).

The hepatic Fluke is found all over Europe, with the exception of Iceland. It is very frequent in the Shetland Islands, and it is not rare in the Faroe Islands. It does not appear to have been observed in Asia, has scarcely been seen in Africa, except in Egypt and Algeria, and it is common in South America, less so in North America; while it is often witnessed in Australia and Tasmania. (It causes most serious
losses in Australia, into which country it was supposed to have been introduced in 1855, by imported Rams sent from Germany to Victoria. It is known in India, and has been found in the Buffalo in that country; while a different species has been met with in the Elephant. According to Hamont, the annual fall of the Nile causes the loss, from 'Rot,' of 160,000 Sheep. In Burmah, Sheep husbandry has been found impracticable because of its ravages.

The *D. lanceolatum* has almost the same distribution. It appears to be absent from England, but is found in the other parts of Europe, in Siberia, and in the region of the Amoor (Manchuria), as well as in Algeria and North America.

Influence of Species.—Notwithstanding the dissemination of these two species of parasites, distomatosis scarcely exists as a special disease except in the domesticated Ruminants. Cadéac has, however, published a very remarkable case in a mare Ass. It is frequent in the Sheep, less so in the Ox and Pig, and still less so in the Horse.

Hertwig’s statistics of animals slaughtered at the Berlin abbaito during the year 1889-90—154,218 adult Bovines, 116,005 Calves, 430,362 Sheep, and 442,115 Pigs—demonstrate the great frequency of distomatosis in Cattle; as 75 to 80 per cent. of the livers of adult Bovines were slightly affected, but the organ itself was condemned as unfit for food—in consequence of the ravages of the parasite—in 31 per 1,000; while it was 9 per 1,000 in Sheep, 6 per 1,000 in Calves, and 12 per 1,000 in Pigs. These differences are explained by the larger quantity of food—and consequently of germs—which the Ox ingests in proportion to the Sheep; while Calves rarely go on any but dry pastures, and Pigs rarely graze at all. If Sheep are more frequently affected than Oxen, it is because their lymphatic temperament offers less resistance to the effects of liver invasion by the parasite.

Influence of Age.—Like most of the parasitic maladies, distomatosis finds a more favourable soil in young than in old animals—Lambs, and year or two year old Sheep paying a heavier tribute to it than adults; and in several of the epizoötias affecting the bovine species, Calves were the first attacked, Cattle two or two and a half years old dying in greater proportion than those of a more advanced age.

Influence of Humidity.—The disease generally appears most frequently in an enzoötic or epizoötic form, and is—because of its frequency and the mortality it occasions—a real scourge to agriculture.

A study of these epizoötias shows that they always follow abundant and prolonged rains, the influence of humidity constantly holding a predominant position in their etiology, as might have been anticipated.

1 Hamont. The Veterinarian, Vol. VII., pp. 557, 587.
2 Steel. A Treatise on Diseases of the Sheep, 1890, p. 136.)
3 Cadéac. Sur un cas de Distomatose Observe Chez une Ass. Revue Vétérinaire, 1885, p. 10.
from what has been said with regard to the migrations of the Distomes (p. 320). We will borrow from Delafond, Reynal, and Davaine a résumé of the principal of these epizoöties.

'The first epizoöty mentioned in history is that which appeared in Holland in 1552, and which Gemma named _lues infantia pecoris._

'Fromann, in 1663, 1664, and 1665, observed in the Duchy of Coburg an epizoöty that attacked Sheep of all ages, Calves and Heifers up to two years old, but no Oxen or Cows. The Hares and Deer in the woods and pastures died of this malady, and Horses, Goats, and Pigs were not exempt. Worms were found in the liver of the diseased animals; in four sheepfolds containing altogether more than 3,000 Sheep, there scarcely remained 40.

'In 1674, an affection also characterized by the presence of the Distome in the liver was observed by Willins in Seeland; it attacked nearly all the animals' (Davaine).

In 1743 and 1744, the Rot carried off nearly all the Sheep in the territory of Arles, and in 1761 all the flocks in Aveyron.

In 1761 and 1762, this disease decimated the Sheep in the North of France, and especially in Bas Boulonnais. These two years were remarkable for the heavy rainfall, particularly in summer, all the valleys being inundated.

In 1809, the greater part of France was ravaged by this disease, especially the Beaujolais and Lyonnais. The Sheep constantly fed in the sheepfolds were generally preserved.1

'In 1812, the disease prevailed in the Midi, and principally in the departments of the Rhone, Herault, and Gard; 300,000 Sheep perished in the Arles territory, and 90,000 in the arrondissements of Nîmes and Montpellier.

'In 1816 and 1817, it again caused great destruction in many departments of France.

'In 1820, it reigned with intensity in the environs of Beziers.

'In 1829 and 1830, it caused destruction in the majority of the localities in the department of the Meuse and the neighbouring departments, and not only the Sheep, but also the Oxen, perished in large numbers. In the arrondissement of Montmédy, of 24,000 or 25,000 Cattle about 5,000 were lost; of the Sheep, scarcely a moiety remained. Certain communes lost 200 Cattle and 1,500 to 1,800 Sheep' (Davaine).2

In the arrondissement of Verdun, of 20,000 to 21,000 Cattle, 2,200 succumbed, and of about 50,000 Sheep, nearly 20,000 were carried off by the Rot.3

'In 1853 and 1854, the disease again prevailed in the greater part of France, and principally in the departments of the centre; in Berry, Gâtinais, and Sologne, the farmers lost a fourth, a third, and three-fourths of their flocks.

'In England, according to Simonds, great outbreaks occurred in the years 1809, 1816, 1824, and 1830' (Davaine).

In 1830, the disease carried off in England about two millions of

1 Grognier. _Correspondance de Fromage de Feugrè, II., 1810, p. 112.
2 Dillcy. _De la Cachexie Aquouse ou Hydropisie des Bêtes à Grosses cornes._ Rec. de Méd. Vétér. Pratique, 1832, p. 139.
3 Mangin. _Ms. sur la Cachexie Aquouse (Pourriture) des Bêtes à Grosses Cornes._ _Ibid._, p. 120. — Taïche. _Ibid._, 1834, p. 289.
Sheep; the following year there were 5,000 less, weekly, in the Metropolitan markets.¹

In 1862, it prevailed so violently in Ireland that 60 per cent. of the Sheep were destroyed.

During 1870, Slavonia lost 40 per cent. of its Cattle from distomatosis.

According to Zundel, the disease killed one-third of the Sheep in Alsace-Lorraine, representing a value of 1,500,000 francs.

Wernicke reports that in 1882, in the southerly provinces of Buenos Ayres, this malady killed not less than a million of Sheep. In the one district of Tandil, more than 100,000 succumbed during the first eight months of 1886, some breeders having lost nearly all of their flocks of 6,000 to 8,000 head each.²

(These are only a very small number of the recorded epizoöties, and there are several before that of 1552. Youatt estimated that, in Great Britain, more than 1,000,000 Sheep annually die of distomatosis. In 1879, England is supposed to have lost about 3,000,000 Sheep, although ten counties did not record any fatality, either because they were free from the malady or did not suffer more than usual. And the loss was put down at the same number in 1880. It has been remarked that epizoöties of unusual magnitude occur about once in every ten years.

Australia would appear to be as severely, and is certainly more constantly, visited by this scourge than Great Britain, the losses being often enormous. In the present year (1891) the destruction has been very great, one owner alone having lost more than 10,000 Sheep.)³

Other considerations also demonstrate the influence of humidity in the development of distomatosis. Thus, it is rare in summer, but prevails with intensity in autumn, at the end of winter, and more especially in the springtime—during the months of March, April, and May.

It is most severely experienced in low-lying, damp, marshy localities, in valleys liable to be inundated, in the neighbourhood of ponds and stagnant water, at the estuaries of rivers, in wooded localities, and on lands the soil or subsoil of which is clay and impermeable. It is present in an almost enzooötic form in Sologne, Berry, Gâtinais, in the argillaceous zone of the landes of Gascony, and in numerous parts of England, where it kills off a million of Sheep every year. It would appear that no country is free from its invasions.

Inundations naturally play an important part in this etiology. The epizoöty observed in 1761 and 1762 in the Bas Boulonnais was due to this accident; and that which ravaged the South of France in 1810, 1811, and 1812 followed the overflowings of the Rhone and its affluents. According to Hamont and Fischer,⁴ the disease appears every year in Egypt after the overflowing of the Nile, and declares itself successively in the places first freed from the floods; they estimate that 16,000

¹ Simonds. The Veterinarian, 1861.
³ (The Live Stock Journal, October 30, 1891.)
Sheep die every year from it. The illustrious Bakewell, having remarked that, at the commencement of the malady, fattening occurred more rapidly, purposely gave it to Sheep intended for slaughter, by placing them for some days during the autumn on pastures which had been flooded during summer.¹

Certain very remarkable facts, in which humidity was only noticeable, markedly indicate the intervention of the parasitic cause.

Dupuy has seen 500 Sheep die of Rot, which had grazed on damp land, where there were ponds full of stagnant water; but fifteen, which could not accompany them to this place because of lameness, remained healthy.²

¹ A farmer in the neighbourhood of Wragby, Lincolnshire, brought twenty Sheep to the fair, and left six at home. The twenty, not having been sold, were brought back and pastured along with the six, and in the course of the following winter the former died of Rot; but those which had not left the farm continued well. There could be no doubt as to the correctness of the fact, as the Sheep sent to the fair were marked, but the others were not; and the loss of the twenty could only be ascribed to the supposition that they had passed through some district or pasture-land where they acquired the germs of the malady.

² A Sheep belonging to a lot of twenty having broken its leg on leaving the fair of Burgh, Lincolnshire, the remaining nineteen were parked in a pasture at the end of the town until a conveyance could be procured to carry the injured one. These nineteen Sheep died of Rot, but the damaged one escaped' (Davaine).

A secular belief entertained by shepherds—and which is related to the influence of moisture—attributes to certain plants the special privilege of producing Rot in Sheep which live upon them. These are more particularly two kinds of Ranunculaceæ—Ranunculus Flammula Linn. and R. Lingua Linn.—and the Nummularia—Lysimachia Nummularia Linn.; they are often called Douves in France, which is also the vulgar name for the Distomes of the liver, the first mentioned plant being called petite Douve, and the second grande Douve. In certain parts of the South of France the Juncus obtusiflorus has the same reputation, and is named Herbe de douves. In Egypt, according to Hamont and Fischer, there is a very tender Juncus known as Bisse, which is supposed to possess this property, and the fellahs call the Rot Bissa. This widespread notion is due to the fact that these plants belong almost exclusively to the marsh flora, and to places liable to inundations.

Development and Metamorphoses of the Distomes.—For a long time our knowledge of the etiology of distomatosis was confined almost entirely to what has just been stated. Several observers—Creplin, Ercolani, Baillet, and Leuekart, among others—were successful in

¹ A. Young, quoted by Chabert. Loc. cit., p. 164.
hatching the ova of the Distoma hepaticum, but could not effect the transformation of the embryo in its cercarigerous sac after encystment in a molluse. So that they were reduced to the most plausible supposition, among others, that for this species the migrations and metamorphoses are analogous to those of the other Distomes. It is to be remembered that Spinola asserted he had developed distomatosis in a healthy (?) Sheep, in causing it to ingest undetermined mollusces collected on infected pastures. The researches of Leuckart and Thomas have, however, dispelled very much of what was obscure.

According to Ercolani, neither ovulation nor hatching take place in winter; but Leuckart asserts that he has seen ova at all seasons of the year in the gall-bladder of infested animals. It was only exceptionally that he found — particularly in winter — Flukes in which the uterus was nearly free from ova. The ova pass into the intestine like the bile — some directly, others after remaining for a variable period in the gall-bladder. They are produced in enormous quantities in animals which are much infested, Thomas estimating that 200 Flukes will yield 7,500,000 ova. These ova do not undergo segmentation, and only
develop their embryo when they have arrived in the bile-ducts, in the intestine of their host, or—which is most frequent—when they have found their way into water after being expelled along with the faces. In summer, the embryo is completely formed in about three to six weeks (Leuckart, Baillet, Ercolani); according to Thomas, it does not arrive at this state unless the surrounding temperature is from 23° to 36° Cent. It then makes its escape by raising an operculum at one end of the shell (Fig. 275, C.).

This embryo is not unlike certain Infusoria—infusiform embryo. It is elongated, attenuated behind, and broader in front. Capable of modifying its dimensions, it has an average length of 130 μ, and is 27 μ broad at its anterior part, at the summit of which is a small papilliform eminence—a kind of rostrum that acts as a perforating, retractile, and protractile apparatus, according to Baillet. All the body is covered by an ectoderm of polygonal cells, on which are long vibratile cilia, except on the rostrum. A short distance from the latter is seen an opaque pigmentary spot, formed of two lobes that make an x in shape, which Leuckart regards as a rudimentary digestive apparatus. The remainder of the cavity of the body is filled by very granular cells. This embryo moves about in water with great agility; but if it does not meet with a suitable host it soon dies. Thomas states that its free phase rarely exceeds an entire day, although he has seen it live for three days in an alkaline fluid.

For a long time the intermediate host, into which the embryo of the Distoma hepaticum must pass, was unknown, and only some species of terrestrial or aquatic mollusces were suspected. Weinland¹ was the first to discover the species so vainly sought for, in the Limnea truncatula Mull. (L. minuta Draper).

This is a pulmonary Gasteropod, with a thin, spiral, shining shell, of a pale, horny, ash-gray tint, dextral, acutely spiral, composed of five or six convex turns, the last of them being large, a little expanded, and alone forming two-thirds of the entire shell; summit pointed; opening wide, being nearly one-half the height, obliquely oval and slightly angular superiorly; the margin of the opening—peristome—thin, short, the external border straight and reflected outwards; height 6 mm. to 10 mm.; diameter 3 mm. to 5 mm.

This species is found over almost the whole of France, and in nearly all the countries of Europe. 'It lives in basins, ponds, ditches, rivulets, drains of pastures, and loves to leave the water. It is one of the species that lives the highest on mountains. Pluton has met with it on the Vosges at an altitude of 1,150 mètres. 'I have seen it in the Pyrenees at nearly 1,200 mètres,' says Moquin-Tandon.² It is, in fine,

a very cosmopolitan species. It inhabits the whole of Europe, Russia, Lapland, Siberia, Afghanistan, Thibet, the territory of the Amoor, Morocco, Algeria, Tunisia, Abyssinia, the Canary and Faroe Islands, and Iceland. It has not been found in Australia, nor in America, nor yet in the Shetland Islands, where, nevertheless, the Fluke exists. Its area of distribution does not quite concord with that of the Distoma hepaticum, so we must conclude that this worm can complete the primary phases of its development in several species of Mollusces, only one of which is actually known; or that, because of its minuteness, the Limnea minuta has escaped notice in several countries. Perhaps the Limnea humilis Say, plays the part of intermediate host for this Trematode in North America, and the L. viator Orb. in the Argentine Republic—these being species which are scarcely distinct from it.

Weinland has found the liver of the Limnea truncatula full of the Rediae which contain the Cercariae covered with spines, as is the cuticle of the Distoma hepaticum. Acting on the indications of this authority, Leuckart succeeded in obtaining the enyzstment of the embryo in individuals of this species. He also succeeded with young specimens of the Limnea peregra Gm.; but in these the development stopped in its first phases. In the L. truncatula, on the contrary, it may be followed to the formation of the Cercariae, as has been done by Weinland and Thomas. Experiments made with other species of Limnaeus, Physi, Planorbo, Paludina, Limacina, Ariona, etc., have failed.

As soon as the embryo of the Fluke meets the Limnaeus suitable to it, it attacks it by means of its rostrum, which is provided in its axis with a kind of semi-rigid rod. It prefers to lodge itself at the bottom of the pulmonary chamber, into which it easily obtains entrance because of its smallness; if it penetrates into the foot of the Mollusc it cannot pursue its development there, but usually dies in two or three days.

When it arrives in the convenient organ, the embryo loses its layer of ciliated cells, and finishes by contracting into an ovoid mass that grows rapidly. The two lobes of the ocular spot separate from each other, and lose their semilunar aspect; the rudiment of the digestive tube finishes by disappearing; a cuticle replaces the ciliated cells, and the embryo is transformed into a Sporocyst (see p. 320). The latter acquires its definitive size—5 mm. to 7 mm.—in less than fifteen days.
during the summer, and in about a month in the autumn. The cavity of the body was filled with round transparent cells, named \textit{germinative cells}; these are now disposed as a muriform mass. The very young Sporocysts may sometimes become multiplied by transverse division. The cellular masses are ordinarily five to eight in number, though they may only form one.

These muriform masses—kinds of \textit{morula}—are transformed into so many \textit{Redia}, provided with a simple digestive apparatus. They are cylindrical, and have at their posterior extremity two short, obtuse appendages. The \textit{Redia} in the same Sporocyst appear in several stages of development. When they have attained an average length of 0.260 mm. they begin to move energetically, and finally rupture the maternal sac, from which they issue one by one.

On obtaining its liberty, the \textit{Redia} quits the pulmonary cavity of the mollusc, passes through the tissues, and fixes itself in another organ, usually in the liver. There it gradually grows to a length of 1.3 mm.
to 1.6 mm. The mouth appears at the anterior extremity, and the digestive tube, as a single cul-de-sac, is more distinct; a circular collar is formed behind the pharynx by a thickening of the cuticle, and represents the oral sucker; and the secretory apparatus is more markedly developed than in the Sporocyst. The cavity of the body of the Redia forms germinative cells, whence are derived the morula that is transformed into daughter-Rediae—ten at most—or into Cercariae, the number of which may be as high as twenty-three.

According to Thomas, the Rediae engender the daughter-Rediae during warm weather; in winter they produce Cercariae. He has seen in the autumn, in the same Redia, a single daughter-Redia developed in the midst of a great number of Cercariae. In favourable circumstances, a single ovum of the Fluke may in this way produce a thousand Cercariae.

The daughter-Rediae or the Cercariae leave the Redia by a single opening at the side, a little behind the collar. Each daughter-Redia forms from fifteen to twenty Cercariae, which are evacuated in the same manner.

The Cercaria is provided with a digestive apparatus, the intestine of which is divided into two branches. The mouth opens at the bottom of the oral sucker; the ventral sucker—of the same size—is seen on the middle of the inferior surface. The excretory apparatus is recognisable. Particular cells—named cystogeneous cells—are distributed in large numbers in the lateral parts of the body. The latter is oval, flattened, covered with very fine spines, and measures on the average 28 mm. long by 23 mm. broad, though it may attain 30 mm. in length. It is prolonged by a very contractile tail, which is twice as long as the body.

When the Cercaria escapes from the body of the Redia by the hatching orifice, it leaves its host—creeping and writhing among the tissue by means of its suckers and its tail; and on gaining its freedom it swims in the water, moving about energetically, and incessantly modifying its shape and dimensions, eventually fixing itself on some submerged body—such as an aquatic plant, or on the herbs of damp pastures—as the dock, dandelion, cress, etc. The cystogeneous cells, expelled from the body, are employed to form a cyst in which the cercaria is enclosed; and its tail disappears either immediately before or after this encystment. The presence of cysts on the leaves of plants is denoted by white points, formed by a kind of mucus accompanying special granules. The peregrinations of the Limnea truncatula facilitate the dissemination of the Cercariae.

It is, therefore, in consuming the herbage of damp pastures that animals become infested; and this explains why Leuckart was unsuccessful, when he caused Rabbits to ingest Cercariae which had not undergone encystment. On the other hand, Thomas affirms that the
Cercariae are more especially found on the lower leaves of plants—those nearest the ground; and it is because of this that Sheep—which cut the herbage close to the ground—are more often infested than Cattle, which do not graze so close. (It has long been remarked in England, that Sheep which have the deformity of the mouth known as 'hog-jawed,' or the other deformity called 'Parrot-mouthed' or 'shuttle-gobbled'—both of which prevent them cropping the herbage so close as normal-mouthed Sheep—are seldom affected with 'rot.')

The molluses may also—because of their small size—be swallowed by the herbivora, with their Rediae; but this mode of infestation is not very probable—at least, with Sheep, which, when drinking, keep the lips close together, leaving only a narrow slit for the passage of the water. Otherwise, they drink but little when they have access to moist herbage.

The encysted Cercaria can remain alive on pastures so long as these remain moist; drought throws it into a kind of latent existence for an undetermined period, during which it lies huddled up in its envelope.

When it arrives in the stomach, the cyst is dissolved, and the worm is set at liberty and penetrates the liver, probably by the ductus choledochus.

The telluric conditions that influence invasion of the liver of Sheep by the Distoma lanceolatum, do not differ from those that rule in the case of the Distoma hepaticum; but the evolution of the first of these two species is still unknown. Contrary to what occurs with the Distoma hepaticum, the ova of the D. lanceolatum undergo segmentation and develop their embryo in the maternal intestine; but it is not hatched until after it has been three weeks in the water. When set free it is globular or pyriform in shape, and ciliated on only the anterior third of the body; it is therefore, as a consequence, less active than that of the D. hepaticum. It is armed with a sharp protractile and retractile cephalic needle. Willemoes-Suhm believes he obtained its encystment in the Planorbis marginatus. A large number of this mollusc having been placed in an aquarium, the water of which had been sown some months previously with the ova of Distoma lanceolatum, were found afterwards to be bearers of a Cercaria (Cercaria cystophora). This Cercaria—previously described by G. Wagener—derived from a Redia that itself comes from a Sporocyst, is remarkable for possessing two unequal tails. Leuckart believed he had developed the D. lanceo-
latum in a Sheep to which he had given the Cercaria cystophora; but he has since repeated the experiment with success. Ercolani asserts that the young D. lanceolatum show no traces of digestive apparatus, and cannot therefore be derived from the Cercaria cystophora, which has one. Lastly, Creutzburg—a pupil of Leuckart—has demonstrated that this Cercaria is that of the Distoma ovocaudatum, which is not rare beneath the tongue of the green Frog.

Piana, having discovered in the Helix earthusiana sporocysts containing the Cercaria longicaudata—which has no intestinal tube—has for this reason admitted that it represents the larval state of Distoma lanceolatum. But, as Blanchard remarks, the embryo of this Distoma—considering its ciliated covering—is necessarily aquatic, and cannot reach terrestrial mollusces.

The question of the migrations and the development of the D. lanceolatum belongs to the problems yet to be solved with regard to it.

**Migrations of the Distomes.**—The infestation of flocks by the larvae of the Distomes may occur at any period of the year (Bollinger, Schaper), as the night frosts do not destroy all the Cercariae (Friedberger). Nevertheless, heat being very favourable to the development of the ova, it is more especially during the summer and autumn, up to the first frost, that infestation takes place. It may occur very rapidly; for instances are recorded in which sojourn for less than half an hour on an infected pasture has been sufficient. In general, however, it occurs in an insidious and progressive manner, though successive invasions may be manifested on the same animals, or a flock may submit to repeated invasions in distinct groups.

Three theories have been promulgated as to the mode of introduction of the Flukes into the liver.
1. The young Flukes penetrate directly—through the intestinal walls—into the intestinal and mesenteric veins, and, consequently, into the roots of the vena portæ, where the current of blood carries them into the liver. There are no facts to support this opinion.

2. The Cercariae are set free by the digestion of their cyst, pass through the walls of the stomach and small intestine, then through the peritoneal covering of the liver, and so enter the biliary canals (Gerlach, Spinola, May). Friedberger remarks that the frequency of hepatic peritonitis (perihepatitis), invoked in favour of this hypothesis, may also testify to a centrifugal emigration of the Flukes, which creep beneath the serous membrane and perforate it from within to without. It is not rare to find Distomes with their cephalic extremity projecting from the surface of the liver. Besides, the young parasites found in the bile-ducts have always their anterior extremity turned towards the periphery of the organ; while the perforations on the surface of the liver correspond, not with the dimensions of the worm on its entrance to the gland, but with those it has acquired since its migration (Leuckart).

3. The Flukes pass directly from the duodenum into the ductus choledochus. This hypothesis, which was promulgated by Leuckart, is the most reasonable. According to that authority, the Fluke wanders into the smallest bile-ducts by dilating them with its cephalic extremity—fixing itself alternatively by means of its oral and ventral suckers, and successively extending and contracting the anterior part of its body, while the spinous prominences on its cuticle prevent its being pushed back. The Distoma lanceolatum, the cuticle of which is smooth, progresses easily, owing to its smallness and tenuity.

No observer has been able to note the precise moment when immigration of the Flukes occurs. Joseph¹ says he has found, on several occasions, small Cercariae without tails in the duodenum of the Sheep. But there is nothing to prove that these were young Distomes in process of being prematurely evacuated.

The majority of the Distomes remain in the bile-ducts; but some pass through their walls, pass into the hepatic parenchyma, excavate and destroy it, and perforate Glisson’s capsule and the peritoneum, and so give rise to perihepatitis or peritonitis. Others reach the roots of the vena portæ and there set up endophlebitis, thrombosis, and embolism; while a small number may enter the sub-lobular veins and thence travel into the most distant parts of the body. In consequence of its proximity, the lung is the organ in which these wandering Flukes are more frequently met with; but they have also been seen in the muscles and connective tissue. Leuckart admits that they arrive there in leaving the venæ cavae; while Friedberger entertains the more plausible opinion that these are Distomes of the lungs which have passed into the pulmonary veins, when the blood-stream carries and disperses them. Gerlach attributes the fatal apoplexies sometimes observed in the first stage of distomatosis, to cerebral embolism produced by the young Flukes.

The Flukes commence to quit the bile-ducts to pass into the intestine as soon as their reproductive organs are completely formed—which, according to Leuckart, takes place in about three weeks. As it is in May and June that there are sometimes found in the faeces Distomes generally very much altered by the intestinal juices, Gerlach allows that their emigration always takes place about this time, and that these worms never exceed the age of nine to twelve months. Pech and Friedberger have found numerous Flukes in the gall-bladder and duodenum in the autumn and winter. Thomas has observed these parasites in two Sheep fifteen months after the period of infestation. The statistics of the cases of distomatosis noted by Hertwig in the Berlin abattoir, show that it prevails at all seasons of the year, but more frequently in October and in the springtime—a circumstance that corresponds exactly with its etiological conditions.

Symptoms.—By its symptomatic physiognomy, distomatosis of the Sheep is the type of pernicious anæmias, and justifies the name of 'cachexia' so often given to it. Otherwise, the signs of the malady have nothing pathognomonic in them, and might be mistaken by many for those of the various helminthiases of this animal. In the course of the distomatosis, Gerlach recognised four periods or stages, based on the varied relations that the Flukes contract with the liver of their host. Very often these periods are not distinct from each other, owing to the repeated infestations obscuring them; but they, nevertheless, give a good idea of the progress of the malady.

1. Period of Immigration.—This period corresponds to the fall of the year, and generally passes unperceived, as the lesions the young Flukes have produced in the liver have scarcely had time to affect the general health of the animals. The cases of death from cerebral apoplexy, remarked upon by Gerlach, occur at this period, the duration of which varies from four to thirteen weeks and more.

2. Period of Anæmia.—This coincides usually with the months of September and November. The Sheep are less lively, and the visible mucous membranes, the inner surface of the ears, and the skin generally, are paler than in their normal state. But the appetite is still good, and the animals have a tendency to fatten more readily, as Bakewell had remarked; and this may be due—according to Simonds—to the stimulus the young Flukes impart at first to the liver, and consequently there is a more abundant biliary secretion and better assimilation. But soon the appetite diminishes, the thirst increases, and rumination becomes irregular; the mucous membranes and the nude skin are of a dull-white, slightly-yellowish hue. There are slight oedemas; the skin is more supple and in parts doughy, the fat regions being soft; the conjunctivæ are infiltrated and puffy, no longer show their vascular network, and form a circular, salient, whitish-yellow ring when the eyes are explored by separating the eyelids and gently press-
ing between the thumb and index-finger; this appearance causes the shepherds and butchers to say the animal has a fat eye. The wool becomes dry, brittle, easily pulled out, and falls off spontaneously in places; debility gradually becomes more marked; the Sheep allow themselves to be easily caught, and scarcely struggle when seized by the hock; this muscular weakness is perhaps most manifest in Sheep still fat, and it is sufficient to enable the butchers to recognise the malady. There is sometimes fever and quickened respiration. Palpa-
tion and percussion indicate ascites. The faces are normal, but at the end of this period they contain numerous Fluke ova.

3. Period of Wasting.—Its commencement corresponds to about the end of the third month after the immigration of the larvæ—that is, generally towards the beginning of January. The disease then reaches its maximum.

Emaciation—at first not very marked—makes considerable progress. The mucous membranes and skin are blanched, but have no icteric tint, though Trasbot says he has often seen icterus lead to the speedy death of fat Sheep ready for slaughter. The temperature is variable, and is marked by a very irregular curve, its maximum being sometimes shown in the morning, sometimes in the evening. The respiration is laboured and quick; the appetite is still maintained, and defecation offers nothing unusual except in the numerous ova of the parasites in the faces; the urine is about normal. The animals are languid and dejected, with their heads carried low, and pressure on the back causes them to fall. With pregnant ewes abortion is frequent, and those which are suckling have the milk transparent and serous, while their lambs are puny, and generally die if they do not have another nurse. The œdemas remarked in the preceding period are localized, and are most perceptible at the dependent parts of the body; they disappear with exercise and reappear with rest. One of them is noticed in the sub-
maxillary space, and it extends gradually below the larynx, and over the cheeks and parotids. The shepherds in France call it bouteille, bourse, boule (bottle, purse, ball; in England the Sheep is said by shepherds to have the 'watery-poke' or to be 'chckered'), and they rightly consider it one of the most characteristic symptoms of the malady. The 'bottle' disappears at night while the animal is resting in the sheepfold, and re-forms again while it is grazing, owing to the dependent position of the head and neck; it is often absent in adults, and during warm weather. In the three following weeks, emaciation is still more noticeable, notwithstanding an abundance of food; but, as a rule, there is neither œdema, icterus, nor indication of pain on pressure in the region of the liver. Death often occurs at this period, though animals are rarely allowed to live so long. In other instances, amelioration takes place, and the Sheep reach the next phase.

4. Period of Emigration of the Flukes.—This is the period of conva.
lescence and spontaneous recovery, shown by progressive attenuation of all the symptoms, and it corresponds, according to Gerlach, to the months of May and June, though it may occur earlier. But recovery is never complete, the lesions in the liver being irreparable; and even in these limits it is exceptional.

The duration of the malady is very variable, and depends upon the degree of infestation, the temperament of the animals, and the conditions of hygiene to which they are submitted. Most frequently the duration does not exceed six months, and exceptionally it may be very rapid. Bonvicini has seen two Sheep, in which the parasites had induced acute hepatitis, die, one on the seventh, the other on the ninth day after the appearance of the first symptoms.

Complications frequently occur in distomatosis. The enfeebled economy is predisposed to numerous affections, and especially to those of a parasitic nature—such as scabies, ' gid,' verminous bronchitis, and intestinal helminthiasis. These of themselves prepare the soil for distomatosis, and the coincidence of these various parasitic disorders accounts for the opinion of those who do not recognise the autonomy of distomatosis, but include it in a general helminthiasis.

**Diagnosis.**—The diagnosis of individual cases may present some difficulties. But it is assured when a microscopical examination of the faeces results in the discovery of the Fluke ova in them. It is a long time since Davaine pointed out the value of this element in diagnosis, and Bunck was the first to have recourse to it; he estimated the number of ova in 500 grammes of faeces at from 1,000 to 3,000. According to Perroncito, there is found on the average an ovum in each microscopical preparation when the liver contains 85 Flukes, and 10 ova for 800 Flukes; but Brusaferro's figures do not accord with these, as his researches showed that if—in distomatous Sheep—the ova of Flukes are always found in the excrements, their number by preparation is not always in proportion to that of the parasites in the liver, the relation between them varying from 1 to 13 for every 100 worms. In certain grave cases thirty may be found in each preparation. Otherwise, the number of the ova may also vary according to the time of day when the faeces are passed, this variation being no doubt due to the differences in activity of the biliary secretion, which will carry into the intestine a more or less large number of ova. On the other hand, the ova of the Distoma lanceolatum are relatively rare, and the search for them may be fruitless, although the number of parasites is great.²

The ova of the Distomes present the features already indicated; a magnifying power of 70 to 80 diameters is sufficient for their search; and their presence in the faeces is almost the only sign which permits

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¹ Bonvicini. La Veterinaria, 1881; and Archives Vétérinaire, 1882, p. 114.
distomatosis to be distinguished from simple dropsy—though it has
been stated that 'Flukey' Sheep are yellow about the eyes, while the
dropsical ones are not so; that the feebleness of the latter keeps them
quiet, and that the 'bottle' is most frequently observed in the former.
But these differences are very inconstant, and when the disease pre-
vails in an epizoötic manner in a flock, the nature of the malady is at
once discovered by an autopsy of the animals which have died or been
killed.

(Beattie\(^1\)—an experienced observer—notes that if, in spring, when the
Ewes are dropping their lambs, the liquor amnii is very white, and
like thin watery bubbles, it is a bad sign; and in September, when
drafting the Ewes, he adopts the usual method of feeling the condition.
Those in which the lumbar muscles feel soft and flabby, and in which the
extremities of the lumbar transverse processes can be readily felt,
are considered unsound—they are known as 'lean on the back'; and
the impression is conveyed to the fingers of crackling, as though there
were water and bubbles below the skin—'rippling,' as it is termed.
Beattie insists that this test is of value only when applied by an ex-
perienced man, and that no one can, with absolute certainty, 'draw' a
flock tainted with 'rot.')

Prognosis.—The symptoms of distomatosis always indicate a serious
affection, as they testify to the presence of a large number of Flukes in
the liver; but that which gives a special gravity to the prognosis, is
the fact that the disease is rarely confined to a few individuals of the
flock, but generally affects all, and greatly harasses rearing operations,
as it brings Sheep prematurely to the butcher, and at a heavy deprecia-
tion in their value. We have seen above, when dealing with its etiology,
how extensive and damaging the epizoöties of distomatosis sometimes
are.

Pathological Anatomy.—The fundamental lesions are found in the
liver, the others being only a corollary. The first vary according to
the period at which the autopsy takes place, and they have been
particularly well studied by Friedberger.

1. Period of Immigration.—The first effect of the penetration of the
Flukes into the bile-ducts is inflammation (period of traumatic hepatitis,
according to Gerlach). The liver is enlarged, and contains more blood
than usual; it is friable in texture, and its surface is smooth, or marked
in places by openings the size of a pin's head to that of a millet-seed,
from which exudes a sanious fluid on pressure. There are traces of
local peritonitis, or of exudations, which cover the young Flukes; and
small hemorrhagic centres exist in the parenchyma. The bile is slightly
reddened, and the peritoneal serosity is more abundant, and often con-
tains small Flukes. The faeces do not yet contain ova.

(\(^1\) Beattie. Transactions of the Highland and Agricultural Society, III., 1807; quoted by Steel.)
2. *Period of Anaemia.*—The character of the lesions, which have been more particularly described by Friedberger, may be summed up as follows:¹

Considerable emaciation; various oëdemas; serous effusions into the natural cavities, often associated with recent blood-clots and fibrinous exudates; adhesions, especially between the liver and peritoneum; loss of transparency and thickening of the parietal serous membrane, which is easily detached from the abdominal walls; tumefaction of the mesenteric, diaphragmatic, bronchial, and intestinal glands; liver notably increased in volume, particularly in thickness. In the majority of cases, the left lobe of the liver is the first to be invaded (Falk, Schaper). The surface of the organ is covered—especially in front—with slightly adherent fibrinous exudates, beneath which are found, in some instances, a number of young Flukes 5 mm. to 8 mm. long; they are even sometimes met with in the abdominal cavity. The capsule of the liver is velvety, and rough to the touch, as well as opaque, uneven, limpy, and at times covered with calcareous concretions; the parenchyma has a porphyroid appearance, and has small subserous haemorrhagic centres and channels excavated by the worms, and containing—as a nucleus—a small Fluke from 3 mm. to 5 mm. long. Flukes are also met with beneath the serous membrane in different parts; in certain cases there are those which have their oral extremity free in the peritoneal cavity, the capsule being perforated at the corresponding points by openings similar to those observed in the first period. The gall-bladder may or may not contain Flukes, ova not being found in it except when the parasites are adult, and the bile varies in colour between green and deep violet.

The hepatic parenchyma is soft, and the thickened connective tissue slightly grates on section; the surface of the latter is of a dirty-gray, yellowish-red, or blood colour, and perforated by spaces the size of a pea, which contain one or more young Flukes in a blood-clot, or in a sanguinous fluid formed of white and red corpuscles, hepatic cells which have undergone fatty degeneration, and a finely granular detritus. The vena portae sometimes contains a stratified thrombus lodging a Fluke in its centre; or a small vessel may be found occluded by the worm, and a thrombus that extends into the vena portae. The mucous membrane of the bile-ducts is everywhere tumefied, injected, ecchymosed, and sometimes torn; the epithelium has been removed by a catarrhal desquamation, which often assumes a purulent character, and it has those of a diffused adenoma; the hyperplasia of the walls of the ducts may intrude on the surrounding tissues, and act in the manner of a destructive adenoma (Bollinger). Over the entire liver the cells are granular, and infiltrated with fat; the connective tissue is in process of proliferation.

3. Period of Wasting.—The preceding lesions become accentuated, and assume a chronic character. The emaciation is considerable, the fat having completely disappeared, or if there is any left it is soft, nearly transparent, and yellowish. Beneath the visceral pleura—above and behind—are nodules the size of a hemp-seed; erratic Flukes have produced local splenizations and haemorrhagic centres in the pulmonary parenchyma. Petechie beneath the endocardium. Borders of the liver rounded; its two lobes, but especially the left, are atrophied, and their tissue is firm, hard, and even grates beneath the scalpel. The connective-tissue hyperplasia and the cirrhosis are considerable; and section of the organ has a spongy appearance, due to cavities more or less close together. Glisson's capsule is very granular, in consequence of numerous cicatrical retractions.

The bile-ducts are the seat of a dilatation that augments from their origin towards the periphery, their diameter being about that of a finger, and they are more or less moniliform. The finest canaliculi are dilated to their end, and have there acquired the calibre of canals of the first order. Compression of the bile-ducts causes the expulsion of adult Flukes, among a brownish-green mixture. One canal, particularly in the left lobe, may contain as many as ten parasites.

(Thomas remarks that, in some of the small bile-ducts, where the ova have not been floated away by the bile, these may be present in such enormous multitudes as to form a stiff, dark-brown mass, looking like fine, wet sand, and completely occluding the duct. In the earlier stage, when the liver is gorged with blood and bile, and death is frequent from acute congestion of the organ, though no adult Flukes are present, yet careful examination on section will detect myriads of very minute young parasites, which appear on the point of the scalpel as small masses of jelly or inspissated bile. A good observer has stated that young Flukes may sometimes be found in the ducts of the liver as a thick, light-coloured liquor that appears all in motion, and an inspection of this with a pocket-lens confirms the view that the fluid is chiefly composed of the immature parasites.)

The gall-bladder contains a mucus bile of a dirty, greenish-brown hue, and adult Flukes and ova in great numbers. There are generally observed on the surface of the bile-ducts punctiform incrustations, which may be more extensive—sometimes are even tubular—formed of phosphate of lime, with traces of phosphate of magnesia. At the same time their walls are thickened, and have become cartilaginous. The liver crepitates if it is compressed or incised.

The presence of the Flukes has been regarded as the cause of the formation of biliary calculi; but only two instances in support of this view are furnished by Simonds and Brouisson, who, in such calculi, have found, the one twelve Flukes, the other only one.

(1 Bath Agricultural Society's Papers, II., p. 118.)
4. Period of Emigration of the Flukes.—At the autopsy of animals sacrificed during this period, the disappearance of the Flukes is remarked, and also the persistence of the irreparable alterations which the liver has undergone in the preceding periods.

The number of hepatic Distomes the liver may contain is very variable, and is always high when the malady is accentuated. Dupuy has counted more than 1,000 in the liver of one Sheep.

The Distoma lanceolatum never produces such serious symptoms or lesions as the Distoma hepaticum, and it alone cannot produce 'rot.' This relative innocuousness is attributed by Leuckart to its smaller size, and to the absence of prickles on the integument. Otherwise, the two species are very often found in the same host; but by reason of its minuteness the D. lanceolatum penetrates the smallest bile-duct, which the other species cannot enter. This is why its number often appears less than it really is, because its presence is sometimes not noticed. Friedberger has obtained thousands from the bile-ducts by compression—these canals were literally swarming with them; they were also found in multitudes in the gall-bladder and intestine at the time of their spontaneous emigration.

It has been attempted to assign to cirrhosis the alterations that occur in the liver, under the influence of its invasion by Flukes. But the localization of these lesions does not admit of their being allied with either hypertrophic or atrophic cirrhosis, in which they are always diffused; otherwise, the existence of ascites is sufficient to eliminate hypertrophic cirrhosis. There is, no doubt, chronic interstitial or sclerous hepatitis; but it is partial, though very dispersed.

The effusions into the serous sacs or the connective tissue should be ascribed to the cachectic state, and to the general alteration in the blood—to its deglobulization—which favours passive effusions. The obstruction to the circulation in the portal system has a large share in the production of these effusions, as there results a transudation of serum throughout all the accessory venous branches, with consequent ascites.

Anemia is also partly due to the blood extracted by the Distomes for their nourishment. Some authorities are of the opinion that the D. hepaticum lives on the bile; but Leuckart and Küchemeister are convinced that they subsist on the blood in the mucous membrane of the bile-ducts. An observation made by Railliet confirms this statement. In the liver of a Sheep, the arterial system of which had been injected with coloured plaster, he found a great number of Flukes with their digestive canal also injected with the plaster. That substance had evidently been obtained by suction from the small intact bloodvessels of the bile-ducts at the moment of injection.1

Prophylaxis.—Every effort should be made to keep Sheep away from damp pastures, where all the conditions necessary for the existence

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of the larval forms of the Distomes are present. The vigilance of the shepherd is, in this respect, the first element of success.

Thomas has formulated prophylactic prescriptions which, if adopted, would certainly go a long way in limiting the ravages of distomatosis.

1. Everything should be done to destroy or render inoffensive all the ova of Flukes, and the molluscs which serve as intermediate hosts to the Distomes. This may be effected by the following measures:
   a. Destroy the diseased Sheep, and bury them; or do not give their carcases to Dogs until they have been cooked, and only then if there is no reason to apprehend that the ova of the Flukes may pass through the intestines of these animals, to be spread by them over pastures along with their excrements.
   b. Only put on dry pastures affected Sheep intended for the butcher, as the Fluke ova they evacuate cannot develop in the absence of humidity.
   c. As Hares and Rabbits—which are sometimes bearers of Distomes—may infest pastures, they should be interdicted from access to those on which Sheep graze. But this recommendation cannot well be carried out.
   d. Drain wet pastures, or, if this cannot be accomplished, dress them with salt or lime. The latter in solution—75 per cent.—will destroy embryos of the Distomes as well as molluscs. With regard to salt, we are indebted to Perroncito for some precise notions as to its action.1 Ercolani had for a long time observed that water slightly impregnated with salt killed the Cercariae, and in acting on these and on the encysted larvæ of the Limnaea palustris, Perroncito found that in a 2 per cent. solution these parasites died in less than five minutes; in a 1 per cent. solution they rolled themselves up at the end of two to seven minutes, and perished after twenty to thirty-five minutes. The same happened in 64 per cent. solutions; and in those of 25 per cent. they were still alive after more than twenty hours. The period when salt or lime should be spread on the pastures should coincide with the time when the embryos of the Distomes and the Cercariae abound—that is, June and July for the first, and August for the second.

2. If Sheep must be placed on infested lands, the ill effects likely to result therefrom may be much reduced by the following precautions:
   a. Do not allow the animals to come too near each other while at pasture, as the closer they are the closer they graze the herbage, and it is on the parts of the plants nearest the ground, according to Thomas, that the Cercariae prefer to fix themselves.
   b. Give every day to each Sheep 7 or 8 grammes of salt, and 230 to 240 grammes of oats. The salt is fatal to the Cercariae, and favours digestion and assimilation. Perroncito recommends its being put into the drinking water; 50 per cent. does not render the water undrinkable.

We may also give, as a preventive remedy, a mixture prescribed by Veith, and composed of:

- Powdered oak-bark
- Root of calamus aromaticus
- powdered gentian-root
- powdered juniper-berries
- powdered sulphate of iron
- powdered salt

Of each 1,000 grammes.

- 500 grammes.

These substances are to be thoroughly mixed, and an ordinary spoonful given to each Sheep every two or three days.

(Salt has for ages been known in England as a most valuable preventive remedy; and long before its modus operandi was understood, the knowledge of its value was probably derived from observation of the fact that Sheep grazed on salt marshes, no matter how humid they were, did not suffer from rot.

Zundel proposed that there should be two feeding-grounds for Sheep in wet seasons, on marshy localities—one pasture for spring grazing to June, the other for autumn grazing. The first, though much infested, would not have convenient hosts for the final phases of development of the parasites, and the frosts of winter would probably free the pasture of the embryos and intermediary bearers; while the autumn pasture would not become contaminated with ova, or these would not find suitable conditions for their development.

Simonds advises the adoption of the following precautions:

The animals must be carefully guarded against all vicissitudes of weather by being folded in the best sheltered situations, more especially at night. The food should consist of a liberal supply of materials which are rich in flesh-forming principles, and which also contain a large proportion of sugar, starch, and similar ingredients, that the heat of the body may be kept up equally with nutrition. If placed on meadows or artificial grasses, the Sheep should be often changed, care being taken to avoid those pastures which are wet and cold or which contain inferior herbage. Manger food must be supplied, and this should consist, in part at least, of crushed corn, of which beans, peas, lentils, etc., are to be preferred. Oats and maize are also good, and to these a moderate allowance of oilcake may be added. Frequent changing of the food will induce the animals to eat more, for which reason, when they are on pastures, no objection is to be taken to an occasional supply of turnips or other roots; but, unless compelled by the character of the farm and the system of cultivation, continuous folding on turnips should be avoided. Where this has to be done, great care will have to be exercised in regulating the quantity of turnips, according to the condition of the crop, the state of the weather, etc. Under such circumstances, an allowance of good hay, in addition to the other food, will be imperatively required.

A good compound of these several medicinal agents, with some
highly nitrogenized alimentary matters, is contained in the following
formula: Take of finely-ground oilcake (linseed), finely-ground pea-
meal, each one bushel; finely-ground salt, finely-ground aniseed,
each 4 lb.; finely-ground sulphate of iron, 1 lb. Let the salt, aniseed
and sulphate of iron be mixed together first, and afterwards well
incorporate with the cake and peameal.

The quantity of the mixture to be given to each Sheep daily should
be half a pint to a pint, in addition to an ordinary allowance of corn
or cake and hay-chaff. It may be used with advantage for three or
four weeks in succession, but should be discontinued occasionally for a
day or two, especially if the animals become affected with diarrhoea.)

Trasbot states that branches of oak-trees, elm, hornbeam, etc., cut
in summer and dried with their leaves, are an excellent preventive if
given to the Sheep before they are driven to pasture, as well as those
of juniper or any other aromatic trees.

Treatment.—All the resources of therapeutics have been tried
against distomatosis, but no really efficacious agent for every case has
yet been discovered; this is owing to the remote location of the
Distomes, and which can scarcely be reached by any substance given
to the affected animals.

However, if, generally, a cure is not to be tried, it is usually possible
to so ameliorate their condition as to enable them to pasture and
fatten. This result is obtained by the employment of tonic and
astringent preparations, by good feeding, and especially by driving the
Sheep away from the infested pastures.

The leaves of wild chicory, tansy-roots, wormwood, pine-leaves,
spruce-leaves, walnut-leaves,1 juniper-berries, willow-bark, oak-bark,
infusion of pepper in alcoholic drinks (Teissier and Huzard), Chabert's
oil, petroleum, limewater, creosote, benzine (Bunck), picrate of potass,
liver of antimony, nux vomica (Prinz), tincture of iodine (De Romanet),
asafetida and garlic (Vallada),2 chimney-soot (Raynaud),3 etc., are
agents which have been apparently successfully employed, but most
frequently they are inconvenient.

Various salts of iron and culinary salt, dissolved in the drinking
water or mixed with the provender, have with more reason been
recommended by all authorities.

Trasbot asserts that the young dried buds of maritime pine-trees,
mixed with bran, produce really curative effects.

The experiments of Perroncito show that the ethereal extract of male
shield-fern, given with oil of turpentine, or benzine, castor-oil, wine,
etc., kills the Distomes; but it has the inconvenience of causing

2 Delafond. Rapport à la Soc. Centr. d'Agriculture; Rec. de Méd. Vétérinaire,
anaesthesia and serious tympanites, so that before it can be recommended as a safe remedy further trials are required.1

Mojkowski2 has obtained very encouraging results in treating distomatosis and teniasis in the Sheep, with naphthaline given twice a day for a week, in doses of 0.70 gramme to 1 gramme, alone or mixed with gentian powder.

In Germany, recourse is had to lupin forage, then to lupin-seeds, giving about 40 litres per day to 100 Sheep. Crushed barley, roasted malt, linseed-cake, bran, oats, boiled or grilled pods of legumes, hay of good quality, etc., are also given, as régime, because of their nutritive properties.

As remedies, bitter tonics, mixed with sulphate of iron, are utilized. The following preparations, recommended by Haubner, enjoy a certain degree of credit:

1. Sulphate of iron... 60 grammes.  
   Calamus aromatics  500 grammes.  
   Crushed oats  
   Roasted malt  
   20 litres.  
   Dose for 100 Sheep.

2. Sulphate of iron... 30 grammes.  
   Powdered juniper-berries  
   Gentian powder  
   Crushed wheat  
   500 grammes.  
   20 litres.  
   Dose for 50 Sheep.

A mixture of powdered culinary salt, 10 litres, and plaster, 5 litres, has also been recommended as a dose for 300 Sheep. It is at first given every second day, then twice a week, and gradually to every fifteen days until the end of the summer.

In France, on several occasions, Gasparin, Rey, and Roche-Lubin have employed anti-cachectic bread, which was given morning and evening to the diseased Sheep. The simplest formula is that of Delafond.

Undressed wheatmeal 1 kilogramme.  
Oatmeal 2 kilogrammes.  
Barleymeal 1 kilogramme.  
Sulphate of iron 30 grammes.  
Carbonate of soda  
Culinary salt 200 grammes.

These are made into a paste with water, which is allowed to ferment, and is then baked in an oven. Delafond says that in fifteen days this bread produced a considerable amelioration.

It would be advantageous to cook the provender, and add to it the broth of Horse-flesh.

With regard to the various tinctures that have been recommended—as of gentian, quinine, etc.—their price limits them to valuable animals, the preservation of which is of great importance.

To sum up, the resources of the pharmacy ought not to be relied upon

1 Perroncito. Il Medico Veterinario, 1887, p. 97.  
to any extent, but attention must be specially directed to the régime, which should be as strengthening as possible.

Sanitary Police and Jurisprudence.—In dealing with prophylaxis, we have mentioned the measures to be adopted in order to diminish the extension of distomatosis.

The flesh of cachectic Sheep is soft and blanched, and yields insipid broth, wasting much in cooking; when roasted its juice is pale and scarcely rose-tinted, and it never bleeds, no matter how underdone it may be. In fact, it contains but little nutriment, is of the third quality, and should only be allowed for human consumption during the two first periods of the disease; later it should be refused.

Distomatosis is classed among the vices rédhibitoires in Germany, Austria, and Switzerland. The period to which legal process is limited is 14 days in Bavaria, Grand-Duchy of Baden, Hohenzollern and Wurtemberg; 28 days in Hesse, 30 in Saxony, 2 months in Austria, 14 days in Thurgovia, 15 in Bâle, 31 at Schaffhausen, and 12 at Frankfort-on-the Main (Friedberger and Fröhner).

DISTOMATOSIS IN CATTLE.—Distomatosis in bovine animals is manifested by symptoms quite analogous to those observed in Sheep. But they often pass unperceived, because of their less intensity and the stronger resisting power of the larger Ruminants. The coat is dull and staring, the skin tight and adherent, the appetite capricious or nil, and rumination is suspended; constipation alternates with diarrhœa, and the urine becomes acid. Serious symptoms only appear later, and the malady rarely terminates in death; when it does, the animals succumb to profound marasmus, extreme emaciation, continuous diarrhœa, and a complete consumption. The duration of the disease is from two to five months. The lesions are those noted in Sheep. The bile-ducts may attain the diameter of an inch, and the liver, consequently, has a vesicular appearance. In the slaughter-house very important hepatic lesions are found in animals which, during life, did not show any sign of such alterations.

Treatment demands the same prophylactic and curative measures as for Sheep suffering from distomatosis.

DISTOMATOSIS OF THE GUINEA-PIG.—Del Chiappa has found, in the biliary ducts of a Guinea-pig, two specimens of a species of Distome that Sousino has provisionally named Distoma cavice. Its branched intestine places it in the sub-genus Cladocœlœm (see p. 322). After being kept a long time in alcohol, one measured 12 mm. long and 9 mm. broad, the other 8 mm. by 6 mm. They resembled the D. hepaticum, of which they were perhaps only young specimens.1

(DISTOMATOSIS OF THE CAMEL AND ELEPHANT.—Cobbold states that D. hepaticum is found in the Camel, but distomatosis must be rare in that animal. This authority also asserts, in treating of the Fluke, that

1 Sousino. Studi e Notizie Elmintologiche. Soc. Toscana di Scienza Naturali, May 4, 1890.
the Elephant is often seriously infested. 'As causing disease, and zoologically speaking, this entozoon is the most important of the whole group of parasites infesting Elephants.' Not much appears to be known of the parasite. It is described as closely allied to the *D. hepaticum* of the Sheep, but rounder in outline and otherwise differing to such an extent as, in the opinion of Cobbold, to warrant its being classed as a distinct species—*Fasciola Jacksoni* Cobb.

It accumulates in the bile-ducts to such an extent as to seriously debilitate the host, profoundly alter the liver—as in the Sheep—and frequently causes death. Much loss among Elephants from this Fluke has occurred in our Indian possessions, and especially in Burmah. 'There is every likelihood that the mollusc harbouring the Cercaria larva of *Fasciola Jacksoni* is small, and possessed of amphibious habits.'—Cobbold.)

2. DISTOMATOSIS IN THE CARNIVORA.

On several occasions, the presence of Distomes in the biliary canals of the Dog and Cat has been recorded.

Van Tricht classed with the *Distoma lanceolatum* those which he discovered in the Dog, and Leuckart cites the Cat among the hosts which harbour that parasite;1 but it is possible that these cases should be classed as belonging to one of the two following species, which are included in the sub-genus *Dicromocercalis*.

1. *Distoma truncatum* (Rud., *D. Conus Creplin, D. conjunctum* Cobb., *D. felineum* Riv., *D. campanulatum* Fric.).2—Sonsino has demonstrated that the Distomes of the Dog and Cat, described under these different names, belong to one species—a worm, the maximum length of which is 7 mm., and breadth 2 mm. Body reddish in the fresh state, depressed, covered—at least, when very young—with very small spines that are easily shed; anterior part conical, and distinct from the rest of the body from the ventral sucker, which is a little smaller than the oral one. Intestine divided into two simple ceca, which are prolonged to the posterior extremity. Genital openings in front of the ventral

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sucker. Testicles more or less lobulated, situated one behind the other at the posterior part of the body. Ovary lobular, situated on the median line, at the posterior third of the body. Vitello-genes short, occupying the middle third of the body, and formed of seven glomerules on the left, and eight on the right side. Ova operculated, with a small, acute prominence at the pole opposite the operculum; their length is 26 μ to 30 μ, and width from 12 μ to 15 μ.

This Distome was first found in the Greenland Seal (Otto and Rudolph), then in the Cat (Creplin, Rivolta, Zwaardemaker, Generali), Dog (Ercolani, Rivolta, Zwaardemaker, De Jong, Sonsino), American Fox (Cobbold), Indian Pariah Dogs (Lewis). It is frequent in Holland and in India. It lodges itself in the bile-duets and gall-bladder, and gives rise to a cirrhosis that has been studied by Zwaardemaker, and which we have also observed in the Cat.

At the commencement, the presence of the Distome irritates the walls of the bile-duets, and occasions a series of pisiform dilatations of the finest canals and those of medium calibre; at the same time their walls become thickened, owing to the proliferation of the surrounding connective tissue; hence there results a shell of connective tissue enveloping the parasite, in a portion of the bile-duet from which the epithelium has disappeared. These connective-tissue nodules lodge a Distome, which may attain a size of several millimetres. Later, in the spaces between the hepatic lobules appear connective-tissue fibres surrounding the ramifications of the vena porta. The central or intralobular veins have also a similar fibrous sheath. Under the increasing pressure of this neoform connective tissue, the hepatic cells diminish in size, and the parenchyma becomes atrophied at the periphery and centre of the lobule. This parasitic cirrhosis is, therefore, at the same time an intra- and inter-lobular process. One of the Dogs observed by Zwaardemaker during its life had very marked ascites, accompanied by general debility, but there was no icterus; three litres of fluid were withdrawn from the abdomen.

2. Distoma sinense (Cobb., D. spathulatum Leuckart).—A worm 10 mm. to 13 mm. long, and 2 mm. to 3 mm. broad, flat, almost transparent in the fresh state, and with a smooth integument. It differs from the preceding species chiefly by the form of its testicles, which are constituted by a small number of slightly ramifying tubes. Ova elliptical, with brown shell, and measuring 28 μ to 30 μ long, and 16 μ to 17 μ broad.

This species is special to China and Japan, and it is also a parasite of the bile-duets of Man. Ijima has often met with it in the liver of the Cat, and he states that this animal also harbours a smaller species, the skin of which has fine spines; but it appears to be the D. truncatum.¹

¹ Ijima. Journ. of the College of Science. Imperial University of Japan, I., 1886, p. 47.
CHAPTER V.

PARASITES OF THE PANCREAS AND SPLEEN.

Pancreas.—The pancreas is very rarely invaded by parasites; but Echinococci and the agamous *Sclerostoma armatum* have been found in it, though the health of the animals had not been affected thereby (Florman, Goubaux, Liénaux, Montané).

Spleen.—The parasites of the spleen are not common. They are the Linguatules in the Dog, Cysticerci in the Pig, and Echinococci in animals capable of harbouring them—Ox, Pig, and Sheep. Ostertag has found in the spleen of a Cow an old multilocular Echinococcus, partly calcified, and surrounded by a fibrous capsule. In the spleen of a Horse, Dieckerhoff met with a sterile hydatid the size of a Canary's egg, but there was no other lesion;¹ while, in the spleen of a Cow, Lucet observed a cyst containing an adult living *Distoma hepaticum*.

BOOK III.

PARASITES OF THE SEROUS MEMBRANES.

This book will only treat of the animal parasites of the peritoneum, pleura, and pericardium, which are, however, often of the same species; those of the arachnoid will be dealt with when we consider the diseases of the cerebro-spinal axis; the synovial serous membranes have not yet been recorded as the seat of parasites.

The three large serous membranes which we have mentioned, closely adjoin each other, and it is therefore advantageous to examine the parasites they may contain, as the majority of them arrive through the abdominal digestive organs, which they first traverse in order to reach their selected location.

These parasites are relatively rare, and come from a small number of species belonging to the Cestodes, Trematodes, and Nematodes.

Equide.—Erratic Echinococci may be met with in the pleura and peritoneum of the Horse. Liénaux has published a remarkable case of echinococcus of the pleura and lungs of a Horse; nearly the whole surface of the membrane was covered with Echinococci.¹

Railliet has found in the mesentry of a Horse, some cysts containing the Sclerostoma equinum in an agamous state (see p. 397), and Kitt has collected adult Sclerostomes in the peritoneal cavity of two horses.²

Cysticercus fistularis Rud.—Rudolphi gave this name to a Cysticercus that Chabert found in the peritoneum of a horse, and several specimens of which were preserved in the museum of the Alfort Veterinary College, but are not there now. Some years afterwards, the same parasite was found at the Berlin Veterinary School by Reckleben.

The entire worm is an elongated oval, broader behind than in front, and 7 cm. to 13 cm. long, by 12 mm. to 14 mm. at its widest part. The head is small, tetragonal, suckers little developed, and carries a double crown of hooks.

Filaria equina (Abildgaard, F. papillosa Rud.).—Body long, filiform, white, attenuated at both ends, and especially behind. Mouth small,

and provided with a chitinous infundibuliform ring, the border of which is divided into four rounded and salient papillae; outside this ring are other four sub-median papillae, in the form of spinules. 

*Male* 6 cm. to 8 cm. long; tail curved in a spiral manner, and having eight papillae on each side, of which there are four pre-anal and four post-anal; two unequal spicula enveloped in a transparent sheath. 

*Female* 9 cm. to 15 cm. long; tail slightly spiral, and terminated by a papilla preceded by two others. Vulva situated near the anterior extremity. Ovoviviparous.

This Filaria is frequently met with in the peritoneal cavity, more rarely in that of the pleura of the Horse, the Ass, and Mule, and principally in cachectic animals. Usually only a few are found at a time, and the females are more numerous than the males; but occasionally they occur in large numbers, and Menges asserts that he collected as many in the thoracic cavity of a Horse as would fill a basket. The lungs were transformed into a vast purulent cavity. This observation is quite exceptional, if it is not erroneous; for the pleural and peritoneal membranes themselves ordinarily appear to be indifferent to the presence of Filariae.

(Macgillivray, of Banff, in a letter, informs me that not long ago he was castrating a year-old Clydesdale colt, and in opening the right scrotal sac, along with a large quantity of fluid, there escaped thirty-five worms, of from 1 inch to 1½ inches long, all alive and lively; and from the left sac there emerged twenty-one worms of the same kind. They had evidently descended from the abdominal cavity. About a fortnight after castration the colt died of hydrops abdominalis, and in the abdominal cavity were found thousands of these worms crawling about on the surface of the viscera. From his description I
infer they were the *F. papillosa*. Steel\(^1\) writes: 'The frequency of enlarged testis and oedematous cord among Arab and Persian Horses is a notorious fact, and possibly is in association—as due to the same irritant influence—with relaxed abdominal rings, and consequent inguinal and scrotal herniae-lesions also—very familiar among imported horses in Western India. My colleague, Veterinary-Surgeon Pottenger, fully confirms my observations as to the dependence on—or, at any rate, association with—big testicle and dropsical cord, often Filaria papillosa. Almost invariably on incision into the scrotum in hydrocele, sarcocoele, and cases of adhesions of the testis to the scrotum, one or more specimens of the thread-worms in question wriggle through the incision, or come away with the hydrocele fluid. A bay Gulf-Arab entire Horse, four years old, was admitted into the hospital associated with the Bombay Veterinary College, for treatment of debility of unascertainable origin but extreme degree. The animal was so reduced in condition that it apparently could not long survive admission; but it continued to feed freely for a month or so before it succumbed. No amount of iron, linseed-oil, or other tonics seemed to have any effect in strengthening the patient. Its food seemed well digested; its visible mucous membranes were uniformly of an extreme pallor, coat unthrifty, and appearance such that he used to be pointed out to visitors as a remarkable instance of extreme emaciation, and called the "Anatomical Horse," on account of his value for demonstrating osteology. A very faint yellow tinge of the conjunctiva led us to think there might be some liver derangement, but the evidences of this were anything but satisfactory. Finally, the animal fell in the stall during the night, remained recumbent for a couple of days, and after a short period of delirium expired. Autopsy showed merely the liver small and of a yellow colour, an enormous number of Filaria papillosa in the peritoneal sac, and softening of the bones, so that the ileum of the side on which the animal fell shortly before death was broken through its blade. Subsequent examination of the bones after maceration showed that they were like pasteboard in consistency. The enormous number of parasites in the abdomen led me to surmise that they were the producers of the anaemia, debility, and mollities ossium, but this view would be difficult to establish conclusively. The animal had been in Bombay for about one year, and had never been in saleable condition after import from the Persian Gulf. Filaria papillosa is almost invariably found in the abdomen of working Oxen in Bombay.')

This Nematode has been observed also in the arachnoideal space, in the sub-peritoneal connective tissue, and in the substance of the diaphragm. To this species belong the Filariae found in the interior of the eye. Baruchello has also attributed to them the cutaneous

helminthiasis of the Horse already referred to (p. 261). The course by
which the Filarias of the Horse find their way to their final locality is
not known.

Ruminants.—Independently of the Echinococci, there are often
found in the peritoneum of various Ruminants—and, in particular, the
Ox, Sheep, Goat, Camel, and Reindeer—the Cysticercus of the *Taenia
marginata* of the Dog—the *Cysticercus tenuicollis* Rud. It is rarely
met with in the pleura or pericardium.

The *Cysticercus tenuicollis* has an elliptical caudal vesicle from
15 mm. to 50 mm. long, and is often as large as a Pigeon’s egg. The
head is similar to that of the *Taenia marginata* (see p. 441), and is invaginated
at the bottom of a slit observed at the free extremity of the scolex, which is
from 14 mm. to 30 mm. long, and plicated transversely.

Known by the butchers by the name of *Water-ball*, this Cysticercus may be
found in varying numbers and sizes in animals slaughtered in the abbatoirs. It
does not appear to cause any disturbance of health—at least, in the majority of
cases. Its action is limited to the formation of the cyst that lodges it. Never-
theless, we have seen that (p. 497) in his experiments to establish that the *C.
tenuicollis* in the cystic form of *Taenia marginata* of the Dog, Baillet produced
in Lambs and Kids grave—sometimes fatal—lesions. These experi-
ments show that the ova of this *Taenia* reach the intestines with the
food and water, and that the majority of the embryos attain the
peritoneal cavity in passing through the liver. On the tenth day
after infestation, in fact, the liver is found traced on its surface and in
its substance by sinuous galleries, each occupied by a small blood-clot,
and one, two, or three vesicles (or *bladders*) of 5 mm. to 3.5 mm. in
diameter. The head only begins to appear towards the twenty-fifth
day; it is well formed about the fortieth day, and in about the seventh
to the eighth mouth the Cysticerci are completely developed. Certain
experimental animals succumbed to a diffused haemorrhagic hepatitis,
or to peritonitis. We have also seen that similar occurrences were
observed in Pigs under ordinary conditions—by Leuckart and by
Boudeaud, and in the Cow by Pütz.

On the other hand, Fromage de Feugré has collected the *Cyst. tenui-
collis* in the liver of a Sheep, and we have also met with it in the
muscles of this animal (see *Pseudo-Measles in Sheep*). (I have found
this Cysticercus in the subcutaneous connective tissue and the superficial muscles of a lamb that had died from Filariae in the air-passages.)

As the Cysticercus tenuicollis very rarely produces serious alterations, we need scarcely occupy ourselves with the prophylaxis to be opposed to it, further than to say that it would be useful to suppress the original cause—the Taenia marginata—by preventing Dogs having access to viscera infested with T. tenuicollis.

Morot has found a cystic tumour containing a Distoma hepaticum, on the inner surface of the abdominal wall of a Cow.²

Filaria of the Ox (Filaria cervina Duj., F. labiato-papillosa Alessandrini, F. terebra Dies.).—Alessandrini was the first to distinguish this Filaria from that of the Horse, and Baillet has shown that it belongs to the same species as that of the Deer. It much resembles

— Cephalic extremity of the Fig. 289.—Caudal extremity of the female
Filaria cervina; magnified 150 diameters.
Filaria cervina; magnified 150 diameters.

that of the Horse, from which it differs, however, by the absence of the four posterior—submedian—papillae around the mouth, by having no integumentary strie, and by the caudal papilla of the female, which terminate in a fasciculus of small blunt points, preceded by two thick conical lateral papillae. The length of the male is 5 cm. to 6 cm., and of the female 6 cm. to 10 cm. It is ovoviviparous.

This Filaria is sometimes met with in the peritoneum of Cattle, but no pathological effects have been attributed to it. The Filaria described by some veterinary surgeons as found in the eye of the Ox, is considered as belonging to this species.

Fig.—Besides the Echinococci, the Cysticercus tenuicollis and Stephanurus dentatus have been found in the peritoneal cavity of this animal.

Cysticercus tenuicollis.—This parasite occupies the same habitat in the Pig as it does in Ruminants—that is, the peritoneal folds; but it may also localize itself in the liver, a remarkable instance of this occurrence in the Pig having been given by Semmer (see p. 497). In the Pig, this Cysticercus may also exceptionally follow the example of the C. cellulosae, in occupying the muscular portion of the diaphragm.

Stephanurus dentatus (Dies.).—The Stephanures are Nematodes

belonging to the family of Strongylides (see p. 325), related to the Sclerostomes (see p. 385), but differing from them by the body being attenuated in front, the presence of a single spicule, and a multilobular sac in the males. The only species known is the S. dentatus.

The mouth is terminal and orbicular, with six very small teeth, of which the two opposed are the strongest. The male is 22 mm. to 30 mm. long, the female being 30 mm. to 40 mm.

Natterer was the first to find this worm in Brazil, in cysts of the mesentery of a Chinese Pig. White found it in the United States, where it appears to be very common, and Verrill has described it under the name of Sclerostoma pinguicola. Cobbold also reported its existence in Australia, and stated that it was met with in the abdominal viscera, especially in the adipose tissue surrounding them. No doubt, a more than exaggerated rôle has been attributed to it in the development of the diseases which have destroyed so many Pigs in the United States during some recent years, and which the Americans have qualified as mysterious disease, or Hog-cholera (Railliet).

However, Lutz has observed peri-

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Fig. 290.—Fragment of the mesentery of a Rabbit invaded by the Cysticercus pisisformis; natural size.—Railliet.

Fig. 291.—Section of the completely developed Cysticercus pisisformis; magnified 15 diameters. The head is invaginated, and is succeeded by a long portion that passes nearly entire in the adult state.

—Moniez.*

* d, a constant depression at the posterior part of the Cysticercus, due to atrophy of a portion of the body at the preceding stage (represented in Fig. 290); vs, section of vessels in the vesicle or bladder; vs', section of the vessels where they anastomose; vesc, vesicle; p, papillae; ct, cuticle; sc, subcuticular layer; cc, calcareous corpuscles; ml, longitudinal muscular fibres; mt, transverse muscular fibres; r, suckers; bb, cephalic bulb.

(1 Cobbold. The Internal Parasites of our Domesticated Animals, 1873, p. 119.)

'Decidedly one of the most important parasites of Swine is the Stephanurus dentatus, or, as we may call it, the crown-tailed Strongle. From specimens of a worm forwarded to me by Dr. Fletcher, of Indiana, I had the satisfaction of identifying its true character. When first discovered in the United States, it was supposed to be new to science, and was accordingly described by Professor Verrill under the name of Sclerostoma pinguicola. Strange to say, I also shortly afterwards detected this parasite among a batch of worms sent for identification from Australia; so that it appears quite certain that the geographical range of this parasite is co-extensive with that of the hog in its domesticated state. At present, however, it has not been seen in Europe. . . . Thousands of hogs are infested by this Nematode, which takes up its abode in the abdominal viscera, and especially in the fatty tissues surrounding these organs.')
toneal effusions and fistulous indurations around the kidneys where it has been met with.  

**Rabbit.**—The *Cysticercus pisiformis* Zeder—the cystic form of the *Tænia serrata* of the Dog—is the most common parasite in the peritoneum of the Rabbit. We have already seen (pp. 440, 497) the phases through which it passes in traversing the liver, before reaching the peritoneum, where, when it has arrived, it excites the formation of the cyst that envelops it, and appears as a small bladder full of fluid, and about the size of a pea. It is sometimes found in such numbers as to resemble clusters of grapes. On the surface of each bladder is noticed a white spot; this is the scolex invaginated in the interior of the vesicle, from which it is easy to evaginate it. The head has all the characters of that of *T. servala*.

There ought to be classed with this species, the *Cyst. elongatus*, described and figured under this name by Leuckart. Its distinctive feature is the great length of its vesicle. It is usually encysted in the pelvic peritoneum. But whatever Leuckart may say, it does not appear to be different, in the number and character of its hooks, from *Cyst. pisiformis*.

It is also probable that—as Diesing remarks—the parasite found by Kuhn in the peritoneum of the Rabbit, and named by him *Monostoma leporis*, is the *Cysticercus pisiformis*.

There are sometimes found—and especially in wild Rabbits—*Cysticerci pisiformes* which have left their cysts, and are sometimes even evaginated and have begun to develop their segments. Mégnin has imagined that these worms, in passing into the intestine, are transformed into *T. pectinata*; but there is no proof in support of this, and our personal experience does not concord with these indications' (Railliet).

**Dog and Cat.**—The large serous cavities of the Dog and Cat rarely lodge parasites. Up to the present time there only have been found Cestodes in the larval form—the *Plerocercoides Bailleti* and Echinococci, the giant Eustrongles, the *Linguatula denticulata*, and an undetermined Pentastome.

**Plerocercoides—Cysticercus—Bailleti** (Raill.).—Body very extensible and contractile, and narrow; it may measure 105 mm. long, but usually does not exceed 1 cm. to 2 cm. The anterior part—which is 1·5 mm. to 3 mm.—is of an opaque white, irregularly plicated, and shows at its summit a longitudinal slit—the invagination opening. The head—very difficult to evaginate—is irregularly globular, and has neither rostellum nor hooks, but is provided with four elliptical and usually dark-coloured suckers, measuring 5 mm. to 6 mm. in diameter. The anterior portion is succeeded by a narrower distended part in the form of a tail scarcely attenuated behind, where it is about 1 mm. broad. In small specimens this tail is very short, and they are cordiform because of the anterior slit. The whole body is full of calcareous corpuscles. This Cystic maintains its movements for a long time in

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tep1d water—even when the autopsy has been made forty-eight hours after the death of its host, it will be found alive and moving.

Baillet has named this Cystic, which had been hitherto nameless, *Cysticercus Bailleti*, as Baillet was the first to find it in the Cat and Dog. It appears to us to belong to the Plerocercoides of Braun, which includes the larval form of the Bothriocephales. Several of the *Piestocystis* of Diesing—and particularly *P. maris* and *P. taxi*—are probably only this Plerocercoid; and we believe it to be the same with regard to the *Cysticercus cordatus* Tschudi, found in the peritoneal cavity and liver of the Pole-cat. Blumberg gave the name of *Cysticercus elongatus* to these parasites found in the Dog and Cat; but this had to be withdrawn, as it had already been applied to the form of the *Cyst. pisi-formis* of the Rabbit.

Baillet¹ has met with these parasites in two Cats: in one case 21 were found in the peritoneal cavity, and in the other 80 were discovered in the pleural sacs. He also found 12 young specimens in the peritoneum of a Rat. Blumberg² described them anew, and figured them; he met with a small number in the pleura of one Cat, a considerable quantity in the peritoneum of another, and about 100 in the pleura and peritoneum of a Dog. Our colleague, Labat, has had occasion to observe these parasites in a Dog affected with Ascites; the fluid extracted by paracentesis contained a certain number of great size, and at the autopsy a considerable quantity were found encysted in the peritoneum, the large omentum, and the lungs. In 19 of 76 Cats, we have found them in the pleurae or peritoneum, or in both together; in 14 there were only one, two or three; once there were six, once twelve, and in three others they were in very large number in the pleurae and peritoneum. In two of the cases in which they were numerous, many of them—not yet having grown larger than a

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millet-seed—were lodged in the texture of the great omentum, in the interior of cysts varying in colour from yellow to brick-red. These cysts contained from one to seven, and they were nearly all situated on the course of the omental vessels. It might therefore be supposed that, before being set free in the serous cavity, these parasites are at first encysted in the substance of the membrane, and that they are probably brought there from the stomach or intestine by the blood-circulation.

We have found 6 young Plerocercoids in the peritoneal cavity of an Ichneumon (Herpestes Ichneumon), 4 in the same cavity of a Pole-cat; and a great number in that and the pleural cavities, as well as beneath the visceral serous membrane of the liver and lungs, of a Fox.

**Echinococci.**—Three instances are known of Echinococci in the peritoneal cavity of Dogs, and in each of these the animal was considered dropsical.

The first is due to J. Hartmann, who, in 1694, found in the peritoneum of a Dog such a large number of hydatids, as to fill several plates with them. Their volume varied from that of a pea to a hen’s egg; some were free, others adhered to the peritoneum and to all the organs it covered; the liver alone was penetrated by them, but these were generally of small size. Although Hartmann mistook the nature of these hydatids, yet this cannot be doubtful when the two following instances are considered.

The second published observation belongs to Reimann. The majority of the Echinococci varied in size, from that of a hazel-nut to a small hen’s egg; the smallest was as big as a pea, the largest as voluminous as a man’s fist. They belonged to simple types—endogenous and exogenous—the latter predominating. The scolecites were abundant; but there were, nevertheless, many acephalocysts. The hydatids were spread over the whole of the peritoneal cavity, even into the pelvic cavity and the vaginal sac around the testicles; but there were none on the parietal or visceral serous membranes, nor yet in the interior of the abdominal organs. Those which were not free adhered to the mesentery or omentum. Their quantity was considerable, and they weighed about 8,872 grammes, of which 6,672 were made up of free Echinococci from the peritoneal cavity, and these were six litres by measure. The total number was estimated at 3,000. The parietal serous membrane was inflamed in places.

The third case occurred in our own experience in 1883. With the exception of three large vesicles, the size of a hazel to a walnut, all had a volume varying from that of a pin’s head to that of a pea; in this respect they approached the type of the multilocular Echinococcus. Our persevering search could not enable us to discover a single head, and it is known that they are somewhat rare in the multilocular Echinococci. Nearly all the hydatids belonged to the exogenous type; and they measured, with the clear fluid in which they were suspended, between 4 and 5 litres. It was not possible to count them,

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but there were certainly more than 100,000. Besides filling the peritoneal cavity, they adhered here and there on different parts of its surface; and they were also found in the middle lobe of the liver—which was full of them—and in the omental fixture of the spleen. There was general chronic peritonitis.

These three observations are remarkable for the enormous quantity of hydatids found in each; and in this respect they have some analogy with that of Anel, having reference to a dropsical Man. The small size of the vesicles, their great number, and the absence of scoleces, class them with the multilocular Echinococci.

With regard to the origin of these Echinococci of the Dog, this is inexplicable. In the two last observations—and probably in the first—the Dogs did not harbour the *Taenia echinococcus* in their intestines; but as they might have been bearers of it previously, and it had been eliminated, there is reason to ask if exceptional auto-infestation had not taken place by one or more *Taenia*, the embryos of which could pass spontaneously through the intestinal wall, or be favoured by some primary lesion; for in the spleen of our Dog there was found a sewing needle, that had probably come from the intestine. In order to verify this hypothesis, we have on several occasions introduced living and mature *Taenia echinococcus* into the peritoneal cavity of a number of Dogs, but with negative results. This might have been anticipated, as the ova had not previously undergone the erosive action of the gastric juice, which is necessary in order to set the embryos free.

**Linguatules.**—In each of two Cats, we have met with a free larval Linguatule (*Linguatula denticulata*) in the peritoneal cavity.

**Pentastomes.**—Bochefontaine has found in an experimental Dog, in apparent good condition, thousands of free agamous Pentastomes in the peritoneal cavity, or lodged in cysts on the hepatic peritoneum, or in the mesentery; each cyst only contained one parasite. These larvae were 16 mm. long and 2 mm. to 3 mm. broad; they were white, cylindrical, moniliform, the extremities being rounded, about equal, but a little attenuated behind. Mégnin considered them—but without sufficient cause—as belonging to the *Pentastoma moniliforme* Dies., which, in the adult state, is only found in the lung of the striped Python.

**BIRDS.**—Baillet found in the peritoneal cavity of a Fowl, three Cysticerci the size of a millet-seed, each of them being isolated in a cyst. The head had four suckers, but no proboscis or hooks.

The *Filaria cygni* Rud., found by Redi, has been already studied in dealing with the intestinal helminths of the Swan (p. 494).

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BOOK IV.

PARASITES OF THE RESPIRATORY APPARATUS.

Parasitism of the respiratory organs is very frequent. Their wide, constant, and necessary communication with the atmosphere, permits the innumerable germs floating about in it to penetrate to their inmost recesses. Parasites, in the larval condition and of very small dimensions, may also find their way into them during the prehension of food and drinking of water—agents which afford these minute creatures shelter, or serve as transitory vehicles. They enter by the nostrils or the mouth, utilizing the communication of the latter cavity with the vestibule of the air-passages.

Parasites may also arrive at the lungs by travelling from the stomach or intestines, which at certain points they can only do by boring through the walls of these, and passing through the diaphragm and the serous membranes covering it. Perhaps they may also reach the respiratory organs in being carried passively by the blood, in those vessels which they meet with during their active migrations. The air in the breathing apparatus constitutes one of the conditions that determine the habitat of several of these parasites.

In consequence of their great sensitiveness, the respiratory organs are not very indifferent to the presence of parasites, which usually betray their existence in them by well-marked symptoms, which are furnished by the semeiology proper to these organs. The disturbances that ensue in the respiration are sometimes so serious as to jeopardize the health of the host; but they otherwise vary according to whether the parasites are lodged at the commencement or in the depths of this apparatus.
A.—DOMESTICATED MAMMALIA.

CHAPTER I.

PARASITES OF THE NASAL CAVITIES AND LARYNX.

We have already seen (p. 331) that the *Hemopis*, which prefers the hard and soft palate and pharynx of the Horse, may also be found in the nasal cavities and entrance to the larynx. We have also noted (p. 355) that when the larvae of the *Gastrophiles* become fixed on the margin of the epiglottis, or the vicinity of the larynx, of the Horse, they occasion very frequent fits of coughing that may terminate in asphyxia. Zürn has remarked that the malignant and contagious fever of Rabbits, and which determines a rhinitis that is often fatal, is due to the *Coccidia* that are observed in innumerable quantities in the mucous membrane of the nose, pharynx, and tympanum of the ear, as well as in the secretions of these. 1

Beyond the more or less exceptional cases, the parasites proper to the nasal cavities are the *Linguatula* of the Dog and the Larve of the *Estres* of the Sheep. (There are also the larval *Estres* of the Camel.)

**Article I.—Linguatulae.**

The *Linguatula* are the most interesting type of the order of *Linguatulide*, which is thus characterized:

Endoparasitic *Arachnidae*, with an elongated, vermiform, and annulated body. Mouth destitute of jaws in the adult, and surrounded by two pair of hooks representing rudimentary legs. No heart. Respiration cutaneous.

This order only comprises the two genera, *Pentastoma* and *Linguatula*, separated by Railliet, 2 and already indicated by Leuckart 3 as sub-genera. Their characters are as follows:

Pentastome (*Pentastoma* Rud.).—Body cylindroid, with continuous cavity. This genus has no representative in the domesticated animals, unless it be a larval form once found in the peritoneum of a Dog.

**Linguatula** (*Linguatula* Frölich).—Body depressed, dorsal surface rounded, borders crenellated, the cavity of the body forming diver- ticuli in the lateral parts of the rings or segments.

The species which the domesticated animals harbour is very often named, in the adult state, *Linguatula tænioides*.

**Linguatula tænioides** (*Linguatula rhinaria* Pilger, *Pentastoma tænioides* Rud.).—Body white, lanceolated, very elongated, vermiform, flattened above and below, the ventral surface nearly plane, the dorsal surface rounded; anterior extremity broad and rounded; posterior ex-
and are moved by muscular cords arranged in different directions. Mouth sub-quadrangular, and rounded at the angles; digestive tube simple and rectilinear; anus terminal. Male white, 18 mm. to 20 mm. long, 3 mm. broad in front, 5 mm. behind, and provided with two saciform testicles, which occupy the posterior three-fourths of the cavity of the body. Female grayish-white, often rendered brown by the ova placed along the middle line, where the integument is thin and semi-transparent; from 8 cm. to 10 cm. long, 8 mm. to 10 mm. broad in front, and 2 mm. behind. Eggs ovoid, 90 μ long and 70 μ broad.

The nervous system is composed of a sub-cesophageal ganglion, the two lobes of which are united by a commissure passing above the cesophagus, and completing the cesophageal ring. It gives off three or four filaments that go to the cephalo-thoracic organs, and two long cords parallel to the intestine. There are no sensory organs, though Leuckart has described, as tactile organs, scarcely visible appendages situated at the anterior border of the cephalo-thorax. Organs of circulation and respiration are also absent.

History.1—Davaine states that the Linguatula tenuioides was met with for the first time by Wrisberg, in 1763, in the frontal sinuses of a Dog. In 1787, Chabert saw it in the frontal sinuses of the Horse and Dog. Since that time numerous observers have found it in the Dog. It was noticed in the nasal cavity of a Mule by Greve, at Oldenburg, in 1818; in the Wolf by Bremer, at Vienna, 1824; Colin at Auxerre, in the same year; Miram at Wilna, in 1836; in the Fox by Moniez; in the Sheep by Rhind in Scotland; in the Goat by Bruckmiller, in Austria; in the Horse by Chabert and Leblanc, in France, and by Rose in England; and in Man by Laudon, in Germany, in 1878.

Wrisberg classed this species with the leeches; Chabert named it the Tænia lanceolatum or Ver rhinaire, which Pilger transformed into Tænia rhinaria. Rudolphi at first called it Prionoderma rhinarium, then Polystoma tenuioides, and finally Pentastoma tenuioides. It is to Lamarck that we owe the denomination of Linguatula tenuioides, which Cuvier—who had at first adopted the name of Prionoderma lanceolata—accepted definitively. (Raillet).

The first of these denominations indicates that these creatures were for a long time classed among the worms. In 1849, P. J. van Beneden demonstrated, by the study of embryogeny, that they were degraded Arthropodes—an idea already promulgated by Schübert and Dujardin. With regard to the class to which they should be relegated, there has been long hesitation between the Crustaceans and the Arachnidae. But it is now almost universally recognised that they are degraded Arachnidae, allied to the Acarina, and in particular to the Demodes. The Linguatules seem rather to be Acarina which—by the fact of their parasitism—have undergone a regressive metamorphosis.

For a long time nothing was known of the phases through which they must pass before attaining their adult state, in which they were at first known.

Nevertheless, from 1789, the larval form had been seen on the surface of the liver of a le-Goat by Abilgaard, in an American Goat by

Flormann, and in the lungs of a Hare by Frölich. At a later period—
1811—Legallois found it in the lungs of a Guinea-pig; in 1829, Crepin
discovered it in the liver of a cat; in 1825, Hermann met with it in the
lungs of an Ox, Otto in those of a Porcupine, and Dujardin in those of
a Guinea-pig in 1838. The nature of these larve was not at first
recognised, and therefore they received very different names. Rudolph
first, and then Frölich, pronounced them to be Linguatules or Pentas-
tomes. That of the Goat became Pentastoma denticulatum Rud., that
of the Hare P. serratum Frölich, that of the Guinea-pig P. emargina-
tum, etc., until Diesing, having had occasion to compare these pre-
tended diverse forms with each other, recognised their perfect identity,
and they were then classed together by the name of P. denticulatum.
Since then, this parasite has been found in the lungs of the Rabbit by
Kauffmann in 1847; and in 1854 by Kichenmeister, in the liver, kidneys,
and submucous connective tissue of the small intestine of Man, in the
mesenteric glands of the Sheep, and, lastly, in various animals, such as
the Cat, Horse, Camel, Antelope, Fallow-deer, brown Rat, etc. The
Pentastoma denticulatum has been reported as existing in the various
countries of Europe.

Gurlt suspected its relations to the Linguatula tenuioides, but
Leuckart was the first to give experimental proof of this. Having
found in a Rabbit some of the Linguatula denticulatum, he introduced
them into the nose of several Dogs, and they became developed into
the Linguatula tenuioides. Inversely, he gave Rabbits the ova of adult
Linguatules, and afterwards found numbers of the Linguatula den-
ticulatum in their organs. He closely studied them in their phases of
development, and gave a tableau of these in the remarkable work
already referred to.

Soon afterwards Colin, of Alfort\(^1\), observed the frequency of the
Linguatula denticulatum in the mesenteric glands of the Sheep, Goat,
Ox, and Dromedary; and resuming the experiments of Leuckart, con-
firmed their correctness, and completed our knowledge of the parasite.
Gerlach, in Germany, did the same; so that the migrations of the
Linguatules have received, on different occasions, the most complete
demonstration.

Evolution.—The female Linguatula tenuioides deposits its ova in
the nasal cavities of the Dog which is its bearer. These ova are expelled
along with mucus during the fits of sneezing induced by the presence of
the parasite. Those which fall on the grass of pastures or on forage are
retained there, surrounded by mucus, and may in this state resist
atmospheric influences for several weeks. If this soiled grass or forage
be eaten by any herbivorous animal—Sheep, Rabbit, Ox, etc.—the shell
of the eggs is dissolved, and the embryos, which had begun to appear
immediately after the eggs were laid, are set at liberty in the intestine
of its new host.

This embryo has a certain resemblance to the Acarina (Fig. 296, B).
It is ovoid, flat on the ventral surface, round on the dorsal surface, and

\(^1\) Colin. *Rech. sur une Maladie Vermineuse du Mouton due à la présence d’une Linguatule dans les Ganglions Mésentériques*.
Rech. de Méd. Vétérinaire, 1861, p. 676. — *Sur le Développement de la Linguatule des Ganglions Mésentériques*.
Ibid., 1862, p. 312. — *Rech. sur le Pentastome tenuioid*.
Ibid., 1863, p. 721.
constricted and dentated at its posterior extremity. It measures 130 μ long, and 60 μ broad; it is furnished with two pairs of articulated, bi-ungulated legs, and at its anterior part it has a perforating apparatus formed by a median stylet and two curved hooks. By means of this apparatus it bores through the wall of the digestive tube, and reaches the organ in which it is to be encysted—mesenteric glands, liver, lungs, etc.

Arrived at this first destination, it loses its rostrum and legs, and is transformed into a motionless, rolled-up pupa, showing no traces of segments, hooks, or bristles, and measuring 250 μ to 300 μ long, by 180 μ broad (Fig. 296, C). At the end of eight weeks after infestation, Leuckart observed these encysted nymphæ.

Some time afterwards they are transformed into secondary larvae by a series of successive moultings (Fig. 297). The body is elongated, broader in front, and divided into 80 to 90 segments, which have a series of fine points on their posterior border. The digestive canal is very wide; the mouth is elliptical, and encircled by four characteristic hooks, as well as accessory ones. This larva is agamous, for its genital organs are only represented by a small granular mass situated in the posterior part of the body. Towards the sixth or seventh month, the larva is completely developed, measures 6 mm. to 8 mm., and represents that which has been designated the Linguatula denticulatum.

After a certain time, these mature larvae begin to move by means of their hooks and the chitinous spiculae on their skin, which prevent slipping back. They leave their primary location, fall into the peritoneal or pleural cavity, and the majority of them die. There are some, however, which succeed in encysting themselves on some other point, and Colin has found traces of these internal migrations.
PARASITES OF THE NASAL CAVITIES AND LARYNX.

It is not impossible—as Gerlach imagined—that they sometimes reach the bronchi, thence to be thrown out of the body of the host; and then they would be capable of resisting desiccation for a long time, and returning to active life under the influence of humidity. It might also be admitted—according to the same authority—that they could, after having attained the bronchi, reach the nasal cavities of their host, and there become perfect. In this way would be explained the presence—quite exceptional, it is true—of the *Linguatula tenuioides* in the nasal cavities of herbivora; and the presence of free larvae found by Gurlt in the trachea of a Hare and a Goat support this hypothesis.

One thing is certain, and that is that, in general, these larvae cannot acquire their complete development except in the respiratory apparatus. They only survive a few days after they leave their original host, unless the viscera of this is devoured by a carnivore—a Dog, for example.

![Fig. 299.—Head of a Dog opened in the middle, showing three of the *Linguatula tenuioides* (two of which are placed side by side) in the nasal cavities.—Colin.](image)

Then these agamous Linguatules reach the nasal cavities of their new host, either by the nostrils, the guttural openings, or in ascending from the oesophagus or pharynx. Gerlach admits also that they may arrive in the trachea, after passing through the wall of the stomach, and the peritoneum, pleura, and lungs. Once installed in the nasal cavities, toward the third week in one moultling they lose their numerous spiculae—which have now become useless—and wear a simple smooth skin. At the same time, the genital organs complete their development—those of the male sooner than those of the female. They may copulate about the end of the sixth or seventh week.

The area they occupy is somewhat limited. The males are nomadic, and will be found at different points in the nasal cavities—even in the pharynx and larynx, no doubt in search of the non-fecundated females; but most frequently they are hidden away in some corners. The females are more sedentary, but—contrary to the assertion of Chabert—they are never found in the ethmoidal cells, and it is only after the death of their hosts that they wander into the pharynx, and even into the
larynx. Gellé found one in the middle ear of a Dog, where it had penetrated by the Eustachian tube.1 Exceptionally it passes into the frontal sinuses, in which it is sometimes found half engaged. But in general they are only met with at the bottom of the meatuses, between the turbinated bones, and in the interstices between the ethmoidal volutes—their favourite abode being the wide and regular hollow that constitutes the cul-de-sac of the middle meatus. There they are sheltered from the respiratory currents of air, while the secretion of the mucous membrane—rich in glands—provides them with an abundant alimentation.

But little developed at the time of coupling, the females soon after this event assume their definitive size, chiefly owing to the accumulation of eggs in their oviduct. The number of these is considerable, Leuckart estimating them at 500,000 in one female. Ovulation begins towards the sixth month of the parasite’s nasal existence, and is continued for an undetermined period.

Concisely treated, the evolution of the Linguatule may be said to comprise four distinct and successive stages: 1. Acariform embryo; 2. Encysted nympha; 3. Free or encysted larva—Linguatula denticulatum; 4. Adult state in the nasal cavities—Linguatula tænioides.

**Frequency.**—The majority of authorities consider the Linguatula tænioides as a rare parasite in the nasal cavities of the Dog; but Colin, on the contrary, has asserted that it is very common, at least in Central France; in 630 Dogs which he had opened within two years at Alfort, at all seasons, 64 of them had from 1 to 11—in all, 146 parasites—a proportion of about 10 per cent. But it would not appear to be the same at Toulouse, for in 60 Dogs specially examined with this special object, only 5 furnished Linguatules, the number of which varied from 1 to 4.

A knowledge of the migrations of these parasites allows us to understand their extreme rarity in house Dogs, and their relative frequency in shepherds’ or butchers’ Dogs, as well as in street Dogs.

**Action of the Adult Linguatules.**—The Linguatula tænioides has been met with in the nasal cavities of the Horse, Mule, Sheep, Goat, and even of Man. But its natural host being the Dog, it is chiefly in this animal that the symptoms due to its presence are known, and these chiefly through experimentation.

Chabert had manifestly exaggerated these symptoms, and this appears to have been suspected by his contemporaries. Colin has been able to note them from day to day, and so to settle the question.

In wandering into the nasal cavities, the hooks of the parasites produce a slight irritation of the pituitary membrane, and hence some slight sneezings which would not usually attract attention. After some time, when the Linguatules have become more developed, they hinder the passage

1 Gellé. Comp. Rend. de la Soc. de Biologie, 1877, p. 394.
of air into the nasal cavities. Then the sneezing is more frequent, sudden, irregular, and sometimes long continued—especially when the respiration has been accelerated by running. Occasionally the animals stop anxiously, take very deep respirations, open the mouth, and attempt to swallow. These periods of agitation are alternated with others of perfect calm. Sleep is often disturbed by difficult inspirations and attacks of sneezing; some animals appear to be even threatened with asphyxia, and in their agony raise their paws to the nose, as if to remove some obstacle to their breathing. They become irritable, but rarely to such a degree as to lead to the belief that they are suffering from epilepsy or rabies.¹

We have mentioned that, during these sneezings, the Dog ejects mucus charged with ova; it may also throw out Linguatules, as has often been noticed.

It is doubtful if the epistaxis remarked in Dogs affected with these Linguatules, should be attributed to the presence of the parasites; for in the majority of cases the animals are also suffering from intestinal uncinariosis, or essential anaemia (see p. 463).

The Linguatules may, in becoming displaced in the respiratory apparatus, cause fatal asphyxia; although those that are found in the larynx are generally introduced there after death (Colin). ¹ Professor Dick² relates an interesting fact with regard to this. It was the case of a Dog in perfect health, which died suddenly, and at the autopsy there was found nothing that could account for death, except three Linguatules lodged—one in the larynx, another in the trachea, and a third in the left bronchus. Cobbold explains this displacement, by observing that the animal had gone out in the morning—it being winter—and that probably the action of the cold air had caused the parasites to wander in search of warmth; hence resulted the asphyxia’ (Railliet).

The duration of sojourn of these parasites in the nasal cavities may be very long. Colin has known it to exceed fifteen months. Eventually, however, they are expelled or perish sur place, and with them disappear the symptoms.

Chabert drew up a list of the lesions produced by the Linguatules, as startling and erroneous as that he gave of the symptoms. According to Colin, they are in reality insignificant. The pituitary membrane retains its normal characters 'so completely that, without the aid of the hand-lens, the practised eye would have great difficulty in discovering the slight imprints of their microscopical hooks.' Leuckart has noted a little injection and softening of the mucous membrane.

² Dick. The Veterinarian, 1840, p 42.)
When, exceptionally, the Linguatules have located themselves in the frontal sinuses, the mucous membrane is slightly inflamed, and there is a small collection of muco-pus.

The preventive treatment consists in keeping Dogs away from the entrails of Sheep, Rabbits, etc., which may contain agamous Linguatules; though the slight gravity of this nasal parasitism would scarcely justify this measure if it did not, at least, have its utility with regard to other parasitic affections—such as those due to the Cystics and Tænie. (Cobbold says: 'Our Dogs commonly obtain their worms by frequenting butchers' stalls and slaughter-houses, where portions of the fresh viscera are apt to be inconsiderately flung to hungry animals.')

There is no need to have recourse, in curative treatment, to trephining of the frontal sinuses, as advised by Chabert, as these cavities are not the usual habitat of the Linguatules. Injections are more indicated, and for these dilute ammonia or benzine, or, better, empyreumatic oil mixed with an infusion of savory—1 oz. of the first in 12 oz. of the second (Chabert)—may be employed. These irritating injections should be followed by emollient fumigations. Inhalations of ammonia or chloroform might be tried (as might also tobacco-smoke, or the fumes of chlorine or burning sulphur). The insufflation of errhine powders, and especially snuff, does not give favourable results.

Action of the Larval Linguatules. — We have seen that the agamous Linguatules, or denticulated Linguatules, are sometimes found encysted and sometimes in the free state, in the abdominal or thoracic viscera of a large number of animals, and that they are frequent in the Sheep. Those in which the parasites are found in the lymphatic glands are generally the least thriving in the flock; their flesh is pale, and they are predisposed to cachexia (Colin).

The mesenteric glands which are commencing to be filled with Linguatules, at first do not show in their appearance anything that might cause suspicion of the presence of these parasites. But soon they become brown in places, are diminished in consistence, seem shrivelled up, and are hollowed out by little cavities full of larvae. These cavities are at first separate from each other, but often end in communicating as they enlarge, the substance of the gland being destroyed and transformed into a brown fluid, in which the Linguatules swim about. Sometimes there are observed certain glands, on the surface of which are openings with regular borders, by which the parasites have made their escape, to wander elsewhere. At other times the surface of these glands has irregular greenish spots, fibrinous deposits and false membranes, which appear to indicate a recent departure or the destruction of the parasites; while other glands have their tissue thickened, indurated, and offering here and there tuberculous granules formed by old nests of the Linguatules. The glands

(1 Cobbold. The Internal Parasites of our Domesticated Animals, p. 108.)
which are altered in these several ways are scarcely permeable to the chyle, and nutrition must therefore be unfavourably influenced.

We do not know how long the Linguatules remain in the glands. We see above that they die in their habitat or emigrate, wander through the peritoneal cavity, and gain the liver or lungs; traces of their wanderings can be found in the various organs.

In any case, notwithstanding the equivocal alterations witnessed by Colin in a great number of affected Sheep, the presence of the larvae cannot be affirmed in the living animal.

Ox.—Babes has noticed that the denticulated Linguatules are very frequent in Roumanian Oxen, especially those in the region of the Danube. Of 35 Oxen killed in different localities, not one was free from the parasites. They were first found in the mesenteric glands, which showed alterations similar to those that Colin had witnessed in Sheep. The parasites left the glands, and crawled on the external surface of the peritoneum, where they were often found between the folds of the mesentery. They reached the intestines in passing through their walls, in which they were often noticed in process of penetration, or haemorrhagic spots or cicatricial traces marked their emigration. According to Babes, their presence has no direct influence on the health of their host; but the intestinal perforations may favour the passage, into the blood and tissues, of the diplococci which this authority considers to be the cause of the haemoglobinæmia that prevails among the bovine species in Roumania.

Horse.—Csokor has found a Linguatula denticulatum in the liver of a Horse.

Cat.—In 76 Cats we have examined, we only found 5 infested with the Linguatula denticulatum: a Cat had one in the pleural cavity, another had one in the peritoneal cavity, and the others had 1 to 5 on the surface of the lungs; they were isolated, and coiled up in small subpleural abscesses.

Dog.—In treating of the parasites of the serous membranes, we mentioned the larval Linguatules found by Bochefontaine in the peritoneal cavity of a Dog.

**Article II.—Larvae of the Estrus.**

The larvæ of the *Estrus clavicoles*, which live in the sinuses of the head of the Sheep, belong to several species of the genus *Estrus* (Linn.), as it has been established by Schiner.

This genus, in Brauer’s classification, enters into the group that has wings with a transverse nervule; the latter is somewhat oblique with regard to the posterior border of the wing, the first cell of which is closed and lengthilly pediculated. The species of this genus are generally of small size,

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3 For the bibliography, see p. 44.
with short and feeble legs, and short and scanty hairs of a silvery tint. Examined at their third stage, the larva have a single pair of jaws, two small membranous antennae, each carrying two oculiform points; the stigmatic plates of the last segment are irregularly pentagonal.

Brauer describes four kinds of Oestrus, only one of which—the Oestrus ovis—manifestly lives in the larval state in the sinuses of the Sheep, and probably also the Goat (Railliet).

**Oestrus ovis** (Linn., Cephalomyia ovis Latreille).—A small species, of a grayish-yellow hue, and slightly hairy. Face yellow; buccal pieces testaceous. Upper surface of the thorax of a brownish-gray, granular, and streaked by obscure or nebulous lines. Abdomen marbled and spotted with white, yellow, and black, covered with fine hairs behind, having a silky hue. Wings hyaline and transparent, marked at their base by three black points. Length of the body 10 mm. to 12 mm.

This species is very widespread, being found throughout Europe, in Asia, Africa, and the Canary Islands, as well as in the two Americas.

Like the other Oestridæ, it lives in the perfect state during the warm season—from the middle of May to the month of October—and it only flies in dry and warm weather. It hides in holes and crevices in the walls of the sheepfolds, which it leaves when coupling time has arrived and the temperature is sufficiently high. It then flies in a lively manner to greater elevations, and rests on rocks warmed by the sun. The fecundated female now goes in search of flocks of Sheep, which are afraid of its approach, and to avoid it lie down, bury their nose in the dust between their fore-feet, or are huddled together with their heads down. According to Bracy-Clark, they raise clouds of dust to deceive their enemy. It is during rumination that the insect finds a particularly favourable time for depositing its progeny. Its small size, gray colour, and the rapidity of its flight, do not allow its ovulation to be observed; but there can be no doubt that it does not take place on the nose of the Sheep. As soon, in fact, as these animals have been touched by the Oestrus, they become excited, run in every direction, hold down their nose and rub it against the ground or against their feet, often look anxiously around them, sneeze and snort, and seek ditches, furrows, and dusty roads. Owing to the repeated rubbings, the nostrils are often abraded and inflamed.

**Evolution.**—The non-fecundated ova are reniform. With Dufour and Cockerill, Brauer is inclined to admit that they are hatched in the body of the female. However this may be, the larva enter the nasal cavities of the Sheep, crawl into the maxillary and frontal sinuses, even into those of the horn-cores, and are developed.
In the first stage—which appears to be the longest—they are white, transparent, measure as much as 2 mm. long, and greatly resemble those of the *Gastrophilus* of the Horse. During the second stage they are about 6 mm. long, are yellowish-white in colour, have no spines, except a few around the mouth and on the ventral surface of the last segment; the stigmatic plates differ little from those of the adult larvae.

The latter, during the third stage, are a little broader behind than in front. Their ventral surface is plane; the dorsal surface is convex, and on each side has two series of prominences placed one above the other, and separated by a zigzag line. The middle part is smooth, and shows—from the second to the tenth segment—a nude and fusiform ring. At its inferior surface each segment from the third has on its anterior border several series of red-pointed spiniform tubercles. The cephalic segment is furnished with two dark-brown mandibular hooks, the points of which are curved downwards, outwards, and backwards. Between the base of these hooks is the buccal depression, small and nude. Above are two short and thick antennæ. The last segment is sharply truncated upwards, and shows a circular margin projecting above the stigmatic cavity and a kind of inferior lip, garnished with small spines between two mamelons. The stigmatic plates are pentagonal, with rounded angles, and the orifice of the stigmates is towards the centre. When they have attained their maturity, the larvae are at first white, and have dark, transverse streaks on their segments; their total length is then from 20 mm. to 30 mm. long, and 7 mm. to 10 mm. broad.

The larvae remain about ten months in the nasal cavities of the Sheep. Having attained its complete maturity, it detaches itself from the mucous membrane, creeps about, and owing to the large opening between the sinuses and the middle meatus, it leaves its abode, passes into the nose, and is expelled therefrom by the violent snorting it excites in its host. Twenty-four hours after its exit it is transformed into a nympha; and the shell, which was at first soft and red, with transverse streaks, is now brown, then black, its upper surface being convex, and the lower concave. The duration of nymphosis is from a month to six weeks, and the issue of the perfect insect occurs according to the mode common to the Oestridae.

**Symptoms.**—It is usual to find three or four larvae of the Oestrus in the frontal sinuses of Sheep, which, during life, had not given any indication of their presence. They rarely occasion any morbid disturbance, unless they are numerous and advanced in development, at the commencement of spring. The first signs of their presence is a discharge, often unilateral, at first clear and serous, then thick and mucous, from the nostrils. Then there are frequent sneezings and snortings, accompanied by the expulsion of the mucus, and sometimes of the larvae.
Later, the animals throw the head upwards, often shake it, rub the nose on the ground, against some part of their body within reach, or with the fore-feet. As the malady progresses the Sheep hold their head low, lift their limbs high in movement, as if walking in water—their gait resembling that of horses affected with *immobilita*. Sometimes they suddenly throw up the head, carry the nose high, then move it convulsively. From time to time they stagger and are attacked with vertigo, but they do not turn in a circle. In more serious cases there is dyspnœa, the upper air-passages being obstructed by the larvæ or the inflammation of the pituitary membrane. The eyes are red and lachrymose. The disease may be more complicated, the animals losing their appetite and their condition; they grind their teeth; foamy saliva flows from their mouth; the eyes pirouette in their orbits; and convulsions set in, then death ensues, sometimes in six to eight days after the appearance of the first symptoms. (Randall, describing the disease as he saw it in the United States of America, states that the term 'grub in the head' covers many fatal cases in the spring of the year, but bad effects from it are rare. The symptoms he mentions are: loss of condition, without any assignable cause, in the early spring, bloody mucus from the nostrils, irregular movements, and twisting the head occasionally, as if in pain. Observers in Great Britain have noted severe distress when the C'estres are numerous, and enumerate, among the other symptoms, occasional cough of a suffocative character, frequent sneezing, impeded respiration, swelling around the anterior nares, effusion into the submaxillary connective tissue, great depression—leading in some instances to semi-coma—loathing of food, and diarrhoea, often terminating fatally. The common saying that a whimsical person is 'maggotty,' or has got 'maggots in the head,' perhaps arose from the freaks of Sheep affected by these larvæ.)

But it is rare that the malady reaches this paroxysm; it continues for a long time, and generally—the larvæ being ejected one after another—the symptoms gradually subside, until they disappear altogether.

This affection has been sometimes mistaken for the 'gid,' caused by the *Caenurus cerebralis*—whence the names of *false gid* and *Estral vertigo* which have been given to it. But such a mistake would be avoided if it is remembered that the Sheep does not move in a circle in this affection, and that this is nearly always accompanied by nasal discharge and snorting, which are not present in 'gid'; besides, the latter is generally seen in young animals.

**Lesions.**—At the autopsy, there are found in the sinuses the still living larvæ of the C'estrus, the number of which is very variable. There are usually from two to about six in one fourth of the Sheep.

(1 Randall. *The Practical Shepherd*, New York, 1871.)
(2 Steel. *Diseases of the Sheep*, p. 89.)
killed from April to July—at least, this is so in the South of France; but frequently there are from ten to fifteen. Greve found great quantities of larvae in the Sheep that graze on the heaths of Luneburg, Hanover; but they did not appear to give rise to any manifest symptoms, except an intense nasal catarrh (Röll). Hertwig mentions having counted forty in one animal, and Zürn says he has found from sixty to eighty.

In those animals which have manifested symptoms of parasitism in the sinuses, these larvae are found enveloped in mucus and pus, which, is often foetid; they occupy the frontal sinuses and their dependencies, the horn-cores. According to Hertwig, they may also be met with in the maxillary sinuses. The mucous membrane is very tumefied, thickened, and injected—more rarely sphacelous at some points. The meninges are sometimes hyperæmic, and there is serous effusion into the two cerebral ventricles. When the larvae are very numerous, some are dead, and others may be encountered in the larynx and trachea, where they had probably wandered after the death of their host.

(Bracy-Clark mentions the lining membrane of the sinuses as becoming dense, white, and more or less inflamed, and observes that this change occurs more in the maxillary than the frontal sinuses—inferring that during the life of the host the parasites inhabit the former, and crawl into the latter after its death. He also states that young and old larvae are generally present together. Butchers, farmers, and others often state that the larvae have been found in the cranial cavity, and even in the brain-substance, and Cobbold received some carefully-recorded cases in which they had been met with in that organ; it is possible that, through absorption of the cribiform plate of the ethmoid bone, they may, in rare instances, find their way there.)

**Prophylaxis.**—With the view of preserving Sheep from the attacks of the Êstrus, it has been recommended to keep them from grazing—from the end of June to the end of September—on pasturesbordered by underwood or trees; or to remove the scrub that harbours the flies; or to smear the nose of the Sheep with empyreumatic oil or tar—a tedious operation in a large flock, and one which has only an ephemeral advantage. It has also been advised that, as soon as the shepherd sees the fly about the flock, he ought to clean around the nostrils of the Sheep, so as to remove the larvae that may have been deposited there—an onerous prescription that stands little chance of being carried out.

(1 Bracy-Clark. Transactions of the Linnean Society, III.)
A more practical measure is to destroy all the larvæ found on making autopsies of Sheep, or which have been ejected from them during life, to limewash the sheepfolds from time to time, and to resort to fumigations during the absence of the Sheep, so as to kill the adult Oestrus which may have taken refuge there.

(In invaded localities, or during seasons of extreme prevalence, it might be advisable to apply non-poisonous dressings—such as fish-oil—around the muzzle of the Sheep. Automatic application of this material, Stockholm tar, or any other similar substance might be tried by adopting Walker's plan; which is to place rock or culinary salt in a long box covered by a lid, perforated with round holes about two inches in diameter, the upper surface and margin of the holes being smeared with the repellent substance; so that every time the Sheep seek the salt—of which they are very fond—they involuntarily receive a dressing on the parts to be protected.

It may be mentioned that the belief is entertained that flocks fed where 'broom'—Saratamhus or Cytisus scoparius—is in flower, are never troubled by the Oestrus. It is known that Sheep are very fond of this plant, the pods of which they eagerly devour, and these produce in them a kind of intoxication. They lie down and appear to be unable to walk; but this soon passes off, and leaves no inconvenience behind.)

**Treatment.**—Many kinds of treatment have been made known, but very few have yielded altogether satisfactory results.

Errhines do not cause more vigorous sneezings than do the larvæ, and yet they are ineffectual in expelling the deeply-seated parasites. The best of the sternutatory powders are tobacco snuff and the rhizome of white hellebore. The shepherd introduces it several times a day by his fingers into the nostrils of the affected Sheep, or it may be blown into them by means of a quill. Such powders can only be useful when the young larvæ are migrating, as they generally remain for several weeks in the nasal cavities before seeking the sinuses.

Injections can no more be reckoned up. These are usually composed of empyreumatic oil suspended in vinegar and water, or salt and water. Bénion recommends injections of a mixture of ether and oil of turpentine; the employment of these, however, must excite violent irritation in the nasal cavities. Pyrogenous fumigations are also no more beneficial.

All these medicaments can only disturb the larvæ—they may cause them to be displaced, but will not kill them; for they have great powers of resistance, as Fischer long ago demonstrated.¹ Injections would perhaps cause the departure of the larvæ, if they could be introduced directly into the sinuses by means of trephining, or even resection of the horns.

Zürn indicates the following operation: Draw a transverse line, with
coloured chalk, in the middle of the two supra-orbital processes, and
divide by another longitudinal median line; then trephine in each of
the two upper angles so obtained, without impinging on the lines—the
operation being performed according to the ordinary rules of surgery.
The larvæ often creep out through these artificial openings, and they
should then be carefully destroyed. Those which are accessible ought
to be removed by means of forceps, and the others may be killed by an
injection of benzine diluted with water, this being an agent the parasites
resist badly. The flaps of skin are then well cleansed, replaced, and
fixed by two or three points of sutures, over the whole being laid a piece
of leather steeped in oil of turpentine. The Sheep operated upon is
separated from the flock for a few days. Robust Sheep seem to suffer
as little from this operation as they do from ear-marking, or any other
trifling operation (Zürn).

When there is reason to believe that the larvæ are in the diverticuli
running from the frontal sinuses to the horn-cores, we may amputate
the horns close to the forehead, and extract the larvæ, or kill them by
injection, applying a turpentine bandage over the wounds afterwards.
Sometimes it suffices to apply the trephine at the base of each horn,
and inject through the openings.

Surgical intervention is the most efficacious measure for getting rid
of the larvæ, and it can be had recourse to more especially in the case
of valuable animals. But a complete result cannot always be reckoned
upon, as the larvæ are often not collected in the frontal sinuses, and
those in the maxillary sinuses escape the injections. Zürn says he has
many times opened the frontal sinuses, and notwithstanding the extrac-
tion of from six to ten larvæ, after a transitory amelioration the symp-
toms have reappeared. Generally, when only a small number of
animals is attacked they are carefully watched, and those which show
serious symptoms are sent to the butcher.

(Steel asserts that inhalation of the fumes of burning tar—especially
if they are mixed with those of sulphur—causes early expulsion, and
proves particularly useful when resorted to for animals showing early
indications of invasion. Exhibition through the nostrils of a mixture
of glycerine and oil of turpentine has been found useful.)

(E Estrus of the Camel—E Estrus cameli var. Pharyngobalbus.—Besides
the E Estrus or Cephalomyia ovis, there are other Bot-flies that attack
animals, their larvæ invading the upper air-passages—Cephenomyia and
Pharyngomyia, for instance, infesting, in their larval state, Deer, Goats,
and other hoofed Mammals. The ova of one of the species which
attacks the Fallow-deer are deposited in the nostrils, and the larvæ
make their way in large numbers to a cavity near the pharynx. Rein-
der are excessively tormented by a similar species, the larvæ of which
infest the cavities of the head, and sometimes cause much destruction.
The Camel suffers much from the attacks of its Oestrus, and in India—particularly during the campaigns in Afghanistan, and in North Africa—Nile expeditions—the Camels in the British armies have experienced great inconvenience. The continuous irritation produced in the nasal cavities and pharynx—marked by snorting, perpetual shaking of the head, an offensive sanguineous discharge from the nostrils, dulness of the animal, loss of appetite, and exhaustion—led, in association probably with other causes, to much mortality.

According to Steel, the Camel Bot is half as large again as that of the Horse, is much softer and more tapering towards the hookless extremity, but broader, rounder, and more compressed towards the hooked end; it is also flattened on its inferior surface, convex on the superior. This authority gives a particular description of the larva, comparing it with that of the Horse-fly.)

(Steel. *A Manual of the Diseases of the Camel*, p. 76.)
CHAPTER II.

PARASITES OF THE TRACHEA, BRONCHI AND LUNGS.1

The most remote parts of the respiratory apparatus may be invaded by numerous parasites. For some, they are an accidental and, in a way, a facultative habitat; for others, they are a necessary lodgment. Among the first, there are those that are only exceptionally found, and they will be merely mentioned here; on the contrary, however, there are some which are most important, and which will be the object of special notice so far as their parasitic action is concerned—these are the Echinococci, Distomes, and Nematodes.

A. Fungi.—In the Horse and Cow, there have been several times found alterations of the lungs caused by the development of the Fungi of moulds belonging to the genus Aspergillus Mich. These Pneumomycoses—in which the Aspergillus lives as an accidental parasite—are very distinct from those vegetable Pneumoconioses in which the lesions in the lungs are due to vegetable dust acting merely as a foreign body, without vegetating in any way. As the Pneumomycoses are more especially frequent in Birds, what is to be said with regard to those of Mammalia will be treated in an appendix in that portion of this work in which the parasitic affections of the respiratory organs of Birds are dealt with.

B. Coccidia.—In a primary cylindrical epithelioma of the lungs of the Dog, Liénaux2 has seen, in the alveoli of the tumour, special bodies that he considered were Coccidia. They were present in several forms, chiefly free, but sometimes enclosed in an epithelial cell; some were also in the state of nude cells, with homogeneous protoplasm, and possessing one, two, or more cysts. Others differed from the preceding in being encysted—that is, surrounded by a double-contoured membrane, which they either wholly or partially filled; the same cyst might contain several cells. Lastly, a third form represented the most advanced phase, and consisted of simple or divided cysts, containing corpuscles (spores ?). These cysts were globular or ovoid, and measured 10 μ to 40 μ.

C. Infusoria.—In 1873, Perroncito found in the lungs of a Sheep two kinds of Infusoria, one of which appeared to belong to the genus Isotricha (see p. 360), and the other to the Diplodinium vortex. These

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Infusoria were contained, in certain numbers, in miliary nodules situated more particularly about the upper borders of the lungs. Brusafret has also found a tumour the size of a walnut in the right lung of a young Ox; the contents of this tumour were a lactescent, purulent, foamy fluid, in which were numerous Infusoria that he regarded as the *Balantidium coli*, but which were probably *Isotricha*.1

D. **Cysticerci.**—The *Cysticercus tenuicollis* Rud., a parasite of the serous membranes, has also been observed, in the very young state, in the parenchyma of the lungs of Lambs, Kids, and Pigs which had ingested the mature segments of the *Taenia marginata* (Baillet, Leuckart, Railliet). Boudeaud witnessed a similar instance on the Pig, as the result of spontaneous infestation (see p. 497).

The *Cysticercus cellulose* Rud., which is a parasite of the connective tissue, has sometimes been met with in the lungs of the Pig and Dog, and the *Cysticercus bovis* Cobb, in those of the Ox (see Measles).

E. **Linguatules.**—The *Linguatula tenioïdes* may be found in the larval condition in the lungs of various herbivora and of the Cat (see p. 564).

F. **Acarina.**—At the autopsy of a Rabbit, Villemin found the two lungs full of numerous granules, about the size of a hemp-seed; they were gray, transparent, slightly yellow in their centre, and projected from the surface of a section of the lung. He thought at first that it was a case of true tuberculosis; but on a microscopical examination he found in each granule, which formed a cyst, a dead acarus. 2

> When compared with several individuals of its species, it appeared to us to be the *Acarus* of the Horse. Although Villemin does not mention it, it is probable that this Rabbit was, or had been, affected with auricular acarisis, due to the *Psoroptes communis* var, *cuniculi*. These Psoroptes—similar to those of the Horse—must have, after perforation of the membrane of the tympanum, passed from the Eustachian tube into the air-passages, where, in the lungs, their dead bodies played the part of an irritant foreign body.

# Article I. **Pulmonary Echinococcosis.**

The species liable to hepatic echinococcosis (see p. 506) often show also, and generally coincidently, pulmonary echinococcosis. Instances of this condition have been observed in the Horse and Ass. Among cattle slaughtered in Berlin, Echinococci are found more frequently in the lungs than in the liver.

(Steel states that hydatid cysts are of very frequent occurrence in the Camel, and one writer of authority has not hesitated to term them a very common cause of loss among Camels.) They are observed in

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2 Villemin. _Etudes sur la Tuberculose_, 1868, pp. 483, 534.

the lungs, liver, and spleen, and are from the size of a pea to that of a cricket-ball. They have also been met with in the lungs of the elephant.)

The study of pulmonary echinococcosis in bovine animals is particularly interesting, because of the importance of establishing a differential diagnosis between it and contagious pleuro-pneumonia and tuberculosis. What follows here more especially concerns the larger ruminants, though it is applicable, with some shades of difference, to the other species.

**Symptoms.**—The presence of Echinococci in the lungs is only betrayed by serious functional disturbance, when they are numerous and of large volume in the two masses.

The first symptoms of this condition are a feeble, stridulous cough—at first rare, then becoming more and more frequent, until it is repeated every five or ten minutes. At the same time, the respiration is quickened and interrupted, and there may be slight fever. Pressure on, or percussion of, the chest rarely causes pain; but percussion elicits a dead sound in places—though it is not so deep or dull as in pleuro-pneumonia. The vesicular murmur is absent in the invaded regions; but in the others it is stronger, rougher and mingled with **sifflements**, buzzing, or gurgling sounds, and interrupted bronchial **rales** corresponding to the inspirations, and also with a particular characteristic sound at the precise moment when inspiration ceases—the **cloc-cloc** of Hartenstein. **Dyspnée** sometimes occurs suddenly, or it acquires its greatest intensity when the animals have been exposed to heat, are fatigued, or have been running—even for a short time. When the lungs are very much invaded by the Echinococci, there may be also noted those disturbances general in nutrition already mentioned (p. 514) as present in echinococcosis of the liver, which generally accompanies that of the lungs.

Hartenstein says he has only seen the disease develop itself during summer weather, and in animals turned out to graze; when they returned to their homes, it became less marked, and finally disappeared.

**Lesions.**—On opening the thorax, the lungs appear as if enlarged in size, though they are slightly collapsed in places, and are here and there lumpy and marbled—presenting, in fact, if allowance be made for difference in structure, the macroscopic lesions and the different kinds of Echinococci observed in the liver (p. 514). The weight of the lungs may be increased to 40 or 50 pounds (Ringk, Friedberger and Fröhner), and even to 54 pounds, according to Morot, six pounds being the normal weight. The volume of the hydatid cysts varies from that

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**References:**


of a pea to the size of a man's fist; around them the parenchyma is compressed and atrophied; but elsewhere it is normal. The air-vesicles may open into the bronchi, and their cavity then takes the characters of a pulmonary cavern.\(^1\) Reynaud\(^2\) says he has found acephalocysts developed in the interior of the bronchial terminations in the lungs of a Cow, Deer and Gazelle; but his observation is doubtless incomplete, and the instances ought to be looked upon as not primary, but accidental communications.

Hartenstein thinks he has proof that the hydatid cysts are developed during the summer, and are destroyed in the autumn; but the experiments of Leuckart demonstrate that it requires at least five months for the Echinococci to form heads, so that their destruction requires a longer time than Hartenstein allows. But it takes place sooner or later, as the result of modifications that occur in the adventitious cyst of the Echinococcus; its inner surface—which had for a long time been smooth and transparent—becomes dull and covered with a caseous matter, the layers of which compress the vesicle. The membrane of the hydatid undergoes fatty degeneration; the internal fluid gradually exudes through it and mixes with the peripheral caseous matter, which becomes thicker and more concrete. The hydatid contracts, shrivels up, becomes wrinkled, and forms a gelatinous, and finally an amorphous mass. Often the internal surface of the cysts is impregnated with lime salts, especially the carbonate; and it is the same with the remains of the parasite. Berthold—quoted by Leuckart—has analyzed the calcareous shell of a pulmonary Echinococcus from an old Dromedy, and found two concentric layers in it: an external, the hardest, consisting of phosphate of lime, and an internal of carbonate, with here and there crystalline deposits. An Echinococcus of the largest size may, in this way, be gradually reduced to a simple nodule.

At first sight, a lung invaded by Echinococci might be mistaken for a tuberculous one. But a close examination will show the absence of true tubercles, the presence of hydatids which still preserve all their characters, or the persistence of the hooks in the mass undergoing regressive phenomena.

**Diagnosis.**—Echinococcosis of the lungs is distinguished from tuberculosis more particularly by the characteristic gurgling sound, and the more laboured respiration occurring in an animal exhibiting all the indications of good health; as well as by the enlargement of the liver, which may be ascertained by rectal exploration.

It might be easily mistaken for pleuro-pneumonia; but the diagnosis of echinococcosis is based more especially on the absence or slight degree of fever, the pulmonary sounds, the duller resonance on percussion, and the less sensibility of the chest.

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The best course to adopt with animals severely affected, is to send them to the butcher.

**ARTICLE II.—Pulmonary Distomatosi**

The hepatic Distome, so frequent in the bile-ducts of the Sheep, Ox, and other animals (see p. 518), is sometimes found wandering in the lungs. The larger number of facts of this kind pertain to the Ox, and are derived from various countries. 1

Morot—to whom we owe the most complete researches on this subject—inspected 2,458 Cattle in six months at the abbatoir of Troyes, France, and found hepatic Distomes in the lungs of 101—or a little more than 4 per cent. Of these 101, 93 were more than five years old, and in many of them these parasites were also met with in the liver, in variable number.

The lung Flukes are contained in cysts which usually occupy the posterior lobe of one of the lungs—more particularly the base and towards the borders; being near the surface of the organ, they sometimes form a slight projection from it. Most frequently each animal shows only a single cyst, although the number may be as high as ten.

The volume of these cysts varies in size—being as large as a walnut to an apple—and their shape is globular or ovoid, rarely discoid; they are limited by a fibrous capsule of a grayish-white colour, more or less rosy, and sometimes encrusted with lime-salts. Their cavity is generally closed, and rarely communicates with the bronchi; they have at times septa, which divide their interior into angular spaces. The smaller cysts contain a reddish, yellow, or brown syrupy fluid; the larger have a glutinous, and more or less thick magma, which is sometimes of a uniform, sometimes variable, streaky tint; or they have a very thick

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pultaceous, scarcely viscid mass, having the same colour as the magma; or it may be a cheesy, more or less clotted, yellowish or streaky substance.

Each cyst contains one Fluke, rarely two, the parasite being usually small—13 mm. long and 3 mm. to 7 mm. broad; it is often difficult to discover in the fluid surrounding it, and of which it has the same colour. In some instances it cannot be found, and only the ova of the Distomes are met with, as Lindqvist has remarked; it is probable that the worm has died and been absorbed, or it has emigrated. Friedberger admits, in fact, that the parasites pass into the pulmonary veins, and are carried by the circulation into the most varied organs.

Pulmonary distomatosis is not betrayed by any appreciable symptom; but according to Bollinger, Lydtin has witnessed a malady in a large number of Cattle, that began like pleuro-pneumonia, and at the autopsies he found here and there—in the ectasiated bronchi—numerous hepatic Distomes.

The cysts of Distomes have also been sometimes found in Sheep, showing the same characters as in the Ox. In three Sheep, Bollinger saw hæmorrhagic centres and galleries containing young Flukes, the immigration of which was certainly recent. Burke has also met with pulmonary distomatosis in a Camel, in India.¹

Article III.—Bronchial and Pulmonary Strongyloses.

The domesticated animals, and exceptionally the herbivora, are exposed to more or less apparent diseases produced by Nematodes in the bronchi or in the whole pulmonary parenchyma. With some rare exceptions—which will be indicated in their proper place—these Nematodes belong to the genus Strongle (Strongylus Müller—see p. 346); hence the name Strongylosis—bronchial or pulmonary—very often applied nowadays to the maladies they determine.

The Strongles of the air-passages are distinguished from the other species of the same genus, as Leuckart has remarked,² by their embryos having a slightly developed oesophageal bulb, are destitute of teeth, and cannot grow in water by ingesting the matters suspended in it. With the Strongles of the digestive passages, on the contrary—Sclerostomes and Uncinarias—the embryos have a well-developed oesophageal bulb, are provided with three chitinous teeth, and may be nourished and grow at the expense of the organic matter contained in stagnant water.

There are eight known species of Strongles which live in the air-passages of various domesticated Mammals.³


³ The *Strongylus minutissimus* Méglin, which causes the verminous bronchitis of African Sheep, is only a form of *Str. rufescens*, as Railliet has shown (Bull. Soc. Centr. de Méd. Vétérinaire, 1888, p. 99).
1. **Strongylus filaria** (Rud.—Figs. 304, 305).—A very long filiform worm, somewhat attenuated at the extremities, and of a white colour. Head obtuse, and having no wings; mouth circular, and destitute of papillae. Male, 3 cm. to 8 cm. long; caudal pouch, elongated, notched in front; the posterior ribs trifid, middle ribs simple, and anterior ones bilobate. Spiculae short, thick, and winged. Female, 5 cm. to 10 cm. long; tail straight and conical; vulva situated behind, towards three-fifths of the length of the body. Ovoviviparous. Embryos 540 μ long by 20 μ in diameter, tapering to a blunt point behind, and having a kind of tubercle at the end of the cephalic extremity. Habitat, the bronchi of the Sheep, Goat, Dromedary (Camel in India), Roe-buck, Fallow-deer, Argali, and Gazelle.

Fig. 305.—*Strongyulus filaria*; natural size.

A, male; B, female.

Fig. 306.—*Strongyulus filaria*.—Delafond.

A, anterior extremity, showing the oesophagus, so-called salivary glands, and the origin of the intestine; B, caudal pouch of the male; C, ova at different stages of development; magnified 120 diameters.

2. **Strongylus rufescens** (Leuck., *Nematoideum ovis*pulmonale—Diesing, *Pseudalbus ovis pulmonalis* A. Koch, *Strongylus ovis pulmonalis* Curtice—Figs. 306, 307, 308).—A filiform reddish-brown worm; mouth surrounded by three papilliform lips. Male, 18 mm. to 28 mm.; caudal pouch excised behind, and slightly notched on each side in front; posterior ribs not very distinct, the middle double, the anterior cleft. Spiculae arched and striped transversely. Female, 25 mm. to 35 mm.; tail terminating in a blunt point; vulva situated at the base of a small pre-anal eminence. Oviparous; ova ellipsoid, and from 75 μ to 120 μ long by 45 μ to 82 μ broad. Habitat, the bronchi of the Sheep, Goat, and Roe-buck.

3. **Strongylus micrurus** (Mehlis—Fig. 309).—Body filiform, very
long, and tapering at the extremities. Head rounded and not winged; mouth round and nude. \textit{Male}, 4 cm. long; caudal pouch small, entire, and suspended on each side by five ribs, the posterior of which is tridented, the anterior bipartite, and the others simple; spiculae short and strong. \textit{Female}, 6 cm. to 8 cm. long, with a short sharp tail; vulva situated towards the posterior sixth of the body. Ovoviviparous. \textit{Habitat}, the bronchi of bovine animals, the Horse (?), and the Ass (?).

4. \textit{Strongylus pulmonaris} (Ercolani).—Length 1 cm. to 4 cm. Mouth surrounded by a crown of small subspherical papillae. \textit{Male}, thicker behind than in front; the caudal pouch semi-campanulated, and sustained by seven ribs. \textit{Female} has very thin, oblique, mucronated tail. Ovoviviparous. \textit{Habitat}, the bronchi of Calves.

5. \textit{Strongylus Arnfieldi} (Cobbold—Figs. 310, 311, 312).—Body filiform and white. Mouth nude and orbicular. \textit{Male}, 28 mm. to 36 mm. long; caudal pouch short and faintly lobulated, anterior ribs being bifid—the anterior branch a little shorter than the posterior—the middle ones bifid, the branches equally long, and the posterior ribs thick, bilobate at their end, and widely united at the base. Spicule slightly arched, reticulated, from 200 \(\mu\) to 240 \(\mu\) long, and accompanied by an accessory short piece of a pale-yellow tint. \textit{Female}, 45 mm. to 55 mm. long—90 mm. according to Cobbold—with a short, slightly curved tail terminating in a blunt point. Vulva non-salient, situated at the anterior three-fifths of the body. Ova 80 \(\mu\) to 100 \(\mu\) long, and 50 \(\mu\) to 60 \(\mu\) broad. Ovoviviparous. Embryos 400 \(\mu\) to 490 \(\mu\) long by 14 \(\mu\) to 28 \(\mu\) broad, and provided with a small, thin, and transparent caudal appendage. \textit{Habitat}, the bronchi of the Horse and Ass (Railliet).

6. \textit{Strongylus paradoxus} (Mehlis, \textit{St. elongatus} Duj.—Fig. 313).—Body relatively short, and white or brown. Mouth encircled by six lips, the two lateral being the largest. \textit{Male}, 16 mm. to 25 mm. long; caudal pouch deeply bilobate, each lobe being sustained by five ribs. Spicule slender and very long. \textit{Female}, 20 mm. to 40 mm. long, with curved and mucronated tail; vulva situated on a pre-anal eminence. Oviviparous and ovoviviparous. \textit{Habitat}, the bronchi of the Pig and Wild Boar, and also of the Sheep, according to Koch.

7. \textit{Strongylus commutatus} (Diesing).—Head rounded. Mouth with three very small papillae around it. \textit{Male}, 18 mm. to 30 mm. long; caudal pouch cordiform, and sustained on each side by five short ribs. \textit{Female}, 28 mm. to 32 mm. long, and having a conical tail; vulva situated immediately in front of the anus. \textit{Habitat}, the bronchi of Hares and wild Rabbits; rarely seen in the domesticated Rabbit.

8. \textit{Strongylus pusillus} (V. Müller).—Body filiform. Mouth nude and without papillae. \textit{Male}, 4-9 mm. long; caudal pouch short and slightly festooned, its anterior ribs being bifid, the posterior divided, and the others simple; spiculae long and slender. \textit{Female}, 9-6 mm. to 9-9 mm. long, with a short tail terminating in a blunt point. Vulva non-salient, and situated a little in front of the anus. Ova globular, and from 50 \(\mu\) to 70 \(\mu\) in diameter. Oviviparous. Embryos 270 \(\mu\) to 350 \(\mu\) long by 17 \(\mu\) to 23 \(\mu\) broad, and provided with a small, thin, transparent caudal appendage (Fig. 316). \textit{Habitat}, the bronchi of the Cat.

Strongylosis of the air-passages is frequent in the smaller Ruminants, especially the Sheep, and it is manifested at one time in the form of bronchitis, another time in that of pneumonia, and at another time again—and that oftenest—as broncho-pneumonia. These forms of disease are subordinate to the zoological species of worms causing them, and to the more or less superficial or remote habitat of these

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entozoa. This disease—which appears to have been first observed in 1768—and then in epizoïtic form—by Daubenton, in the flocks of Sheep at Bourgogne, has often ravaged the various countries in Europe, and has formed the subject of numerous memoirs.

**Symptoms.**—Bronchial and pulmonary strongylosis often co-exist in the same Sheep, so that it is difficult to decide as to the part each plays in the evolution of the symptoms that mark the disease. But pulmonary strongylosis leaves the animals it attacks more indifferent, while the manifestations of parasitic broncho-pneumonia are usually due to the bronchial strongle. Otherwise, the symptoms of this malady vary much in their intensity, and not unfrequently lesions are found at the autopsy of animals which during life appeared to be in good health. What often causes the affection to remain unperceived, is the fact of its often coinciding with distomatosis, which alone attracts attention. But, generally, broncho-pneumonia, or at least verminous bronchitis, may be recognised by a distinct group of symptoms.

Strongylosis of the air-passages of Sheep appears at all seasons; but it is more particularly observed from the month of March, until September or October. In its bronchial form it attacks young animals—Lambs and year-olds—by preference, while verminous pneumonia is more often developed in adults.

At the commencement of the attack, the symptoms are slight and fugitive; but they become more marked as the bronchi are invaded. The affected animal manifests all the signs of a violent bronchial catarrh—painful, difficult dyspnœic respiration; a strong, plaintive, painful and convulsive cough coming on in fits, chiefly during movement, and producing a degree of suffocation that leaves the animal prostrate. There is a thick and abundant discharge from the nostrils, and masses of mucus are often expelled during the attacks of coughing; in these matters, numerous Strongles and embryos are usually found. These symptoms become more acute, and notwithstanding that the appetite is preserved, the Sheep lose condition, fall into a state of consumption and anaemia—recognisable by the pallor of the skin and visible mucous membranes, and dryness of the wool; diminution of the respiration is the essential cause of this. Death occurs from cachexia or asphyxia at the end of two, three or four months—according to the

strength of the animals and the care they receive. When the symptoms are very well marked, recovery can scarcely be looked for unless the worms are in small number, and the animal is sufficiently vigorous to expectorate. The disease is most intense in the autumn, and if it does not cause death, it becomes attenuated in winter, and usually disappears in the spring, unless there is new infestation.

Prognosis.—The verminous broncho-pneumonia of Sheep may remain unperceived—so slight are the signs by which it might be manifested—and its existence be only revealed in the abbatoir. But when it is betrayed by the array of symptoms just enumerated, it is always a serious affection—usually fatal—and one which, in any case, much depreciates animals in value. And what renders it still more serious, is the circumstance that it is often present in an epizootic—and even an enzootic—form, causing great damage to Sheep-rearing.

Pathological Anatomy.—At the autopsy, the lesions of asphyxia and cachexia are noted—general emaciation, scanty and watery blood, serous effusions into the peritoneal, pleural, and pericardial sacs, and generally numerous Flukes in the liver. But there are always pulmonary lesions directly due to the presence of Strongles, which may be divided into three distinct species—Strongylus filaria, Strongylus rufescens, and Strongyulus paradoxus (see p. 581).¹

The Strongylus filaria and St. rufescens are the most widespread. The St. paradoxus—which is considered as specially belonging to the Pig and Wild Boar—has been found at Vienna, by Koch, in the verminous bronchitis of the Sheep, in which it played the part of the Strongylus filaria; but as it is only exceptionally encountered, we will limit ourselves to studying the effects of the St. filaria and St. rufescens.

¹ We ought to mention here, the finding by Ebertz of very lively Nematodes in the lungs of a year-old Sheep, and which—according to Leuckart—were the larvae of a Strongle or Filaria. A little smaller than the muscular Trichine, and not striped transversely, they resembled these before their encystment. The lungs were somewhat more serous than in health, and rough and dull on the surface. The worms were also met with in the muscles and kidneys. The Sheep had presented signs of debility, paresis of the limbs, muscular tremblings, frequent falls, anaemia, and paroxysms of coughing (Archiv f. Wiss. u. Prakt. Tierheilkunde, XIII, 1857, p. 232). Leuckart—to whom these parasites were submitted—has declared he had only once before seen such a worm; it had been obtained from the lymphatic glands of an Ox affected with melanosis. He has represented it (Fig. 255) in his treatise (Die Menschlichen Parasiten, Vol. II.).
These two parasites—which often co-exist in the same individual—do not comport themselves in the same way, the first living in the bronchi and giving rise to bronchitis; and the second partly operating in the pulmonary vesicles, and causing pneumonia.

In *Verminous bronchitis*, the bronchi are sinuous, and offer saciform dilatations—which are sometimes considerable—in which bundles of worms are found interlaced, and mixed with more or less purulent mucus. A microscopical examination of this mucus shows numerous embryos moving about in every direction. The plugs of worms and mucus penetrate the bronchioles, and ascend into the trachea, partially obstructing their lumen. There are often inflammatory streaks on the surface of the bronchial mucous membrane, and in the vicinity of the bronchial dilatations the pulmonary tissue is compressed, obliterated, and pale. The lungs have often contracted local adhesions by their serous covering.

*Verminous pneumonia* often accompanies parasitic bronchitis, and is due to the *Strongylus rufescens*, which, in the adult state, is met with in various degrees in the bronchi. It may wander as far as their ultimate ramifications, by stretching itself out, as it were, and fix itself in the pulmonary parenchyma; then we find one or more individuals in the form of very fine twisted filaments, and it is in this condition that Koch has described it as a distinct species, under the name of *Pseudalis ovis pulmonalis*. Railliet has demonstrated that it is nothing more than a form of *Strongylus rufescens*.

*Verminous pneumonia* caused by the *St. rufescens*—either in the adult condition or as ova or embryos—may present itself in the three forms distinguished by Bugnion: 1. A *lobular pneumonia* produced by the adult Strongles arrested in the bronchi; 2. A *diffuse pneumonia*, due to ova and embryos disseminated by thousands in the parenchyma, and which realizes what Bollinger has termed 'exudative pneumonia'; 3. A *nodular or pseudo-tuberculous pneumonia*, in which the ova and embryos occupy circumscribed points in the parenchyma—this is the most frequent form.

This nodular pneumonia is constituted by distinct centres apparently tuberculous, the size of a millet-seed to that of a pea, of a grayish-yellow colour and semi-transparent, or of a more or less intense dark-red hue, according to their age and the acuteness of the inflammatory phenomena. The consistence of the dark-red nodules is not so great as in those of a yellow colour, and in the latter it diminishes from the centre to the periphery. Generally, in all except the oldest they adhere to the surrounding tissue, from which it is impossible to enucleate them. All these centres may assume a caseous character, and even undergo calcareous infiltration. The majority occupy the periphery of the lungs, and particularly the borders, while many lie immediately beneath the visceral pleura.
These nodules owe their production to the ova that the females of *St. rufescens* deposit in the pulmonary alveoli, where they pass through all the phases of their development. The result of this deposition is a series of special inflammatory phenomena—the walls of the invaded alveoli undergoing an abundant infiltration of embryonic elements, and so acquiring a very great thickness, the infiltration extending some distance beyond the spot. This change appears as a network, each mesh of which contains an ovum in one or other stage of development. The epithelium in these inflammatory formations is almost null, except in those exceptional instances in which the ovum has not quite filled the alveolus, and the space left free is then filled with epithelioid cells (Laulanié). After the ova are hatched, the embryos set free engender a much greater amount of irritation, which leads to the production of a miliary pneumonia, that may present itself in all its forms, from hæmorrhagic to purulent. We cannot, therefore, assimilate this affection with tuberculosis, as Colin imagined, nor retain the designation of *Verminous phthisis* which is often given to this affection, and which is not justified, either by the symptomatology or the pathological anatomy of the malady.

The scraping of sections gives a foamy fluid, in which are found a large number of ova and embryos—the latter measuring 300 μ to 400 μ long by 16 μ to 20 μ broad; the caudal extremity being very slender, and terminating in a short, undulated, fine point.

Very often in the small tumours there are adult, or nearly adult, worms (Baillet, Colin, Bewley, etc.). Bewley has remarked that the Strongles are coiled up, not encysted, in the centre of a dense portion that surrounds a zone of radiating epithelioid cells, themselves surrounded by a zone of lymphoid cells, which are in direct contact with the healthy parenchyma.

**Etiology, Evolution.**—Verminous bronchitis and pneumonia have analogous conditions of expansion, although the *Strongylus filaria* and *St. rufescens* have not the same mode of development.

The *St. filaria* is ovoviviparous, but the embryos directly thrown out by the females into the bronchi of their host do not appear to develop there, and it is probable they require to be expelled from the animal in order to pass through the first phases of their existence. Ejected with the bronchial mucus, they may—if they fall into water—remain alive for several months (Baillet, Colin), provided the liquid does not undergo putrefaction because of the organic matters suspended in it (Railliet). In the course of the second week they moult, and this brings about the disappearance of the cephalic knob with which they were provided; they then appear more attenuated posteriorly, and have a slight greenish tint. It would even appear that they undergo a second moulting, and that the larvae yet retaining their envelope, and in a manner encapsuled, may resist desiccation for a long time.
(Leuckart, Railliet); Ercolani went so far as to say that he had seen them become revivified on coming into contact with water, after being dried for a year. This will explain how it is that the malady may appear in Lambs which have had no direct contact with animals suffering from verminous bronchitis, and also how it may continue, as an enzooty, in a country. It is very probable that the embryos enter the body along with the grass of damp pastures, and the water the Sheep drink; and this view is in accordance with the older notions as to the etiology of the malady, which testified to the great influence of humidity in the development of verminous bronchitis. It is chiefly in the springtime and summer that the embryos of the *Strongylus filaria* are disseminated over humid pastures. Leuckart has been quite unsuccessful in infesting Sheep by feeding them with bronchial mucus rich in embryos, and he therefore concludes, from this result, that these embryos—as well as those of all the Strongyles of the air-passages—must pass their first phases in an intermediate host—an insect or mollusc; but this hypothesis is not based on any element capable of demonstration. (Cobbold was of opinion that the young of the Strongles which occasion 'husk,' undergo their primary changes of development either within soft mud alone, or within the bodies of larval insects and minute entomostracans inhabiting ponds, ditches, and running streams.) Nothing is known as to the course followed by the embryos of the Strongles which have found their way to the digestive organs, in reaching the interior of the bronchi. Zürn teaches—but without any assignable reason—that they pass from the stomach into the oesophagus, reach the pharynx, and then their intrusion into the respiratory organs is easy. (Moffat and Grey have imagined that the young worms enter the nostrils of grazing Sheep, and that if only two or three can crawl thence into the bronchi, they may there reproduce, ovoviviparously, after they attain the adult stage, and so furnish such a progeny as to cause the death of the animal in time—the embryos becoming developed while they are encysted in the parenchyma of the lungs, to penetrate which they are furnished with the boring apparatus already described.)

With regard to the origin of verminous pneumonia, this occurs in similar telluric conditions, the embryos of the *Strongylus rufescens* ejected with the mucus being capable of living a long time in a moist medium outside the animal body; they can be kept alive for months in water—Railliet has even seen them resume their activity after three days' complete desiccation.

**Prophylaxis.**—Our ignorance of the evolution of *Strongylus filaria* and *St. rufescens* renders uncertain any prophylactic measures that may be recommended against the verminous bronchitis of Sheep. As young animals are more susceptible to attack than older ones, it is advisable to feed the Lambs and year-olds in the folds in those countries in
which the malady prevails; or, at any rate, they should not be turned out to pasture in the spring and commencement of summer, when the embryonal progeniture of the worms are distributed over the meadows. They may be driven on to the stubble-fields until feeding-time in the folds arrives. But if circumstances render it imperative that they must be grazed, care should be taken to break their fast in the morning by a little dry forage; and some clean water ought to be allowed, so that they will not require to drink from ponds or ditches, by which they might be infested by the larvæ these contain.

In order to combat a surreptitious infestation and destroy the embryos as they arrive in the stomach, substances which are toxic for the larvæ are placed within reach of the Sheep during May, June and July—such a substance is culinary salt. Spinola has recommended bread composed as follows:

<table>
<thead>
<tr>
<th>Substance</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea-salt</td>
<td>500 grammes.</td>
</tr>
<tr>
<td>Stockholm tar</td>
<td></td>
</tr>
<tr>
<td>Wormwood</td>
<td>1,000 grammes</td>
</tr>
<tr>
<td>Tansy</td>
<td></td>
</tr>
</tbody>
</table>

These substances are pulverized and mixed with flour and water, so as to form a firm paste, which is to be made into flat cakes. These, after being dried in the air, are to be given to the Sheep, along with scorched oats.

Zürn also recommends the following formula:

<table>
<thead>
<tr>
<th>Substance</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wormwood</td>
<td>1,000 grammes</td>
</tr>
<tr>
<td>Root of Calamus aromaticus</td>
<td></td>
</tr>
<tr>
<td>Tansy</td>
<td>500 grammes</td>
</tr>
<tr>
<td>Calcined bones</td>
<td></td>
</tr>
<tr>
<td>Sulphate of iron</td>
<td></td>
</tr>
</tbody>
</table>

These substances should be reduced to powder, and given with scorched oats, in the proportion of 12 to 15 grammes to each Lamb.

Prophylaxis also recognises the utility of drying and draining damp pastures, and the destruction of the lungs of animals killed during the course of the malady.

(For the prevention of this disease in the Calf, it has been recommended that infected land should be dressed with crushed rock-salt in the early spring months—5 or 6 cwt. to the acre; also that all rough grasses on old-laid grazing pastures should be mown in autumn and converted into ensilage.

In seasons when the malady is prevalent, Lambs should not be allowed on natural pastures, or old grass-lands previously fed over by Sheep, but if possible put on high and dry grazing-grounds. It is advisable also to separate the diseased from those still healthy. Care should be taken, in introducing fresh Sheep among a flock, that they are not infested, as there is evidence to show that contamination may take place in this way. An instance is recorded in which a Ram was introduced among Ewes in the autumn, and fed and drank with them;
the animal died from verminous bronchitis, and the flock subsequently suffered seriously—contamination having taken place, it was supposed, from the water-troughs.¹ Hay from infested meadows may also prove a source of infestation.²)

TREATMENT.—Two different procedures in treatment are pursued. In one, substances are passed into the digestive canal, which—being diffused in the blood—are believed to be capable of attacking the worms in the bronchial tubes. With this view, the picrate of potass—·20 to ·40 gramma per head—is given, dissolved in thin gruel or mucilage; creosote; oil of turpentine; a mixture of equal parts of oil of turpentine and tincture of camphor—a teaspoonful every day to each Lamb in a mucilaginous fluid; a mixture of creosote—120 gramma—spirits of wine—500 gramma—and water—700 gramma; an ordinary spoonful every day to each animal; or creosote—60 gramma—benzine—300 gramma—water—2 litres: an ordinary spoonful given every day for eight days to each Sheep. Hall³ states he has successfully employed prussic acid in ten-drop doses, morning and evening.

But experience has shown that, while such treatment is troublesome to carry out, its efficacy cannot be relied upon.

Success is more certain with fumigations, as they penetrate directly to the worms, stupefy them, and induce fits of coughing that causes their expulsion. They are practised in buildings from which all forage is previously removed, and which are well closed. Into these the diseased are introduced, and on a red-hot shovel are placed rags, horns, feathers, hair, old pieces of leather, empyreumatic oil, tar, juniper-berries, asafetida, etc. The intensity, duration, and number of these fumigations are graduated as the Sheep become accustomed to them; at first once a day may suffice, and then the intensity should be moderate, and the duration about ten minutes; afterwards two, and finally three, may be given during the day, each lasting for twenty minutes. Kowalewsky says he has obtained very good results from similar fumigations.⁴ Fumigations with chlorine, sulphur, and sulphuret of mercury or cinnabar, have been recommended; but they are dangerous.

(Stephen recommends as follows: Put about forty Lambs at a time into an air-tight house, and place tar, sulphur and turpentine in a pot of burning coals, suspended by a chain from the ceiling, and brought as near to the heads of the animals as possible; the fumes are to be allowed to fill the house, and more ingredients are added as required—the Lambs being kept in the place for twenty-five minutes each time, and the process to be repeated on three occasions.)

Tracheal injections in the verminous bronchitis of Calves are of

¹ Robertson. The Veterinary Journal, II., 1876, p. 336.)  
² Ibid., p. 337.)  
³ Hall. The Veterinarian, 1868.  
great utility; but for a flock of Sheep they would be troublesome and difficult to administer. However, Nieman has successfully employed them on 384 Sheep belonging to several small owners. He used a solution of 2 parts iodine and 10 parts iodide of potassium, in 100 parts of distilled water. This fluid was mixed, in equal parts, with oil of turpentine, and made into an emulsion with olive-oil; each Sheep received 5 to 8 grammes of the mixture, and the number of injections varied according to the gravity of the disease—from 2 to 3 at two days' interval. The worms were killed and expelled during the paroxysms of coughing, and the bronchitis was modified.1

The medical treatment should be assisted by very nourishing food, and by bitter, stimulating, and ferruginous tonics, which arouse the digestive functions and allow those animals which are least exhausted to reach the period of elimination of the parasites.

At the commencement of any kind of treatment, it is well to have an examination of the flock, with the object of sending the worse cases to the butcher.

2. VERMINOUS BRONCHITIS OF BOVINES.

The verminous bronchitis of Calves is that which was first observed. Ruysch had, so long ago as 1744, noticed worms living in the air-passages of these animals; but Nicholls was the first—in 1756—to speak of a disease caused by these entozoa, and which prevailed in an epizoötic form in England. Camper also alluded to a similar occurrence in 1803. Since that date it has been often observed and described.2

Symptoms.—When the Strongles are not numerous, the symptoms are only an infrequent, slight, and sonorous cough occurring in fits; it becomes gradually stronger, broken and husky, and at last comes on in long paroxysms, accompanied by dyspnœa and suffocation. During these attacks the respiration is hurried, the flanks are agitated, the pulse quickened, and the conjunctivæ injected; the animal elongates its neck, extends the head, opens its mouth—the tongue protruding, and saliva flowing from the commissures of the lips. During the most violent paroxysms, the animal—asphyxiated—falls prostrate on its side, with the eyes protruding and haggard, the mouth gaping, and the tongue pendulous. These fits occur several times during the day, and sometimes the animal dies in one of them. The coughing causes the expul-

1 Nieman. Revue für Thierheilkunde und Thierzucht, 1887, p. 79.
sion, by the mouth or nasal cavities, of mucus that may be streaked with blood, and contains single worms or masses of them, which are readily recognised, more particularly by their movements when they are put into tepid water.

When the disease progresses slowly, the symptoms are milder, but there is also a great alteration in nutrition—emaciation, pallor of the mucous membranes, sunken eyes, debility, dull and staring coat, then partial depilations, phthiriasis, gradual loss of appetite, irregular ruminations, diarrhoea, haemoptysis, foetid breath, and, finally, fatal marasmus.

The duration of the malady varies with its intensity. Death—which is generally brought about by asphyxia or extreme cachexia—may also be due to an intercurrent pneumonia or pulmonary haemorrhage; it may take place in three, four, or five months. Morier has seen some animals live for a year.

The diagnosis is based on the character of the paroxysms of coughing, and more especially on the presence of Strongles in the expectorated matters. Adult worms may not be present, but their embryos are always to be found, and a microscopical examination will reveal their existence. It often happens at the commencement of the malady, that the animals swallow their expectorations as soon as these arrive in the pharynx; so that an examination cannot be made. When this is the case, the animal should be compelled to cough, then the tongue is seized by one hand, while the other extracts from the back of the mouth some of the mucus thrown up from the bronchi.

Verminous bronchitis has often been mistaken for contagious pleuro-pneumonia—an error which might have grave consequences, and which an autopsy only could rectify. This mistake might be averted if it is remembered that in verminous bronchitis the respiratory murmur is heard throughout the chest, amid mucus rattles, and that there never is a blowing sound. Percussion gives a resonant, though diminished, sound over all the thoracic parietes.

But it must be insisted upon, that the presence of the Strongles and their embryos in the expectorations is the criterium of the disease.

The prognosis is usually serious, especially when the malady has not been recognised; and the gravity will vary, not only with its intensity, but also with the general condition of the animal and the intercurrent complications.

Pathological Anatomy.—The lesions are analogous to those of the verminous bronchitis of the Sheep. The inflammation of the bronchial mucous membrane is usually more intense; there is nearly always general pulmonary emphysema, with secondary lobular pneumonia. Van Tright has described, in the Ox, a form of pseudo-tuberculosis analogous to that observed in the Sheep. The worms, which were found in more or less voluminous bundles from the last divisions of the bronchi
to the upper part of the trachea, belonged to the Strongylus micrurus (see p. 581); the name of Strongylus pulmonaris has been given by Ercolani to different worms he found in large numbers in the bronchi of a Calf. Prangé had sent him the identical worm from France, which he had also met with in a Calf.

**Etiology, Evolution.** — Like the Strongylus filaria of the Sheep, the St. micrurus is oovoviviparous; and though its development has not been much investigated, yet we may probably apply to it the knowledge we have obtained with regard to the St. filaria — the embryos can only become developed after they have left their first host, and nothing is known as to the phases they assume before their immigration into a new individual. However this may be, experience has shown— as for the St. filaria of the Sheep—the influence of humidity on the appearance of the disease in the bovine species; and it would appear to establish the fact that affected animals may be contagious to those which are healthy (Vigney, Delafond, Janné)—though this requires scientific confirmation. It may be noted as remarkable, that adult animals are rarely attacked, and that Calves almost alone pay their tribute to the affection, which most frequently appears in an epizootic form.

**Prophylaxis.** — This is the same as for the verminous bronchitis of the Sheep (see p. 588).

**Treatment.** — The same medicaments have been employed in treating this malady in Calves as in that of Sheep, and no better results have been obtained. Numan¹ and Janné have, however, been successful with asafoetida (30 grammes), Chabert’s empyreumatic oil (60 grammes), and a mucilaginous decoction (500 grammes)—a spoonful of this mixture being given in a half-litre of milk, and the treatment continued for about a month.

The results are less uncertain if the worms lodged in the bronchial tubes are directly acted upon, either by means of injections of the same kind as those employed for Sheep, or fluid medicaments introduced directly into the bronchi.

Read says he has cured Calves worn down almost to skeletons by

¹ Numan. Vee Artsenykundig Magazyn, 1845; Rec. de Méd. Vétérinaire, 1846, p. 951.
verminous bronchitis, by the following procedure: The head of the Calf is slightly elevated, and about two drachms of ether, chloroform, oil of turpentine, or rectified oil of amber—single or combined—are poured into each nostril, and allowed to vaporize there; it will then, by the respiration, be carried into the air-passages, and thus destroy the filaria. In some cases it must be repeated two or three times, but once has frequently the desired effect.1

The method of treatment by inter-tracheal injection, introduced by Levi of Pisa, has yielded very satisfactory results.2 Levi has been completely successful with a Sheep. Élloire has employed it in 16 Calves affected with the disease, and all were cured. He used the following mixture:

<table>
<thead>
<tr>
<th>Black poppy oil</th>
<th>Oil of turpentine</th>
<th>Carabolic acid</th>
<th>Purified cade oil</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 parts</td>
<td>100 parts</td>
<td>2 parts</td>
<td>2 parts</td>
</tr>
</tbody>
</table>

Each Calf received 10 grammes of this mixture daily for three days.

The injection, which should be given slowly, is followed by a fit of coughing, and the expired air has the odour of turpentine. This treatment has also been successful at Milan. Similar favourable results have followed Hutton’s treatment of 8 Calves, some of which were in the last stage of verminous bronchitis. He employed a mixture of oil of turpentine, tincture of opium, pure carabolic acid, and water—the oil of turpentine forming one-half of the mixture. The dose was half an ounce, and in the serious cases this was given every day for three days, and in other cases every second or third day. Krwonogow has likewise cured 22 Calves, by giving each of them two tracheal injections of 8 grammes of the following mixture: Essence of cloves and oil of turpentine, 360 parts of each; carbo acid and olive-oil, 30 parts of each.

(Williams speaks highly of the administration of prussic acid. Penhale gives—by intra-tracheal injection, and slowly—oil of turpentine 2 drachms, carbo acid 20 minims, and chloroform half a drachm.)

3. VERMINOUS BRONCHITIS OF THE CAMEL.

Helminthologists have for a long time known of the presence of the Strongylus filaria in the bronchi of the Camel and Dromedary. Piot3 has reported that this helminth may cause an epizootic verminous bronchitis.

The first symptom is sneezing, which is repeated in short fits, with

1 Read. The Veterinarian, 1848, p. 604 (The Farmer’s Magazine, 1840).
sighing in the intervals, and at each sigh the larynx is much projected forward; at the end of expiration, which is accompanied by a gurgling laryngeal sound, the head and neck are protruded. Respiration is buccal and nasal, the air often distending the cheeks and parotideal region, and is swallowed with a noise like hiccough. There is at first a serous, then a mucus discharge from the nostrils, which becomes foamy, tinged with blood, and profuse; it is sometimes accompanied by epistaxis, and contains numerous embryos. There is at first excitement, then sluggishness, cachexia, inappetence, constipation, tympanitis, feebler thoracic resonance, and mucus \textit{rales} and blowing sounds. Nearly all those attacked are affected with labial pruritus, which causes them to rub their upper lip and nose until these are excoriated.

The disease continues for 12 to 15 days, sometimes a month, and then terminates by death or recovery.

At the autopsy, lesions of bronchitis, and even of pneumonia and pleurisy, are found.

Piot has successfully employed fumigations of tar, and more especially tracheal injections of a preparation composed of oil of turpentine 10 grammes, ether 10 grammes, tincture of opium 0.5 gramme, and 1 per cent. carbolized water 20 grammes.

4. \textbf{VERMINOUS BRONCHITIS OF EQUINES.}^1

The bronchial Strongylosis of Equines appears to have been seldom seen. Morier has observed it in Horses of all ages in Switzerland, where it prevailed at the same time among Calves from six months to two years old. Eichler collected from the bronchi of a Horse at Berlin, worms which Diesing classed with the \textit{Strongylus micrurus}; and Gurlt attached to that species Nematodes from the bronchi of the Horse and Ass. Cobbold has demonstrated that the Strongyles of the bronchi of the Ass form a separate species—the \textit{Str. Arnfieldi} (see p. 582), and Railliet has recognised that those of the Horse belong to the same species, and completes their description. This rare form of Strongylosis appears to manifest itself by symptoms analogous to those of verminous bronchitis in the other species, is accompanied by similar lesions, and is developed in the same etiological conditions.

Railliet has remarked that the larvae of the \textit{Str. Arnfieldi} do not at all withstand desiccation, and do not live more than eight days in pure water. They can, therefore, only pursue their evolution if they arrive quickly into a suitable medium; and this will explain the rarity of bronchial Strongylosis in the Horse.

An agamous Sclerostome has been found by Morot in a pulmonary vessel of a Horse (Railliet).

5. Verminous Bronchitis of the Pig.

The presence of Strongyles in the bronchi of the Pig was noted towards the end of the eighteenth century by Ebel, Goeze, Modeer, Mehlis, etc. They have since then been met with several times by Rayer, Chaussat, Dujardin, Bellingham, etc. They do not appear to be frequent, except in certain regions, and they do not usually cause such grave functional disorders as those remarked in Sheep and Calves.

Chaussat stated, in 1850, that it was usual to find the Strongylus paradoxus in the bronchi of Pigs brought to Paris—at least, in certain seasons of the year. Chatin also asserted that this parasite is very common in France. Boudeaud informs us that it is frequent in young Pigs in the Indre department; and Modena observed it very often in Pigs in Sardinia and the Maremmes of Tuscany, where verminous bronchitis appears to be enzootic.

The bronchial Strongylosis of the Pig often remains unperceived, and in the majority of the animals in which they are found after death.

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1 For the bibliography, see Davaine. *Traité des Entozoaire*, 2nd edition, 1877, p. 35.
there was nothing observed during life to raise any suspicions of their presence. Sometimes their existence was betrayed merely by cachexia and resistance to fattening. In other cases there was a moist, troublesome coughing fit, and a group of serious symptoms analogous to those we have already depicted for the other domesticated animals. Death may result, and especially in young Pigs—a remarkable instance of which is cited by Deguillème.¹

At the autopsy there are found the lesions—more or less accentuated—of verminous bronchitis. They are generally slight, and the worms are lodged in the smaller bronchi; the lungs are the seat of local congestion. Vulpian once found in them a great number of small tumours, which he qualified as epitheliomas, and without being able to ascribe them with certainty to parasites. Gratia² mentions having on several occasions met with verminous pneumonia in the Pig, in the form of pseudotubercles having the closest analogy to those which Str. rufescens gives rise to in the Pig. These broncho-pneumonia nodules were essentially constituted by endoalveolitis and endo-bronchitis in limited foci.'

The treatment—which should be based on that prescribed for Sheep

¹ Deguillème. In Mémoires et Observations de Gohier, II., 1813, p. 434.
affected with the same disease—should only be resorted to in the case of valuable young or adult Pigs, as it is more advantageous to kill others for food if their age is suitable.

6. VERMINOUS BRONCHITIS OF THE RABBIT.

This disease is extremely rare in the domesticated Rabbit; for the *Strongylus commutatus* almost exclusively infests the bronchi of the wild Rabbit, and especially of the Hare, which it sometimes destroys in large numbers.

**ARTICLE IV.—Helminthiasis of the Trachea, Bronchi and Lungs of the Dog.**

The worms observed in the trachea, bronchi and lungs of the Dog are Nematodes, which make the air-passages of this animal their ordinary, accidental, or transitory *habitat*. Several of them are little known as yet.

1. **Tracheo-bronchial Filaria of the Dog.**—There are five observations on record of verminous tubercles of the trachea and bronchi, caused by the Nematodes that Blumberg and Rabe doubtfully place in the genus *Filaria*. Of these five observations, one is due to Renault, two to Blumberg, and the other two to Rabe. These tubercles are situated in the inferior part of the trachea, at its bifurcation, and in the bronchi towards their origin. Their number is very variable—from four to a hundred; while their volume may be from that of a millet-seed to that of a pea. Situated beneath the mucous membrane, which is raised over them, they are generally oval in shape, somewhat flattened, hard, reddish in colour, and slightly uneven. Each of them contains a notable quantity of small Nematodes, which, in passing through the wall, protrude on the surface by one or other of their extremities, and in this way they simulate vili. Their description is as follows:

Body filiform. Mouth surrounded by two or three prominences or concentric lips of variable height, behind which are three unequal papillae; pharynx dilated. **Male**, 5 mm. long, with the posterior extremity rounded; two unequal, curved spicules. **Female**, 9 mm. to 15 mm. long; vulva situated immediately in front of the anus. Ovoviparous. These worms, imbedded as they are in the substance of the nodules, are very difficult to extract, and their study is still incomplete.

Their presence is usually not betrayed by any particular symptoms; though in a case related by Rabe there was very marked respiratory disturbance; the tubercles found at the autopsy were very numerous, and were more particularly concentrated in the thoracic portion of the trachea. The lungs also contained a great number of gray tubercles, the size of a grain of sand; they chiefly abounded beneath the pleura, and the largest of them was inhabited by one or more females.

The *verminous bronchitis* described by Professor Osler,² of Montreal,

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Canada, appears to have been this affection. The parasite to which he attributed it, and which he named Strongylus bronchialis canis, was designated Filaria Osleri by Cobbold. The largest males measured scarcely 4 mm., and the females a little more than 6 mm.

Of 30 Dogs attacked by this disease, 21 succumbed to it; all of them, except six, were not more than eight months old. The principal symptoms were: Inappetence, indifference, weakness; sometimes paraplegia, often convulsions; rarely diarrhoea; vomiting after food; sometimes a short, husky cough; and intense fever. Duration, three to ten days. In eight bodies on which an autopsy was made, there were observed lesions of broncho-pneumonia, but only in six were parasites found; these were nearly all lodged in nodules in the tracheal mucous membrane, chiefly at the bifurcation of the tube and in the larger bronchi, the nodules projecting from the surface of the membrane as in the preceding cases. A certain number of adult Nematodes and embryos were concealed in the mucus of the smaller bronchi. The lining membrane of the trachea was highly hyperaemic. It might be questioned whether all these cases were of the same kind, and if they did not rather coincide with the 'distemper' of young Dogs, localized in the respiratory apparatus. The details given would support this hypothesis.

Courtin, of Bordeaux, has also met with Nematodes in the bronchi and pulmonary vesicles of the Dog; but these were embryos the origin of which could not be determined. The inferior lobes of the lungs showed, posteriorly, patches of white, indurated substance in which were found embryos—some free, others encysted. Mégnin reports having observed a similar instance in a Fox-terrier that died of consumption.  

2. Filaria immitis (Leidy).—This worm inhabits the right side of the heart and the pulmonary artery, but it may be met with in making sections of the lungs (see Hematozoa of the Dog).

3. Spiroptera sanguinolenta. —This entozoon lives in tumours in the oesophagus and stomach of the Dog; nevertheless, it may also be found in the walls of the aorta, whence it throws off its embryos into the circulating blood, by means of the pulmonary vessels. Railliet has seen a tumour in a Dog's lung which contained several of these worms. The lung adhered to the oesophagus, which had a similar tumour at the same level.

4. Indetermined Nematode.  

Strongylus vasorum (Baillot).—In the adult state, this worm lives

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in the right side of the heart and the larger divisions of the pulmonary artery (see *Hamatozoa of the Dog*). The ova laid by the female are arrested in the finer arterioles, and there pass through all their phases of development. Their presence gives rise to special granules which are characteristic of this pulmonary Strongylosis, and which were discovered and well studied by Laulanîé.¹

Little is known of the *symptoms* it provokes. Its presence is sometimes betrayed by severe and sudden dyspnoea, which may subside in a few days, or it may terminate in asphyxia. Auscultation and percussion do not furnish any appreciable sign. There is sometimes anaemia, emaciation, dry and feeble fits of coughing, and marked ascites that disappears after a long rest. The diagnosis may perhaps be assisted by the search for embryos in the mucus or foam ejected during the paroxysms of coughing. Most frequently the affection remains unperceived during life, and is only recognised at the autopsy. It is generally sporadic; though it may become established as an enzooty in the same pack of Dogs, and make serious ravages.

At the *autopsy* there are found, in the right side of the heart, or in the branches of the pulmonary artery, adult vessel-Strongles. When dealing with the parasites of the circulatory apparatus, we will refer to the characteristics and distribution of these parasites, as well as the alterations they cause in the bloodvessels.

The pulmonary lobes show a well-defined zone at their base, in which the tissue is gray, compact, incompletely retracted, and heavier than water. It is studded with grayish, semi-transparent granules, that rarely attain the size of a pin’s head; their accumulation gives a pearly roughened aspect to the free surfaces and to those of sections, and they become more numerous and confluent as they approach the exterior of the lungs. Beneath the pleura they sometimes form yellow patches which, to the pocket-lens, resolve themselves into distinct granules. Beyond the affected zone these granules are very rare, and they almost completely disappear at the summit of the lungs. This granular zone may consist of only a few sub-pleural islets, or occupy two-thirds of the height of the lung; sometimes the islets are voluminous, and disposed irregularly throughout the periphery of the organ.

In preparations made by teasing out the fresh tissue, there is found—amongst various anatomical elements—a more or less considerable number of elliptical ova, 70 μ to 80 μ long, and 40 μ to 50 μ broad, the shell of which is very thin and often wrinkled, and contains a very granular vitellus, more or less segmented, or already developed into an embryo. There are also a certain number of free living embryos, and

when this is the case the bronchi contain masses of them surrounded by mucus.

The granules are the products of nodular vascularities, corresponding to the varieties established by Kiener under the name of 'tubercles of the endogenous type,' and 'tubercles of the exogenous type.' These two types are rarely associated, but when they are, then one of them is in the minority, and appears to be accidental.

The pseudo-follicles of the _endogenous_ type may, by their confluence, form nodules varying from 25 mm. to 1 mm. They are developed in the interior of the smaller arterioles, the epithelium of which proliferates; each comprises: 1. A central zone formed by a giant cell, having a cavity in which is an ovum or embryo; 2. A middle zone, formed by epithelioid cells; 3. A peripheral zone, composed of embryonal elements arranged in a circular manner.

![Fig. 315. — Pseudo-follicle undergoing formation on the course of an arteriole, a, between two layers of muscular fibres, the direction of which is indicated at b by a line of epithelial cells; c, fissure and epithelial lining ensuring continuity in the circulation; d, oval cavity. —Laulanié.](image)

![Fig. 316. — Pseudo-follicle in pulmonary strongylosis of the Dog, showing the ovigerous giant cell. The ovum of the _Strongyulus vasorum_, o, contained in this cell is segmented. —Laulanié.](image)

The pseudo-follicles of the _exogenous_ type form smaller and more discrete granules. They are developed in the external tunic of the arterioles and surrounding tissue, and have the same structure as the follicles of the endogenous type, except that the central giant cell rarely acquires such large dimensions, that the embryonal cells accompany the epithelioid cells of the middle zone, and that the peripheral zone—less limited externally—encroaches on the alveolar walls, sending out buds that project into the alveoli.

In fine, the pseudo-follicles of this Strongylosis have a structure
similar to that of tubercle nodules. Laulanié has shown how much this fact supports the doctrine which considers elementary tuberculosis as the result of an inflammatory reaction due to a foreign body.

Exceptionally, non-tuberculous strongylosis is met with. It then consists of a catarrhal pneumonia, probably due to the alterations in the large vessels in which the evolution of the ova is concentrated. Lastly, even with the granuloma there is always pneumonia of an epithelial nature, peri-bronchitis, frequently thromboses of the vessels, and emphysema in the granular zone.

Evolution.—Judging by the distribution of the ova and embryos in the granular zone and bronchi, and from a number of experiments with regard to infestation—in which Dogs ate pieces of lungs affected with parasitic granuloma—Laulanié believed he was warranted in arriving at the following conclusions, with respect to the cycle of migrations of the Strongylius vasorum:

1. The adult Strongles fix themselves in the right side of the heart, or the large divisions of the pulmonary artery, couple at these various points, where the females lay their eggs, which are arrested in the finest arterioles, and there undergo all the phases of their development;

2. The hatched embryos leave the inflammatory foci, which have protected them, and wander towards the bronchi, whence they are ejected from the body of the host;

3. They are accidentally swallowed by Dogs, and in their digestive apparatus or venous system submit to those modifications which bring them to the adult state in the right side of the heart.

'By the light of these facts,' say Laulanié, 'it can be very well understood how strongylosis may assume an enzootic form, and affect several Dogs in a pack. The attacks—which are marked by much distress and extremely severe dyspnaea—occur from time to time, and apparently coincide with renewed laying of an abundance of eggs by the females—a generation of ova passing into the arterioles, and causing temporary occlusion of these vessels.'

Article V.—Helminthiasis of the Trachea, Bronchi, and Lungs of the Cat.

Independently of the Linguatula denticulata which is met with in the lungs of the Cat (see p. 567), other Nematodes have been noticed, either in the adult state or as embryos. These are the Ollulanus tricuspis, Strongylius pusillus, and Trichosoma aerophilum.

1. Ollulanus tricuspis (Leuck.)—In the adult state, this worm inhabits the substance of the gastric mucous membrane of the Cat. The embryos laid by the females emigrate in the same manner as the Trichina, and the lungs are among the organs they may invade. Each embryo is surrounded by a cyst, in which it remains immovable; and when the number of these formations is considerable, they give the membrane the appearance of being affected with miliary tuberculosis,
each of them being encircled by a zone of hepatization. The inflammatory process may be so extensive as to cause death. In serious cases, the bronchial mucus is more or less sanguinolent, and contains embryos. (For the history of the development of the Ollulanus, see *Parasites of the Stomach of the Cat*, p. 372.)

2. Strongylus pusillus (Miiller).—On several occasions, there has been reported a verminous affection of the lungs of the Cat, the macroscopical lesions of which resemble those of tuberculosis in Man; but it is possible that—as Leuckart remarked—some of these instances were *Ollulaniasis* (Cobbold). But, with Railliet, we admit that nearly all the cases of pulmonary helminthiasis in the Cat are due to a Strongle. The simultaneous presence of the ova and embryos proves, in fact, that both are deposited on the spot. But the worm is very difficult to discover. We once found a non-ovigerous female, and Railliet has obtained portions of the body of a female. Miiller, however, has succeeded in removing entire specimens—male and female—from certain foci; he described them by the name of *Strongylus pusillus* (see p. 582).

The ova and embryos of this strongle cause the formation of verminous pneumonia foci, which usually appear as whitish-yellow granules, from the size of a pin's head to that of a hemp-seed, slightly projecting beneath the pleura, or on the surface of a section. Sometimes they are grouped as grayish, semi-transparent nodules the size of a pea, or are imbedded in a somewhat extensive mass of gray hepatization. They often form prominent sinusous streaks.

The pulmonary tissue intermediate to the granule retains its rosy tint and its permeability. By scraping a section of the invaded tissue, a foamy fluid is obtained, in which ova are seen in all degrees of segmentation, and even containing a well-formed embryo. A large number of embryos move about in this fluid; they are also observed in the mucus of the bronchi, trachea, and upper air passages—Railliet states that he has seen them likewise in the digestive canal.

Laulanié has furnished precise details of the histological lesions of this pulmonary strongylosis.

The ova and embryos are lodged in the pulmonary alveoli. The first are accumulated by hundreds, over a large extent of the field of the microscope—indeed, they are in such compact masses that the network formed by the alveolar walls is broken through, and reduced to thin shreds. They are in all stages and degrees of segmentation and development. They do not produce any other lesion at the points where they are accumulated, than this atrophy by compression of the

alveolar walls. On the other hand, the embryos that come from them, by their migration determine a very abundant diapedesis of leucocytes, which fill the pulmonary alveoli, and from this results foci of purulent miliary pneumonia, which, however, have no resemblance to tubercles.

This strongylosis is very frequent; we have remarked it in a fourth of the Cats—19 of 76—we examined. It sometimes co-exists with scabies, and the disease of the lungs probably induces a cachectic condition that favours the installation of the psoric malady, or the reverse. In many cases, this verminous pneumonia of the Cat does not reveal itself by any noticeable sign. In some instances there is frequent cough, coming on in fits, and often followed by vomiting; after a variable time the animal loses condition, its hair is erect, diarrhoea sets in, and the cachexia—which becomes more and more pronounced—brings about a fatal result after an illness of two or three months. Tracheal parasiticide injections is the only treatment that can be recommended.

3. Trichosoma (Eucoleus) aerophilum (Creplin). This is a filiform worm, the male of which is 24 mm. long, and the female 32 mm.; the body becomes gradually thicker behind, where it attains 100 μ to 180 μ in diameter, and is again attenuated to the posterior extremity. There are two longitudinal bands formed of numerous rods, one of which is ventral, and in width is three-fourths of the total diameter, the other being dorsal and only one-third of this diameter. The tail of the male is truncated, and divided into two lobes, which are united by a thin circular caudal pouch. The sheath of the spicula is covered by very small spines. Eggs ovoid and 72 μ long; they are held on the surface of the female’s body by a mucilaginous layer.

This worm was known as a parasite in the trachea of the Fox; A. Müller found it in the lungs of a Marten, and he also met with eight individuals in the trachea of a Cat, affected with strongylosis to a very high degree. We have found three worms of this species in the trachea or larger bronchi of three Cats, two of which were affected with pulmonary strongylosis. These worms were young females, only one of which contained eggs, but they were not yet fully formed.

1 Ebsteiner and Nicolaier have described, in a zooparasitic tuberculosis of the lungs of a Cat, granules situated between the alveoli, consisting essentially of epithelioid cells with giant cells, and surrounded for the most part by a narrow zone of fibrillar connective tissue (Beiträge zur Lehre von der Zooparasitären Tuberculose). Virchow’s Archiv (CXVIII., 1889, p. 432).
B.—DOMESTICATED BIRDS.

With the exception of Cytodites and Syngames, the majority of the animal parasites found in the respiratory apparatus of Birds are merely accidental, and only met with at autopsies. The vegetable parasites are represented by the Aspergillus, which cause several kinds of mycoses. We have already said enough with regard to acariasis of the trachea and bronchi, and especially of the air-sacs of the Gallinacea (see p. 243). The Syngames and the Aspergillus have an importance which requires a special chapter for each. A brief mention will suffice for the other parasites.

Echinococcus gallopavonis (Siebold).—A fertile Echinococcus found by Von Siebold, in 1837, in the lungs of a Turkey.

Monostoma mutable (Zeder).—Body of a dirty-yellow or slight rosy colour, 5 mm. to 24 mm. long, foliaceous; flat beneath, a little convex above; attenuated into a cone anteriorly, broader and rounded behind, where it is 2 mm. to 8 mm. wide. Sucker subterminal, very small, and surrounding the mouth. Ova brown, ovold, 173 μ long and 84 μ broad; hatched in the uterus, and yielding an embryo that contains a sporocyst. Lives in various parts of the respiratory apparatus of several kind of birds, the majority of which are aquatic. Wiesenthal, Von Siebold, Diesing and Zürrn found it in the sub-orbital sinus of the domesticated Goose; the first of these authorities had witnessed an epizooty caused by it in 1799 (Diesing). A particular interest attaches to this Monostome, as it was the object of the first observations relative to the development of the Trematodes. Von Siebold showed, in 1835, that the foreign body contained in the embryo survived it in the form of a sporocyst, from which Cercariae were derived.
CHAPTER I.

VERMINOUS TRACHEO-BRONCHITIS (SYNGAMOSIS).

The Nematodes which live in the air-passages of Poultry, and give rise to symptoms of tracheo-bronchitis, almost exclusively belong to the genus *Syngamus*, family of *Strongylidae*—tribe of *Sclerostominae* (see p. 325)—a genus in which the species are not numerous, and which infests the trachea and bronchi of Birds and Mammals.

Genus *Syngamus* (Sieb.).—Head thick; mouth large, and succeeded by a chitinous capsule that keeps it open. *Males* relatively small, and provided with two spiculae. *Females* furnished with a double ovary; vulva situated in the anterior part of the body. Copulation—which is permanent in the principal species—*δωρογάμος*, marriage—is effected at an acute angle, and in such a manner that two individuals so united might be taken for a worm with two heads.

Two species have been described in domesticated Birds.

1. *Syngamus trachealis* (Siebold. *S. primitivus* Molin).—A cylindroid worm, coloured red by the fluid between its organs. Head broad and truncated. Mouth orbicular, and sustained by a hemispherical capsule, at the bottom of which are six or seven sharp lanceolated, chitinous eminences arranged around the oesophageal opening, the margin of which is thick and everted, and cut into six festoons divided symmetrically into four lips. *Male* 2 mm. to 6 mm. long; caudal pouch obliquely truncated, suspended by about twelve ribs and attached around the vulva. *Female* 5 mm. to 20 mm., thin in front, irregularly dilated when it is full of eggs; vulva salient

towards the anterior fourth or fifth of the body. Ova ellipsoid, operculated, 85 µ long and 50 µ broad. A remarkable feature in these Syngames is the permanence of copulation, which is so intimate that the males cannot be separated from the females without tearing their integuments.

This worm—which is known to Pheasant-keepers as the red worm or forked worm—lives in the trachea and large bronchi of a large number of the domesticated Birds—common Pheasant, golden Pheasant, Fowl, Turkey, Peacock; and of wild Birds—gray Partridge, Magpie, hooded Crow, Chocard of the Alps, green Woodpecker, Sparrow, Martin. It is most frequent in the Gallinea, and especially Pheasants.

History.—The disease caused by the *Syngamus trachealis* was reported for the first time in 1799, by Wiesenthal, who observed it at Baltimore, America, in Fowls and Turkeys. Montagu in 1806, 1807, 1808, saw it prevail in an epizootic manner among Pullets, Pheasants, and Partridges in England, into which the parasite had probably been imported from America. Since that date, it has been many times observed in America, England, France, Germany and Italy. Bellingham and Railliet have noticed it in the Peacock. It is scarcely more than twenty years since it began to figure in French publications. Our knowledge of the development of the Syngamus is due to Leuckart, Ehlers, Mégnin and Walker.

**Symptoms.**—Birds attacked by Syngamosis are recognised by

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FIG. 318. *Syngamus trachealis*: natural size, and magnified 10 diameters.—Railliet.
'a kind of sudden, whistling cough, something like a sneeze, which more or less affects young individuals. Those most seriously affected yawn and open the beak, at the same time stretching the neck by a peculiar movement, indicative of the inconvenience they experience. The worst cases have the mouth filled with foamy saliva, which they cannot get rid of' (Mégnin).

The name 'gapes' given to this disease in England and America, indicates the principal symptom. The general signs consist of a diminution of appetite, dulness, feathers erect, and all the characters of a cachexia, which, if asphyxia does not intervene, will terminate in death. According to Renne, there is subcutaneous emphysema of the neck and breast. A German breeder says that, in order to confirm the diagnosis, it is only necessary to hold up a sick Bird—with its neck extended—in the sunlight; the parasite can then be seen through the skin and trachea.\(^1\)

A spontaneous recovery is exceptional, especially in young Birds. A gentleman in Somersetshire wrote to Youatt, stating that Pullets would resist the disease when the feathers of the head and neck began to grow.

This parasite may be the cause of deadly epizooties. Wiesenthal estimated the losses at four-fifths of the Gallinæ in the invaded localities; Crisp placed at half a million the number of Pullets destroyed by it in England every year: while Mégnin alleges that, in a pheasantry at Rambouillet, there are about 1,200 victims daily.

**Lesions.**—At the autopsy of Gallinæ which have succumbed to this affection, the Syngames are found throughout the trachea—chiefly near its division into bronchi, sometimes at their origin; they are enveloped in foamy mucus. The majority of the parasites adhere so firmly by their buccal capsule, that they will allow themselves to be torn rather than relax their hold; the point to which they are fixed is often formed into a small tumour full of yellow caseous pus. This abscess may become so developed as to obstruct the trachea, and one alone may induce asphyxia. The number of couples found in one Bird is variable; but two or three may kill a Pheasant of four to six weeks old, though it requires twenty-five to thirty to asphyxiate an adult Pheasant. Independently of the power of resistance conferred by age, the differences in other respects may be related to the diameter of the trachea (Mégnin).

**Etiology.**—The disease scarcely attacks any but young Birds, and then more especially during certain years, though there is nothing certain to account for this. Some poultry-breeders declare that the fattest and best conditioned Birds are the first attacked.

The ova of the Syngamus are developed to a variable degree in the uterus of the female, according to its age and size; when it is 20 mm.

\(^1\) E.-W. Sc. Dresdener Blätter f. Geflügelzucht, 1882; and Arch. Vétérinaires, 1884, p. 90.
to 22 mm. long, the embryo is completely formed (Cobbold, Mégnin). These ova are not laid, and they can only escape from the body of the female in case of rupture, which, in ordinary circumstances, results from cadaveric decomposition. The ova—whether embryonated or not—fall on damp ground or in pools of water, and are hatched in from seven to forty days, according to the temperature. Ehlers has shown that the embryo has no need of an intermediate host, in order to become transformed into an adult worm. In Birds which he had caused to ingest ova containing embryos, in about twelve days he found coupled individuals, and—after seventeen days—females full of eggs. Walker has observed that the embryos remain alive in the digestive canal of the earth-worms, and that when Birds swallow these they become affected with Syngamosis. Mégnin has given the 'gapes' to a Parrot, by feeding it with a certain number of Syngames collected from Pheasants. It has been noted that affected birds often cough up the parasites, and their companions immediately swallow them with avidity. This is evidently the way in which Syngamosis is propagated.

The way in which the embryos reach the respiratory apparatus is not known. Perhaps they become adherent in the pharynx during deglutition, and afterwards pass directly into the trachea.

**Treatment.**—Isolate the affected Birds, and put those yet healthy on clean ground. Bury deeply or burn the bodies of dead Birds; disinfect the ground of pheasanteries or poultry-yards, by sprinkling over it a 1 per cent. solution of salicylic or sulphuric acid; give uncontaminated food and water to the Birds, adding to the water two or three drachms of salicylate of soda to the quart—such are the preventive measures recommended by Mégnin.

In America (and also in England), a feather from which all the barbules have been removed except those at the point, is introduced into the trachea and turned round there, with the object of detaching the worms; but this is an insufficient and dangerous proceeding, and can only remove a small number of the parasites which are situated at the upper parts of the trachea, and are exceptionally slightly attached to the mucous membrane; while it may cause suffocation that will lead to sudden death.

Following Cobbold's advice, we may, in cases of imminent asphyxia, open the trachea and withdraw the worms.

Montagu has been successful with a vulgar remedy in England, which consists in damping with wine, instead of water, the grain with which the diseased Birds are fed.

Garlic has been employed with much success, first by Montagu, then by Mégnin. Montagu gave an infusion of rue and garlic, instead of water, to drink. Mégnin prescribed, as food, a mixture of hard-boiled eggs, ox-heart soup, stale bread, and salad, all well mixed up with chopped garlic, and given in the proportion of one clove of the latter daily to
every six Pheasants. He was also fortunate in the employment of powdered asafoetida with an equal part of powdered gentian, these being incorporated in a cake, and given in the proportion of 50 grammes per head every day. He also mixed in every quart of drinking water, a solution of 1 gramme of salicylic acid to every 100 grammes of water.

It is in being eliminated by the air passages, that the volatile principles of garlic and asafoetida act as toxicants on the red worms of the trachea.

Mégnin recommends, besides, fumigation with sulphurous acid; the fits of coughing to which it gives rise cause the expulsion of the parasites. But this means requires much watchfulness, in order to avert accidents from suffocation.

The German breeder above-mentioned, advises the employment of an 8 or 10 per cent. solution of salicylic acid, a few drops of which are to be carefully injected into the trachea by means of a straw stalk. And an English farmer says he has rarely lost an affected individual since he resorted to tobacco smoke. He places the pullets in a box, which he covers with a cloth; then puts a little tobacco in a pipe, lights it, puts some more tobacco on the top, introduces the pipe into the box and blows gently through the stem, until the Birds fall over almost inanimate. He then restores them to the open air, 'when they soon recover their health (Railliet)'.

Tracheal injections do not yet appear to have been seriously tried. (Those who have employed it speak highly of paraffin, applied directly to the upper part of the trachea by means of the tip of a feather.)

2. Syngamus bronchialis (Mühlig).—Body cylindrical, and tapering slightly in front. Mouth arranged as in *S. trachealis*. Male, 10 mm. long; caudal pouch spherical, entire, and sustained by ribs, the two posterior of which are trigonated, and arise from a common trunk that is nearly double their length, the middle and anterior ones cleft—the external anterior lying alongside the middle one; spicula filiform, curved at the end, and fringed at the inner margin. Female, 25 mm. long, the posterior extremity terminating in a conical point; vulva slightly salient, and situated at the first third of the length of the body. Ova ellipsoidal, non-operculated, and 90 μ long by 60 μ broad. Copulation is not constant, and the coupled worms may be disengaged without tearing the integuments.

This worm has been found by Mühlig in some young Japanese Geese. It is at least closely related to the species that lives in the black Stork, and which Diesing named *Sclerostomum tracheale*—the *Syngamus Sclerostomum* of Molin.

Mühlig met with this Syngamus to the number of 20 to 30, forming bundles in the larynx, trachea and bronchi, the ultimate ramifications of which they had reached, and where they were enveloped in a thick

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mucus. There was sometimes a croupal pneumonia, and an exudate of the same character was thrown out into the air-sacs, which also contained ova that had undergone segmentation to a variable degree, and free embryos. The symptoms were analogous to those noted in the Gallinæ, and consisted chiefly in gaping and a characteristic cough.

Przibylka has several times observed the same affection in Geese. It attacked, by preference, the young ones, and always terminated in death. Besides the above symptoms, he remarked a state of debility that kept the Birds lying for a long time, accompanied with convulsive movements of the head, and efforts to vomit—due to the mucus, mixed with worms, that had accumulated in the trachea and bronchi.

Hayem found in each of two Ducks—which were at the same time affected with pulmonary mycosis—twenty worms agglomerated in bundles in the trachea, and particularly in the syrinx; some had even penetrated the lungs. Hayem assigned to them a length of 35 mm. to 40 mm. for the females, and about 15 mm. for the males. He classed them with the *Sclerostoma armatum* Dies. of the Horse—the *Scl. equinum* Müll.; but it is more probable that they belong to another species of Sclerostome or Syngame—perhaps, even, to the *Syngamus bronchialis*.
CHAPTER II.

MYCOSIS OF THE AIR-PASSAGES.

A large number of observations have established the fact that the Fungi of moulds—Mucorinae—belonging to the genus Aspergillus Micheli, may develop and vegetate in the respiratory apparatus of Birds—exceptionally in Mammals—and cause serious alterations in it. According to the seat they occupy, we have broncho-mycoses, pneumomycoses, and cytomyces or mycoses of the air-sacs. These affections will be examined first in Birds—in which they are relatively frequent, and then in the domesticated Mammals—in which they are quite rare.

Birds.1—The first recorded case of pneumomycosis goes back as far as 1815, and is due to Meyer and Emert, who observed it in a Jay. Afterwards, similar occurrences were noted in the Flamingo, Eider-duck, Sea-gull, Stork, Ostrich, Plover, Parrot, Bullfinch, Raven, Owl, Falcon, etc., with regard to wild Birds; and in such domesticated Birds as the Fowl, Pheasant, Pigeon, Goose, Duck, and Swan.

The Aspergilli are Fungi belonging to the order of the Ascomycetes—that is, of those which form their spores by partial division in the interior of tubular mother-cells, named asques or thecae, and are grouped in special apparatuses—the perithece. The latter do not open, and must be destroyed before the spores are set free; this is the character of the family of Perisporiaceae.

The Aspergilli are endowed with great vegetative power, and are constituted by filaments of colourless mycelium, having thin, transparent walls, with unequal spaces formed by partitions, and throwing out lateral ramifications. These filaments form, on the surface of their

substratum, a felted layer—the *thallum*—above which is spread a looser layer in the form of down—the *aerial mycelium*. From it grows the fertile, non-partitioned filaments that expand into a head at their summit. This head buds and is covered with branches—*sterigmata*—each terminating in a chaplet of radiating, globular spores—*conidia*—the whole of which forms a kind of *capitulum*. In certain species—*Asp. nigrescens*—these primary branches ramify at the summit in their turn, and terminate by a vorticelli of sterigmates, each of which bears a chaplet of conidia. Besides this conidian apparatus, the *Aspergillus* are also characterized by their perithecae, which have been seen in only two species—*A. glaucus*, or *A. repens*. These are globular masses—kind of tubercles carrying mycelian filaments at their ends, and containing, when ripe, special cells—*asques*—each of which divides in other eight cells—*ascospores*. The wall of each peritheca may at first, by thickening and modification of its external cells—assume the consistence of a hard body—*sclerote*—in which the asques only form at a later period. In any case, the *asques* or, better, *ascospores* are only set free by rupture of the external wall of the peritheca, which has previously become very thin.

Four species of *Aspergillus* have been found in the parasitic state, though this is only accidental for them, as, like the other moulds, they develop almost exclusively on dead organic matters.

1. *Aspergillus glaucus* Link (Eurotiun herbariorum Link, Eurotiun Aspergillus glaucus De Bary).—Filaments of the mycelium partitioned at long intervals; salient filaments 1 cm. long. Capitules irregularly rounded, greenish-blue, yellow or brown. Conidie grayish green, round or oval, and from 8 μ to 15 μ. Perithecae globular, and from 75 μ to 80 μ. Asques from 12 μ to 15 μ, containing 8 lenticular, colourless ascospores from 8 μ to 10 μ in diameter.

2. *Asp. nigrescens* (Asp. Niger Von Tieg.).—In tufts of a chocolate brown colour. Capitules very compact, each formed by an expanded globular base, the sterigmates of which are brown and long, and are divided into from three to eight digitiform branches, on which are reared the conidian chaplets; these are very small—2·5 μ to 3·5 μ—and brown or brownish-violet. Perithecae are irregular in shape, and brownish-gray or red.

3. *Asp. funigatus* Fresenius.—This has a great resemblance to the preceding species by the size and tint of the capitules, which are, however, a little brighter and rounder; but the cones are inverted. Sterigmates undivided, yellow or blue, then brown or dark-gray. Conidie round, smooth, and colourless.

4. *Asp. candidus* Link.—Sterigmates transparent. Capitules truncated. Conidie colourless, snowy white when seen in masses, and from 2 μ to 3 μ in diameter.

Mycoses of the air-passages have been observed in Poultry, by Serrurier and Rousseau in 1841, Bollinger in 1881, and Perroncito in 1883; in Pheasants by Robin in 1848, and Rivolta in 1887; in Pigeons by Serrurier and Rousseau in 1841, Bonizzi in 1876, Generali in 1879, Bollinger and Kitt in 1881; in Geese by Fresenius in 1858, and Schütz
in 1881; in Ducks by Hayem in 1873; and in Swans by Jäger in 1810, and Zschokke in 1887.

The Symptoms consist at first in an acceleration of the respiration, in a more or less serious catarrh of the trachea and bronchi, and a ronchus heard loudest in expiration. Then the respiration becomes more and more difficult and suffocant, and the ronchus louder and rumbling, as in diphtheria. There is fever, the temperature of the body is elevated, the appetite is diminished or has altogether disappeared, but the thirst is, on the contrary, increased. The sick creatures keep aloof, and are feeble and depressed; the wings droop, the feathers are erect, the eyelids half closed, the head pendulous, and the aspect somnolent. Emaciation sets in more or less rapidly, and a colliquative diarrhoea carries off the Birds in from one to several weeks—or even two months' illness. In mycosis of the air-sacs, marasmus is sometimes the only sign of the malady.

The Lesions are seated in the trachea, bronchi and lungs, and various air-sacs—rarely in the nasal cavities, or the air-sinuses of the bones.

They are tubercles, or plane or discoid membranous formations, 3 mm. to 10 mm. thick, of a dirty-yellow or greenish colour, and are at first soft, then more consistent, and in the form of a fibrino-purulent exudate. Sometimes the air-cavities are more or less obstructed by these formations, which are then thicker and firmer. They may undergo caseous or calcareous degeneration. In their substance, but more especially on their surface or superficial layers, are found the mycelium and conidian apparatus of an Aspergillus. The exudate is composed of fibrin in which are many leucocytes—the majority of these being infiltrated with fat—and multitudes of micrococci. In the lungs are agglomerated or disseminated tubercles, these organs presenting the appearance of caseous pneumonia, or phthisis with crude tubercles. Perroneito on one occasion found the affection localized in the membrane lining the thoracic sacs and the peritoneum, the lesions consisting of tubercles, the largest of which were the size of a pin's head, and altogether resembling those of the acariasis due to the Symplectoptes cysticola (see p. 245). In their centre was a mycelium of the Aspergillus.

It is possible that, in some cases, the Fungi establish themselves only in respiratory organs already enfeebled by some disease; but generally they are veritably and primarily pathogenic. Spores from forage and litter penetrate with the inspired air, and find in the mucous membrane of the respiratory passages a warm, moist medium that is favourable to them; there they throw out a mycelium which, in developing, gives rise to inflammatory phenomena. This conclusion results from the interesting researches of Schütz. Siebenmann had shown that the Asp. fumigatus and Asp. nigrescens vegetate at a somewhat high temperature; and Schütz has recognised that the first of these species—which requires a temperature of 37° to 40° Cent., is the most
dangerous; while *Asp. nigrescens*—which grows at 35° only—is less to be feared, for if its spores germinate at the temperature of the body of Birds, it will not produce a true mycelium. With regard to the *Asp. glaucus*, it does not germinate at the animal temperature, and, according to Schüttz, its spores can only act as a foreign body by mechanical irritation and obstruction of the air-passages.

The experiments instituted by Dieulafoy, Chantemesse and Widal, with the *Aspergillus fumigatus*—and of which we have already spoken (p. 343)—also throw light on the pathogenic action of these moulds. Cultures have been made with this *Aspergillus* removed from the lung of a diseased Pigeon, and the spores of this culture, on being injected into the axillary vein of a healthy Pigeon, gave rise to a hepatic and pulmonary tuberculosis that was fatal in three or four days. Injected into the trachea, they cause death in a period varying from ten to twenty days, according to the dose. The lesions are in this instance predominant in the lungs, where the agglomerated tubercles may simulate blocks of pneumonic infiltration in which caseous masses form. The histological lesions are in every way like those of bacillary tuberculosis; sections show the tubercular nodules surrounded by giant cells.

The youngest nodules are formed by an agglomeration of leucocytic or epithelioid cells around one or several mycelian filaments. The oldest granules have in their middle a felting of mycelia, with branches more vigorous at the periphery than in the centre. In certain cases the tubercle is only represented by a large giant cell, the protoplasm of which contains a ramification of the mycelium either alive, altered, or moniliform, as if digested by phagocytosis. Some tubercles attain a fibrous evolution, their centre being only represented by fibrillar protoplasm which merely contains vestiges of the Fungus, or even nothing of it—as if the tubercle had entirely destroyed the parasite.

The finer and more delicate breeds of Pigeons are, according to Generali, more exposed than the common breeds to the pneumomycoses and mycoses of the air-sacs.

The prophylaxis of this affection—which may appear in an epizoötic form—evidently consists in rigorous cleanliness of the fowl-roosts and dove-cots, etc., in their disinfection with boiling water, and in the destruction of everything invaded by the moulds.

The malady is usually fatal. At its commencement, however, benefit may be derived from the employment of tar vapour, engendered as follows: a spoonful of vegetable tar is poured on a pint of water, and this is then stirred about with a piece of red-hot iron; but the vapour should not be so dense as to be irritating.

**Mammalia.**—Several moulds in the form of spores may enter the air-passages of the domesticated Mammalia, and become developed there if any pathological alteration—such as a pulmonary cavern,
tracheotomy, etc.—locally suppresses the current of air, and offers a favourable habitat to these Cryptogams. But in such a case they do not become pathogenic, and we need not further refer to them; nor is it necessary to notice the cases of pneumonias or pneumoconioses due to the penetration of spores that act simply as irritants, and do not vegetate. The pulmonary mycoses due to micrococci, do not enter into the scope of this treatise. Owing to this elimination, there remain only a small number of real pneumomycoses in the domesticated Mammalia to consider.

Zürn states that Schütz has on several occasions observed aspergillassary pneumomycosis in the Horse, he (Zürn) having witnessed it in Oxen.

At the autopsy of a Horse destroyed because affected with paralysis of the pharynx, Rivolta found a tumour of the right sinus, the sanguineous and purulent contents of which contained numerous filaments of mycelium and shining nucleated cells. There was also pneumonia of the right lung, and filaments of mycelium in the pulmonary vesicles. The pathogenic role of the Fungus is far from being well established.1

Martin has published an interesting observation with regard to pneumomycosis in a Horse four years old, which was destroyed because it was so wasted, it having scarcely eaten anything for several months. In the whole anterior portion, and in the inferior moiety of both lungs, the pleura was unequally thickened, injected, and opaque. The anterior lobes of the lungs were hepatized, and in their mass were disseminated purulent nodules—bigger than a pea—surrounded by a thick connective-tissue membrane, and often communicating with the bronchi. The mucous membrane of these was inflamed, and their lumen obstructed by purulent products. Larger nodules were found in the liver. All of these showed—in the midst of pathological products—the filaments of mycelium from 2 μ to 3 μ broad by 15 μ to 30 μ long; some of them were as much as 6 μ broad and 20 μ to 90 μ long. Their nature and origin were not determined.2

Roeckl has made a similar observation with regard to a Cow. Nodules the size of a hemp-seed were scattered throughout the pulmonary tissue. Partial pneumonias gave to the organ an appearance analogous to that of pleuro-pneumonia. The bronchial mucous membrane was ulcerated at several points; the nodules corresponded to the pulmonary alveoli, their centre being formed of a mycelium, the filaments of which had a radiated arrangement at their periphery. By their dimensions they appeared to belong to the Asp. fumigatus. Piana has recorded a similar case in a Cow.3

Mazzanti has also found the lungs of a Lamb full of tubercles, which had puriform contents; they were the size of a poppy to that of a hemp-seed, surrounded by an inflammatory areola, and sometimes three or four of them were collected in a mass. Their contents contained spores and a mycelium formed by a central cell, that threw out a small number of filaments 11 μ long and 4 μ broad, terminating in an enlargement from which new filaments issued. The nodules had their point of

1 Rivolta. Il Medico Veterinario, 1856.
origin in the air-cells, whence the morbid process had invaded the neighbouring parts—irritation of the interlobular connective tissue, exudation into the terminal bronchial divisions, tumefaction of their mucous membrane, and hyperplasia of the peri-bronchial connective tissue. Rivolta has given the name of *Mucorimyces canis familiaris* to a Fungus he found in a Bitch that died in a state of marasmus, after presenting the following symptoms: dry and frequent cough, respiration hurried, lameness of a hind-leg. The kidneys, lungs, spleen, and left cornu of the uterus were invaded by encephaloid sarcoma, which contained filaments interlaced in various directions, some of them being formed by round cells or spores placed end to end. Their diameter varied from 4 \( \mu \) to 22 \( \mu \), and their length reached 28 \( \mu \). It is regrettable that this Fungus had not been cultivated, as this would have revealed its nature, and probably have led to the suppression of the arbitrary name of *Mucorimyces* given to it.\(^1\)

\(^1\) Mazzanti. *Pneumonicosi in un Agnello.* Il Moderno Zootatro, II., 1891, p. 87.

BOOK V.

PARASITES OF THE CIRCULATORY APPARATUS.

Among the embryos of parasites which, when introduced into the digestive apparatus, do not find there the conditions required for their development, a large number pass through the gastric or intestinal wall in search of a habitat better adapted to their needs. Some of them in these migrations enter the bloodvessels, and in them are passively carried on to the place where they will undergo their ulterior development—such are, as an incontestable example, the parasitic Helminths of the nerve centres. The blood from various parts of the body, in this way often acts as a carrier of the parasites, which, owing to their microscopical dimensions, and their extensibility, can pass through the capillary networks. The majority only pass through the circulation, but there are some which make the blood their habitat—it attracts and retains them; these, for this reason, are named Hæmatozoa, because one of the phases of their existence requires the blood as a medium.¹

The majority of Hæmatozoa are Helminths, though the presence of Infusoria has been observed in the blood of several Mammals and domesticated Birds.

Generally speaking, the Hæmatozoa have no appreciable influence on the health of their host; but sometimes they bring about local or general disorders, which are most frequently subordinate to disturbance in the circulation.

Independently of the Hæmatozoa, other Helminths—in developing in the myocardium—are capable of determining grave alterations. If the heart could admit all the parasites which have the muscles for their habitat, the Echinococci would alone deserve to be examined here, as they of themselves are a source of danger. They may be met with in the heart of all the animals which harbour them, but their evil effects have only been noted in the Ox and Horse.

In the following chapters we will examine the various parasites which have been found in the circulatory apparatus of the domesticated animals.

CHAPTER I.

H.EMATOZOA OF THE HORSE.

The parasites of the blood or of the organs of circulation in the Horse, are Infusoria, or Nematodes in the embryonic or larval states. Echinococci are sometimes also found in the walls of the heart or arteries; but this matter will be considered when studying the parasites in the heart of the Ox—only the parasitic Infusoria and Nematodes of the circulatory apparatus being dealt with here.

Article I.—Infusoria. ¹

The Horses and Mules of the Indian army are often attacked by a very deadly disease, which is also observed in Camels, and which is designated Surra (an Indian word) by the English army veterinary-surgeons; it is accompanied, in the majority of cases, by an Infusorium in the blood. This is a Euflagellate of the family of Cercomonadidae, like the Monocercosmonas and Trichomonas (see p. 318). Evans, who was the first to observe it, mistook it for a Spirillum; Steel afterwards described it by the name of Spirochate Evansi; but Crookshank, after a minute study of this organism, recognised it as a flagellated Infusorium, and gave it the name of Trichomonas Evansi. Osler subsequently classed it in the genus Haemotomonas—a class created in 1883 for a Protozoön found in the blood of Fishes—under the designation of H. Evansi. But, as Balbiani observed, it is in reality a Trypanosoma, and ought to be called Trypanosoma Evansi.

It measures 20 μ to 45 μ in length, by about 1 μ in breadth towards

the middle. Very variable in shape, it resembles an embryonic Nematode, and has a longitudinal undulating membrane that prolongs the body behind, like a long, slender, and very flexible tail.

_Surra_ is an epizootic pernicious anæmia, which is manifested by elevation of temperature, inappetence, rapid emaciation, an icteric tint of the visible mucous membranes, lachrymation, leucocytosis, swelling of the limbs, and thick, high-coloured urine. The wasted animal falls into a state of extreme debility, and death occurs in marasmus and coma in about from ten to sixty days.

An examination of the blood during life shows an increase in the number of white corpuscles, and a diminution in that of the red—the majority of which are altered, and have a crenellated contour; in the midst of these, and displacing them by its movements, is the _Trypanosoma Evansi._

At the autopsy, there are observed infiltrations into the connective-tissue, enlargement of the lymphatic glands, and slight dropsy of the serous membranes; the stomach and intestines are congested, and contain a certain quantity of a yellow fetid fluid; the gastric mucous membrane shows ulcers of variable dimensions, which may extend to the muscular tunic, and lead to perforation; the spleen is enormous in size, and may weigh two kilogrammes; the lungs are congested; all the other organs are anæmic.

Nothing is known as to the etiological conditions of the disease, although it is considered as allied to malaria. Evans has recognised that it is transmissible by inoculation, and that the blood of affected animals may spontaneously or experimentally contain the Trypanosome. It is probably the same organism that Lewis found at Calcutta in 1855, in the blood of a young Dog, and in that of the Horse and Camel.

_Surra_ has sometimes decimated the English cavalry in India, killing 50 per cent. of the Horses. There is no doubt that it is the same disease observed by Blanchard among the Mules imported into Tonquin (Cochin-China) for the use of the French army. There is yet much to be done in order to establish the pathogeny of this affection, and the part played in its production by the _Trypanosoma Evansi._

(This parasite would appear to infest the blood of several species of animals, without causing them any perceptible inconvenience. As has been mentioned, Horses, Mules, and Camels—but especially Horses—suffer from a disease in which the Trypanosome is generally found in the blood, and in which the most marked feature is anæmia. It is more prevalent in some parts of India than others, and appears to be very common in Burmah and Cochin-China—though it will probably be found, on investigation, to have a wide geographical extension in the warm and humid regions of Asia.

It is looked upon as invariably fatal, though the total losses from it in India are not so serious as Neumann states, as it is not generally prevalent; nevertheless, the mortality caused by it in that country and Burmah has been described as enormous. In one regiment alone—the fifth Bengal Lancers—15 Horses and 13 Mules succumbed to it in 1890; and in 1891, 11 Horses and 7 Mules perished. Dogs appear to be spontaneously affected, and die. Dogs and Monkeys have been successfully inoculated, and Rabbits are very susceptible—though the disease is not so fatal in them.

The Symptoms—as Neumann remarks—are progressive anæmia,
with lassitude, emaciation, conjunctival petechiae, abundant urine, and ultimately death from exhaustion. The urine in most cases is albuminous. Ranking—the latest observer—states that the course of the disease is characterized by fever of a remittent or intermittent type, with irregular exacerbations, and not often rising beyond 104° F., falling, however, as low as 98° F.

Ranking made most careful examinations of the blood in a number of cases, but in only one specimen did he find the organism—Spirillum, Hæmatomonas, Spirochaæt—hitherto supposed to be the cause of 'Surra.' He remarked the crenellated condition of the red corpuscles—which he terms echinosis, from their resemblance to an echinus; but what particularly struck him was the appearance—in the interior of the corpuscle—of a foreign substance presenting ameboid movements and very various form, varying from circular through stellate and piletate forms to a veritable bacillar form—straight, curved or spiral. These bodies he considered comparable to, if not identical with, the Plasmodium malariae of Marchiafova and Celli, as they corresponded in all particulars—both of morphology and development—with those organisms. In Ranking's experiments, this organism—which was invariably present in all the cases—conformed in every point to the requirements of Koch's postulates, with regard to such organisms and contagious disease.

When the blood was in the stage of 'echinosis,' the red cells had adherent to them, or imbedded in their substance, minute circular organisms, varying in size from 0004 mm. to 002 mm. in diameter. These—which he named 'spores'—were in some stages seen free in the plasma in variable quantities, and exhibiting actively motile properties. They attached themselves to the surface of the red blood-discohs, giving rise to the echinoid corpuscles of early echinosis.

After a variable time, the cells lost the echinoid appearance and became plasmodic—that is, they were occupied by the organisms mentioned above, and were comparable to the Plasmodium malariae. These plasmodic corpuscles were of irregular contour in most instances. After a further period the plasmodia broke up, underwent rapid fission into spores 002 mm. in diameter, escaped from the blood-cell, and became free in the plasma. The red cell, having lost the spores, almost immediately resumes its normal contour; but only for an instant, as it rapidly loses all colouring matter, becomes translucent, and all but invisible—which serves to explain the extreme anemia that specially characterizes the disease. In suitable preparations, in addition to these organisms, are seen colourless wandering masses of plasma ovoid in shape, and beaked or flagellated at either pole; ordinary leucocytes; bodies evidently phagocytes; mulberry-shaped masses of yellow spores, believed to be aggregations of spores in phagocytes; large irregularly globose leucocytes with one or more nuclei, in many cases containing the beaked plasmodia above mentioned, and frequently full of motile spores; fusiform bodies resembling those figured by Golgi, as one stage in the development of Laveran's parasite.

Ranking cultivated this organism—which became a bacillus—in milk, in which it grows quickly, on potato, and in bouillon.

From his researches, Ranking is of opinion that 'Surra' is a disease

(1 Carter. Blood Contamination and Infective Disease of the Rat and of Equus in India. Scientific Memoirs by the Medical Officers of the Army of India, Part III., 1888.)
of malarial origin comparable to ague, both by the period of prevalence and results of treatment—the relation between the *Plasmodium malariae* and the *Bacillus malariae* of Klebs being shown to be very close.

It is very probable that infestation occurs through drinking water, Ranking having found the spores of this bacillus in well water. Therefore if all water used for drinking could be boiled, this source of harm would be suppressed. Forage should be dried, when possible, and dry fodder ought to be exposed to a high temperature. By giving very large doses of quinine frequently in milk, with iron and arsenic, at the commencement of the malady, Ranking is hopeful that it might be checked in its development. A Horse seriously affected was recovered by the adoption of this treatment.)

**Article II.—Nematodes.**

The Nematodes most frequently met with in the circulatory apparatus of the Horse, are the armed Sclerostomes. Sometimes embryos are observed, which may belong to a recognised adult form.

**Embryos of Nematodes.**—Sonsino has given the name of *Filaria sanguinis equi*, to microscopical larvae discovered in the blood of a Horse in Egypt. They were similar to those of the *Filaria sanguinis hominis*, which is found in Man in the hot parts of Asia and America; but they were smaller, those of Man measuring 120 μ to 125 μ long, and 8 μ to 11 μ broad. It must be remarked that at the autopsy of the Horse in question, a number of the *Filaria papillosa* were found in the peritoneal cavity, and these may have been the source of the Hæmatozoa; for Wedl had observed embryos in the blood of a Horse, in the peritoneum of which was a *Filaria papillosa*.

Lange, of Kazan, reports that Jakimoff found in the blood from various parts of the body of a Horse affected with hematuria, the embryos of Nematodes in such quantities that each drop of blood contained one or two. They were about 30 μ long and 5-4 μ broad. None were met with in the urine of this Horse, which recovered rapidly. Lange was inclined to consider these Nematodes as the cause of hæmaturia, chiefly in an enzootic form, and he likens their effects to those produced by the *Filaria sanguinis hominis*.

Mazzanti found at Pisa, in the hepatic vessels of a Horse, the embryos of Nematodes from 10 μ to 180 μ, and 2-85 μ to 5-7 μ, with a tail sometimes obtuse, sometimes acuminate. They were different from those of the *Filaria papillosa*, and Mazzanti regarded them as the cause of the nodules that are at times observed in the hepatic parenchyma (see p. 500).

**Sclerostoma armatum** (Rud., *Sclerostoma equinum Müll.*).—This parasite, in the adult state, inhabits the cæcum and commencement of the large colon (see p. 404), but it is often met with in the arteries of the Horse, Ass and Mule, and generally causes the formation of aneurisms.

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3. Ruysch. *Dilucidatio Valcularum... Accesserunt*, etc. The Hague, 1565, and
A knowledge of them goes back to the seventeenth century. In 1655, Ruysch discovered in an aneurism of the mesenteric artery of a Horse an innumerable quantity of small worms, and later he published three or four similar observations. In 1725, Schultze recorded another instance; as did Chabert in 1782, he quite naturally calling these worms crionis. Since then such observations have been greatly multiplied, principally by Rudolph, Hodgson, Greve, Rigot, Trousseau and Leblanc, and Hering. Bayer, but more essentially Bollinger, have made an attentive study of this parasitism, and in following it out have definitively established its essential points.

FREQUENCY OF THE ANEURISMS.—These verminous aneurisms have only been seen in the Equidae—Horse, Ass, Mule, and Hemione (Laboulbène).

According to Numan, they are more frequent in the Ass than in the Horse. Hering asserted that, except in young Foals, it is rare to find a Horse without aneurismal dilatation; and Bollinger estimated at 90 to 94 per cent. the proportion of adult Horses so affected. According to Semmer, at Dorpat all the Foals, without exception, have verminous aneurisms. Mather has witnessed a kind of epizooty break out among Foals, consisting of verminous aneurisms of the aorta, near the origin of the renal arteries.

SEAT.—These aneurisms are only seen on certain viseral branches of the posterior aorta, and exceptionally on the posterior aorta itself. In 65 Horses, Hering has noted aneurism of the trunk of the great mesenteric artery in 7 cases; the coeliac artery in 59 cases; the celiac artery in 18 cases; the artery of the small intestine in 16 cases; the small mesenteric artery in 2 cases; the coeliac trunk in 2 cases; the hepatic artery in 3 cases; and in the renal artery in 1 case. It is not uncommon to find more than one aneurism in the same Horse.

In 35 Horses, Bollinger counted 60 aneurisms; and in adding these

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to the 108 seen by Hering in 65 Horses, he reckoned that in 100 Horses there were 168 aneurisms, of which 153 were in the large mesenteric artery and its branches, 4 in the celiac trunk, 3 in the hepatic artery, 3 in the small mesenteric artery, 3 in the renal arteries, and 2 in the posterior aorta. In 100 Horses, 90 to 94 had one or more verminous aneurisms. Sclerostomes were also several times found in the spermatic artery, and on three occasions in the cerebral arteries (see Parasites of the Genital Organs, and Parasites of the Nerve Centres). Lastly, Roll indicates them as being found in the vena cava, and, according to Valentine, a specimen was discovered in the vena portae, at the Berne veterinary school.

Pathological Anatomy.—The verminous aneurism is usually fusiform, sometimes globular or cylindroid. Its average size is about that of a walnut; though it may not exceed that of a pea, or it may attain the dimensions of a Man's head.

It consists of a dilatation of the affected artery, with hypertrophy of its walls. The dilatation is sometimes absent, notwithstanding grave thrombic lesions in the vessel (Durieux).

The external tunic is usually thickened, and variably indurated, according to the age of the tumour. It adheres firmly to the neighbouring parts, and is more or less confounded with the surrounding connective tissue.

The middle tunic is always hypertrophied, and sometimes very much so. Its thickness—which is ordinarily about a millimètre—may attain, and even exceed, two centimètres. At one time this thickening is due to simple hypertrophy of the tunic; at another time it is owing to inflammatory phenomena, with atrophy of the muscular fibres.
The internal tunic is nearly always altered. It may present every degree of endarteritis, and of regressive metamorphosis—from partial thickenings, and a white milky tint, to ulceration, atheromatous transformation, and calcification; the latter, however, is always rare, and may exceptionally assume an aspect of real ossification.

In the interior of the aneurism there is usually a fibrinous deposit—a thrombus—always adhering, though to a variable degree, to the internal membrane. It is more or less regular and consistent, and partially blocks the vessels; but there is always a canal in the middle for the passage of blood. This thrombus is often prolonged in the artery beyond the aneurism, both before and behind; and its external layers are capable of becoming organized and undergoing

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Fig. 320.—Verminous aneurism of the great Mesenteric Artery; one-half the natural size.—Railliet.

α, aorta; c, coeliac trunk; h, hepatic artery; g, gastric artery; s, splenic artery; m, trunk of the great mesenteric artery; ta, trunk of the anterior fasciculus, the seat of a small aneurism; cg, left colic artery; cf, first artery of the floating colon; fg, arteries of the left fasciculus or small intestine; td, trunk of the right fasciculus, the seat of an aneurism: the upper wall of the vessel has been excised, to show the thickening of the middle coat of the artery, the internal clots, and the sclerostomes fixed therein; cd, right or straight colic artery; cl, inferior caecal artery; cs, superior caecal artery; ic, iléo-caecal artery; ry, left renal artery.
softening. Its formation is essentially connected with the presence of
the worms, the inflammatory processes—ulcerative and regressive—in
the internal tunic, and the dilatation of the vessel. Decroly has pub-
lished a remarkable case, in which the alteration in the aorta extended
from the heart to the lumbar region.

In the aneurism, worms are found in nine cases out of ten; their
average number is from 9 to 11, and varies between 2 and 121. When
they are absent, the lesions have a chronic character; but when they
are present, then these are more or less acute. The parasites are
young armed Sclerostomes. They are rose-tinted, and their average
length is from 1 to 3 cm.; their sexual characters are already well
declared, but their genital organs remain rudimentary. They undergo
one moulding in this situation, in which their buccal armature assumes
its definitive characters. Rayer and Diesing, who erroneously con-
sidered them as a distinct variety, named them—the former—the
*Strongylus armatus minor*, and—the latter—the *Sclerostoma armatum
aneurysmaticum*.

Amongst the aneurismal Sclerostomes, some are almost free in the
cavity of the artery; but the majority are more or less concealed in
the layers of the thrombus—the head or tail usually projecting into the
blood-stream. They are also found in the hypertrophied walls of the
artery, in either the internal or middle coats, or between these two.
Sometimes nothing is found of them except the integuments they left
after their final moulding. Generali found in an Ass—besides the
aneurism of the mesenteric artery—a tumour situated at the origin
of the arteries of the small intestine, which had two abscesses in its
interior, each of which contained a male Strongle.

The gravity of verminous aneurisms is due to the risk of rupture
of the vessels, and more especially—as Bollinger has pointed out—
to their influence on the frequency and seriousness of colics.

The clot formed in the interior of the great mesenteric, or other
arteries liable to these aneurisms, may throw off one or more fragments,
which are carried by the blood, and constitute so many embola in
the arterial ramifications passing to the intestine. According to the size
of the embolus, the obliterated artery is itself more or less voluminous,
and the disturbance set up more or less serious; there is sudden
anaemia or ischæmia of that portion of the intestine to which the artery
is distributed, and consequently paralysis of one or more of the sections
of the digestive tube, the secretions and movements of which are sus-
pended. Cohn and Panum have shown experimentally, in fact, that
such are the results of embolism of the great mesenteric artery. The
ischæmic portion of the intestine becomes at first pale, then of a dark-
red colour; the mucous membrane is swollen, there are hemorrhagic
infarcts, serous exudates, ecchymoses, and sometimes a considerable
increase of the organ in volume.
These phenomena—which are almost immediately consecutive—are related to the total absence of pressure in the capillaries of the artery, and even in the venous trunk succeeding them, as far as the next veinule, where the circulation can go on freely. The blood flows from this point towards the capillaries, where the tension is nearly nil, and soon causes engorgement, and even small hemorrhages. In consequence of all this disturbance, there are colics, which rapidly disappear if the obstructed artery is of small calibre; for the collaterals soon supplement it. The duration of these colics depends upon the facility with which this collateral circulation can be effected. It is sometimes easier in a large branch nearer the trunk of emergence, and this explains why an attack of colic that appears very serious will quickly disappear.

Otherwise, the establishment of the collateral circulation plays an important part in the post-ischemic hyperemia; and this collateral or compensatory hyperemia is related to the increase of blood pressure in the vessels adjoining the obliterated one, as Feltz has shown. When it does not produce irreparable lesions, the equilibrium is quickly restored, and all trouble disappears.

The circulation disturbances of the intestine cause a local paralysis in it, stagnation and consequent fermentation of its contents, with an abundant production of gas. The enteralgia induced in the healthy portions causes energetic contractions, which frequently lead to volvulus and invaginations. Friedberger and Fröhner have often observed the rotation on its axis of the left part of the large colon—that is, its free portion—which is, of all the intestinal divisions, the most liable to thromboses and embolisms. Paralysis of the intestine often brings about rupture of it, the stomach, or the diaphragm, owing to fermentation and enormous accumulation of matter and gas therein.

In animals which have been cured of colic for some time, old lesions in the form of thromboses are often found in the branches of the great mesenteric artery, as well as in the corresponding veins, these vessels being partially or totally obliterated, and around them pigmentation of the peritoneum and other organs is usually observed. Bollinger says that on a square centimètre of surface, there are sometimes found five or six arterioles or veinules so obliterated.

At the autopsy of Horses which have died from colic, it is often difficult to discover the obliterated artery and the seat of the embolus, because of the great development of the intestinal vessels, and more especially on account of their congested condition; so that much care and patience are needed in this search.

The effects of the aneurisms—the thromboses, and the embolisms—are evidently subordinate to their situation. The presence alone of the aneurism and its clot reduces the calibre of the great mesenteric artery, and consequently diminishes the supply of blood to the
intestine; this is sufficient to explain the chronic indigestion troubles observed, and these effects are all the more marked if the diminution in the lumen is extended to a ramification, but they are especially so if the vessel becomes completely obstructed by a detached fragment of the thrombus. But as the arteries of the small intestine anastomose freely by inoscelation close to the concave curvature of the organ (Fig. 320, fg), embolism of one of the vessels is never a fatal accident. It is the same with obliteration of one of the two cæcal arteries; for the other which anastomoses with it near the point of the cæcum can assume its function, so that the attacks of colic pass off. But if the trunk of the right fasciculus (td) of the great mesenteric artery is completely obstructed, the cæcum does not receive any blood, and death quickly ensues. The large colon receives its blood by the two colic arteries, which have an independent origin; so that it seldom happens that both are blocked at the same time.

The floating colon would be exempt from the danger of aneurismal embolism but for its first artery, which is derived from the great mesenteric; the other arteries arise from the small mesenteric, in which aneurism is rare.

In cases of death from aneurisms, the alterations described above are most frequently found. There may also be rupture of a verminous aneurism, and abdominal hæmorrhage. But, as Friedberger and Fröhner have remarked, embolic colics may terminate in death in twelve to twenty-four hours, and before serious intestinal alterations have had time to occur. The intestine is in such cases usually very distended by gas, and obstructed; and death is then due to one of the following mechanical causes:

1. Asphyxia and oedema of the lungs, as a consequence of severe and prolonged compression on the diaphragm. 2. Cerebral or pulmonary apoplexy, due to the increased arterial tension from the pressure of the distended abdominal viscera on the larger arteries. 3. Carbonic intoxication, by diffusion of that gas from the digestive organs into the blood. 4. Intoxication by septic products or infection from particulate elements, derived from the necrosed intestine, and accumulated more particularly in the liver, which is found immediately after death in a state of advanced decomposition. 5. Cardiac syncope, induced by the violence of the intestinal pain, or resulting from the poisoning by phenol, which is produced in large quantity in the course of the abnormal intestinal fermentation. Tereg, however, estimates that in colic the production of phenol is rather diminished than increased.

Symptoms, Course.—Verminous aneurisms rarely give rise to characteristic symptoms, and their presence is often only recognised when rupture has taken place, which rapidly terminates in death from internal hæmorrhage. On the occurrence of this accident—which coincides ordinarily with a severe effort—the animal crouches or sits on its
hind-quarters, knuckles over at the fetlock-joints, and falls as if struck with paraplegia; the pulse is thready, limbs cold, visible mucous membranes blanched, etc.; and, generally, the last moments of life are marked by signs of profound and violent suffering. Aneurisms of the aorta appear to be more liable to rupture than those of the great mesenteric artery. As a rule, the blood flows into the peritoneal cavity, but sometimes rupture takes place directly into the intestinal canal. In 18 cases collected by Bollinger, 15 were of rupture into the abdominal cavity, and 3 into the intestine. The latter result might be recognised sometimes from the presence of blood which impregnates the faeces passed before death.

Rupture of verminous aneurisms is attributable to the feeble resistance of their walls—which have lost their elasticity and contractility—and to the increased arterial pressure, resulting from diminution in the lumen of the vessel.

Besides the cases of rapid death, there have been noted—as symptoms of aneurism of the posterior aorta—decrease in vigour of the animal, stiffness in movement of the hind-quarters, difficulty and pain in micturition, arching of the loins, infiltration and intermittent lameness of one or both hind-limbs, cramps, and signs of paraplegia; but these indications are not sufficiently characteristic to afford a sure diagnosis, though they may arouse suspicions, which will sometimes be confirmed by a rectal exploration.

Attacks of colic are the most frequent sign of verminous aneurism, and are the consequence of embolism in the branches of the diseased vessels; but neither are these symptoms characteristic. Sometimes the colic is sudden and acute, and disappears in a short time, to reappear after a variable interval; it depends upon local obstruction, which is soon compensated for by neighbouring anastomoses, and is usually ascribed to indigestion, as there is no appreciable cause. In other cases the colics are sub-acute and a little painful, and are due to sudden paralysis of a portion of the intestine; death soon follows. Or the disease runs a chronic course, and is characterized by difficult digestion, constipation alternating with diarrhoea, slight colic, some fever, and a capricious appetite; it is a kind of intestinal catarrh, that may continue for some days, or even weeks, and terminates either in recovery or—which is more frequent—by marasmus, cachexia, and death.

Lastly, in some cases the embolic obstruction of the small arteries of the intestine—when often repeated—ends in haemorrhagic enteritis, to which the animal succumbs in several days or weeks. Friedberger and Fröhner attribute to this state the following symptoms: Diminution of appetite or complete inappetence, increased thirst, and rare defeation; the faecal pellets are small and dry at first, then become soft, pasty, and, later, sanguinolent and foetid; the urine is acid, and rich in phos-
phates; the fever is intense and persistent, and the pulse small and quick; the general debility increases, the animals become emaciated and the abdomen retracted; and now and again there is coma. Frequently, after feeding there is general aggravation of the symptoms and colic. Death is often ushered in by febrile paroxysms, muscular tremors, shivering, coldness of the limbs, pallor of the mucous membranes, quickened, difficult, and rattling respiration, tumultuous beating of the heart, and considerable elevation of the rectal temperature.

To sum up, colics which have their origin in disturbance of the circulation, have no particular signs which would allow them to be distinguished with sufficient precision in the complex group of abdominal complaints.

The relations between the obliteration of the great mesenteric artery and attacks of colic, have often been pointed out in particular instances, and especially by Rigot, Hering, Reynal, Bruckmüller, Bonnaud, and Andrieux. But it is to Bollinger that we owe the logical systematization of these facts. He especially has shown the great frequency of the colics of arterial origin, and the numerous statistics he has brought together indicate that of 100 Horses treated for internal maladies, there is an average of 40 suffering from colic; that in 100 deaths, 40 also are due to colic; and, lastly, that of 100 cases of this affection, 87 recover and 13 succumb. We have already seen the considerable proportion of Horses which are the subjects of verminous aneurisms, and no doubt there is some exaggeration in the estimate; but the serious damage attributable to the armed Sclerostomes is none the less an established fact.

TREATMENT.—It is of the highest importance, from the above considerations, to diminish the extension of the Sclerostomes as much as possible. This can only be done by a most careful inspection of the water Horses drink, and filtration alone affords reliable security. But the nocuity of the aneurismatic worms is not sufficiently tangible—at least, to owners of Horses—to permit of the hope that a precaution which would be so disturbing to current usages is likely to be adopted.

With regard to treatment, this can only be brought to bear on the principal symptoms. The stasis of intestinal matters should be combated by the employment of saline purgatives or calomel; drastic purgatives—such as tartar emetic and aloes and eserine—are prescribed to avert irritation and violent contractions of the intestines. A good régime, frictions, exercise, enemas, or frequent manual evacuation of the rectum, are particularly indicated.

In the case of Horses subject to colic, or which manifest rigidity or exceptional sensibility in the lumbar region, the prolonged but carefully

observed use of oil of turpentine might have a good effect; for it is not inadmissible that this medicament may act efficaciously against the worms contained in the aneurisms to which they have given rise.

*Observation.*—We need only mention here the *Spiroptera reticulata* Creplin, which has been found sometimes in the collateral artery of the cannon and in the arteries adjoining the cervical ligament. As it is more particularly met with in the ligaments, it will be most appropriately considered when noticing the parasites of the muscles and connective tissue.
CHAPTER II.

HÆMATOZOA OF RUMINANTS.

Only two observations with regard to Nematodes in the blood of Ruminants have been recorded, and both have reference to the Camel.¹ Goubaux mentions having found in this animal numerous 'Filarie', in a lachrymal gland, in the lungs, in the blood, and in the lymphatic vessels. Evans has also discovered in the blood of a Camel a Filaria, which Lewis has described under the name of Filaria Evansi. (They were met with in the bloodvessels of the lungs and mesentery, in tangled skeins. Their description is given in the 'Proceedings of the Asiatic Society of Bengal,' for March, 1882.)

It was no doubt by an error that Schneider quoted Gurlt as having found in the arterial aneurisms of the Cow the Strongylus micrurus, which has the bronchi of Bovines for its normal habitat.

The only important Hæmatozoon of Ruminants is the Bilharzia crassa; though mention should also be made of the Cystics that may be seen in the walls of the aorta, or in those of the heart, which may also harbour in its tissue the various muscle parasites.

Fig. 321.—Bilharzia hæmatobia, male and female; highly magnified. — After Bilharz.

abc, female partly contained in the gynecophorous canal; a, anterior extremity; c, posterior extremity; d, body seen through the wall of the canal; ig, male; ef, gynecophorous canal half opened in front, and behind is the female, which has been partly extracted; g, k, limit towards the back of the ventral depression which constitutes the canal; i, buccal sucker; k, ventral sucker.

intestines, and there occasion haematuria or enteritis. An analogous
worm was also found in 1876, at Zagazig, Egypt, by Sonsino, in the
portal vein of a Bull, and subsequently in the Sheep. He named it
the Bilharzia bovis, a name which he rightly changed afterwards for
that of Bilharzia crassa.

The Bilharzia belongs to the Trematodes, of the family of Distomidae,
which offers the remarkable peculiarity of separate sexes. The male is
white, cylindroid, and possesses an oral and a buccal sucker quite close
to each other. It carries the female in a ventral furrow—the canalis
gynaecophorus—formed by the two sides of the body, which are broad
and reflected inwards. The female is filiform, longer, and much narrower
than the male; its middle portion only is contained in the gynaeco-
phorous canal, its anterior and posterior portions remaining free. The
genital apertures of the two individuals correspond—they are situated
immediately behind the ventral sucker.

The Bilharzia crassa is a little longer and sensibly thicker than the
B. haematobia, the length of which is about 14 mm. in the male and
20 mm. in the female. A more important difference is to be found in
the form of the ova, which in B. crassa are 16 mm. to 18 mm., are
longer, narrower, and fusiform, and are also prolonged at one of their
poles by a pyriform point. These ova contain a ciliated embryo, which
is set free in water, and shows traces of a digestive apparatus.

The B. crassa causes, in animals, similar disorders to those which the
B. haematobia engenders in Man. In an Ox, the blood of which furnished
thirty of these parasites, Sonsino observed very pronounced intestinal
catarrh, with thickening, exudation, and ecchymoses in the walls of
that tube. The vesical mucous membrane was ecchymosed and covered
with papilliform elevations, which were yellow at the point, and about
the size of a pin's head. The vessels contained the ova of Bilharzia. It
is possible that the haematuria which so frequently affects Cattle in
East Africa and the Cape of Good Hope is due to this parasite. Like
Man, they will derive the germs of it from the impure water they drink.

At the autopsy of Oxen which were killed at Calcutta, suspected of
being affected with cattle-plague, Bomford found in the substance of
the mucous membrane or in the papillary excrescences at the margin of
the anus, ova of the Bilharzia, which, from their characters, belonged
rather to the B. haematobia than to B. crassa. If these Cattle had never
been in Africa—as this authority states—we might conclude that the
Bilharzia also lives in India.1

On the other hand, Grassi and Rovelli2 have announced that 75 per
cent. of the Cattle slaughtered at Catania, and which come from a
neighbouring locality—Piana di Catania—are infested with the Bilharzia
crassa. If this is really so, these Ruminants would be really dangerous
for Mankind, as we must look upon B. crassa as merely a variety of B.
haematobia.

Hydatids of the Circulatory System.—We will hereafter, with
regard to Measles, notice the presence of Cysticerci—Cysticercus cellu-
lose and C. bovis—in the muscular tissue of the heart. In the mean-
time it may be observed that, according to Davaine, Bremser has on

1 Bomford. The Quarterly Journal of Veterinary Science in India, V., 1887, p. 345.
2 Grassi and Rovelli. Atti de R. Accademia dei Lincei, IV., 1888, quoted by Sonsino
two occasions seen the *C. tenuicollis* in the walls of the Ox's heart. The parasites with which we have now chiefly to deal are the *Echino-
cocci*.

These Echinococci are more particularly observed in the heart of the Ox; nevertheless, Bollinger records two cases of Echinococci in the *Horsethroughout*, one of these being in the walls of the common aorta near its bifurcation, the other in the posterior aorta. Palat has seen a Horse die suddenly from compression of the aorta, caused by a hydatid cyst situated at the base of the left ventricle; the cyst contained only a simple vesicle. Goubaux has also witnessed the sudden death of a Horse, from rupture of the aorta at its origin; the walls of the vessel contained three small acephalocysts.¹

Hydatid cysts in the heart of the *Ox* have been observed several times in Germany, England, Italy, and France.² Alix has found six or seven specimens in Tunisian Oxen killed in the abattoir of Sfax.

These cysts remain unperceived during the life of their host, and only attract attention when they cause death by rupture of the walls of the heart, or by compression of vessels and obstructed circulation. Generally there is only one Echinococcus cyst; but the number may occasionally rise to twenty (Morot). Their volume varies between that of a millet-seed and a Turkey's egg. They may occupy various points, either on the external surface of the organ or near its inner surface, or in the interventricular septum, near the base or point of the heart, and more frequently in the walls of the ventricles than in those of the auricles.

Generally the vesicle is simple—that is, it has no secondary vesicles, external or internal; and it rarely appears as an acephalocyst—or sterile. It may undergo caseous or calcareous degeneration. Grimm considered what he found in the interventricular septum of a Cow, to be a multilocular (?) cyst.

No reliable signs have yet been made known by which the presence of these hydatid cysts in the heart may be suspected during life.

CHAPTER III.

HEMATOZOA OF RODENTS.

Rabbit.—Jolyet and De Nabias have discovered, in the blood of the domesticated Rabbit, a flagellate Infusorium which should be classed in the genus *Trypanosoma*, so frequent in Birds, and one species of which has been already mentioned as having been found in the blood of Horses and Mules affected with 'Surra' in India.

Fully formed and coloured, this parasite is elongated and transparent, cylindrical in its middle portion, gradually tapering behind into a long tail or flagellum. It measures from 30 \( \mu \) to 36 \( \mu \) long, including the flagellum, which is 15 \( \mu \), and the anterior point, which is 3 \( \mu \); its breadth in the middle part is 2 \( \mu \) to 3 \( \mu \). A very narrow longitudinal crest extends along one side of the body, and stops at the commencement of the flagellum. At the origin of the anterior tapering portion, where the crest also stops, the body shows a rounded corpuscle which can be highly coloured by re-agents, and which appears to correspond to the point of fixation of the parasite. The Trypanosome of Birds offers exactly the same peculiarities.

These Infusoria move rapidly among the blood-corpuscles, which are incessantly being displaced by their energetic movements—as seen in preparations.

Jolyet and De Nabias have found these parasites in 4 of every 10 Rabbits they examined. The animals may appear to be quite healthy, but most frequently they are thin, weakly, and have diarrhoea. Sometimes more than 50 Trypanosomes are observed in a drop of blood.

Guinea-pig.—Kunstler has reported the presence of a Trypanosome in the blood of a Guinea-pig.

1 Jolyet and De Nabias. *Journ. de Med. de Bordeaux*. March 1, 1891; *La Médecine Moderne*, II., 1891, p. 239.
CHAPTER IV.

HÆMATOZOA OF THE DOG.

The Dog is the domesticated animal in which Hæmatozoa are most frequent, and these are always Nematodes. They belong to four distinct species: Filaria immitis Leidy; Strongyulus vasorum Baillet, which, in the adult state, lives in the right side of the heart and the pulmonary artery; Spiroptera sanguinolenta Rud., which is usually found in tumours in the oesophagus and stomach, but has also been met with in similar tumours in the aorta; Filaria recondita Grassi, of which little more than the embryos—Hæmatozoon of Lewis—are known, which float in the blood, and which must not be mistaken for those of the Filaria immitis.

ARTICLE I.—Hæmatozoon of Lewis. 2

Grassi gave the name of Hæmatozoon of Lewis—Hæmatozoon Lewis—to embryonic Nematodes, which several observers have often met with in the blood of the Dog, and which cannot be classed with the Filaria immitis. They were first noticed by Gruby and Delafond, and afterwards found by Lewis, Manson, Sonsino, Grassi, etc.

1 Leisering (Ueber Hämatozen der Haussäugthiere. Ber. u. d. Veterinärwesen d. K. Sachsen f. 1864, p. 47) has found in the venous blood of two dogs viviparous Nematodes from 1:20 to 2 mm. long; in one Dog there were from 30 to 35 in a kind of pulmonary nodule, and in the other they were in considerable quantity in the dorsal vein of the penis. Gurlt classed these worms as Hämatozoon subulatum, but Cobbold included them afterwards in the genus Strongyulus under the name of Str. subulatus. Schneider (Archiv f. Anat. u. Physiologie, 1865, p. 421) is of the opinion that they are pseudoparasites introduced into the blood after death, and multiply rapidly in the dead body. Leuckart (Archiv f. Naturgeschichte, II., 1865, p. 234) does not hesitate to consider them as the Rhaditis (Diplogaster). A Enstroongyulus gigas (?) has been found by Jones in the right ventricle of the heart of a Dog, along with Filariae immitis; but this is a unique and doubtful case, as this parasite has its habitat in the kidneys (J. Leidy. A Synopsis of Entozoa. Philadelphia, 1856, p. 24.)

These embryos are about 280 μ long by 5 μ in diameter; they are slightly attenuated in front, and terminate behind in a very fine tail. They show a rudimentary digestive tube, and much resemble the embryos of the *Filaria immitis* (Fig. 324); they are more especially distinguished from them, however, in being able to attach themselves by their buccal extremity to the cover-glass or slide, and remain a long time fixed, while their body moves about in every direction; that extremity then appears enlarged, as if it were compressed (Lewis, Grassi).

The frequency of these embryos varies with the countries in which they are observed. In their examination of 480 Dogs, Gruby and Delafond found 1 affected in 20 to 25. Of 40 Dogs suffering from various diseases, Manson, at Amoy, China, discovered 13 with the embryos of Nematodes in their blood. At Pisa, Sonsino found them in the proportion of 7 in 20; and Lewis, at Calcutta, in 1 in 3. Grassi has also found these *haematozoa* in a great number of Dogs.

According to Gruby and Delafond, these worms are very vivacious, and are still movable ten days after the blood has been withdrawn from the vessels and kept in a vase at a temperature of 15° C. Their small diameter allows them to pass through the capillaries, so that they are found in venous as well as in arterial blood, though they are not met with in any other of the fluids in the body. Their number is considerable, and Gruby and Delafond were perhaps below the mark in approximately estimating them at from 11,000 to nearly 224,000; the average in 30 Dogs has been calculated at more than 52,000. In some instances there are seen 3 to 5, and in others as many as 12 or 15, in every drop of blood.

Although, in general, Dogs do not appear to be affected by these embryonic parasites, yet Gruby and Delafond report epileptiform attacks in three of these animals, two of which succumbed to them.

Gruby and Delafond believed they could trace the hereditary transmission of this helminthiasis; but in all the instances they could only find the *Filariae* in the blood of the progeny when these were five or six months old; and as, in addition, these authorities imagined they could distinguish the maternal and the paternal heredity, there is reason to think the appearance was due to infestation of the young animals after birth.

By injecting defibrinated verminous blood into the bloodvessels of Dogs which were free from the parasites, in nine cases they noticed the

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disappearance of the microscopic Filariae from the circulation in from eight to forty days; in two other Dogs they persisted for more than three years or until their death, and at the autopsy the adult worm was not to be found in the heart or vessels.

In recent years, the origin of the embryonic Nematodes of the blood has been the object of persevering researches by Lewis and Sonsino, but more especially by Grassi.

The latter, adopting the opinion abandoned by Lewis, at first thought they belonged to the *Spiroptera sanguinolenta*, as he believed he had found these haematozoa in Dog-Fleas (*Pulex serraticeps*); but he met with Dogs infested with Fleas, nearly all of which were full of Nematodes, and though these animals themselves had haematozoa in their blood, yet they did not harbour Spiroptera. On the other hand, Dogs infested with the latter had neither haematozoa nor Fleas containing Nematodes. Otherwise, there is no concordance—neither in form nor development—between the larva; found in Fleas and the embryos of the Spiroptera. It has been stated elsewhere (p. 371), that Grassi discovered that the real intermediate host of the *Spiroptera sanguinolenta* is the common Cockroach or Black-beetle (*Pleriplaneta orientalis* Linn.).

The larvae of the Nematodes—more than 50 of which may be counted in a single Flea—live as parasites in the intestine and abdominal cavity of that Insect. Their description agrees exactly with those that Manson observed in Mosquitos, and which he regarded as belonging to the evolutive cycle of the *Filaria sanguinis hominis*. Sonsino has found these same larvae not only in the Fleas of Dogs, but also in their Lice (*Haematopinus piliferus*); and it is probable that it was the same species of Dog-Louse that Bancroft was dealing with, relative to its Nematode parasites, and which he thought was the *Trichodectes latus*, believing it to be the intermediate host of the *Filaria immitis*.

Neither Grassi nor Calandrucio have confirmed Sonsino's observation respecting the part played by the Lice in this question. On the contrary, they have found embryonic Nematodes in Cat-Fleas (*Pulex serraticeps*), in those of Man (*Pulex irritans*)—which also live on the Dog—and in a kind of Tick, the *Rhipicephalus sicularis* Koch.

The embryos of the Nematodes, having reached the digestive passages of the Flea, pass through the walls of its intestine, and become encysted in the adipose tissue of the Insect—though they sometimes remain free in the cavity of its body. These embryos become larva; which pass through two or three successive phases of development, and acquire a length of 1.5 mm., and 30 μ to 35 μ in diameter, developing also two or three papillae around the mouth, and a much larger number at the anal extremity.

With the exception of Galeb and Pourquier, all those who have recognised the frequency of Nematodes in the blood of the Dog have
remarked on the rarity of the *Filaria immitis* in the same countries. From several Dogs—at the autopsy of which he found the *Filaria immitis* in the heart—Grassi collected a great number of Flies, and never was he able to discover a single larva of the Nematodes in their abdominal cavity.

From these considerations, it may be concluded that the *Hæmatozoa* of Lewis do not represent the embryonic form of a Nematode actually known in the adult state. Grassi and Calandrucio have given the name of *Filaria recondita* Grassi to the species—yet to be discovered—to which these worms belong; and they consider as an adult, but non-fecundated female of this mysterious species, a Nematode they once found coiled up in the midst of adipose tissue in the vicinity of the right hilum of the kidney of a Dog. It was 3 cm. long, and 178 mm. in diameter; there were at least four very small papillae behind the mouth; three papillae at the posterior extremity—one terminal and two lateral; anus 228 μ from the caudal extremity; and vulva about 840 μ behind the mouth.

**Article II.**—*Hæmatic Filariosis.*

*Filaria immitis* (Leidy).—Body white, a little obtuse at the ends, the anterior being somewhat thicker than the posterior. Mouth surrounded by six small and not very distinct papillae. **Male,** 12 cm. to 18 cm. long, tail tapering and closely spiral, with two lateral wings; 11 papillae on each side, of which 6 are post-anal, and 1, 4, 5, 8, 10, and 11 are marginal, the others being near the middle line; while 1, 2, 3, 4, 5,
6, and 7 are very small, and on one side only there is a single pre-anal, marginal papilla. Two unequal spiculae. *Female*, 25 cm. to 30 cm. long, and about 1 mm. in diameter; tail short and obtuse. Ovoviviparous.

Fig. 323.—Caudal extremity of the male *Filaria immitis*; magnified 50 diameters.—Railliet.

Fig. 322.—Male and female *Filaria immitis*; natural size.—Railliet.

Fig. 324.—*Filaria immitis*. Embryos collected from the heart of a Dog; magnified 300 diameters.—Railliet.

This worm appears to have been seen for the first time by Panthot, in 1679; then a century later by La Peyronnie, in 1778. It has since
been found by Peyson, Zeviani, Bobe-Moreau, Jones, and a number of other observers.

It chiefly inhabits the right side of the heart and the pulmonary artery of the Dog.

It has been met with in various parts of Europe, among them being Denmark and Italy. Jones, Leidy, and Schuppert, have found it in the United States, and Silva Aranjo at Brazil. It is very frequent in China and Japan; according to Somerville, it is scarcely possible to open a Dog which has lived for any time in China, without finding *Filaria immitis* in its bloodvessels or in the right ventricle of the heart. Friedberger, Reuther, and Deffke have observed this worm in Germany in Dogs which have lived for several years in China and Japan. On the other hand, Lewis, at Calcutta, did not find it in a single animal, although one-third of the Dogs there have embryonic *Hematozoa*.

**Symptoms.**—The *Filaria immitis* does not often betray its presence by any appreciable disturbance to health; though its existence may be predicated by a microscopical examination of the blood, in which will be found embryos that have a very close resemblance to the *Hematozoa* of Lewis. They are, however, distinguished—according to Grassi—by their number, which is always more considerable, and by their never attaching themselves by their oral extremity to the slides or cover-glasses.

Manson states that the embryos of the *F. immitis* offer—though in a lesser degree than those of the *F. sanguinis hominis*—the curious peculiarity of abandoning the peripheral circulation during the day, and reappearing in it at night—or, rather, showing themselves in much greater number at that time; and Sonsino has verified this fact. In making the autopsy of Dogs which have been killed by prussic acid or strychnine, Manson has observed that the embryos accumulate in the large vessels of the thorax and abdomen during the day.

In the majority of instances, the worms are found at the autopsy of Dogs which have died after various morbid manifestations. Sometimes death is sudden, or has only been preceded for an hour or two by dyspnœa and convulsions. But more frequently the animal has exhibited for a variable number of days, dulness, debility, dropsies, and more or less frequent attacks of convulsions or epileptiform seizures; there are even occasionally rabiform symptoms (Osborne, Rivolta, Hoysted). Deffke has noticed those of chronic interstitial nephritis; and Reuther has remarked pain on the inner surface of the thigh, with lameness—but no local lesion—atrophy of the whole upper part of the limbs, vomiting, paralysis, and death amid convulsions. In India there has been more especially noted extreme emaciation, with insatiable hunger and thirst. De Montigny—formerly French Consul at Shanghai—informed Davaine, that, in China, Dogs affected with this filariosis became
weak, and died vomiting blood. Leidy has noticed a frequent cough, and, after running, sudden insensibility and chill, though these were of short duration. Among the matters vomited by a Dog, he on two occasions found living Filariae 15 cm. long.

Death is the usual result of haematic filariosis. In China, it kills nearly all the European Dogs, and, as a consequence, these animals are very scarce and dear (Montigny).

Pathological Anatomy.—At the autopsy of Dogs which have succumbed to the disease, there are found in both cavities of the right side of the heart, and in the pulmonary artery for some distance from its commencement, the Filaria immitis in very variable number—perhaps only five or seven in some instances, or hundreds in others, as in the case reported by Mégnin. On the average, there is one male to two females; sometimes there are only males (cases reported by Manson and Silva Araujo), or only females (Manson).

The worms, especially if numerous, are interlaced in an almost inextricable manner, in one or more bundles, which obstruct the cavities of the heart by winding themselves round the columnae carnea. There is frequently hypertrophy of the heart, and more or less marked endocarditis and endarteritis; sometimes there is rupture of the myocardium and hemorrhage into the pericardium and pleura. Zeviani and Silvestri have also found the worm in the left side of the heart; Schuppert met with it in the anterior vena cava, and Labat in the posterior vena cava; while Leidy observed it not only in the lungs, but also in the liver.

Ercolani was the first to remark, that when the Filariae are found in the heart, they are also in the subcutaneous tissue of some region of the body; they are sometimes more frequent there than in the heart, from which they may be absent, and they are seen at various points—males or females—coiled up together, living or dead, or calcified. Rivolta, Vachetta, Lanzilloti-Buonsanti, and Grassi have corroborated this observation. Lanzilloti-Buonsanti has remarked that the Filariae in the subcutaneous connective tissue are smaller than those in the heart; and he has also found in the intermuscular connective tissue, cysts containing both young male and female Filariae.

When the worms exist in one of the numerous parts of the body which they may inhabit, their embryos are met with in the blood—provided, of course, that there are fecundated females, which there will not be if the males and females are isolated.

There may be other lesions subordinate to the presence of these worms. Labat has met with the parasites in the branches of the pulmonary artery of a Dog that died of unilateral pneumonia; they were more numerous in the affected lung than in the other. Leidy has noted hemorrhage of the kidneys and bladder; Reuther, some tumours in the spleen; Lanzilloti-Buonsanti, white sub-pleural pulmonary nodules with
a red point in the centre, which was occupied by embryos of the Filariae— the nodules varying in size from that of a millet-seed to a pea; the same authority has also noted some alterations in the kidneys. Deffke has seen lesions of a gastro-intestinal and vesical catarrh; the kidneys showed those of chronic interstitial nephritis, more particularly affecting the glomeruli, which were atrophied, while the uriniferous tubes were dilated and varicose.

The pathogenic action of this Filaria commences with chronic endocarditis, embarrassed pulmonary circulation, and the development of embolisms and thromboses in the lungs. The embryos thrown out in the heart and pulmonary artery, are disseminated throughout the whole circulatory apparatus, and can be observed in various organs. The hypertrophy of the heart, and irregularity and insufficiency of the circulation, explain the occurrence of the digestive, respiratory, and urinary catarrhs; while anemia of the nerve-centres brings about convulsions, intellectual disturbance, paraplegia, and, finally, collapse. It is not very probable that—as Rivolta imagined—the embryos exercise an embolic action which causes hyperemia of the brain and various organs, as the diameter of these embryos—which is not greater than that of the Hæmatozoa of Lewis—admits of their passing along the capillaries.

The alterations in the kidneys—which have been many times observed—are due, according to Deffke, to the great number of embryos which tend to be eliminated by the urinary passages—like those of the Filaria sanguinis hominis, which produce the chyluria or hæmato-chyluria that is endemic in hot countries. Grassi formally contests the opinion that the embryos of the Filaria immittis are evacuated with the urine, and relies for proof on observations carried out for a year on one Dog, and for two months on four others, all of which were affected with hæmatic filariasis.

Etiology.—The etiology of this helminthiasis is still obscure. It is supposed that infestation takes place by the drinking-water, as is generally admitted it does with regard to the F. sanguinis hominis. Manson, a physician at Hong-Kong, has recognised that the embryos of the latter pass into the digestive tube of a Mosquito (Culex mosquito), when it sucks the blood of people affected with hæmatic helminthiasis. In this new habitat they undergo changes—the tail becomes shortened, the anterior part of the body is developed, and the sexual organs appear. These alterations are effected in about five days, and the Filaria then measures about 1 mm. At this period the Mosquitos have resorted to stagnant water to lay their eggs; there they die, and the Filariae escape from their dead bodies, and live at liberty in the water. It is in drinking this water that Man becomes infested.

Grassi does not accept this opinion, and bases his objection on the circumstance, that the majority of the embryos of the F. sanguinis hominis

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which enter the intestine of the Mosquito perish there, and that scarcely 12 per cent. continue their development. He admits, also, that all the embryos of the Filaria immitis ingested by the Fleas and Lice of the Dog die in the intestine of these epizoa, the rôle of which is limited to relieving the mammal of a portion of its haematozoa. The latter are also eliminated by the various wounds of the skin that the Dog is exposed to—either in hunting, or running through gorse, brushwood, etc. But this elimination is nearly always insignificant, and Grassi's objections do not affect the question much.

The Filaria immitis appears to belong more particularly to countries rich in marshes and surface-water; and it might therefore be supposed that the intermediate host—crustacean or mollusc—through which this worm passes is concealed in the water, in an unknown form.

In pregnant Bitches which harboured the F. immitis, Galeb and Pourquier found its embryos in the blood of the foetus, as in that of the parent. This fact tends to establish hereditary transmission of the parasite, by means of the placenta.

**Article III.**—**Strongylosis of Blood-Vessels.**

The Strongle of vessels, the embryos of which give rise to pulmonary strongylosis of the Dog (see p. 600), lives in the right side of the heart and pulmonary artery. It belongs essentially to the fauna of Toulouse, where it has been often met with. Beyond this region, the same (?) worm has been twice seen in Italy by Bossi.

**Strongyulus vasorum** (Baillot).—Body filiform, a little attenuated at both extremities, white or rose-coloured, some individuals marked with a kind of reddish, spiral, and often interrupted line, which marks the digestive tube, as seen through the integuments. Head bordered by two small wings—formed perhaps after death—which join in front; mouth nude. *Male,* 14 mm. to 15 mm. long; caudal pouch with two lobes, each sustained by four ribs, the anterior and middle of these being double. *Female,* 18 mm. to 21 mm. long; vulva situated in front of the anus. Ova ellipsoid, and 70 µ to 80 µ long, by 40 µ to 50 µ broad.

It was probably this worm which, according to Dujardin, was found in 1813, at Paris, 'in the heart' of a Dog. But the first precise mention of it is due to Serres. At the autopsy of a Dog which died suddenly, after having presented vague symptoms which were thought to be indicative of gastro-enteritis, the right ventricle was hypertrophied, and in

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its cavity and the right auricle were disseminated 'an infinity' of worms. Some of these were collected in small bundles the size of a pea, and the lumen of the pulmonary artery was almost entirely obstructed by them; they extended as far as the last divisions of that vessel. A description of the case has been given by Baillet.

In the heart they are more especially located in the furrow separating the columnae carneae at the lateral borders of the ventricle, or beneath the tricuspid valve. They are most frequently met with in the larger divisions of the pulmonary artery, particularly at the origin of the collateral branches. They occasion an endarteritis in the form of granulations, layers, or resisting and anastomosing cords, amongst which they lie. The internal wall of the artery has a reticulated aspect, resembling that of the inner surface of the auricles. The smaller arteries are constantly affected with thromboses. The lumen of the vessel is filled by a hard and yellow clot, above which the Strongles are accumu-

![Diagram](image)

**Fig. 325.** *Strongylus vasorum.*

A, male and female; natural size. B, cephalic extremity; magnified 100 diameters. C, caudal extremity of the male; magnified 100 diameters.—Railliet.

lated. Laulanié has observed that the *Strongylus vasorum* determines—by the deposition and dissemination of its ova—a pulmonary granulosis, the histological study of which is full of interest, and of which we have given a résumé (p. 600), as well as indicated the symptoms by which it may be manifested. But, with the exception of that of Serres, no cases in which the termination was fatal have been published; in that instance the number of hematozoa was exceptionally high. Generally, the animals are killed after suffering for a long time.

Lafosse believed he had found good results in treating Dogs infested by the *Strongylus vasorum* with oil of turpentine in 2 to 4 gramme doses made up into four pills, and given daily for a week. He mentions that two Dogs which offered the symptoms of this helminthiasis completely recovered by means of this treatment. The symptoms consisted of
marked oppression, fits of coughing, irregular—sometimes tumultuous—beating of the heart, a certain repletion of the jugulars, coinciding with unimpaired appetite and the absence of fever, all which symptoms, he says, were observed many times in animals which died or were killed, and in the heart of which this helminth was found at the autopsy. Labat—who in this strongylosis has noted, as a very distinct symptom, a soft systolic blowing in the femoral artery—has also in two Dogs obtained a recovery with Bordeaux turpentine, given every day in doses of 2 to 4 grammes in the form of pills, along with calcined magnesia, or in emulsion with yolk of egg.

Article IV.—Spiroptera Sanguinolenta. 1

The Spiroptera sanguinolenta (Rud.), which has a predilection for submucous tumours in the stomach or oesophagus (see p. 369), was found for the first time in similar tumours in the walls of the aorta by Morgagni and Courten in 1760. In France, it has only been seen on two occasions, by Mégnin and Chauvrat. 'For myself,' says Rayer, 'I have opened more than 300 Dogs, 127 of them specially with the object of finding these worms in the walls of the aorta, and I have not been able to discover a single instance of verminous tubercle of that vessel.' On the contrary, Lewis at Calcutta, India, Manson at Amoy, China, and Silva Araujo in Brazil, have frequently seen it: and Oreste, Perroncito, and Caparini have observed it in Italy. 1

These verminous tumours occupy the anterior aorta, and in size they vary between that of a small shot, a pea, nut, or walnut. They are separate, or joined in two or three. Their number is very variable; in the Dogs seen by Morgagni, in one case there were 3; in another 16; and in a third, the aorta, from its origin to the diaphragm, was studded with these tumours. They projected from the external surface of the aorta, and at the corresponding point the internal tunic showed a blood extravasation and slight abrasion. Then there occurs an arteritis, characterized by roughening of the lining membrane, and thinning of the walls of the vessel. In the smaller tumours the worms are still embryonic, and at the most 2½ mm. long. After several moultings, they acquire all their external characteristics, as well as their genital organs. In the larger tumours, there are several well-developed Spiropteres, more or less separated from each other in distinct compartments. The worm sometimes creeps along beneath the tunic of the aorta, and one of its extremities projects through a small opening, and

floats in the interior of the vessel. Lewis has, in some instances, found the lumen of the aorta nearly obliterated by a clot formed around the worm. He had never observed the parasites in the abdominal portion of the aorta. Once, however, Morgagni found them in a tumour situated beneath the renal vessels, but it did not adhere to these, nor to any other vessels; and Mégnin has seen one in the posterior aorta, in the vicinity of the kidneys.

In the observations of Lewis and Manson, the aortic tumours often coincided with similar tumours in the oesophagus.

The contents of the verminous tumour may pass into the aorta by an easily discovered opening; but Lewis has never found the adult Spiroptere in the bloodvessels of the Dogs he examined—only the embryos. It is, therefore, the ova which pass from the tumours into the blood-current, and which, within a variable time, effect their embryonic evolution. Lewis attempted some experiments in order to discover the migrations of these parasites; but they were unsuccessful, and the problem still awaits solution.

When they are of large size, the verminous tumours of the aorta must cause serious disturbance in the circulation. Manson asserts that their possible rupture will bring on a fatal pleurisy, and he attributes to them a somewhat common paraplegia, and which he thinks is due to the ova which have left the aorta and entered the capillaries of the spinal cord. Mégnin, Chauvrat, Perroncito, and Caparini have witnessed Dogs dying suddenly from haemorrhage, owing to rupture of the artery, the walls of which had undergone atheromatous degeneration.

The Spiroptera sanguinolenta is sometimes also found in the lymphatic glands situated at the entrance to the chest, near the oesophagus or anterior aorta. Lewis, Caparini, Chauvrat, and Jacoulet have published instances of this occurrence; and the latter has noticed, in one case, great difficulty in swallowing, frequent vomiting, diarrhoea, and finally cachexia. In another case—which was that of a Dog that was killed because of the rabiform symptoms it presented—the worms were lodged in a bronchial gland, close to the oesophagus. The observation of Chauvrat in 1890 is very analogous to this.
CHAPTER V.

Hæmatozoa of Birds.

Protozoa. — Danilewsky, Grassi, and Feletti have discovered, in the blood of various birds, parasites closely related to those that cause paludism in Man, and which are known as the 'Bodies of Laveran' and Plasmodium malarie (Ital.). Of the domesticated Birds, Pigeons are the only ones in which they have been observed (Grassi and Feletti).

According to Laveran, the hæmatozoon of paludism is unique, but polymorphous. Its various forms can be reduced to four: 1. Spherical bodies or very small cytozoa—1 μ to 2 μ—very difficult to distinguish in the interior of a red corpuscle of the blood—but sometimes larger, containing more or less pigment granules, and found either in the interior of a red corpuscle, or external and isolated, or in small groups; 2. Flagella, globular free bodies, from 5 μ to 7 μ in diameter, with pigment granules, and provided with 1 to 4 very mobile flagella; 3. Crescentic bodies, cylindrical elements from 8 μ to 9 μ long by 2 μ broad in their middle, more or less tapering at their ends, usually curved in crescent form, and generally containing in their middle portion grains of pigment, identical with those observed in the globular bodies; 4. Rosaceous bodies, arising from the segmentation of the endoglobular parasites, and giving origin to 8, 10, and often 20 spores, which become free.

These diverse forms have been found in the blood of Birds, but the cytozoa and crescentic bodies are the most frequent, the first being nearly always included in the red corpuscles. These blood parasites are only found in Pigeons during six or seven months in the year, infestation appearing to take place in the spring, and it increases by multiplication of the parasites; it disappears towards the month of November. But although the hæmatozoon of Birds are chiefly observed in marshy regions, they are generally completely innocuous to their hosts—a circumstance which is related perhaps, according to Danilewsky, either to accommodation transmitted by heredity, or to the temperature of the blood, which may be too elevated for the parasites to be set free.

The zoological position of these hæmatozoon is still uncertain. By reason of their intra-cellular habitat, there is a tendency to ally them more or less closely with the Coecidia.

Danilewsky has also met with a Trypanosome (*Trypanosoma sanguinis avium*) in the blood of Birds.

**Nematodes.**—Mazzanti\(^1\) has found, in the venous blood of a carrier-Pigeon, the embryos of Nematodes, some of them 185 μ long, with an acuminated caudal extremity; others 143 μ long, with the caudal extremity obtuse or not very pointed. At the same time he met with, beneath the skin of the neck, a female Filaria—different to the *Filaria clava* Wedl—which lived in the connective tissue. The uterus of this Filaria contained a number of embryos identical with those in the blood; some of them were spread around the body of the female. Mazzanti gave this worm the following description: Body filiform, ashy-blue, not striped, 23 mm. long, and 3.25 mm. wide; anterior extremity obtuse and rounded; posterior extremity briefly conical. Mouth nude and orbicular. Oesophagus short and narrow; stomach little dilated. Anus terminal. Uterus double. Vulva situated a little behind the position of the stomach, or 213 μ from the mouth. Ovoviviparous.

Rudolphi mentions—but without describing it—a *Filaria anatis* found by Paullinus rolled around the heart of a Duck.\(^2\)

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BOOK VI.

PARASITES OF THE MUSCLES, CONNECTIVE TISSUE AND BONES.

In this division—which is more especially devoted to the parasites of the muscles—we will also study those of the inter-organic connective tissue, as well as those of the bones; for the reason that they are too rare, and altogether of secondary interest to afford material for a distinct section, or because the more important of them are principally met with in the intermuscular and interfascicular connective tissue.

We will only occupy ourselves here with the animal parasites; but with regard to the differential diagnosis of trichinosis, we shall have to say a few words concerning muscular actinomycosis in the Pig.

The parasites to be dealt with in this book are varied and very frequent. They are the Sarcosporidæ, Cestodes in the cystic state—Cysticerci and Cænures—Trematodes—Distoma sp.?—or Nematodes, the most important of which is the Trichina.

They reach their definitive habitat through, as yet, badly defined channels, among which the circulatory system is doubtless the principal.

Special chapters are given to the Sarcosporidæ—muscular Psorospermosis—the Cysticerci—Measles—the Trichina—Trichinosis—and to the parasites of bones. The other parasites will be studied briefly, because of their relatively trifling importance.

Cænurus cerebralis.—The Cystic of the Tænia cænurus of the Dog, the Cænurus cerebralis Rud., the ordinary habitat of which is the brain

1 Zopf, of Halle, has inscribed in the Biologische Centralblatt de Rosenthal (III., 1844, No. 22), under the name of Haplococcus reticulatus, a fungus he found in Pig-flesh, and which it appeared to him should be classed with the Myxomycetes Fungi. It was in such quantity that a dozen specimens could be seen in each preparation, and it was in three forms: myxœamibium, sporanges and telentospores. The latter were spherical or tetrahedral, with markedly round surfaces, from 20 μ to 25 μ in diameter, and thick, polygonally-reticulated episores. In ten months, of 803 Pigs in Torgau, 396 had this parasite. It has not been seen by anyone else. Müller (Real-Encyklopädie der Gesammten Pharmacie, V., p. 99) and Kitt (Centralbl. f. Bakter. u. Parasitenkunde, IV., 1888, p. 659) believe that the Haplococcus of Zopf is nothing else than the spores of Lycopodium that were accidentally introduced into the preparation. If this is the case, it should be removed from the list of parasites.
of Ruminants—principally Sheep—has been found once in the subcutaneous connective tissue of a Calf by Nathusius, and at another time in the Sheep by Eichler. These erratic Coenures were completely developed (Zürn).

**Coenurus serialis.**—The Cystic of the *Taenia serialis* of the Dog—the *Coenurus serialis* P. Gervais—has, on the contrary, its usual habitat in the connective tissue of various regions of the body, and, exceptionally, the spinal cord. It is found in the Rabbit—especially the wild one—the Hare, the Squirrel (Cobbold, Cagny), and the Coypu (Pagenstecher).

The vesicle (or bladder) of the *Coenurus serialis* may be as large as a Fowl’s egg, but it has already numerous scoleces when it is no bigger than a nut. It is generally a little longer than it is broad, and when it occupies the intermuscular connective tissue, its greater axis is parallel with the fasciculi. The perfectly-developed scoleces are three or four times larger than those of the *Coenurus cerebralis*, and their free extremity is often Voluti-shaped. They are sometimes distributed without order, but most frequently they are in linear series not parallel with each other—hence the specific name. The heads have all the characters we have indicated as pertaining to that of the *Taenia serialis* (see p. 443). The vesicle offers a peculiarity which is never present in the *Coenurus cerebralis*—that of sometimes producing by budding, either on its inner or outer surface, other bladders organised like itself, and endowed with the property of originating scoleces in every respect similar to those of the mother vesicle. The external vesicles often remain fixed to the mother-vesicle by a pedicle; but the internal ones, on the contrary, after a certain time float in the fluid of the primary bladder (Baillet).

The *Coenurus serialis* was met with for the first time by De Blain-

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ville in 1822; then it was re-discovered by Rose\(^1\) in 1833, and some time after by E. Rousseau, then by Gervais; but it has been well studied since, principally by Baillet and Perroncito. It has been found—and sometimes in great number, in the most varied parts of the connective tissue—head, neck, loins, thorax, limbs, etc. In general, it does not appear to trouble the health of its host. However, when it is very abundant—due to the budding of the mother-vesicle—it may assist in weakening the animal. Bergeon and Railliet have published a remarkable instance of this.\(^2\)

When Baillet administered the *Coenurus serialis* to Dogs, it produced the *Taenia serialis*; Perroncito obtained the same results. And the ova of this *Taenia*, when given to Rabbits, reproduced the same *Coenurus*; but when the experiment was repeated on Lambs by Baillet, it did not furnish conclusive results, and with Perroncito—who experimented on a Sheep—and ourselves with two Lambs, the results were negative. This confirms the specific distinction established between *T. serialis* and *T. coenurus*.

The researches of Baillet show that the embryos of the *Taenia* are carried to the tissues by the blood-current. They pass through the walls of the capillaries, and excavate in the connective tissue 'galleries more or less elongated, and generally very tapering and fine at one end, wider at the other, and which are always filled with a pulpy matter, unctuous to the touch, very pale-yellow in colour, and markedly distinct from the red background the small quantity of extravasated blood forms around it, after this has coagulated in the connective tissue.' In eighteen to twenty-five days after the ingestion of the ova of *Taenia serialis*, the pro-scoleces form vesicles measuring '75 mm. to 2·50 mm., and after thirty days they are the size of a pea. At the end of the second month they are larger than a cherry, and commence to bear scoleces; at the third month they are as big as a walnut.

English gamekeepers designate as 'bladdery Rabbits' those affected with Cesnures in the connective tissue, and—according to Rose—before they are sent to market, the bladders are punctured through the integuments, and the fluid they contain is in this manner got rid of.

'It should be remarked,' Baillet says, 'that the largest number of Cesnures has been collected from wild Rabbits, and this would appear to indicate that the *Taenia* which produces them must inhabit the intestine of some carnivorous animal that usually lives in the same localities as these Rabbits; so that the development of this *Taenia* in the Dog must be considered purely accidental.

**Echinococci.**—Echinococci are only exceptionally found outside


The parasites, connective tissue and bones.

Parenchymatous organs—such as the liver, lungs, pancreas, spleen, etc., but they may be found in any part of the body. Nevertheless, beyond the cases we have quoted (p. 506), in which they were generalized in the Pig, and that mentioned by Morot, in which hydatid cysts were situated between the pleura and the inner surface of the rib of a Cow, 1 we know of only a small number of observations regarding its presence in the muscles; and what is remarkable in these, is the circumstance that they all refer to the Horse, in which Echinococci are rare.

In one of these cases, a handful of hydatids was lodged in an abscess in the temporal fossa. The temporal, pterygoideon, and ocular muscles were softened and pale, and united by inflammation-tissue. The left wall of the cranium was thickened, and the left cerebral hemisphere compressed (Kirkman). In another case, the cyst—which contained a considerable number of hydatids—was situated between the wall of the thorax and the attachments of the diaphragm (Goubaux). In one more instance, 2 a hydatid cyst formed a tumour in the region of the ribs, which persisted for seven years, and finally disappeared, after having thrown out on several occasions Echinococcus vesicles (Raymond).

In four other cases, the hydatids were located in the upper parts of the posterior limb. In one of them, they were acephaloceysts enclosed in a large pouch, that formed a voluminous tumour between the anus and ischium; the animal had experienced frequent attacks of colic. An incision through the wall of the rectum allowed the extraction of the hydatids, and this was followed by recovery (Villate). On another occasion the hydatids formed an enormous tumour in the lumbar region, having invaded the muscles there; this tumour was reproduced after being twice partially removed. It extended towards the ilium, and Echinococci were even found in the diploe of that bone (Colin). At the autopsy of a Horse killed because of incurable injury to its foot, Broquet and Méggnin found the muscles on the inner aspect of one thigh partly removed, owing to the presence of a large number of hydatid cysts, the vesicles of which varied in size from that of a pea to a pigeon's egg; there were about two quarts of them, and they belonged to the exogenous type. In the case reported by Ranvier and Dehors, the horse had been killed because of the low state into which it had fallen, and on examination there was discovered a vast purulent tumour, extending from the left kidney to the superior border of the ilium, formed of large irregular cavities, communicating with each other by various-sized openings. In the pus floated hundreds of Echinococci—intact

2 Villate. Rec. de Méd. Vétér. Pratique, 1849, p. 681. — Kirkman. The Veterina-
rian, February, 1863. — Goubaux, quoted by Davaine. Tr. des Entozoaires, 2nd edi-
and broken. This multilocular pouch was continued by a number of orifices into the deeper layers of the gluteal muscles, and those of the anterior and posterior crural regions. Johne found a vesicle in the psoas muscles of a Horse (Friedberger and Fröhner).

**Distoma hepaticum**—Morot has published several instances of hepatic Flukes encysted beyond their ordinary habitat, in the Cow. On two occasions he found a tumour situated in an intercostal space, either between the internal and external planes of intercostal muscles, or immediately beneath the pleura. In another instance, the Distoma was contained in a pediculated cyst on the inner surface of the abdominal wall, a short distance from the insertion of the diaphragm at the twelfth rib. The same author has also seen them on various points of the abdominal and pectoral walls. Drosse had already observed the same occurrence.

**Distomes in the muscles of the Pig**—Leunis discovered particular Distomes in Pig’s flesh, which were studied by Duncker, with the concurrence of Leuckart, Fagenstecher and Hess; they were found in the fleshy part of the diaphragm. Happen and Muhle have also seen them in the laryngeal muscles.

These worms occupied ovoid cysts of about the same size as those of Trichinae, and lodged in the interfascicular connective tissue. Owing to the inflammatory zone surrounding them, they appeared as small, red, punctiform nodules. The Distomes measure about 5 mm. long; they are gray, transparent, very lively at the temperature of the body, and show at their anterior extremity an oral sucker, from which arises an acuminated prolongation directed forward, and which is probably, according to Leuckart, a buccal stylet of the Cercaria.

The abdominal sucker is situated towards the middle of the body. The transparency of the integuments allows the arrangement of the digestive tube, the aquiferous vessels and the rudimentary genital organs, to be seen; as well as the presence of four large glands in the anterior moiety. Duncker on one occasion found these Distomes still provided with their cercarial tails. It is evident that these parasites are not called upon to continue their course of development in the Pig, for the membranes surrounding them are too strong to allow them to pass through. The Pig is only an intermediate

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abnormal host for them, and the state in which they are seen does not admit of their being assigned to any particular species.

**Nematodes.**—Several Nematodes have been found in the muscles and connective tissue of various domesticated animals. The most important—the Trichina—will form the subject of a special chapter presently (see Trichinosis); so that we will only now deal with those whose presence is exceptional or accidental.

The *Filaria papillosa*, which usually lives in the peritoneum of the Horse, is noticed by Rudolphi as also found in the sub-peritoneal and inter-muscular connective tissue of the abdominal walls of the same animal.

We have seen that the *Filaria immitis* may be found in the subcutaneous connective tissue of the Dog (p. 642); that the embryos of the *Ollulanus tricuspis* of the Cat may wander from the stomach into the muscles and connective tissue, as well as into diverse organs, and form cysts analogous to those of the Trichinæ (p. 372); and that larval Nematodes have been met with by Eberth in the muscles, kidneys and lungs of the Sheep (p. 585).

*Filaria clava* Wedl.—Female worm found at Vienna in the peritrichal connective tissue of a Pigeon. Mouth unarmed; body attenuated in front, expanded behind and claviform; length 28 mm. to 36 mm., and diameter 1 mm. to 1·5 mm. Ovoviviparous. Mazzanti says he possesses a dozen specimens.

Zürn found in the flesh of three Pigs, small Nematodes which he believed to belong to the Anguillulides, and which should not be mistaken for muscle Trichinæ. Their maximum length was 1·4 mm. and breadth 63 μ; they were not encysted, and their presence was probably accidental; as it was thought they might have penetrated the specimens examined, by coming in contact with water or instruments containing them.¹

In a Horse killed for human consumption, and which for at least eighteen months previously, though in excellent condition, had shown a certain stiffness in the hind-quarters and a great tendency to decubitus, Vittu found all the muscles invaded by cysts which were generally the size and appearance of a rye-seed.² These cysts had undergone calcareous degeneration, and by their position in the inter-fibrillar connective tissue, the structure of their walls, and the mass of fat at their ends, they resembled old cysts of the *Trichina spiralis*. Giard, who studied them, was convinced that he had to do with a parasite related to the Trichinæ,³ though much larger; but perhaps there was more reason in classing it with the *Spiroplera reticulata*, of which mention will be made presently.

An analogous observation to that of Vittu, was made on a Cow by Wolff, at Berlin. He found the muscles of this animal full of nodules—some round and as large as a lentil, others oval and as big as a grain of rice. These nodules were situated between the muscular fasciculi, and were

limited by a thick membrane; in their brown caseous contents Schütz found a coiled-up Nematode, a little larger than the Trichina.1

The Armed Sclerostome (Strongylus armatus or Sclerostoma equinum), which in the adult state inhabits the cecum and large colon of Equines (see p. 403), is—in the agamous state—very apt to wander. Consequently, it has been on several occasions met with in the muscles and connective tissue, where it arrives by means of the circulation. Harvey found not less than 200 specimens in the vicinity of the kidneys of a foal; Litt, in 1852, met with hundreds in the connective tissue between the peritoneum and abdominal muscles; Meyrick, in 1859, observed the same in the peritoneal cavity, on the liver, and in the abdominal muscles; and Miller, at Seville, Ohio, collected considerable quantities in the abdominal muscles, and especially in those of the flank. Lastly, Liénaux on several occasions found them encysted beneath the peritoneum, in various parts of the abdominal walls, underneath the pleura, on the inner surface of the arms, etc. The Sclerostomes of the abdominal walls may cause the formation of small purulent centres around them (Railliet). Although agamous, these worms are sometimes larger than the adults.2

Fig. 328.—Spiroptera reticulata; portion of the body of the female, showing the transverse stria and the spiral ridges on the cuticle; magnified 80 diameters.—Railliet.

Spiroptera reticulata (Crep., Sp. cincinnata Ercol., Onchocera reticulata Dies., etc.).—Body filiform, very elongated, and turned in a

PARASITES OF THE MUSCLES, CONNECTIVE TISSUE AND BONES. 657

spiral manner. Head not separated from the body; mouth orbicular. Male in a wide spiral form; tail excavated beneath, and margined by two vertical lobes, the base of which has small hooks and the upper border a papilla; there is a single spicule between the two lobes. Female in a close spiral form; body attenuated behind; vulva situated at a short distance from the head. Ovo-viviparous. The length of these parasites is not exactly known, as they cannot be extracted entire, in conse-

Fig. 330.—Spiroptera reticulata; portion of the body of the female, showing the intestine and the two genital tubes filled with embryos; magnified 80 diameters. — Railliet.

Fig. 332.—Embryos of the Spiroptera reticulata; magnified 200 diameters. — Railliet.

sequence of their being rolled around muscular and tendinous fibres. The female appears to measure from 40 to 50 centimètres long, and from 35 mm. to 40 mm. in diameter, which is 15 mm. in the male. This worm is special to Equines, and was discovered in 1840, by Hermann and Bleiweiss, at the Vienna Veterinary Institute. It was afterwards found in Germany and Austria, by Gurlt, Baumgarten and Zürn; in Italy, by Ercolani, Bassi, Gotti, Baruchello, Berto and Vigezzi; in Russia, by Tschulowski and Popow; and in France, by Railliet and Moussu. 1

It has been sometimes observed in the cervical ligament or in the tissue of neighbouring arteries, between muscular fibres, and in subcutaneous nodules; but it has been most frequently met with in the flexor tendons of the foot, the suspensory ligament of the fetlock, and in the walls of the collateral artery of the cannon.

It is very common at Kazan, as Tschulowski found it in fifty-one of the fifty-three Horses in which he looked for it.

It has been met with at all seasons of the year—but more particularly in the spring and summer—and in Horses of every age.

Its most frequent seat—and also the most important, but it is betrayed by significant symptoms—is in the limbs, and almost exclusively in the anterior ones. Its presence causes the formation of isolated tumours—parasitic fibromata—which are seen in the region of the tendon—within, without, or behind the perforatus tendon; at the knee—within or without, or in the neighbourhood of the insertion of the flexor of the metacarpus; at the external or posterior surface of the fore-arm; at various points of the shoulder and arm, etc.

These tumours compress the nerves or tendons; hence there results persistent, acute or sub-acute lameness, the cause of which often remains unknown, so long as the parasitic fibroma has not acquired an appreciable size.

Treatment consists in extirpation of the tumour; this leaves only a simple wound that is easily healed.

The extracted tumour is, in general, irregularly ovoid in shape, and from 3 cm. to 6 cm. long. It is composed of dense fibrous tissue which is often calcified, and surrounds yellowish nuclei, in the centre of which is found the worm, which up to the present time has only been extracted in fragments.

In Horses which were bearers of reticulated Spiroptera, Tschulowski has sometimes found an abundance of their embryos in the lymph of the lymphatic vessels of the limbs, in the perivascular connective tissue, in the synovia of the three inferior articulations, and in that of the bursa of tendons—especially in the bursal distensions popularly known as 'wind-galls.' Each drop of lymph or synovia contained three or four. These embryos were very slender, and measured 300 μ to 400 μ long by 6 μ to 9 μ broad; throughout their whole length was remarked a digestive tube filled with a granular matter. This observation tends to establish the fact, that the embryos of the Spiroptera reticulata may effect active migrations, and may even enter the vascular system.

CHAPTER I.

PSOROSPERMOSIS OF THE MUSCLES AND CONNECTIVE TISSUE.

The Sporozoa which inhabit the muscles and connective tissue form the order of Sarcosporidiae or Psorospermæ utriculiformes (see p. 4). They are divided into three genera, according to the following table:

| Seated in the connective tissue. | Enveloping membrane thin and without definite structure |  | Balbiania. |
| Seated in the striped muscles | thin and anhistic |  | Miescheria. |
| Enveloping membrane | thick and traversed by fine canaliculi |  | Sarcocystis. |

The Sporozoa of the domesticated animals belong to the genera Balbiania (Blanch.) and Sarcocystis (Ray Lank.).

The Sarcosporidiae—which are also frequently named the Utricles of Miescher or Rainey’s Corpuscles—were seen for the first time in 1843, by Miescher, of Bâle, in the muscles of the Mouse. Herbst afterwards found them in those of the Pig in 1851. Von Hessling, who in 1846 had observed them in the breast-muscles of a Roebuck, discovered them also in the myocardium of the Ox, Calf and Sheep; and Rainey, in 1857, saw them in the muscles of the Pig. They have since been met with in the majority of the domesticated Herbivora—Horse, Ox, Buffalo, Sheep, Goat and Rabbit; and amongst Birds, in the Fowl.

We may, at least provisionally, attach these Sarcosporidiae to three distinct species: Sarcocystis Miescheri (Ray Lank.), Sarcocystis tenella (Raill.), and Balbiania gigantea (Raill.). But with the exception of the Pig, the Sarcosporidiae of which are well known, there are too few observations recorded to allow of a rigorous determination of the species of parasite being made. This summary study in Psorospermosis will be divided into Psorospermosis of the muscular tissue and Psorospermosis of the connective tissue.

ARTICLE I.—Muscular Psorospermosis.

Fig.1.—The Sarcosporidia of the Pig is the Sarcoeystis Miescheri. First observed by Herbst, then by Rainey in the muscles of this animal, it has since been studied by numerous observers, and is now well known, owing more especially to the investigations of Leuckart and Manz.

It is only at an autopsy that the presence of these parasites can be ascertained. All the striped muscles may be infested by them, and these have then a granular aspect and darker colour; while a close inspection discovers small white, elongated points in the midst of the muscular tissue, and which are sometimes so long as to be readily seen. These are the Sarcocysts.

They may be as much as 2 mm. to 3 mm. long, and their breadth varies between 80 μ and 300 μ. They appear in the microscope as elongated bodies, slightly refrangent, granular, and tapering at both ends—though sometimes only at one. They are limited by a somewhat thick enveloping membrane, showing a transversal striation that Leuckart ascribes to the presence of numerous canalculi; by compression this wall becomes disaggregated, and then appears as a ciliary


covering, which some authorities have regarded as a normal arrangement in the Psorospermia. The interior of the Utricle is divided into a great number of spaces by anastomosing partitions. Towards the extremities, the membrane seems to be slightly separated from its contents, and a conical space is seen there, containing refrangant granules. For the remainder of its extent, the Utricle holds in its spaces spores—numerous and closely-packed corpuscles which, when they are set free by the rupture of the membrane, appear semi-lunar, reniform, or fusiform in shape. They have one or—more frequently—two clear points that are generally regarded as nuclei.

The Sarcocysts are situated even in the axis of the primary fasciculi, surrounded by a layer of the substance of which these are composed, and which has been pushed beneath the sarcolemma by the pressure of the parasite. The majority of authorities do not mention any other alteration than the

dilatations and moniliform aspect of the primary fasciculi. According to Perroncito, the Utricles may move in the interior of the sarcolemma and leave evident traces of their passage. When they are old they may undergo calcareous degeneration.

Laualanié has noticed that, while in certain points the invaded primary fasciculi remain healthy, at others they undergo vitreous degeneration, the parasite acting there as an irritant on the connective tissue; there is diffuse interstitial myositis and formation at these points of nodules analogous to tubercular granules. ‘The peripheral zone of these granules is developed on a territory originally occupied by muscular elements, which it surrounds and progressively destroys.’ The primary fasciculi most distant from the centre are at first atrophied, and there sometimes appear new-formation cells; so that parenchymatous myositis is added to interstitial myositis.’

Muscular psorospermosis is not betrayed during life by any appre-
ciable signs. Nevertheless, Virchow has observed, in some Pigs which were affected, feebleness or intermittent paralysis of the hind-quarters, ardent thirst, a nodular exanthem, transient symptoms of 'rouget,' and in one instance lachrymation and a dull appearance of the eyes—which might be due to the presence of the parasites in the ocular muscles.

The Sarcocysts of Miescher are very frequent—at least, in certain countries and at certain periods. Herbst estimates the number of instances in which he has found them as 50 per cent., and a similar estimate has been made by Rupprecht. Leuckart has found five Pigs affected out of eighteen, and Moulé has seen about 40 per cent.

The attempts at transmission made by Virchow and Manz, in feeding animals with pig-flesh infested with Psorospermiae, were without result.

Leuckart appears to have been more fortunate, for to a Pig—the muscles of which were free from these parasites (as was proved on examination of them by means of the harpoon)—he gave the flesh of one that was infested. The animal was killed six weeks after receiving the first meal, and its muscles were full of very small-sized Psorospermiae. But it cannot be concluded from this unique instance that the Sporozoa of the muscles can be directly transmitted through the digestive organs, and that the ingestion of infested flesh is dangerous for Man. Lindemann has, however, published a case in which Psorospermiae, developed in the valves of the heart of a Man, caused a fatal dropsy. But in every case in which flesh is much infested, its use for human food

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**Fig. 337.**—Completely developed psorospermic granule in the Pig's muscle, the parasite having disappeared in the middle of the degeneration products.—Laulanie.

a, central zone represented by a small centre of calcareous degeneration; b, peripheral zone of embryonal proliferation; c, c, spaces originally occupied by the primary fasciculi, and now filled with cells; d, d, atrophied primary fasciculi buried in the proliferation; e, connective tissue septum.
should be interdicted, because of its bad appearance and diminished nutritive value—due to alterations which inflammation has produced in it. Rabe has published a case of serious intestinal catarrh in a Man, consequent on eating the flesh of a Pig that was intensely affected with muscular psorospermosis.¹

Sheep.²—Psorospermosis of the muscles of the Sheep is produced by the Sarcoeytis tenella. It has often been observed, and is the form best known, thanks to the researches of Huet and Moulé. It occupies in the muscles of the Sheep the same situation that the Sarcoeytis Miescheri does in those of the Pig—that is, the primary fasciuli; but it is distinguished from it by the greater thinness of its enveloping membrane, which is otherwise canaliculated and capable of being reduced to pseudo-cilia by compression.

Moulé has often found the parasites in cachectic Sheep—98 per cent. — and they were usually numerous in proportion as the cachexia was more accentuated. Sometimes there were regularly five, six, and more in the field of the microscope in each preparation; at other times several preparations would have to be examined in order to find one. In 100 Sheep in good condition, he only met with them in 44, and then always in small number. It was the same with a Sheep which had been affected with anthrax, the few which were observed appearing deformed.

They may be found in all the muscles, but they seem least numerous in those of the internal crural region. Von Hessling, Cobbold, Moulé, and Sticker have seen them in the myocardium; Brusaferro in the fibres of Purkinje of the heart; and Krause in the ocular muscles.

Goat.³—Moulé classes with the Sarcoeytis tenella the Sarcosporidiae he found in the Goat, and which had been already seen by Pagenstecher. They are less common, and not so abundant as in the Sheep; for the proportion of cases has only been 46 per cent. in lean animals, and 33 per cent. in those which were fat. They are larger than those of the Sheep, and may be even double their size.

Ox.⁴—Sarcosporidiae have been seen in the Ox, in the muscular fibres of the heart, by Von Hessling, Cobbold and Perroncito; in the muscles of the eye by Krause; in the cremaster of a Bull by Manz; and in

⁴ Authorities already quoted.
various muscles by Beale. Of 100 Oxen condemned for being in extremely bad condition, Moulé found 37 of them infested with Sarcosporidiae; he only found them in three instances in Cattle in good condition. These were probably the Sarcocystis tenella; they are of the same dimensions as those of the Goat, but may attain a centimètre in length, and have longer cilia—Sarcocystis hirsuta Moulé.

Horse.¹—The muscle Sarcosporidiae of the Horse are, doubtless, also the Sarcocystis tenella. They have been seen by Siedamgrotzky, Schulze, Piitz and Moulé.

Siedamgrotzky found Sarcosporidiae in thirteen Horses killed for anatomical purposes, or which had died from different diseases. They were principally in the muscular layer of the pharynx and oesophagus, in the inferior cervical muscles, and in the diaphragm. In the limbs, the infested muscles were atrophied, pale, soft, and yet more fibrous than in the normal state. The nuclei of the sarcolemma were multiplied in the primary fasciculi affected, and even in the healthy fasciculi; they formed a kind of chaplet lying alongside the sarcolemma. In addition, the interfascicular connective tissue had undergone proliferation, and by compression had caused simple atrophy of the contractile fibre. These Sarcosporidia were from 3 mm. to 4 mm. long, and in some points had submitted to calcareous degeneration.

Schulze has met with these parasites in the muscles of the forehead of a Horse, killed because of being affected with paralysis of the anterior limbs. These muscles were degenerated, and showed calcareous granules 20 mm. long by 3 broad. Their elements had undergone alterations analogous to those observed by Siedamgrotzky.

In a Horse observed by Piitz, the majority of the muscles were more or less invaded—sometimes in a high degree—by Psorospermiae of various ages. They—the muscles—were more voluminous and more rigid than in the normal state, and were of a yellowish-grey colour; there was interstitial myositis, by proliferation of the interfascicular connective tissue, increase of the perimysium, and atrophy of the primary fasciculi, the striation of which, nevertheless, generally persisted. There was not always an exact relationship between the muscular alterations and the topographical distribution of the Sarcosporidiae; so that there might have existed doubts as to these parasites being the real cause of this myositis.

Of 65 Horses examined by Moulé, 13 showed the Sarcosporidiae; but only one had them as large as those of the Ox; in the others they were invisible to the naked eye.

Other Species.—Sarcosporidiae have been noted by Krause in the muscles of the eye of the Dog and Cat; by Manz in various muscles of the Rabbit; and by Kühn in those of the Fowl.

Article II.—Psorospermosis of the Connective Tissue.¹

The Psorospermiae of the connective tissue are the Balbiania gigantea. They were first met with in the Sheep by Winckler and Leisering, then by Dammann, Zürn and Brusaféro, and have been well studied by Morot and Railliet. Von Niederhäusern has seen them in the Goat; and Jongh has often observed them in the Ox, Deer, Goat, Pig, and especially the Buffalo, at Java. According to certain observers, it would appear that they may also be met with—like the preceding—in the midst of the primary fasciculi.

The size of a Balbiania gigantea may vary from that of a barley-grain.

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to that of a small hazel-nut. The enveloping membrane is thin and structureless, and in the centre of the largest specimens is a space as large as a pin-head. The remainder of the cavity—which is partitioned into cells—is filled with very regular crescentic-shaped corpuscles, which have no nuclei and do not refract the light. Certain of the Balbianiæ only show a few corpuscles, but have many round bodies, which have a greater or less diameter in proportion to the maximum thickness of the crescents.

The German authorities, who were the first to observe this Sarcosporidia, found it in great numbers in the muscular layer of the œsophagus, and, secondarily, at the base of the tongue, in the muscles of the pharynx, cheeks, neck, thorax, abdomen and thighs. The Sheep which were the bearers of it sometimes died suddenly, at other times after manifesting symptoms of asphyxia or epileptiform seizures. In some instances the mortality was like that of an epizooty, and the losses were attributed to the action of the Sarcosporidiae, which, by their presence in the vicinity of the larynx, caused oedema of the glottis and, consequently, asphyxia. Von Niederhœnsern, who found them in a Goat, arrived at the same conclusion.

But the investigations of Morot certainly seem to establish that there is a simple coincidence between the fatal issue and the psorospermosis of the œsophagus, as he very often found these parasites in Sheep killed at Troyes abbaitoir. Moulé has not met with any in Paris, but Railliet has discovered them there in a Goat.

In about 900 Sheep, Morot found 272 which had the œsophageal cysts of the Sarcosporidiae. Neither the condition, age nor sex appeared to have any influence on their presence or number, which latter varied from 1 to 272, and averaged from 10 to 12. The same Sheep might have them of all sizes, these having no relation to their number.

'Among the 272 Sheep which had the œsophagus nodulated, 6 had at the same time psorospermic cysts beneath the pleura, 10 beneath the peritoneum, and 27 beneath the pleura and peritoneum at the same time.' These subserous cysts were 'usually in the form of elongated patches, the dimensions of which varied from that of a cabbage-seed to that of a prune-stone, and even that of an average haricot-bean.' They were sometimes more, at other times less numerous, than those of the œsophagus.

A Sheep of second quality and in good condition had a large number in every part of the body, and especially in the œsophagus, which had 227, and the tongue, which harboured 128. Some were found in the muscles of the subscapular and crural regions.

CHAPTER II.

MEASLES.

Definition.—Measles (French ladrerie) consists in the presence of certain Cysticerci in the muscles and connective tissue, and accessibly in other parts of the organism. The Cysticerci which constitute the disease are: the Cysticercus cellulosa—the cystic form of the Taenia solium of Man; the C. bovis, of the T. saginata of Man; the C. tenuicollis, of the T. marginata of the Dog; the C. tarandi, of the T. Krabbei of the Dog.

The domesticated animals which may contract the measles are—in the first line—the Pig (C. cellulosa), then the Ox (C. bovis), and exceptionally the Sheep (C. tenuicollis), the Reindeer (C. tarandi), and the Dog and Cat (C. cellulosa). Man himself is not exempt from this affection (C. cellulosa).

Etymology.—The French words ladre, ladrerie—sometimes employed in bygone days as synonymous with leprous and leper—are derived, according to some authorities, from the Greek λαδόρις, deformed or awkward, and according to others—and notably Bescherelle and Littre—from Lazarus, Lazarus, whose name has become corrupted in common speech to ‘Saint Ladre.’ It is not known by what affiliation this designation of ladrerie has passed from leprosy to a parasitic affection from which it is absolutely different in every respect.

(The same remarks may be applied to the English name for this parasitic disorder, as it has no affinity whatever to the specific eruptive fever of Man, known as measles.)

Synonyms.—German, Finnenkrankheiten (Finnen, masern, hydatids finna); Spanish, ladreria (sarampión, noña); Dutch, gortieid; Italian, grandina, panicatura (Greek, παλαταία; Latin, Porci leprosi; English, measles, leprosy; technical, Cysticercus cellulose, Scalesiasis, Cacheria hydatigena, cestode tuberculosis).

In France, during the greater part of the Middle Ages, the disease received the names of mézellerie, meseau, mesel, mesellus, mesiar, mischleria, noscheria, nosellerie, pian, tal, mal de Saint-Lazare, pourriture, etc., while the affected Pigs were called lépreux, mezeaux, corrompus, impurs, and, most frequently, sursemès—a term which indicated the dissemination of the parasites in the flesh. At the commencement of
this century Viborg named the disease *glandine*, and other authorities gave it the designation of *grainerie*; so that Pigs so infested were said to be *glandés* or *graines*.

In these days, the term 'ladricie' is pronounced to have other meanings—such as that of avarice and leper; but the first cannot cause a mistake, while the second has fallen into disuse, and in medical language the word 'ladricie' is (in France) accepted exclusively as applying to this disease. Several authorities—Bouley, Trasbot—have proposed to substitute that of *Cysticercosis*; and this term, composed according to the rules of nomenclature, has the advantage of indicating the nature of the malady to which it is applied. But, logically, it should include all the affections due to *Cysticerci*, and, consequently, those of the Rabbit caused by the *Cysticercus pisiformis*, that of the Dog and Cat by the *C. (Plerocercoids)* Bailleti, that which produces in the Horse the *C. pistularis*, etc. There is no synonym, therefore, between 'cysticercosis' and 'ladricie' (or 'measles'). There are ladric (or measly) cysticercoses, but all the cysticercoses are not ladric (or measly).

**Division.**—Measles differs in its nature, effects, frequency, its importance from a sanitary point of view, etc., according to the species of domesticated mammal attacked. It is, therefore, necessary to study it successively in each, subordinating it—for order's sake—to the kind of Cysticercus giving rise to it.

**Article I.**—**Measles of the Pig.**

The Pig measles is produced by the *Cysticercus cellulose* Rud., the larval form of the *Taenia solium*, or *Taenia armata* of Man.

**History.**—Measles of the Pig has been known from the earliest times, and its influence on human health seems to have inspired the Egyptian priests in the days of the Pharaoths and of Moses—the law-maker of the Jews—when they prohibited the use of the flesh of that animal as food. But the first mention of this disease occurs in the fourth century before our era, and is found in the writings of Aristophanes (b.c. 450-380), where, in his comedy of *The Knights*, it is spoken of as being well known. Aristotle has described it with remarkable precision, and his description has been almost exactly reproduced by Rufus—quoted by Oribasius; then it is mentioned by Pliny and Didymaëus, and again by Plutarch, Aretacus, Archigenes and Androsthenes.

Numerous laws enacted during the Middle Ages prove that it was also well known then, but there was as little idea of its parasitic nature as among the ancients, and we must come to the year 1683 before an indication of this is found in a memoir by Redi. Two years afterwards, Hartmann found a Cysticercus in a Goat, and recognised it

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as a living animal; but to Malpighi belongs the credit of giving the first exact description of the measles Cysticercus. These observations appear to have been little known, however; for it was not until 1760 that Pallas attempted to establish a relationship between the parasite of measles and that of the Tape-worms, and named it the *Tenia hydatigena*. About the same time, Fabricius expressed the opinion that the

measle Cysticerci were derived from a Tape-worm; and Goeze, in 1780, described the bladder-worm with much precision and exactitude.

The year 1842 marked an important advance, as Steenstrup then considered the cystic worms as the first step in the development of Helminths, which, however, he could not determine; while Von
Siebold regarded them as wandering Tænia—an opinion also adopted by Dujardin in 1845. But it required the experiments of Van Beneden and Küchenmeister to put the migrations of the Cestodes beyond doubt, and the facts they established have been confirmed, extended and completed by numerous experimenters to whom we shall have to refer hereafter.

Pathological Anatomy.—It is more especially at an autopsy that the existence of measles is recognised, from the presence of the Cysticercus cellulose Rud. in different parts of the economy. It appears in the form of an elliptical vesicle from 6 mm. to 20 mm. long and 5 mm. to 10 mm., or even more, broad; and showing towards the middle of its length a white spot provided with a scarcely visible opening, that corresponds to the invaginated head. The latter has at first the aspect of a white, opaque, and somewhat consistent tubercle, the size of a millet-seed, which adheres to the wall and projects internally. By methodical pressure between the thumb and forefinger, it is easy to extrude the head and body of the Cysticercus from the caudal vesicle, in which they are invaginated; usually, the vesicle is ruptured in this operation. On examining the evaginated head by a low magnifying power, it is observed to be sensibly tetragonal, and to measure .6 mm. to .8 mm.; it is furnished with four suckers, and a double crown of from 24 to 32 hooks, the largest of which is 160 μ to 180 μ long, and the smallest from 110 μ to 140 μ. These are absolutely the characteristics of the head of the Tænia solium of Man.

Each Cysticercus is enveloped in a cyst, the dimensions of which are scarcely superior to its own; this cyst is formed at the expense of the tissues of its host, and is composed of a thin, transparent, connective-tissue membrane, slightly vascular, and destitute of epithelium. The cysts are lodged in depressions—a kind of cells or alveoli formed in the substance of organs.

The measles Cysticerci are found almost exclusively in the muscular masses, the muscles most frequently invaded being those of the tongue, the neck, and the shoulders; then come—in the order of frequency—the intercostal and psoas muscles, those of the thigh, and, lastly, those of the posterior vertebral region (Delpech). The measles is sometimes so generalized that the Cysticerci are met with in all the striped muscles of the body; their number may be enormous, and represent almost one-half the total volume of the morsel of flesh examined. Küchenmeister has found 133 in a scrap weighing 17 grammes—which would give about 8,000 to the kilogramme (nearly 2½ pounds).

When the measles is not very pronounced, the vesicles are scattered, but they have always their privileged seat in the muscles of the deeper surface of the shoulder, in those of the neck, the fleshy portion of the diaphragm, the triangularis sterni, and the intercostals. It is necessary, in some of these discrete invasions, to make numerous sections in
various directions, in order to find a single vesicle. By squeezing the flesh between the fingers, we may often succeed in rendering some visible, which would otherwise remain unperceived; and frequently, also, measly flesh may be recognised by the little cavities from which the Cysticerci have been removed.

Sometimes the parasites are found in the submucous connective tissue on the inferior surface of the tongue, nearly as frequently as in the above-mentioned muscles. Towards the base of that organ and the sides of the frenum, they are usually seen as opaline, semi-transparent, globular or ovoid vesicles, which raise the mucous membrane, and can be felt by the finger.

The heart is also very often invaded by Cysticerci, and at times in such numbers that there is reason for wonder that the functions of the organ are not seriously interfered with. When there are only a few, they are usually localized towards the point.

It is rare to find them in the fat, but when the disease is generalized they may be met with in the neighbourhood of muscles, adhering to the muscular fibres that enter the layers of adipose tissue.

Otherwise, the specks or grains (as they appear to the naked eye) may be found in all the organs — brain, spinal cord, eyes, lungs, liver, kidneys, spleen, lymphatic glands, and testicles (Cobbold); but they are rarely in notable quantity, though Brusaferro has observed them in large number in the cerebral hemispheres, but not in any other parts of the organism. They are exceptional in the liver, lungs, spleen and kidneys (Hertwig). In the majority of instances in which they were supposed to have been seen, they were really old Echinococci, and not Cysticerci. In the lungs, liver or spleen, they sometimes form gray or reddish, caseous, purulent or calcareous nodules, which have some resemblance to tubercles, and in which an attentive examination will lead to the discovery of hooks, and even of complete heads of the Cysticerci1 (Gratia).

1 Cobbold. The Veterinarian, 1878. — Hertwig. Die Stadtische Fleischbeschau in
The cysts containing the measles Cysticerci are lodged either on the surface or in the substance of muscles, between the secondary fasciculi, and parallel to their direction.

Occasionally the parasites have lost their usual characters, owing to degeneration, which may occur at any stage of their development; their size is then between that of a millet and a hemp seed. They form elliptical tubercles of a yellowish-brown colour, filled with yellow purulent matter, in which neither the scolex nor even the hooks are to be found (Munkenbeck).  

It is usually age that brings about degeneration of the Cysticerci, and their transformation into small, round, hard and compact grains, impregnated with calcareous matter and destitute of fluid. The pork-butchers then name the disease dry measles. It is almost certain that, when in this condition, the parasites are dead. This form of measles is rare in Pigs brought to the Paris market, but it is somewhat common at Bordeaux (L. Baillet).

The degeneration of the Cysticerci is centripetal—that is, it begins with the external membrane and finishes with the scolex; and this is most evident in the caseous or pseudo-purulent degeneration.

The pressure exercised by the cyst is frequently the beginning of atrophy in the secondary fasciculi. Later, the interfascicular connective tissue becomes thickened, and forms streaks like bright veins in marble, which grow more and more marked (Trasbot).

The muscles infested by measles are pale and soft, and in cutting into them the Cysticerci are opened, which causes a copious flow of limpid, amber-coloured serum. But if the disease is of long standing and generalized, the anaemia with which it may then be accompanied gives rise to a passive infiltration into dependent parts, while the muscles themselves are impregnated, and often show, in addition, the Sarcozystis Miescheri.

There is, besides poverty of blood, tumefaction and infiltration of the lymphatic glands, pallor of organs, and the lesions of concomitant affections which have caused death.

The Cysticerci will be absent from the surface of the muscles when the pork-butcher has scraped them off with his knife; they have been, as it were, enucleated, but attentive examination will discover the small cavities they occupied, and all doubts may be removed by cutting into the suspected piece, for it is rare not to find other vesicles in its substance.

It is very difficult to meet with the Cysticerci in chopped-up pork,

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1 Munkenbeck. Adam’s Vierteljahrschrift, XXIV., p. 87.  

because of the small fragments of fat intimately mixed up with it. Schmidt-Mülheim recommends, in such circumstances, a procedure based on the resistance of the Cysticercus to the gastric juice.¹

The gastric mucous membrane of a Pig or Dog is chopped into small pieces, and macerated for some hours in a 5 per cent. solution of hydrochloric acid; then the fluid is filtered, and must be used within a brief period. But if it is desired to have a fluid that will keep for some time, so as to be ready for any emergency, a different course will have to be adopted. The chopped mucous membrane is steeped in glycerine for several days, and then filtered; this fluid will keep for years at the ordinary temperature. When it is to be used, a few drops are thrown into a 5 per 1,000 solution of hydrochloric acid, and a sufficient quantity of the suspected sausage or chopped pork to be examined is digested for several hours at a temperature of 40° Cent., in six to eight times its volume of this mixture of pepsinized glycerine and acidulated water, being shaken from time to time. The flesh and fat are dissolved, the latter appearing as a more or less thick layer on the surface of the liquid. The vesicle of the Cysticercus is slightly attacked, but the head and suckers, and especially the crown of hooks, resist the action of the fluid, fall to the bottom of the vessel, and are easily found in the form of grains resembling rice.

**Symptoms.**—The symptoms of measles are very vague and difficult to appreciate, while they vary according to the susceptibility of the animals and the particular localization of the malady. Most frequently they are null, and especially when infestation is not general. Of all those which have been indicated, the only one that may be accepted as pathognomonic is the presence of the Cysticerci beneath the mucous membranes accessible to exploration—such as the inferior surface of the tongue, and more especially on the sides of the faenum; sometimes on the conjunctivæ, and more rarely in the folds of the rectum. At these points, their presence may be recognised by the unevenness of the surface of the membrane, and the prominences more or less marked which the vesicles form, while their distinctly transparent and opaline aspect contrasts with the rosy tint of the adjacent parts.

At the time of Aristophanes, it was already known how to recognise the measles by the presence of vesicles beneath the tongue and in the rugæ of the anus, and inspection of the tongue (*langueyage*) was practised. This operation consisted in examining that organ by the *langueyeur*; and in the Middle Ages, and up to the end of the eighteenth century, it was carried out (in France) by persons in authority—king's officers called *langueyeurs-jurés*. To-day the operation is free and optional, but its exercise always constitutes a special calling, because of the experience and expertness it demands. Certain towns have even a regularly-appointed and paid official, who examines the Pigs sent to the markets.

In order to make this inspection, the langueyeur commences by throwing the animal down: placing himself alongside it, he pulls it towards him by the bristles of the back and loins, while an assistant on the opposite side pulls it towards him by the hind-leg nearest the operator, so that the Pig loses its balance, and is thrown down by the latter. Or he stands on the right side of the animal, and seizes it by the left fore-leg, and throws it over by pushing his knee into its flank. As soon as it is down, he throws himself upon it and prevents it getting up by planting his left knee on its neck, the assistant holding its hind-feet.

Taking advantage of the animal’s screams, the operator introduces a stick about a yard long between its jaws, the end which enters the mouth resting on the ground, and is kept firmly there by his foot, the other end being passed below his thigh and right armpit, where it is held by an aide. In this way the stick plays the part of a lever in keeping the mouth open. The expert now introduces his hand, enveloped in a towel, into the mouth of the Pig, pulls out the tongue, examines it attentively, and passes his fingers over it from the base to the tip. He generally completes his inspection by examining the conjunctive.

‘When one is not sufficiently practised at this,’ says Lafosse, ‘it is better to throw down and fix the Pig by assistants, and separate the jaws by a speculum; the tongue may then be seized and examined without fear of having the fingers crushed.’

If vesicles are observed about the tongue, the existence of measles is certain, though if they are not found there, the absence of the disease must not be inferred; for of 41 cases of measles discovered after death during one quarter of the year, L. Baillet noted 10 in which there was no trace of Cysticerci in the lingual region. This practical result shows that in litigation between buyer and seller, the fact that the mouth of the animal had been inspected before purchase would not be a proof in favour of the vendor.

The vesicles in the mouth, conjunctivæ and anus, may be removed by a trifling operation named ‘pricking’ (épinglage), which consists of either a simple puncture that emptied the Cysticercus, or an incision that allows of its removal. There remains a small wound that suppurates for a short time, and which might be ascribed to an injury caused by the teeth or some hard body—such as a bone. When these wounds are healed, they leave a small temporary cicatrix, which cannot serve as an aid in ante mortem diagnosis.

Except for the presence of Cysticerci beneath the visible mucous membranes, there are no other signs that permit the disease to be recognised in the living animal—though a good number have been mentioned as belonging to it; but they are exceptional or of little value, and are only seen in animals which are very largely infested. Such is hoarseness, accompanied by a small, suppressed husky cough, and a tendency to breathlessness—symptoms very probably due to the

1 Lafosse. *Traité de Pathologie Vétérinaire*, II., 1861, p. 96.
presence of numerous Cysticerci beneath the mucous membrane and in the muscles of the larynx, and which are often the first indication that attracts attention.

A particular swelling of the parotideal region has been mentioned; but neither Dupuy, Hurtel d’Arboval, nor Delpech has noticed it.

Greve says he has remarked in many measly Pigs an increased sensitiveness in the snout which prevents their burrowing, even in soft ground; and in eating grain off a hard floor they avoid contact with that part as much as possible, by raising the nose and upper lip, and seizing the food with the tongue. Tapped slightly on the end of the nose with a stick, the measly Pig cries out because of the pain, while a healthy Pig would remain indifferent. Very measly Pigs have the snout more or less tumid, soft and flaccid. But these indications have not been confirmed by other observers. It is the same with regard to a certain degree of analgesia or anaesthesia of the skin of which some writers have spoken, and also the bristles being easily pulled out and a drop of dark blood at their root—symptoms alluded to by Aristotle.

Many pig-dealers and butchers assert that measly Pigs have the shoulders high, whence results a cramped appearance of the neck and stiffness in movement of the anterior limbs; this may be due, as Trasbot remarks, to an abundance of Cysticerci in the large pectoral and great serratus, etc., muscles, which become relaxed, and allow the thorax to descend between the shoulders.

In a Pig suffering from intense measles, Sobotta observed complete paralysis of the tongue, which was invaded by Cysticerci; the prehension of food was therefore impossible, and the animal perished from inanition.¹

When the Cysticerci are located in the nerve-centres, the symptoms often assume a particular physiognomy. Florman has seen a very manifest turning round in such a case; and Rehrs has witnessed epileptiform convulsions, grinding of the teeth, ptyalism, pleurothotonos and episthotonos, with rabiform vertigo. At the autopsy, he found in the cerebrum and cerebellum an enormous quantity of Cysticerci, several of which were of exceptional size. In similar cases, rabiform symptoms have also been noted by Foucher. Neubert has seen vertigo and a kind of blindness; the brain was softened, and contained more than a hundred Cysticerci. In a case observed by Lippold, the Pig died after presenting all the symptoms of encephalitis; twelve Cysticerci were found in the pia-mater.²

When the affection is chronic, extensive and generalized, the Pigs are feeble and easily put out of breath. They become indifferent, walk

¹ Sobotta. Der Thierärzt, 1859—quoted by Zürm.
slowly, and have much difficulty in following the herd; later they fall into such a state of prostration that they will not get up. Infiltrations occur in dependent parts of the body and beneath the mucous membranes; the appetite diminishes; diarrhoea sets in; the pulse is feeble and quickened; the mouth is pasty and foetid; and the gums are pale, spongy and bleeding. The animals lose condition, and become, as it were, blown out; they appear paralyzed, and finish by dying, if, through negligence, they are not killed earlier. The progress of the disease is subordinate to the number of parasites lodged in the tissues of the Pig; it is also related more especially to the possibility of successive infestations when the etiological conditions upon which they depend persist, and in such a case it may be inferred that the symptoms will attain their greatest intensity.

Diagnosis.—Measles may have to be recognised in the living animal, or after its death. In the first case, the symptoms above enumerated are to be remembered, and especially the evidence furnished by inspection of the tongue.

The post mortem diagnosis—which is the most usual—often requires great attention. As Morot\(^1\) remarks, the facility of this diagnosis is in direct relation to the extent of the muscular surfaces examined. The measly Pig may only show very few 'grains'—perhaps only one; and this may not always be recognised, notwithstanding the most minute and complete examination practicable at the abbatoir, and this even on animals passably measly.

In such a diagnosis, care must be taken to guard against mistaking other alterations in the flesh for this one, and what we have said with regard to the Distomes and Sarcocyst of Miescher should suffice to prevent errors. It will be seen hereafter that measles should not be mistaken for trichinosis or muscular actinomycosis.

The Echinococci which have remained small in size have been mistaken for Cysticerci; but their presence in parenchymatous organs rather than in the muscles, and a microscopical examination, should lead to their recognition. We have spoken of the resemblances which Cysticerci of the lungs have to the lesions of tuberculosis.

The \textit{Cysticercus tenuicollis}—a parasite of the peritoneum—may be found fixed on the muscular portion of the diaphragm, and if it be of small size might suggest the idea of measles. But an error will be avoided if the quite superficial situation of this parasite is noted, as well as its distinct prominenence, and sometimes the short pedicle that sustains it; the measle Cysticercus is always markedly sub-peritoneal, and more or less fixed in the muscular tissue; large \textit{Cysticerci tenuicollis} accompanying the small ones show their real nature; there are no muscle vesicles in the muscles, and, lastly, the character of their hooks is different to those of \textit{C. cellulosae}.


There are found in Pig flesh, especially—and perhaps exclusively—in that which has been salted or smoked, small white concretions, from the size of a millet-seed to that of a pea, round or irregular, hard, and grating under the scalpel. They are composed of guanine, according to Virchow; of tyrosine, according to Voit, who is of opinion that they are formed during salting or smoking. They have no trace of parasites—Cysticerci or others—and are dissolved in hydrochloric acid without disengagement of gas, and in sulphuric acid without formation of sulphate of lime; they are dissolved in caustic potass, and fuming nitric acid also dissolves them into a yellow fluid, which, on the addition of potass solution, assumes a fine red colour on being heated.1

There are also found in smoked American hams—whether trichinosed or not—very refrangent globular corpuscles, of a radiating structure, and with a dark centre. They are probably formed of lime and a fatty acid, and should consequently become transparent by the addition of hydrochloric acid.2

Etiology.—It is now well established that the essential and exclusive cause of measles, consists in the ingestion of the ova of the *Taenia solium* by the Pig. It is also proved by numerous experiments that the *Taenia solium*, or solitary worm of Man, is derived from the measle Cysticercus taken with pig-flesh.

Van Beneden was the first to cause a Pig to swallow the ova of *T. solium*, and at its autopsy he found a great number of Cysticerci in the muscles. Another Pig of the same litter, reared and fed under the same conditions as the preceding, but which had not received any ova of the *Taenia*, had no Cysticerci.3

Küchenmeister and Haubner first, Leuckart next, and C. Bailliet, Gerlach, Mosler, and others afterwards, repeated and varied these experiments, and always had the same results—thus incontestably establishing the origin of measles in the Pig.

When the ripe ova of the *Taenia solium* arrive in the digestive canal of the Pig, their shell is dissolved by the gastric and intestinal juices, and the embryos they contain are set free. By means of their six hooks, they pass through the walls of the stomach or intestine, and become dispersed—probably through the blood circulation—into every part of the body. They are arrested in the interfascicular connective tissue of the muscles, in the brain, spinal cord, and, in general, in all the organs favourable to their evolution. Their presence causes a slight irritation, and the accumulation of anatomical elements destined to form the connective tissue of the cyst, as well as to furnish the Cysticercus with the materials necessary for its development. The latter is not completely achieved until about the end of three months,

according to the experiments of Gerlach. Mosler states that the Cysticerci only measure at the ninth day 0.033 mm. in diameter; at the twentieth day they are the size of a pin's head, and have no cystic membrane; at the fortieth day they are as big as a mustard-seed, their envelope is very thin, the head is apparent, and the suckers and double crown of hooks are recognisable; at sixty days they are the size of a pea, the suckers and hooks are completely formed, but there is no neck. In about three months, their development is accomplished, but the caudal vesicle is still capable of growth. At 110 days the neck shows transverse stripes.

Gerlach has remarked that the ingestion of too many ova of the Tænia may cause intestinal irritation in the Pig, which will terminate in death.

The innumerable quantity of ova that a single proglottis will furnish, explains the generalization of infestation, which is facilitated by their resistance to destructive influences; as they can remain intact for a long time in the ground, manure-pits, pools of water, etc., and it is in the latter that the Pig may find them when they have been washed therein by rain. The habits of that animal and those of the rural population among which it lives, are conditions eminently favourable to its infestation. In the country, the human ordure is usually deposited out of doors, especially in manure-pits, to which the Pigs have free access, and where they can eat the excrements; so that one person infested by the Tape-worm is in this way capable of infesting a whole herd of Swine. Mosler relates the history of a person who infested 15 Pigs, these having broken through a fence that enclosed the privy.

All Pigs have not the same aptitude in contracting this disease. Haubner ascertained that measles infestation is very difficult, if not impossible, in aged Pigs; and Gerlach came to the same conclusion. They are most liable to be infested when they are under six months old.

Breed cannot be considered as predisposing to the disease. If the higher-bred Pigs are less subject to it than common-bred ones, this is exclusively due to the different conditions under which they are respectively reared. For this reason, the Pigs of certain countries are more exposed than others. Measles is of extreme frequency in Ireland, Slavonia, and certain parts of North America.

In France, according to the Betail,¹ the Pig-producing regions are classed as follows, with regard to the prevalence of measles:

1 Le Betail. October 18, 1875—quoted by L. Baillet.
1. Regions exempt from the disease—Flanders, Picardy, Normandy, Champagne, Lorraine, Alsace, Ile-de-France, Orléansais, Nivernais, Anjou, Maine, Perche, Touraine, and Brittany.

2. Regions which have a few measly Pigs—Aunis, Charente, Poitou, Berry, and Bourbonnais.

3. Regions which have many measly Pigs—Marche, Limousin, Auvergne.

It should be stated that only relative confidence should be placed in this classification; for so far as Brittany is concerned, it is this province—Finisterre and Côtes-du-Nord—which, in 1886, furnished most of the measly Pigs condemned by the inspectors of the Paris markets.\(^1\)

According to Kniebusch, measles does not exist in the Servian and Roumanian Pigs known as Bakonyer, which are fed on maize; neither is it seen in Mecklenburg Pigs of English stock, which are reared on beans and peas. On the contrary, it is very common in Polish and Pomeranian Pigs fed on house-slops, scraps from the table, and potatoes (R. Blanchard).

Of 149,500 Pigs inspected in the district of Cassel, from 1872 to 1874, 153 were measly—or 1 in every 946 (Leuckart). From 1876 to 1881, of 15,937,000 examined, 48,880 were measly—or 1 in 326. Statistics show that the disease is less extensive in South than in North Germany (Zundel). In 1876, it was found in 163 of 10,000 Pigs—or 1 in every 307. On the other hand, Mosler's statistics give 9 well-measled Pigs in 20,000—or 1 in 2,222; but one-eighth of these harboured some Cysticerci. Leuckart—who furnishes these so different figures—estimates that in certain parts of Germany there is measles—limited or generalized—in 2 or 3 per cent. of the Pigs.\(^2\)

In Italy, according to Pellizzari, the number of measly Pigs is generally 1 in 3,000 to 4,000; while Perroncito states that, from the information furnished by the mouth-inspectors, there is at Turin 1 measly Pig in every 250, and at Milan 1 in 70 (Leuckart).

All these figures show that measles is not rare, and that it may be found in every country; though it is much less prevalent now than formerly, as its nature is better known, inspection of meat has been instituted, and the rearing of Pigs receives more attention.

(We know not to what extent measles prevails among Pigs in this country, as there is no proper system of meat inspection, nor any records kept as to the parasitic diseases of animals. That it must be a common disease in some parts—especially in Ireland—may be surmised from the habits of the people. The public are certainly not protected in any way from infestation by this and other parasites of animals, for

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\(^1\) Compte Rendu des Opérations du Service de la Boucherie en 1886. Paris, 1887, p. 32.

such an occurrence as seizure of a measly pig's carcase in the United Kingdom is perhaps unknown.)

As for the majority of parasitic affections, so with this, heredity has been supposed to play a part in its development; but such a notion cannot now be entertained. All that can be admitted is, that the embryos of the Tænia, in their migrations in the body of a pregnant Sow, may enter that of the foetus by traversing the placenta. But this is a very disputable hypothesis, and we have only the one instance of congenital infestation recorded by Hervieux, and in that we do not precisely know the age of the young Pigs in which the Cysticerci were found. The following are the terms in which Hurtrel d'Arboval refers to this case: 'The Sucking-pigs were found affected with measles—two in a litter of twelve. Hervieux, to whom we owe this observation, reared a Sow which was mated to a very healthy Boar, and the former produced six measly sucklings.'

Prognosis—Noxiousness of the Flesh of Measly Pigs.—The medical prognosis of measles is always serious, inasmuch as no treat-

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compatible with an appearance of perfect health to the most pronounced cachexia.

The real seriousness of the prognosis is allied with economic considerations—measly flesh is dangerous to people who consume it, and its use should therefore be prohibited.

Küchenmeister was the first to publish an experiment, tending to prove that the measles Cysticercus of the Pig is transformed into the Taenia solium in the intestine of Man.

In the three days preceding the execution of a woman condemned to death, at his instigation, and at several times, she was made to swallow 75 measle Cysticerci. At the autopsy, made forty-eight hours after death, he found 10 young Taenia, 4 mm. to 8 mm. long, some of which already carried several hooks.

The same authority had afterwards occasion to repeat this experiment under more favourable conditions. Another person condemned to death was, at Küchenmeister's request, on two occasions—one four months and the other two and a half months—before execution, given 20 measle Cysticerci. At the autopsy he found 19 Taenia, 11 of which had already mature proglottides.1

On August 10, 1855, a young Man took voluntarily, in tepid milk, four completely developed Cysticerci, divested of their bladder. On October 25, Leuckart, who directed the experiment, discovered the first proglottides in the faeces, and on five different occasions afterwards they were found. On November 26, a double dose of kouso caused the expulsion of two Taenia about eight feet long.2

Humbert, of Geneva—quoted by Bertolus—swallowed 14 measle Cysticerci; three months afterwards he suffered from Taenia, and passed considerable fragments, which Professor Vogt recognised as belonging to the Taenia solium.3

Hollenbach—quoted by Leuckart—having taken some measle Cysticerci in a spoonful of coffee, in five months passed a portion of Taenia five feet long, with numerous segments, but no head. Although this worm was believed to be the Taenia serrata, there can be no doubt that it was the Taenia solium.4

Heller relates that a phthisical patient took 25 measle Cysticerci. He died in about eighteen days, and at the autopsy there were found twelve heads of the Taenia solium, which were still very small, and did not present to the naked eye any traces of segmentation.5

These various experiments, so demonstrative, are in harmony with the observations concerning the frequency of Taenia solium in Man, this corresponding to the prevalence of measles in the pig. This Taenia is not observed in Jews, Musslmans, or other people who abstain from swine's flesh; nor is it seen in the torrid zone, where Pigs cannot be

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2 Leuckart. Blasenbandwärmer, 1856, p. 53.
reared. This intestinal parasite of Man is otherwise becoming more and more rare, as the custom of properly cooking the flesh of the Pig is becoming generalized, while it is also subjected to a severe surveillance in the abattoirs and markets. In France, the progressive diminution of cases of *T. solium* is remarked upon by numerous observers—Laboullene, Berenger-Féraud, etc.—and it is the same elsewhere in Europe. There is another *Taenia*—the *T. saginata*—which is now nearly everywhere more frequent; though, according to Leuckart, the first still predominates in some parts of Germany where Pig-breeding flourishes and pork is largely consumed—such are Thuringia, Saxony, the Duchy of Brunswick, Westphalia, Hesse, and Wurtemberg.

The *T. solium* is more especially met with in people whose business brings them in contact with raw pork—butchers, cooks, sausage-makers, etc.—as they often hold the knife they use in their mouth; they may in this way receive the Cysticerci, which are reduced to small size by rupture of their caudal vesicle. Their taeniasis also doubtless owing to their generally pronounced taste for raw pork.

The largest number of cases of *Taenia solium* are found among persons and populations which eat raw pork; and this is why this Taenia is relatively frequent in Germany. In France, infestation most frequently occurs through insufficient cooking of this flesh in any of its forms.

Measly flesh has characters which should suffice to render its consumption repugnant. When cooked, it is pale, moist, and irregularly tinted. The Cysticerci, reduced to its body, is the size of a hemp-seed; it cracks between the teeth, and gives a disagreeable sensation. In roasting this flesh, it often crackles, from rupture of the measle vesicles. It has a sweetish taste, which renders it acceptable to certain persons.

The power of resistance of the Cysticercus to an elevated temperature is not considerable; but its deep situation in the flesh protects it during the process of cooking. Numerous experiments have been made, with a view to ascertain the degree of resistance of the Cysticercus. The most recent and precise are those of Perroncito. By means of Schultze’s heating-plate, he was able to recognise very exactly the vitality of the parasite by the movements of the rostellum, and to determine the temperature at which death arrives. He was also able to recognise when death occurred, by the facility with which the tissues imbibe the neutral tincture of carmine and the tincture of haematoxylin. Lastly, he acquired proof of death by the voluntary ingestion of these Cysticerci by his assistants. In this way he was able to ascertain that the death of the Cysticercus sometimes takes place at 40° Cent., more frequently at 47°, and usually at 48°; though it may live at 49°, and quite exceptionally at 50°. But death is certain if it is kept for more than a minute at the latter temperature.

The practical difficulty is in knowing under what conditions the
centre of the piece of flesh will reach this destructive temperature. In cooking large pieces of meat, Küchenmeister had noticed that after half an hour, when the external temperature was 60°, the interior had reached 55°; in about three-quarters of an hour the exterior was 77-80°, and the interior 63°. In experiments made at Lille in 1863, a ham cooked by boiling for two hours, was 58° in parts near the surface, and only 38° in the central parts. Another ham cooked in the same way for six hours, was 75° on the surface and 65° in the interior.

Pellizzari, using measly flesh, put two pieces, weighing 600 grammes and 10 cm. thick, in boiling water, one piece for five minutes, the other for half an hour. When removed, one was 45-5° in the centre, the other 81°; taking into account the loss of heat by radiation, these two temperatures may be estimated at 51° and 83°.

From these experiments and others made by this authority, as well as those of Cobbold, Lewis and Perroncito—besides those which will be alluded to when dealing with trichinosis—it may be concluded that, in a relatively short period, cooking may act on different points in a piece of meat at a temperature above 50°, and so destroy the vitality of the Cysticerci.

For roasted flesh, Vallin has found that, while its external temperature necessarily exceeds 100°, beneath this superficial layer it is 'touched' by cooking, a layer beneath this again oscillates between 52° and 53°, but in the centre it does not exceed 46° to 48°. In comparing these figures with those Perroncito gives for the destruction of the Cysticercus cellulose, we may conclude that flesh, even when conveniently roasted, is still likely to produce taniastic infestation; but it is more especially with underdone meat that there is danger.

With regard to preserved pork, there is no precise information. There is reason to doubt the correctness of the fact reported by Weiland, that English soldiers during the Crimean War contracted Tapeworm from eating salt pork. Perroncito's investigations show, however, that the Cysticercus may yet be alive in flesh which has not undergone putrefaction, more than twenty days after the Pig has been killed. But it may be generally admitted that proper salting and prolonged smoking will destroy the vitality of the Cysticerci.

In any case, it is well not to allow measly flesh to be consumed, no matter what its condition may be; and it is the duty of the authorities to interdict its sale.

**Pig Measles from a Legislative Point of View.**—This disease may require the application of sanitary or commercial legislation, or both.

I. **Sanitary Legislation.**—This is constituted by the French law of March 27, 1851, and that of April 5, 1884, known as the Municipal

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1 We owe the following remarks concerning *Measles of the Pig in relation to Legislation*, to the courtesy of our colleague, Professor Peuch, than whom a more competent authority could not be found.
Law. In the terms of Article 97 of the latter, the municipal police comprises, among other attributes, "inspection as to the healthiness of food exposed for sale." Consequently, the communal authorities take all necessary precautions to prevent dangers resulting from the consumption of measly pork; and in order to effect this object, they must organize a service of meat inspectors, whose mission will more especially be to seize and render unfit for food measly pork, so that it will not be offered for consumption. With regard to this, it should be remarked that the measles may be more or less pronounced—the Cysticerci being more or less numerous; so that the salubrit of the flesh is subordinate to the extent of the disease—that is, to the number of measle 'grains' it contains. What, then, is the rule to be followed with respect to seizing such flesh? Must it be decided that, in every case—no matter what number of these 'grains' may be present—the flesh should be prohibited for consumption, or allowed to be sold for this purpose if they are few?

This question is solved in a variable manner, according to localities. Thus, in Paris, the inspection service seizes all the measly Pigs 'without any distinction as to number of vesicles apparent; the lard alone is allowed to be retained by those interested.' At Bordeaux, the inspection service allows the sale of measly pork when 'the measle grains are few; for beyond special cases, says L. Baillet, I am in favour of the most absolute severity in dealing with measly meat.' At Lyons, the Order of August 3, 1884, regulating the inspection of meat, stipulates in Article 17 that, 'in cases in which there are not more than ten to twenty grains, the flesh may be consumed after being salted.' In other cases it should all be seized, with the exception of the lard, in which the Cysticerci do not develop.

These quotations show that the inspectors do not agree—some tolerating the sale of pork slightly measled, so as not to injure trade too much while protecting the public health, while others condemn it altogether. There is a general tendency, however, to a certain degree of toleration—such as that stipulated for in the Order by the Mayor of Lyons just referred to; for, on the one hand, as L. Baillet observes, the measle grains are so visible that it is possible to free the flesh from them when they are not numerous, and, on the other hand, proper cooking destroys the vitality of the Cysticerci. But reservations must be made with regard to the destructive effects of salting, although the old regulations—Acts of Parliament of Paris, February 23, 1602, and July 2, 1607—admit the harmlessness of salted meat; for there is no precise information on this point.

When the flesh of a measly Pig is condemned, the holder of it may be made to suffer penalties as laid down in Article 2 of the law of March 27, 1851—a fine of 50 to 500 francs, and imprisonment of three months to two years. But before this can be done, it must be proved that the holder knew of or suspected its condition, because of his profession or from any other circumstance; penal culpability only exists on this condition. It has been decided, however, that measly flesh is neither decomposed nor insalubrious—Order of the Court of Bordeaux, 1854, and tribunal of police of Carpentras, 1860. But more recent decisions in jurisprudence—that of the Court of Montpellier, 1873, and...
the correctional tribunal of the Seine, 1876—justly establish that flesh manifestly sprinkled with measly grains is insalubrious, that it should be declared corrupted, and that its sale, knowing it to be so, renders the seller liable to the application of the law of 1851, which is directed to the repression of certain frauds in the sale of merchandise.

It is not sufficient that the communal authority organizes a service of meat inspection to meet entirely the obligations stipulated for by the law of April 5, 1884—Art. 97, No. 5; it is also necessary that in towns which have abattoirs, it will decide, by order, that the slaughter of Pigs shall not take place outside the communal abattoir, so that every carcase, without exception, shall undergo inspection. It is customary in certain towns, however—as at Toulouse, and Troyes more particularly—to allow the slaughter of Pigs by people for their own personal consumption, provided it is carried out in an enclosed place away from the public thoroughfares; and the law has sanctioned this custom, though the Supreme Court has ruled that no infraction of the laws which prohibit private individuals and pork butchers from slaughtering elsewhere than in the places prescribed shall be allowed.2

We cannot protest too strongly against this tolerance, which greatly favours the multiplication of cases of *Twemia solium* in our own species; for it is impossible to inspect Pigs killed in private, and measly flesh may be readily made unrecognisable by transforming it into sausages, which may not only be consumed by the owners of the animals, but be sold to various persons.

For these reasons, it is desirable that Pigs should be slaughtered only in a public abattoir, where the inspectors carefully examine the carcases before they are passed for consumption.

II. COMMERCIAL LEGISLATION.—This is constituted by the law of August 2, 1884, on 'redhibitory vices' in the sale and exchange of animals, and by the common law—Art. 1641 to 1648, Civil Code. There is, therefore, need to examine, successively, the action of warranty according to each of these laws.

1. Warranty according to the Law of August 2, 1884.—This law includes Pig measles among the 'redhibitory vices,' with a delay of nine clear days, not including the day fixed for delivery, it being stipulated that the action in warranty will not be exercised unless the value of the animal sold exceeds 100 francs. The parties concerned may depart from this restrictive arrangement, by a conventional warranty—as in all the other points of the law special to redhibitory vices—but when this is not done, the first condition relating to the claim of the buyer may be declared receivable, provided the price of the Pig suspected of being measled does not exceed 100 francs. The inspection may be made on the living animal or on its carcase.

a. On the Living Animal.—The expert proceeds to inspect the tongue (see p. 674), in order to ascertain if there are any Cysticerci on its sides, or wounds or scars on it. The presence of the latter lesions should lead to the suspicion that the measle vesicles have been extirpated. The conjunctivæ and around the anus should also be examined.

It rarely happens that the living animal has to be examined, as measles is only suspected, as a rule, on opening the carcase. Then

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1 Galtier. Manuel de l'Inspection des Animaux et des Vitudes de Boucherie, 1885, p. 82.
2 Brossard-Marsillac. Traité de la Legislation relative aux Animaux, 1885, p. 89.
the buyer ought—if an interval of nine days has not expired—to procure the nomination of experts; and, as the case demands expedition, he should, through a justice of the peace, give notice to the vendor as to expert examination, unless he is domiciled at a distance. The entire carcase of the animal in litigation is to be preserved, so that there may be no doubt as to its identity, which should otherwise be well established by witnesses or any other mode of proof.

b. On the Carcase.—Here the task of the expert is easy, for the seat of the Cysticerci and their characters are well defined.

If the Cysticerci are not numerous, or supposing that there are only one or two, ought the expert to decide as to the existence of measles? The solution of this question is based on the regulations applicable to experts. The function of an expert consists, in fact, in describing in his report the lesions he has observed, and their significance or their consequences with regard to the salubrity of the flesh. In a case of this kind, he cannot certainly go beyond his orders in expressing his opinion on this point. It will be for the tribunal to decide afterwards, if the measles described by the expert is really that which the legislature had in view, and which manifestly renders the flesh wholly or in great part unhealthy. It would certainly be going beyond reason to conclude as to the total redhibition in such circumstances, and all the more so as the law allows the buyer the right to demanding a reduction in price, which will compensate for the loss resulting from the elimination of part of the flesh containing the Cysticerci.

If a measly Pig is slaughtered within the interval of warranty, the buyer may take action against the vendor on the Articles 2, 4, 5 and 7, in the Act of August 2, 1884, and not on Article 10 of that law, which provides for cases in which the animal has died; for in this instance it would deal with the case of an animal which had perished in a natural manner, and not one that had been killed for food. The Pig being exclusively intended for this purpose, it would be absurd to maintain that, if death did not result from measles, the vendor was not liable to the law of warranty; while the legislature, in placing Pig measles among the redhibitory vices, desired to ‘protect the public health by prohibiting the consumption of unhealthy meat.’

If a measly Pig is slaughtered after the interval of warranty laid down in the law of 1884, the buyer cannot any longer avail himself of the provisions of that, but may proceed on the Articles 1641 to 1648 of the Civil Code.

2. Warranty according to Articles 1641 to 1648 of the Civil Code.—The legislature having placed measles of the Pig among the redhibitory vices—enumerated in the law of August 2, 1884, which is a double limitative law—it may appear bold to take action with regard to warranty, because of this vice, in invoking the general regulations of the Civil Code. But if it is considered, on the one side, that the Pig is essentially intended for food, and, on the other part, that a judgment of the Court of Cassation, dated November 10, 1855, establishes that in the sale of an animal for food, the obligation of warranty results from the nature even of the thing sold, with the view that the parties are agreed to it, and which forms the essential condition of the contract, we are led to admit that the Articles 1641 to 1648 of the Civil Code may be applicable to Pig measles. Otherwise, the report of M. Maunoury to the Chamber of Deputies demonstrates that Article 12 of the law of August 2, 1884, implicitly establishes that the common law
controls the sale of slaughter animals. It would not, therefore, be departing from the spirit of the law to admit measles into the list of lesions which render the article sold—that is, the flesh of a Pig—improper for the use for which it was intended.

But when the purchaser of a measly Pig, killed for food, desires to enter on an action in warranty, he must prove: (1) that the vice was concealed at the time of sale, for the vendor does not guarantee against apparent defects which the buyer could discover—as, for instance, if the Cysticerci are visible externally or beneath the tongue, and the buyer has not inspected the animal's mouth; (2) that the measles, only visible in the carcass, existed before the sale. It is by expert examination that he can prove this, and enter an action of warranty according to Article 1641 of the Civil Code. If the buyer gives this double proof—impossibility and anterior vice—his claim may then be admitted, even if the value of the animal does not exceed 100 francs; for in such a case the common law does not fix any limitative quantum.

**Article II.—Measles of the Dog.**

It is remarkable that the *Cysticercus cellulose* is capable of living in the Dog, and infesting its various organs. At least a dozen observations have been published with regard to this subject, and there can be no doubt that the number would be considerably increased if the flesh of the Dog were as frequently under inspection as that of the Pig. Except in those instances in which the Cysticerci are lodged in the nerve-centres, they do not appear to disturb the health, and so do not demand *post mortem* investigation. The majority of the observations were made on young Dogs.

These Cysticerci have been found in the muscles, liver and lungs (Leisering), the liver and lungs (Roloff), the liver (Caparini), the muscles (Cornevin), and the muscles, lungs, heart, peritoneum, intestine, brain (Rivolta, Trasbot and Railliet, Dufour and Gacon). In the observation of Trasbot and Railliet, the animal manifested cutaneous hyperæsthesia; it was absolutely immovable, the slightest movement appearing to cause it the most acute pain. At the autopsy, all the muscles were found to be full of Cysticerci.

It must be noted that, among the published observations, eight refer to localization in the brain (Dupuy, Rivolta, Vogel, Siedamgrotzky, Leblanc, Lesbre, Dufour and Gacon, and Pirl). Dupuy gives no details of his case. Rivolta's Dog died suddenly from a violent attack of epilepsy, without showing any evidence of illness previously. Vogel's Dog was blind and apathetic. That of Siedamgrotzky was suddenly seized with cramps and convulsions—especially of the jaws; then it had fever, prostration accompanied by vertigo and delirium, and death.

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occurred during the day; 23 Cysticerci were found lodged in the super-
official part of the two cerebral hemispheres, which were hyperaemic, as
were the cranial meninges; nothing abnormal was observed elsewhere.
In Lesbre’s case, the Dog had been paralyzed for two days, but for a
long time previously it had grinding of the teeth, was excited, and had
attacks of vertigo. It was killed, when 30 to 40 Cysticerci were found
in different parts of the brain, the substance of which was hyperaemic
and softened around them. The Dog observed by Leblanc had been
unwell for two months, when it was sacrificed. It showed symptoms
of epilepsy—convulsions, grinding of the teeth with champing of the
jaws, foamy saliva at the angles of the mouth, falling on the ground, a
tendency to circle to the left, and stufpefaction. The liver and pan-
creas contained some Cysticerci; there were four of these in the lateral
and superior part of the right lobe of the brain, and only one in the left.

The Dog examined by Dufour and Gacon had been liable to fits of
suffocation, followed by syncope, after running; it died suddenly.

In a Dog aged five years, which was subject to epileptiform attacks,
was soft, dull, had no appetite, circled to the right—the head being
carried to the left—and which died after six weeks’ illness, Pirl found
two Cysticerci—probably the Cysticerucus cellulosae—lodged, one in the
right olfactory lobe, the other partly in the right hemisphere and in the
interlobular fissure; around the parasites the gray substance was soft
and diffusent.

We have observed an instance of intense measles in a Dog that sud-
denly died, without having ever shown any signs of illness; the measles
was generalized, but there was special localization in the brain.

In these observations, the Cysticerci were reported as the Cysticerucus
cellulosae, the only exception being Lesbre, who believed that the para-
site in his case was the Cysticerucus pisiformis; but he was probably in
error. Mégnin, who had studied the Cysticerci found by Leblanc, and
Railliet, who had examined those discovered by Trasbot, have shown that
the parasites were identical with the Cysticerci of the Pig.

The Dog is evidently infested by eating human excrement or food
soiled by it; but there must exist a special predisposition, as
Leuckart and Railliet failed in their attempts to produce measles
experimentally in Dogs to which they gave the ova of the *Tenaia
solium*. Of four Dogs which we submitted to this experiment, only
one showed—at its autopsy—some Cysticerci disseminated in the
olecranian and crural muscles.

Auto-infection cannot be said to occur in the Dog, as it is admitted
it does in Man; for the reason that this animal never harbours the
*Tenaia solium*, nor has anyone ever succeeded in infesting it with that
parasite by feeding it on measly pork.

**Article III.—Measles of the Ox.**

The measles of bovine animals is produced by the *Cysticerucus bovis*,
the larval form of the *Tenaia saginata* Goeze—the *Tenaia mediocanellata*,
or unarmed *Tenaia* of Man.

1 Railliet. *La Ladriere des Bêtes Bovines.* Archives Vétérinaire, 1876. pp. 615, 655,
*La Ladrie des Bêtes Bovines en Tunisie.* Rec. de Mém. et Observ. sur l’Hyg. et la
History.—Although the existence of the unarmed Tœnia of Man was noted nearly two centuries ago, and its species was distinctly described by Gœze in 1782, under the name of Tœnia saginata, its origin was only recognised at a relatively recent period. Following the somewhat general application of the treatment suggested by Weissé of St. Petersburg, in 1847, of giving patients raw meat, it was often noticed that these suffered from unarmed Tape-worm, and attention began to be directed to the measles of the Ox. The Cysticercus which caused it appears to have been seen for the first time by Judas, in 1854, in the lungs of an Ox killed at Orleansville, Algeria. It was subsequently found in the flesh of cattle by Knoch at St. Petersburg, by Arnold and Cauvert in Algeria, by Talairach at Beyrout, etc. In 1861, Leuckart gave the first experimental proof that the cystic state of the unarmed Tœnia is passed in the body of the Ox. These experiments were repeated by numerous investigators. Inversely, the development of the strobilar condition was obtained in Man by the ingestion of the Cysticercus bovis, the significance of which was then distinctly established. But our knowledge of Ox measles is far from being so advanced as that of Pig measles; for the reason that the first is rarely witnessed over the greater part of Europe, doubtless owing to the small size of its Cysticercus.

Pathological Anatomy.—The Cysticercus bovis Cobb.—Cyst. mediocanellata Davaine—presents itself in the form of a spherical or elliptical, sometimes irregular, vesicle, measuring 4 mm. to 3:4 or 6 mm. long, or even to a maximum of 10 to 15 mm. (Masse, Alix); and showing at one point a yellowish-white spot about the size of a millet-seed, which is formed by the invaginated scolex. If, in order to examine the Cyst. cellulosae, it be squeezed out of the vesicle, there is seen a markedly tetragonal head, 7 mm. in diameter, provided with four large suckers, and a central depression that corresponds to the rostellum of the armed Tœnia, and which is, according to Cobbold, retractile and protractile like theirs. The head is succeeded by a transversely striped neck. The characters of this scolex are, in fact, those of the head of the Tœnia saginata. Each Cysticercus is enveloped in an adventitious cyst, like the Cysticercus of the Pig.

The Cysticerci of the Ox are found in every organ, but more especially in the striped muscles, and of these they appear, according to Hertwig, to prefer those in the masseteric region—the internal and external pterygoids. In order to discover them, that authority makes a section of these muscles, parallel to the branch of the inferior maxilla, in the direction of the base of the cranium. Since this procedure has been carried out at the Berlin abattoir, measles has been found in 390 animals during the course of the year. Except with 22, in which the Cysticerci infested all the muscles of the body, they were chiefly met with in the muscles of the anterior parts—360 times in the pterygoids,

exclusively in these in 316 instances; 41 times in the heart, 10 times in the tongue, 3 times in the muscles of the neck, and once in those of the chest. In the measles produced experimentally by several investigators, the muscles most frequently invaded were those of the shoulder, thighs, chest and tongue; then came the panniculus carnosus and diaphragm.Alix gives the following order of frequency: tongue, entire surface of the heart, muscles of the thigh, of the shoulder—inner surface especially—of the croup, intercostals, pectorals, psoas, etc.

Cobbold asserts that the Cysticerci in the heart remain smaller, being sometimes incompletely developed, owing to the density of the tissue of that organ. Alix, on the contrary, has not found them different from the others. The Cysticerci seated in the interfascicular connective tissue of the muscles, have their larger axis nearly always parallel with the fibres, like the Cysticercus of the Pig. Leuckart has seen them in the adipose capsule of the kidneys, the lymphatic glands, and between the cerebral convolutions; and Mosler and Saint-Cyr have observed them in the sub-mucous, and even in the sub-peritoneal, connective tissue. They have never been found in the liver, spleen, or kidneys at the Berlin abbatoir.

The Cysticerci of the Ox are generally few in number, and thinly scattered, when compared with those of the Pig, and this, together with their smaller size, contributes to their being passed unperceived; nevertheless, J. Fleming has counted in a pound of psoas muscle 300 living

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Fig. 348.—Head of the *Tania saynata*, seen three-quarters face.—Laboubléne.

Fig. 349.—Head of the *Tania saynata*, seen in front.—Laboubléne.

Fig. 350.—Fragment of muscle from a Heifer, containing the Cysticercus boris.—Railliet.

1 Hewlett states that the region named the 'rump' is generally that which is the most completely invaded by the Cysticerci.
Cysticerci. Mosler has seen the heart of a Calf literally studded with vesicles the size of a pin's head to that of a lentil; so that its volume was increased by more than one-fourth.

At the end of a certain period—more frequently and quickly than with the Pig—the Cysticerci of the Ox undergo caseous degeneration, then calcareous infiltration. In one of his ingestion experiments with the ova of *Tenuia saginata*, Saint-Cyr—at the end of 244 days—only found dead Cysticerci, the majority of which were in a state of advanced calcification. In the muscles of a Heifer killed more than a year after the first ingestion of proglottides, Simonds and Cobbold saw numerous yellow points—chalky deposits—which were dead and calcified Cysticerci.

This frequent degeneration, which had been already observed by Leuckart, sometimes gives measly flesh a certain resemblance to that which is tuberculosed—the *Cestodon tuberculose* of the Germans. Guillebeau¹ had chanced to notice the inflammatory process which tends to shorten the life of the Cysticercus.

When the head is not well preserved, the dead Cysticerci may—because of the absence of hooks—be confounded with various lesions—such as little intermuscular abscesses, small altered lymphatic glands, etc. Nevertheless, the Cysticerci are generally distinguished by the facility with which they can be enucleated by pressure. Ostertag² recommends, in order to recognise the degenerated Cysticerci, seeking for the calcareous corpuscles with which they are studded, and which resist degeneration. They appear to be easily distinguished in the midst of the deposit of chalk, which most frequently invades the parasite.

The Cysticerci are difficult to recognise, by reason of their being often of very small size, and their dissemination. Laboulbène³ has remarked, besides, that they rapidly lose their vesicular aspect, shrink, and change their character when exposed to the air. But if the shrunken vesicle is moistened with water, it soon becomes apparent.

**Symptoms.**—The observations of Alix show that the symptoms of bovine measles are most frequently nil. In many cases of ordinary and not exceptional gravity, as J. Fleming says, the Cysticerci may be recognised by examining the tongue, on the lower surface and sides of which they form more or less salient projections, which roll under the finger when pressed upon. Mosler, Masse and Pourquier, Biggs, and Laboulbène have made the same remark, and Fleming states that he found on the side of a tongue the largest Cysticercus he ever saw—nearly 4 cm. long! Saint-Cyr's two experimental Calves had on the inferior surface of the tongue, and near the frenum, three weeks to a

² Ostertag. Monatshfeste f. Prakt. Thierheilkunde, I., 1889, p. 64.
month after ingestion of the proglottides, one or two small submucous tumours, in every respect similar to, but smaller than, those found in the same region in the measly pig.

With the exception of this sign, the little we know of the symptoms of bovine measles has been exclusively derived from experimental animals, several of which have not shown anything appreciable—such were those of Gerlach and Laboulbène. Masse and Pourquier have seen an experimental calf become greatly emaciated after showing some signs of illness; and Simonds and Cobbold noted in another, after some days, an intense pruritus, a little depression and dulness, some indications of uneasiness and slight fever, trifling quivering in the muscles of the neck and shoulders, and loss of condition for some days; then the health became normal. Leuckart, Mosler, Ziürn, and E. van Beneden have seen calves die as a result of infestation. That of Ziürn became unwell on the fourth day of the experiment—the anal temperature was 40°, pulse quick, inappetence, tympanitis, pain on pressure of the sides, and staring coat. These symptoms at first diminished, but on the ninth day the fever was stronger, the animal became rapidly emaciated and feeble, kept the recumbent position, and only got up with difficulty; there was also apathy and pain. It succumbed on the twenty-third day, with all the signs of slow asphyxia and paralysis of the heart. The measles infestation was generalized, the heart being particularly invaded.

From what has been stated, it will be seen that bovine measles is difficult to detect in the living animal. But trials might be made of the harpoon, which yields such good results in trichinosis. Leuckart and Cobbold have employed it in their experiments, to remove small shreds of the sterno-maxillaris muscle, in which they readily discovered a certain number of vesicles.

A diagnosis post mortem is easier. But the opportunity for this is quite exceptional in Europe, although the Ténia saginata is very common in Man; and this is only incompletely explained by the usually small size of the Cysticerci, and their discrete dissemination in the muscles. There is need for further persevering and attentive research in this direction.

Etiology.—There cannot remain a doubt that the Ox measles has its origin in the ova of the Ténia saginata ingested with the food, as experiment and observation have fully proved this.

The first experiment was made by Leuckart in 1861; in this he gave two Calves portions of the Ténia saginata, and one died after twenty-five days, when there were found in it incompletely-developed Cysticerci in immense numbers in all the muscles, the adipose capsule of the kidneys, the lymphatic glands, and the surface of the brain. On the forty-eighth day, a fragment of the sterno-mastoïdeus muscle was removed from the second Calf, and a dozen well-developed Cysticerci
were readily discovered in it. These experiments were repeated a score of times afterwards by Mosler in 1863, Cobbold from 1864 to 1875, Roll in 1865, Gerlach in 1870, Züll in 1872, Saint-Cyr in 1873, Jolicoeur in 1873, Masse and Pourquier in 1878, Perroncito in 1876, Pütz in 1885, Laboulbène in 1890, and Hertwig in 1891. All yielded positive results, except two among those of Cobbold and Simonds, which were doubtful.

The mode of dissemination in the organism is the same as for the Cysticercus cellulosa of the Pig, and the migration is probably effected through the blood circulation. The abundance of Cysticerci on the course of the vessels belonging to the heart in the case published by Jolicoeur, is a demonstration of the commencement of this. According to Hertwig, the Ox Cysticercus develops more slowly than that of the Pig, and the evolution of the scolex is not so rapid as that of the vesicle. Leuckart has noted that, at the end of twenty-five days, the vesicles are already 2 mm. to 4 mm. long by 1.5 mm. to 3 mm. broad; but they are not completely developed before the fortieth day. Their existence is brief. In one of Cobbold's experiments, the parasites had disappeared in about a year; Saint-Cyr has seen them completely calcified in seven and a half months. It may be concluded that the Cysticerci of the Ox do not live longer than some months; and in this they differ from the Pig Cysticerci, which exist for a long time. This explains why in India, as Oliver states, the Cysticerci disappear from Cattle a few months after they receive well-water.

The profusion of ova in a single Taenia also furnishes an explanation as to the frequency of Ox measles, and the readiness with which infestation occurs is due to the resistance of these ova to causes of destruction. Davaine says he has kept them for fifteen months in water more or less pure, without their losing their vitality. If we admit, with Cobbold, that a Man affected with Tape-worm expels about 400 proglottides per month, and that each of these may contain 30,000 ova, a total is reached of more than 140,000,000 expelled by one person in the course of a year. Fortunately, an immense proportion of these germs are destroyed by various causes; but we can conceive how great are the chances of propagation of the measles.

People infested with the unarmered Taenia disperse the proglottides with their faces, and the ova which escape from them are disseminated by rain-water, or in any other way on plants, and into pools and ditches. Uncleanliness is, therefore, one of the conditions in the transmission of the parasite, and it is in countries where Cattle are reared
that this condition is realized. Human faeces are deposited everywhere, and the majority of privies are situated on streams where animals drink, and where everything necessary for the perpetuation of the Taenia is to be found. This is why Ox measles is particularly observed in Syria and Algeria, and more especially in the Punjab, India, where it is of extreme frequency. Oliver examined the water and mud of tanks by means of the microscope, and found ova of the Taenia; and J. Fleming remarks on the coprophagous habits of the Cattle in India, having seen them devour fresh human excrements with avidity, and his observations have been confirmed by various officers.

It would appear that for measles, as for various other parasitic affections, the youth of the animals is a condition favourable to infestation; so that Calves are best adapted for experiment. Nevertheless, J. Fleming has never observed that youth had any influence on the number of Cysticerci disseminated in the tissues; and at Berlin a very great majority of the cases of measles were furnished by adults.

We have precise notions as to the geographical distribution of bovine measles by that of the unarmed Taenia itself. This parasite of Man is becoming more and more frequent, and is everywhere supplanting the Taenia solium; such is the case in France, Germany, Austria, Italy, Switzerland and Denmark. It is particularly widespread in Asia, where in many regions it is the only Tape-worm observed. Africa is, perhaps, the division of the world in which it is most common—Algeria, Egypt, the Cape of Good Hope, Senegal, and especially Tunisia and Abyssinia. 'All the Abyssinians,' says Rochet d'Héricourt, 'are affected with Taenia.' America is not exempt from it, as it abounds in the Argentine Republic and Brazil, and is propagated in Peru; but it would seem to be very rare in the United States (Blanchard).

In presence of this cosmopolitanism and of this frequency of the Taenia saginata, we might expect to find Ox measles everywhere. But it is far from being so; for except at Berlin, where, as has been said, it is no longer rare, it is only exceptionally met with in Europe. Knoch was the first to note it, at St. Petersburg, in 1864; Siedam-grotzky saw two cases at Zurich in 1869; Guillebeau in 1880, and Eichenberger in 1889, observed two cases in the Canton of Berne; a measly Ox was found at Frankfort-on-the-Maine by Closs, and three by Hengst at Leipsic. Fuchs—quoted by Zundel—observed measles in Hungarian Cattle from the Danubian provinces. It has also been many times seen in various parts of Italy by Brusaferro, Carità, Ferranini, Perrugati, Bertuetti, Trevisan, etc., but it has only as yet been once noted in France, and this by Bascou, in a four-years-old Cow killed in 1888, at the Boulogne-sur-Seine abbatoir. It does not appear that this malady has been recognised in England (where, never-
theless, it may prevail but pass unnoticed, as there is no slaughter-house inspection of meat).

In Africa and Asia, on the contrary, bovine measles has been many times observed. Arnould, in 1864, and Cauvet, in 1874, have found it at Constantine; Jaillard has often seen it in Algiers, and Dupuy in Senegal. Leuckart mentions that Schimper, who lived a long time in Abyssinia, recognised the unarmed Cysticerci in the Cattle there; and, according to Alix, it is very frequent in Tunisia, as 'one-fifth at least of the cattle slaughtered for consumption by the troops of the garrison in the place where they were detached, were measled more or less extensively.' In Asia, the disease has been witnessed in Syria by Talairach, and in India by various observers. The number of bladder-worms is there something like what it is in Pig measles. In 1869, of 13,818 cattle slaughtered for consumption in the Upper Punjab, 768, or 5-55 per cent., were infested with the Cysticerci. The proportion in 1868 was 6-12 per cent. The diminution in 1869 was attributed to the severe regulations enforced (J. Fleming). The extreme filthiness of the natives of India is the cause of this frequent infestation; and the camel-drivers are most blamed, as they are often affected with taeniasis, and deposit their excrements on the sides of tanks and wells where they halt to water their animals.

It results from what we have just said, and especially with regard to the frequency of the unarmed Taenia of Man, that bovine measles is certainly much less rare in Europe than would appear from the small number of observations reported. If it escapes the notice of the abbatoir inspectors, this is evidently because they do not look for it with sufficient assiduity in the flesh of Oxen and Calves, and that they are not sufficiently cognisant of the small dimensions of the Cysticerci and the care required to find them.

Prognosis—Noxiousness of Measly Beef.—It is only in experiments that the symptoms, more or less serious, indicating the dissemination of the Cysticerci in the organism of the Ox, have been observed. Consequently, it cannot be said that, in ordinary conditions of infestation, measles has much importance from a sanitary point of view, with regard to the affected animals, and especially if the short life of the parasites is taken into consideration. The gravity of the prognosis is related to the noxiousness of the flesh to the people who consume it.

It has been known for a long time, from the reports of travellers, that the non-Mussulman Abyssinians nearly all suffer from taeniasis; and their fondness for raw mashed flesh, not only of the Pig, but also of the Ox, is blamed for this. If the Mohammedans are exempted, it is because, from their religion, they look upon raw flesh with horror. In 1819, Knox witnessed a real epidemic of taeniasis among the English soldiers at the Cape of Good Hope, who for the most part were fed on the flesh of over-driven cattle. From 1841, on the initiative of Weisse
of St. Petersburg, raw flesh was given as a remedy for infantile diarrheea throughout Europe. But it was soon discovered—and Weisse himself recognised it—that this treatment, though otherwise of undoubted efficacy, had the inconvenience of inducing the appearance of Tænia among the young patients. In 1861, Karschin reported that the Buratis, in the region of Lake Baikal—and who subsist on the raw flesh of the Ox, Sheep, Camel, and Horse—were very often affected with tæniasis. It was at this time that Leuckart made his first experiment, showing that the Cystic phase of the Tænia sayjinuta is effected in the organism of the Ox.

The inverse proof—that of the origin of the unarmed Tænia—has been furnished experimentally. In 1869, Oliver, a surgeon in the Indian army, stationed at Jullundur, gave two natives some measly flesh of the Ox. One of these was a Mohammedan Syee of the lowest caste, and he developed a Tænia in about three months. The other was a Hindu, who never ate flesh, and who in about three or four months passed fragments of Tape-worm. On his side, Perroncito gave a person, who willingly swallowed it, a living Cysticercus; in 54 days segments began to be eliminated, and on the sixty-seventh day a dose of kouso and castor-oil caused the evacuation of a Tænia, the total length of which was 4·83 m.

All these facts prove that the unarmed Tænia has its origin in Man, in the use of raw or imperfectly-cooked flesh.

Less, even, than the Cysticercus cellulose, the Cysticercus boris resists a slightly elevated temperature. In repeating on the latter the experiments he had made on the first, Perroncito found that the Cysticercus of the Ox perished sometimes at 44°, often at 45° or 46°, and that it always occurred between 47° and 48°. Three of his assistants voluntarily swallowed a Cysticercus which had been heated—one to 47°, and which gave no sign of life; another to 45°, and which did not move; and the third to 44°, and which moved very slightly. In none of these cases was the Tænia developed.

It is interesting to know in what conditions this temperature is reached in the centre of pieces of meat cooked in the ordinary way. To solve the question, recourse may be had to the experiments made with regard to measles in the Pig (p. 683). In comparing the figures obtained by Vallin for the various temperatures of roasted meat, with those given by Perroncito for the suppression of the vitality of the Cysticercus boris, we may conclude that there is no danger to be apprehended from the consumption of flesh infested with the unarmed Tænia, if it is properly roasted. It is only through underdone meat that this parasite can be introduced, and its increasing extension is explained by the greater use of flesh among all classes of people, and by the more general taste for insufficiently cooked meat. There would be no danger whatever if nothing but flesh were consumed, the central
portions of which showed, instead of a reddish tint, the characteristic gray, rosy hue that indicates thorough cooking, and which testifies that it has been submitted to a temperature of about 70°; for Lewis has shown that at this degree the red colouring matter of flesh disappears in cutlets and beefsteaks.

The longevity of the Ox Cysticerci in preserved meat, and their resistance to smoking and salting, is less than that of the *Cysticercus cellulosae*. In dried veal well preserved, Perroneito has found that the Cysticerci died in fourteen days after slaughter of the animal. In a putrefying Calf’s tongue, the number of living Cysticerci diminished with the progress of change; there were none alive after fourteen days.

From all that has been stated, the necessity will be perceived for an attentive examination of meat, in so far as cysticercosis is concerned, in the abattoirs; and the need for thorough cooking. Not less necessary is it that Cattle should be kept away from human excrement.

The Sanitary measures applicable to Pig measles are as valuable with regard to that of bovine animals; but as the disease is so exceptional in our country, it does not appear that there is any legal reason for classing it among the redhibitory maladies.

**Article IV.**—**Various Measles.**

Zenker has produced measles in three Goats by giving them segments of the *Taenia saginata*; and Heller has also obtained positive results in two Goats and a Sheep. But negative experiments are more numerous; they have reference to the Goat (Ziirn), the Sheep (Ziirn, Leuckart, Masse and Pourquier), the Pig (Kochenmeister, Zenker, Leuckart, Schmidt, Van Beneden), the Rabbit (Heller, Masse and Pourquier) the Guinea-pig and Monkey (Heller), and the Dog (Probstmayer, Heller, Masse and Pourquier).

Of six Alpacas which died at Paris soon after their arrival from Peru, four were measly, and contained an extraordinary quantity of Cysticerci, which, unfortunately, were not described.1

Among Reindeer which died at the Lille Zoological Gardens in 1878, Moniez found an abundance of armed Cysticerci in the muscles, and obtained their transformation in the intestine of the Dog into a *Taenia* which he named *T. Krabbei* (see p. 442). These parasites were more especially found in the spinal and intercostal muscles, as well as those of the thigh; they were smaller than the *Cysticercus cellulosae*, the caudal vesicle was very slightly developed, and at first sight they might have been mistaken for the *Cysticercus bovis*.

**Pseudo-Measles of the Sheep.**—Cobbold found on several occasions, in the measles of Sheep, an armed Cysticercus smaller than that of the Pig, the head of which was 7 mm. broad; it had 26 hooks, the largest of which was 157 µ. Cobbold named it the *Cysticercus ovis*, and considered it as the larva of a *Taenia* of Man—the *Taenia tenella*. But the investigations of Chatin have demonstrated Cobbold’s error, and shown that the pretended *T. tenella* is only a small-sized *T. solium*. With regard to the *Cysticercus ovis*, it was the *Cyst. tenuicollis* slightly

1 Sappey. Comp. Rend. de la Soc. de Biologie, 1880, p. 176.
developed. On several occasions, Chatin had these living Cysticerci—which corresponded as exactly as possible with those of Cobbold—ingested, and he never saw the least indication of the Tænia. Similar Cysticerci given to young Dogs produced the Tænia marginata. In recent years, some military surgeons have attributed to these Cysticerci of the Sheep various cases of tæniasis observed in Algeria, and Chatin has shown that these were the Tænia solium or Tænia saginata on the one hand, and, on the other, the Cysticercus tenuicollis.¹

CHAPTER III.

TRICHINOSIS.¹

Definition.—Trichinosis—or Trichiniasis—is a disease caused by the presence of the Trichina spiralis Owen in the organism of various animals, and particularly of Man and the Pig.

It is present in two forms—one, the most important, is muscular trichinosis, and is due to the presence of the larvae of the Trichinae in the muscles; the other is intestinal trichinosis, caused by the ingestion of trichinose flesh—the larval Trichinae acquire their adult and sexual state in the intestine of their host, couple, and throw off a multitude of embryos which traverse the walls of the digestive tube, to disperse themselves throughout the muscular system.

Trichina.—The genus Trichina comprises only one well-authenticated species—the Trichina spiralis—a Nematode belonging to the family Trichotrachelidae, or, according to some helminthologists, constituting that of the Trichinidae.

In the adult state, the Trichinae are found exclusively in the intestine, and are scarcely visible to the naked eye. Their body is capillary, and gradually tapers in front, commencing at the middle of its length. The integument is smooth, and has no transverse striae. The mouth is terminal, small, orbicular, and destitute of papillæ.

The digestive tube comprises: (1) A buccal intestine, or œsophagus, with thin walls and a little wider behind than in front, its section being triquetral; (2) a middle intestine succeeding the other, with very apparent nucleated cells; (3) a terminal intestine or rectum, longer, narrower, with muscular walls, dilated at its origin and near its termination in the cloaca, which is altogether terminal, and into which opens—in the male—the sexual apparatus.

The male is 1·4 mm. to 1·6 mm. long, and 40 μ broad. With regard to form, it is distinguished from the female by the presence, at the posterior extremity, of two digitiform appendages situated on each side

of the cloaca; the latter is everted at the moment of copulation, and plays the part of a copulatory organ. The reproductive system consists of a single testicular tube, doubled once on itself, and terminating in a long deferent canal, which opens into the cloaca along with the intestine.

The female measures 3 mm. to 4 mm. long, and 60 μ broad. It has only a single ovary, composed of a tube that arises as a cæcum in the vicinity of the anus, and extends almost directly to the end of the anterior fifth of the body, where it opens at the vulva. The cæcal portion acts as an ovary; then comes a short constriction—a kind of oviduct; then a long, wide dilatation, or uterus, which finally contracts into a sort of vagina ending in the vulva.

The Trichina is ovoviviparous; the fecundated ova undergo complete development in the uterus, and when mature are 20 μ in diameter. When hatched, the embryos find their way into the vagina, and escape through the vulva; they are then 90 μ to 100 μ long, by 6 μ in diameter at their middle.

In the larval state, the Trichinæ are found in cysts among the primary fasciculi of the muscles, in the intermuscular connective tissue, and exceptionally in adipose tissue and the intestinal walls. They are coiled up in a spiral or S form, according to whether they are examined in muscles still warm or quite cold, and measure 8 mm. to 1 mm. long, by 40 μ thick. Their body is capillary, tapering at both ends, and particularly so in front. The digestive tube is somewhat the same as in adults. The genital apparatus is rudimentary, and represented by a kind of sac situated in the posterior third of the body.

History.—The first time the muscular Trichina was observed for certain was in 1828, when Peacock deposited in Guy’s Hospital, London, where it is still to be seen, a fragment of muscle containing cysts of calcified Trichina. In 1832, Hilton—demonstrator of anatomy in the same hospital—found in the muscles of a Man 70 years old, and
TRICHINOSIS.

Fig. 354.—Digestive and Sexual Apparatus of the male Trichina.—Colin.

ib, buccal intestine or oesophagus; im, middle intestine; il, terminal intestine or rectum; t, testicle; cl, deferent canal; cl, cloaca; p, copulatory appendages.

Fig. 355.—Digestive and Sexual Apparatus of the female Trichina.—Colin.

ib, buccal intestine or oesophagus; im, middle intestine; it, terminal intestine or rectum; o, ovary; do, oviduct; u, uterine dilatation; va, vagina; vu, vulva.
who had died of a cancerous affection, several ovoid bodies about one millimetre long, situated between the muscular fibres, and parallel to them. These bodies were regarded by Hilton as small Cysticeri, but were probably Trichinae cysts.

In 1839, Wormald—demonstrator of anatomy in St. Bartholomew’s Hospital—remarked that the muscles in certain cadavers were studded with small white spots. James Paget soon after made a similar observation, and noticed that these productions contained Nematodes coiled up on themselves. R. Owen having examined the specimens collected by Wormald and Paget, also recognised the presence of helminths; he studied their organization, and gave them their definitive name of *Trichina spiralis*.

For nearly twenty-five years the knowledge pertaining to this subject remained almost stationary. In 1859, inspired by the alarm caused by the frequency of trichinosis in Germany, Virchow gave a Dog some portions of human muscle invaded by Trichinae, and in three and a half days afterwards he found in its small intestine worms similar to the Trichinae, but larger and oviferous. These he considered adult Trichinae, and concluded that the muscle Trichina achieves its development in the intestine of the Carnivora.

Some months after, Leuckart made the same experiment on a Pig, but the presence of a great number of Trichocephales—*Trichocephalus crenatus*—in the intestine brought the learned observer to an erroneous conclusion, as he mistook these worms for adult Trichinae, and described them as such. Fortunately, however, in the early days of the following year, Professor Zenker of Dresden, in making an autopsy of a young woman who had died from a disease, the symptoms of which led to the supposition that it was typhoid fever, found quantities of Trichinae—encysted or free—in her muscles; there were none of the classical lesions of typhoid fever, and—what was a most important detail—the intestinal mucus contained a great number of worms similar to the Trichinae, but provided with completely developed genital organs. Zenker made inquiry into the history of the case, and learned that some days before she became ill this young woman had eaten some raw pork, the consumption of which had been followed by morbid accidents in other people. The flesh of the Pig, which had been salted, was found to be infested with Trichinae similar to those in the human muscles. A portion of this flesh was introduced into the food of several mammals, and in each of them trichinosis was distinctly developed. Portions of the muscles of the young woman were sent by Zenker to Virchow, Leuckart, and Luschka, and these served for new investigations, which elucidated a great number of questions relative to the history of the Trichina. The important share Zenker took in the whole of these discoveries, explains why it was proposed by Pietra-Santa to give the name of *Zenker’s disease* to trichinosis; but the proposal was not adopted.

It is well to recall these facts to mind, as, if they had been understood, they would have greatly advanced the solution of the whole subject. In 1847, Leidy discovered the Trichina in Pigs in America. In 1850, Herbst, of Göttingen, fed three dogs, six weeks old, with the flesh of a Badger infested with Trichinae, and when they were killed some months afterwards, their muscles were discovered to be invaded by encysted Trichinae.

But it is only since Zenker’s researches that the evolutive cycle of
the Trichina has been exactly known; as it has from that time been
the object of continual study with regard to its anatomy, biology,
 geographical distribution, pathogenic action, and the sanitary police
measures necessary for dealing with it. Among these researches must
be mentioned those of Virchow, Leuckart, Friederich, Böhler and
Königsdörffer, Delpech, Colin, Chatin, etc.

Habitat, Location, Migrations.—The adult Trichinæ are only
found in the intestines, and especially the small intestine, of Mammals
and Birds which have recently eaten trichinous flesh. The Mammals
in which muscular Trichinosis has been seen, either by experiment or
observation, and which are consequently liable to intestinal trichinosis,
are: Man, Pig, Wild Boar, Rat, Norway Rat, Mouse, Hamster,
Guinea-pig, Rabbit, Hippopotamus, Calf, Lamb, Horse, Dog, Fox, Cat,
Marten, Stoat, Badger, Raccoon, Bear, Mole, and Hedgehog. Trichinæ
have been developed, experimentally, in the intestines of several
Birds, and especially in the Gallinæ and Passeres; but Birds are not
favourable subjects for the encystment of the larval Trichinæ. In the
cold-blooded Vertebrata, the Trichina cysts pass through the digestive
canal without undergoing any change; and the Invertebrata are also
unsuitable hosts for the Trichina. In the larvae deposited by Flies
on trichinous flesh, the worms certainly penetrate to the digestive
canal, but they do not develop there (Probstmayer, Zürn, Leuckart).
Chatin has, however, found that sometimes in Crayfish, fed with
infested flesh, the worms had reached a somewhat advanced phase of
development in the intestines, but the ovary had never attained to
the formation of ovules, nor the testicular tube to that of spermatozoa.

When trichinous flesh has been ingested by one of the Mammalia or
Birds above-mentioned, the cysts enveloping the muscle Trichinæ are
dissolved by the gastric juice in about eighteen to twenty hours, and
the worms are set free. On the second, third, or fourth day—rarely the
fifth—these larvae have undergone transformations which bring them to
the adult form. In order to observe them, the intestinal matters are
examined drop by drop, under a magnifying power of 150 diameters.
The males are generally in smaller proportion than the females.
Copulation takes place, and frequently on the third day after infesta-
tion the ovary already shows ova in process of segmentation. Ovula-
tion commences towards the sixth or seventh day, and it is then that
the first symptoms of intestinal trichinosis are remarked. The females
live longer than the males, the average duration of their existence
being five or six weeks; though during the epidemic of trichinosis at
Hedersleben in 1865, Kraatz and Cohnheim found living Trichinæ in the
intestines at the twelfth week; but this long duration is exceptional.
Ovulation is particularly active during the first week of adult life; it
begins to abate after this, and only occurs periodically (Cohnheim). It
is difficult to estimate the number of embryos a single female will bring
forth. Each may contain at one time as many as 1,200, and the total
derived from one individual may amount to 10,000 or 15,000; the
produce of 250 grammes of trichinous flesh may extend to hundreds of
thousands. The search for these embryos in the intestinal matters is
made by means of a magnifying power of 200 or 300 diameters.

The embryos, deposited in crowds in the intestines, only become
developed after migrating into the striped muscles and connective tissue
in every part of the body. Their tenuity allows them to pass through the
intestinal wall, and seek their distant location either by creeping in the
connective tissue, or in utilizing the blood or lymph streams, though this
is hypothetical; but it is probable that the three modes of access are
made available. The part the blood current plays will explain the rapidity
with which the embryos arrive in parts very remote from the intestines,
and there is reason to believe that the Trichinæ met with in the
lymphatic glands have been brought there by the lymphatic vessels;
while the embryos which are found in a free state in the peritoneal,
pleural, and pericardial cavities towards the eighth day, have probably
got there by intra-tissular burrowing. The duration of these migra-
tions external to the intestines is about eight to ten days.

Trichinous infestation is very easy with the Rat, Pig, and Man; it is
still more easy with Mice, the Guinea-pig, and Rabbit; less constant
with the Cat, and very irregular with the Dog, Horse, Ox, and other
Mammals, in which it can scarcely be effected except when they are
young. Perroncito has, however, observed it in an Italian dog, and
Csokor has succeeded in producing it experimentally in an eight years
old Horse.\(^1\)

The larval and encysted Trichinæ have never been observed in Birds;
the muscle Trichinæ they ingest acquire complete development in their
intestines, but the embryos these bring forth are expelled with the
faeces, and do not seem to have the power to pierce the intestinal walls
—a fact brought to notice some time ago by Colin.\(^2\) It has been
mentioned (p. 375) that other Nematodes encysted in the walls of the
stomach and intestines of the Fowl, have been mistaken for Trichinæ.
It would seem that the immunity of Birds is partly owing to their
having so little intra-muscular connective tissue, and partly—and more
especially—to the thickness and resistance of the epithelial lining of
their digestive canal.

We have already spoken of the immunity Reptiles and Batrachians
enjoy. Experiments made at first by Goujon and Legros,\(^3\) show that
this is solely due to the variable temperature of their body. If Sala-
manders are kept at an artificial temperature of about 30° (C), muscular
infestation occurs; but as soon as this experimental condition is


\(^3\) Goujon. Experiences sur la Trichina Spiralis Owen. Thèse de Paris, 1866.
TRICHINOSIS.

removed, encystment ceases, and the parasites soon perish—all the more rapidly as the season is cold.

Muscular trichinosis has never been observed in Fishes, but the Trichinæ may develop in their intestines. Colin assured himself, in 1866, that the excreta of Fish fed on trichinous flesh was charged with Trichinæ, and caused trichinosis in the Rat, Rabbit, and Guinea-pig.¹ Perhaps this infestation was owing to the parasite-cysts having passed intact through the digestive canal of the Fish.

It has been stated that all attempts at trichinous infestation of invertebrates have been negative in their results; and there is nothing to show that spontaneous infestation is possible.

The parasitic Nematodes of certain vegetables, which have been sometimes supposed to be Trichinæ, are entirely different.

The larval Trichinæ are chiefly met with in the muscles of animal life—even in the midst of the primary fasciculi (Virchow, Gerlach, Grancher, Leuckart, Piana), sometimes in the interfascicular connective tissue, or in the adipose septa of the connective tissue (perimysium) interposed between the secondary fasciculi (Colin, Chatin). The investigations of Chatin, confirmed by several observers, have demonstrated that they may also be found in the fat (lard), and in the cellular and muscular tunics of the intestines of the Pig; in these they have the same characters and the same latent existence, or they may preserve their embryonic form.

When it first arrives at its definitive resting-place—which, according to Piana, may be on the sixth day after ingestion—the larval Trichina is curved up into a kind of loop, then it assumes the figure 3 shape, and at last coils itself up into a wide spiral—an appearance that it generally maintains during all this stage. Its contact and movements set up an amount of irritation in the elements of the surrounding tissues that ends in the formation of a cyst.

The fibres of the interfascicular connective tissue, in the midst of which the Nematode sometimes establishes itself, become hypertrophied and produce embryonic cells, which are irregular and subspheroidal, nucleated or non-nucleated, and multiply rapidly; at first, very fine proteic granules can also be distinguished, then other

granules of glycogenic matter. Soon after, the neoformation becomes indurated externally, the elements composing this soon constituting a parietal layer, which is at first very thin, but is not long in growing to a considerable thickness. In this case, the myolemma does not appear to take any part in the formation of the cyst. But under the influence of the inflammatory process induced by the presence of the worm, new vessels are formed; the connective tissue—which has become greatly altered—may completely disappear, and the cyst then comes in contact with the primary muscular fasciculi, the myolemma of which appears to form an integral part of its wall. The contractile substance of the adjacent fasciculi undergoes granular or granulo-adipose degeneration, and there appear indications of proliferation in the nuclei subjacent to the myolemma; then arise embryonic cells, which sometimes strengthen the cystic tissue, or become new primary fasciculi. In the latter case, if the irritation is slight, there is real muscular regeneration (Chatin).

In the majority of instances, the Trichina passes through the softened myolemma—transforming it into a cellular sheath—as far as the primitive fibre, upon which it subsists. The myolemma is charged with cells, which accumulate at a point of the fibre, and assume the appearance of a fusiform cylinder; the muscular fibre loses its colour and striation, and in contact with picric carmine absorbs the picric acid by preference, while the healthy fibres are rose-tinted. The external membrane of the cyst is formed at the expense of the outermost layer of cells that infiltrate the myolemma; at first very thin and fasciculated, it becomes thickened, homogeneous and transparent, and its deeper layers are united at the two poles, by which the ends of the cyst are separated from the muscular fibre. Sometimes the latter is altered throughout its entire length, is imprisoned in a sheath of cells, and is gradually atrophied; at other times, at some millimetres above and below the cyst, it resumes its striation and physiological properties, and the myolemma surrounding it is directly continuous with the most external layer of the cystic membrane. In the immediate vicinity of a cyst, the muscular fasciculi not required by the Trichina are crowded and deformed by compression; but they retain their striation, and show no traces of waxy or granular degeneration (Grancher).  

In general, the trichinous cyst is ovoid, and more or less drawn out at both of its poles or at only one, which is blunt, and gives the cyst the appearance of a lemon. Its larger axis is parallel with the muscular fibres. The two prolongations may be absent, and the cyst is then

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1 Grancher. Bull. de l'Acad. de Médecine (2), XIII., 1884, p. 34.
spherical. Its average length is \(0.40 \text{ mm.}\), and breadth \(0.25 \text{ mm.}\), but in consequence, more especially, of variations in the thickness of its wall, its length may vary between \(0.30 \text{ mm.}\) and \(0.80 \text{ mm.}\), and its breadth between \(0.20 \text{ mm.}\) and \(0.40 \text{ mm.}\). Sometimes two or three similar cysts join by their corresponding ends, and so give rise to a moniliform cavity, the dilatations of which are occupied by the Trichinae. Most frequently each unicellular cyst only contains one worm; but it is not rare to find 2, 3, 4, 5 and 6, or even 7 Trichinae in one and the same cyst, whether this be unicellular or plurilocula (Chatin); this is in accordance with the inflammatory process presiding at the formation of the cyst in the perimysium.

In the definitively constituted cyst, the Trichina is in a dorman condition at first; but soon regressive changes may be observed. To the proteic and glycogenic corpuscles are added pigment granules, which are first yellow, then brown, and more or less numerous—they may be in such quantity that the whole cyst appears as a reddish-brown spot, while the helminth is dried and shrivelled, sometimes even broken up (Chatin).

The tissue of the cyst is capable of undergoing two other kinds of degeneration, more or less important—fatty and calcareous. The first is manifested by the appearance of small fat granules in the interior of the cyst cells; these granules rapidly increase in number, and may—though they rarely do—completely fill the cell. Soon this fat is set free, and invades the whole of the cyst. Calcareous degeneration follows. All nutrition has disappeared from the cyst-tissue, and carbonate and phosphate of lime—in relatively variable proportions—is grouped in small granular globules, forming concentric layers that become multiplied and render the cyst opaque. This deposition occurs in the cyst-membrane and in the tissues of the Trichina, each of which loses all organization, and appears only as a whitish mass. These modifications require a long time for their accomplishment, and are not often seen in Pigs, which are most frequently killed for food soon after the commencement of the malady. In general, calcification does not begin before the seventh month, and it is completed in about fifteen to eighteen months—though Dammann has found it very slight more than eleven years after infestation, and has noted that the Trichinae were yet alive, and could give rise to experimental trichinosis. A similar observation has been made in Man, with regard to Trichinae more than thirteen years old (Tüngel, Virchow), nineteen years (Köllicher, Middeldorp), and even twenty-four years.
TREATISE ON PARASITIC DISEASES.

(Klopsch). But it has not been demonstrated that new infestations did not take place between the first one and the period of observation.

Piana has recognised bacteria in trichinous muscles, which he thought had been carried into the intestines by the embryos in their migrations.1

Pigmentary, fatty and calcareous degenerations are sometimes met with in the infested muscles.

The presence of the cyst, after a certain time, usually leads to the formation of abundant adipose deposits, which begin to appear at one of the poles, and finish by enveloping all the new formation. They result, primarily, from the fatty degeneration of the excess of embryonic cells formed under inflammatory influence. When the mass of fat has enveloped all the cyst, this and the Nematode usually undergo great alterations.

Generally, when the Trichina is arrested in adipose masses—the cells of which have little protoplasm—the cyst formation is only traced out by a granulo-fatty cluster, in which the worm remains in an embryonic state and soon perishes; though it may happen that embryonic cells appear and constitute a normal cyst.

Symptoms.—Trichinosis being very much more frequent in the Pig than in any of the other domesticated animals, it is to this creature that the symptomatology—which has been more particularly established by experimentation—will apply.

Symptoms are only exhibited when the quantity of Trichinaæ ingested is considerable; and in the majority of cases they escape observation. Those which are noted evidently vary with the degree of infestation.

The first troubles are those relating to intestinal trichinosis, and they appear from the third to the tenth day after ingestion of the infested flesh. They consist of more or less complete inappetence, thirst, grinding of the teeth, dulness and fever; the head is depressed, the conjunctivæ infiltrated, and the eye has a peculiar glassy appearance; the back is arched, abdomen retracted and painful on pressure, and the tail flaccid and uncurled; diarrhœa supervenes, and persists for a long time. There is nothing characteristic in these symptoms, as they are merely those of enteritis or peritonitis; they continue for about a month.

From the eighth to the fifteenth day, the symptoms of muscular trichinosis commence; they are due to dissemination of the worms. The appetite gradually returns, but the limbs are stiff, the movements—especially of the hind quarters—are halting and uncertain, and there is an appearance of paraplegia. The articulations and muscular masses are painful; the Pig lies extended on its side; sometimes it suffers so much that it cries out; mastication and deglutition are difficult; the voice is husky; and alvine dejections are passed involuntarily. Finally,

1 Piana. La Veterinaria, II., 1881.
according to Röll, pruritus may be developed in various parts of the body, if the Trichinae have invaded the panniculus muscle abundantly.

In the later stages of the malady, oedema appears at different parts of the body, and is usually the precursor of death.

But the symptoms only attain this gravity when the infestation is extraordinary. Nearly always the Pigs gradually recover; they remain lazy in consequence of the alterations in the muscular fibres, but the appetite becomes normal, and the animals may fatten to an extreme degree.

It results from this description that the diagnosis of trichinosis is usually impossible, as the symptoms are equivocal or scarcely appreciable. However, if there is any doubt, much assistance may be derived from harpoonage, and for this purpose Duchenne's histological punch is used. This is a fine trocar about two millimetres in diameter, the cannula of which carries—a little behind the point—a notch with sharp borders; the central stem is cylindrical; it is pushed in such a way as to temporarily suppress the notch. In this state it is inserted into a mass of muscle known to be most probably infested; the stem is withdrawn about a centimetre, and in withdrawing the instrument there is found a fragment of flesh in the notch of the cannula, the microscopical examination of which should settle the diagnosis. Middledorpf's trocar has its notch on the stalk, a little behind its point; this notch being concealed, the trocar is pushed into the muscle, the stem is pushed through about a centimetre, then drawn back, when it carries with it a small piece of muscle.

But harpoonage of the Pig is difficult, owing to the thick layer of fat between the skin and the muscles.

Pathological Anatomy.—When the animals die or are killed during the period of intestinal trichinosis, there are observed at their autopsy lesions more or less marked, of acute enteritis and peritonitis. A microscopical examination of the fluids from the intestines reveals the presence of adult or embryonic Trichinae.

At a later period, when the trichinosis has become exclusively muscular, the lesions consist merely of cysts having the characters already indicated, their dimensions rendering them visible to the naked eye. But when the affection is chronic, and calcification is complete and extensive, there will be seen in the muscles—by the naked eye or pocket lens—very minute white points formed by the calcified cysts; these, on being treated with a two to five per cent. solution of hydrochloric acid, have the lime salts dissolved, and the Trichinae are rendered apparent in their interior. These white points cannot be seen in lard or in the internuscular connective tissue, where, nevertheless—according to Chatin—the Trichinae may be found. A microscopical examination is therefore necessary.

It ought to be made at those parts where the Trichinae are oftenest
met with, as will be mentioned hereafter. A small piece of muscle is cut off parallel to the direction of the fibres, by means of curved scissors. After steeping it in water, it is placed on the object glass and covered by the cover-glass, which is firmly pressed upon it. The preparation is sufficiently transparent to show the trichinous cysts by a magnifying power of 100 to 150 diameters. It is better, however, first to tease out the fibres under water by means of needles, and then examine the preparation in a .75 per cent. solution of common salt, or—which is preferable—a .1 to .5 per cent. dilution of acetic acid.

Tikhomiroff has described a method of disassociating the muscular fibres, in order to facilitate the search for Trichinæ. The suspected flesh is cut into small fragments, which are digested for half an hour in a mixture of nitric acid—4 parts, and chlorate of potass—1 part. They are then put into a glass filled with distilled water, and well shaken. 'The muscle then breaks up into very fine fibrillæ, some of which readily show—even to the naked eye—fusiform enlargements in their length, which, as a microscopical inspection will show, are the encysted Trichinæ.'

The Trichinæ ought to be sought for towards the extremities of the muscles; they are, in fact, more abundant near the ligamentous or bony insertions, where they appear to be arrested in their migrations.

Kühn's investigations show that, generally, the muscles may be classed—with regard to the frequency of infestation—in the following decreasing order: the diaphragm, and especially its pillars; the muscles of the shoulder; the psoas muscles; the muscles of the larynx; and those of the internal crural region, neck, tongue, cheeks, eye, abdomen, flexors of the thigh, neck, intercostals, and back. Müller asserts that the coccygeal muscles are ordinarily the most infested. Zürn has several times found Trichinæ in the heart.

The quantity of parasitic cysts one individual may carry is capable of attaining an extraordinary high figure. In a gramme of muscle, Leuckart has counted between 12,000 and 15,000, which would raise the total number to 30 or 40 millions. Colin's estimate was 5 millions, in a case of serious invasion; and Fiedler reckoned the number of those found in the body of the young woman examined by Zenker at 94 millions. Cobbold, in one case, carried it as high as 100 millions. These large numbers—though only approximate—afford an idea of the great intensity this infestation may reach.

The Trichinæ should not be confounded with rolled-up muscular nerve or tendinous fibres, nor yet with other parasites—Distomes or Sarcocysts—that may be found in muscles. It is also well to be warned of the presence, in the muscles of the Pig, of a Fungus belonging to the Schizomyzetes, and closely related in its various characters to the Actinomyces bovis, which is so frequent in many organs of the Ox, and especially in the maxillary bones.

1 Tikhomiroff, quoted by Bouley and Nocard. Mémoire lu au Congrès National d'Hygiène de Paris, 1878.
In 1865, Virchow found in the heart of a Pig calcareous tubercles, much resembling calcified Trichinae, but differing from them in their situation, their much larger size, their greater consistency, and their less elongated, even rounder, form at times. In 1884, Duncker discovered these tubercles in the muscles of the Pig, and as they were of different ages, he recognised their mycosic nature, classing them with the Actinomyces, under the name of Actinomyces musculorum suis. This opinion was ratified by Virchow, Israel, Schütz, Zürn, Plaut, etc.\footnote{Hertwig. Archiv f. Wissensch. u. Prakt. Thierheilkunde, 1886, p. 365. — Duncker, \textit{Ibid.}, 1887, p. 224. — Johne. Deutsche Zeitschr. f. Thiermed. u. Vergl. Pathologie, XIII., 1887, p. 140.}

Actinomycesis flesh is soft and wet, particularly when cold. At the invaded points it has a grayish-yellow tint six to twelve hours after slaughter, and when there is calcification the parasites can be recognised as yellowish-white points. With a magnifying power of 40 to 50 diameters, there may be observed among the normal muscular fibres others more or less altered—irregularly broken-up, undulated, retracted at some points, and dilated at others, which have partly lost their striation, and are darker tinted, being gray or brown. At the interruptions are observed, in irregular spaces, dark and round or oval corpuscles, well defined, their diameter being equal to, or even greater than that of the primitive fasciculus.

Magnified 300 diameters, the dark parts of the fasciculi are seen to be invaded by fat globules and corpuscles—kind of micrococci—among which are found numerous claviform filaments. Between the fragments of the fasciculi are the Actinomyetes, arranged in radiating and more or less regular tufts, enveloped in a thicker sarcolemma and granular cells. In preparations stained with carmine, the outline is more distinct than with the Fungus. The Actinomyces musculorum is chiefly formed of scarcely visible filaments, some of which are expanded at their periphery, and intermixed with numerous spores.

Calcification commences either in the centre or at the periphery. In the first case the centre is completely obscured and surrounded, as with a fine crown of rays, by the ends of the conidia. So long as calcification is not complete, the lime salts may be dissolved out with acids, and the central mycelium rendered apparent; but when it is total this means will not succeed, the Fungus having, no doubt, undergone regressive metamorphosis.

These parasites offer a strong resistance to external agencies. Slight boiling in a solution of potash or dilute acetic acid does not alter them, but, on the contrary, makes them more distinct; while they preserve their form in salted flesh, and in a concentrated solution of salt.

The Actinomyetes are most frequent in the pillars of the diaphragm and in the abdominal and intercostal muscles, and this peculiarity leads to the presumption that they penetrate by the digestive passages. Hertwig, who found them in 187 Pigs, believed that infestation occurs in summer or at the commencement of autumn, as at that time there are found only old calcified tubercles in the muscles; while in October new parasites commence to be developed, and form fresh tufts, rich in spores and micrococci corpuscles. The fungus attains its full development in November and December, and begins to calcify during January; so that in summer it is only found in that condition.

Muscular actinomycosis does not appear to have any injurious in-
fluence on the general health of the Pig; but as the flesh has lost its nutritious qualities, it should not be allowed for consumption. At Berlin—where this parasitic affection has been particularly observed, and where the proportion of Pigs condemned because of it is 1 in 2,406—the antinomycesic Pigs are melted down, and the grease sold.

It may be sometimes useful, in doubtful cases of trichinosis, to resort to staining. Sections of the flesh are allowed to steep for ten minutes in a solution of methyl blue—1 to 30 of distilled water; they are then carefully washed in water and examined, when the cyst will be of a dark-blue tint, and the intact worm can be seen distinctly through it, while the remainder of the preparation is uncoloured. We may also employ, as Mazzanti did, the glycerined haematoxylin acid of Ehrlich, leaving the fragments of flesh, cut in the direction of the fibres, in it from six to eighteen hours. They are then washed in distilled water, and afterwards in alcohol acidulated 5 per cent. The staining only persists in the trichinous cysts.

Etiology.—Frequency.—Trichinosis always owes its origin—no matter in what species of animals it may appear—to the ingestion of flesh containing encysted Trichinae, or to excrements in which are the sexualized worms or their embryos. The chain of facts establishing this circumstance results from the labours of Virchow, Zenker, Leuckart, Herbst, Delpech, Colin, etc., as stated at the commencement of this article.

It is in eating the flesh of the Pig that Man contracts trichinosis. The Pig is contaminated by the ingestion of trichinosed meat or animals, such as the Surmulot, Rat, Mouse, etc.; while its coprophagus habits also allow it to be infested by devouring excrements containing adult or embryonic Trichinae.

It is unnecessary to insist on the first source—that of trichinous flesh—or yet on the third. With regard to the second, however—that of the smaller Rodents—it is known that their bodies, when thrown into manure-pits, are readily eaten by wandering Pigs. And Mice and Rats are easily trichinosed; but they often resist the initial period of the disease, and may therefore disseminate the malady. It is rarely seen in other Rats than those living in contact with animals' débris, but these form a relatively considerable proportion.

In 72 sewer Rats of Paris, Goujon found 5 trichinosed, or about 7 per cent. In Germany, the proportion is 2 or 3 per cent. in slaughter-house Rats, and 22 per cent. in those of knackeries. At Bamberg, of 34 Rats obtained from the abattoir attached to the meat-market, 12 were infested (Fessler). The proportion is greater in the United States of America; for of 51 Rats caught in the Boston abattoir, 39 were trichinosed, and 40 captured in a large exportation slaughter-house in the same city were as much infested. Of 60 found in various stables not containing Pigs, only 6 were affected. In epidemics of trichinosis, when the Rats in the invaded localities were examined, it has been observed that a very large proportion were trichinous.
The Rats are infested by eating the *débris* of trichinosed Pigs which is thrown away, though they may also acquire the disease by devouring the dead bodies of their congeners. It might be asked, Which of the two—Pig or Rat—is the original host of the Trichina? It is difficult, if not impossible, to solve this question. If, as is very plausible, the Rat, or rather the Surmulot, is the primary host, then trichinosis is a recent importation, and of Asiatic origin. The black Rat is believed to have come into Europe from Asia during the Crusades, but that in a great number of localities it has been driven away or destroyed by the Surmulot (or brown Rat), which has replaced it. The latter did not appear in Europe until 1727, when it arrived in great crowds, which swam across the Volga. It soon spread into every country in this part of the world, and by means of ships it found its way into Transatlantic regions; no doubt it propagated trichinosis as it extended. Asiatic Pigs might also be incriminated, as they are very liable to the disease, and have been introduced into Europe since the commencement of this century, in order to improve the native breeds.

A vegetable origin for trichinosis cannot be admitted: the Nematodes which are sometimes found—encysted or not—on plants belong to altogether different species; and the same may be said of a large number of other worms found in Rodents, Reptiles, Batrachians, etc., and which have only somewhat remote analogies in habitat with the Trichine.

Trichinosis has been observed in every European country, though in varying frequency. Although trichinosed Rats are not rare in France, the malady has never been observed in the Pig; and it was only in the small outbreak at Crespy-en-Valois, Oise, that an animal of this species was believed to be the cause.¹

In Italy, the only instance of indigenous trichinosis known, is that of a stray Dog observed by Perroncito, and that of a Man reported by Legge.²

In Spain, Trichinæ were found in the Pig, in 1879, at Villar del Arzobispo, Seville and Barcelona.

Trichinosis has also been seen in Algeria, India, South America, etc.

But it is more especially frequent in Holland, Sweden and Denmark, Russia (12 trichinous Pigs in 1,000), in Germany, and still more so in the United States of America. At Copenhagen, the trichinous Pigs are 12-15 per 1,000; at Stockholm, 3-76; and at Linkeping, Sweden, 15-89.

In the whole of the German Empire, the proportion was 10 to 13 per 1,000 in 1871; but it rose considerably in certain regions of that country. While it was null in Westphalia, very small at Brunswick

(10 per 1,000 in 1874), small in Saxony (1 in 4,451, or .22 per 1,000, in 1889), Hamburg (20 per 1,000 in 1879), also small in Pomerania, Dusseldorf, Wiesbaden (in 1854), it was .91 per 1,000 at Cassel in 1875. In Prussia, the average proportion in 1885 was .54 per 1,000, or 1 trichinosed Pig in 1,852; the majority of the affected animals came from the duchy of Posen, where there was an average of 5.18 per 1,000. In certain circles—as that of Schroda, for example—it rose to 14.71 per 1,000; and at Berlin, in 1889-90, there was found 1 infested Pig in 1,514—or .66 per 1,000.

These figures are greatly exceeded, however, by those of the Pigs sent to Europe from the United States of America in such immense numbers, chiefly from the markets of Cincinnati and Chicago; this is demonstrated by the examinations made in different parts of Europe, and even in America. These investigations show that pieces of pork sent from America to Europe are infested with Trichina in the proportion of 3.11 per 100. If the inspection is carried to barrels of salted pork, in which one infested piece will cause the rejection of the whole, the proportion found by Chatin at Havre amounted to 14.65 per 100. American statistics show that trichinosis is very equally distributed throughout the States of the Union. In Indiana the proportion, which, in 1874, was 16.33 per cent., fell afterwards to 6.5 per cent.; at Chicago, in 1878 it was 8 per cent., in 1883 it was 2.4 per cent. At Boston, from 1879 to 1881, it was 4 per cent.; at New Orleans, in 1881, it was .4 per cent. The Agricultural Department reported 1.66 per cent. infested at one time; at another 2.7 per cent.; and at another it had fallen to 0 per cent. One fact results from the figures furnished by the Americans—it is that they say much less about Trichina, since the European countries have taken alarm at their infested importations. The abundance of these worms in American pork caused Reeper to assert, that the abattoirs in that country were the great breeding centres for Trichina.

Prognosis, Treatment, and Prophylaxis of Trichinosis.—As has been stated above, trichinosis is rarely fatal for the Pig; frequently it does not give rise to any appreciable disturbance, but in the majority of cases it coincides with normal fattening. The prognosis is only serious, so far as the health of Man is involved, through eating the flesh of the affected animal. It is, therefore, of importance to discover some means by which the muscular parasites can be destroyed, and it is most desirable, so far as human trichinosis is concerned; but this discovery has yet to be made. It may be compensated for, however, by prophylactic measures, which have a certain efficacy.

In order to suppress trichinosis, it suffices to institute and maintain

1 It is not so in America, however. According to an official report from the English Consul at Philadelphia, trichinosis in 1856 killed 700,000 Pigs in Illinois alone. But, in reality, this mortality was most probably due to the Swine plague, rather than to trichinosis.
a rigorous surveillance in the feeding of Pigs—only allowing them vegetable food, preventing their indulging their coprophagous appetites, and to keep the dead bodies of black and brown Rats and Mice away from them. It is always possible to maintain them in such a condition that all chance of infestation will be averted, and particularly if care be taken not to give them raw slops, whatever may be their composition. In places where animal matters must form part of their rations, these should be chopped up into very small pieces before they are cooked, and this process should be complete.

The extreme extension of trichinosis in the United States is because there are found all the conditions favourable to its development. Everything in the nature of organic matter, otherwise not utilizable, is collected for the alimentation of Pigs, which in certain centres play the part of scavengers.

**Vitality of the Trichinæ.**—The encysted Trichinæ possess remarkable vitality, which contributes to increase the chances of infestation. It is often necessary to know if the muscle Trichinæ are alive or dead; and to ascertain this, recourse may be had to two procedures.

In one, the Trichinæ are placed on a platinum plate, which is heated to a temperature of 35° to 40°; in a short time, if they are alive, they will begin to twist about in a manner proportionate to their vitality. These movements are sometimes rather obscure and doubtful, or—if the cyst is torn—there is a sudden extension, which might either be a spontaneous motion or a mere inert elastic one. The second procedure is very simple and sure, and leaves no doubt, if carried out methodically. It consists in giving the suspected flesh to an animal, in the intestines of which the Trichinæ are capable of attaining their development. After one, two, three, or four days, if the animal is killed and the contents of the intestines examined, adult male and female Trichinæ and embryos will be found, if the meat contained living Nematodes. If they were dead, then they will be discovered free from their cysts—which have been dissolved—more or less uncoiled, but motionless, and having no developed genital organs; they are often damaged by the gastric juice. It is advantageous to experiment upon a small animal, as there is less intestinal fluid to examine. In this respect, small birds—which were employed by Colin—are very convenient, and have the additional advantage of not passing the newly-hatched embryos, which may be found in thousands in the intestines.

'A small bird—a Sparrow, for instance—is made to swallow two or three small pieces of meat taken from the centre of a piece of pork, after kneading it for an instant in order to remove the salt. The creature is killed six, eight or ten hours after feeding, and the contents of the small intestine are spread out on the glass and examined in the microscope by means of a low power. As there are only two or three drops of fluid in the intestine—and which may be diluted, if need be—an examination of the whole can be made in a few minutes. If the trichinæ are dead, they will be found digested, along with their cysts, and perhaps only traces of them will be left in the form of irregular, pointed fragments. But if, on the contrary, they are alive, they are quickly perceived—some coiled up in a spiral manner free of their
envelope, others uncoiled and performing the most varied evolutions in the midst of the surrounding matters. The experiment thus made is expeditious, not difficult, and its result is a mathematical certainty. 1

These tests may be completed by staining with such colouring matters as methylanilin violet, piercarminate of ammonia, anilin blue, etc. The living Trichinae do not stain, and therefore contrast strongly with the coloured muscular fibres; while the dead parasites readily become tinted.

The Trichinae resist for months (a hundred days, it is said) the putrefaction of the flesh in which they are encysted.

To appreciate the effects of heat, Perroncito has heated the larval Trichinae on a Schultz's table, and noted that at 44° to 48° all movement had ceased; hence he concludes that they are killed after at least five minutes' exposure to the latter temperature. By means of the same table, modified and better adapted to these researches, Piana found that the degree of heat necessary to kill the Trichinae is 55°; and his experiments agree with those which were made with the object of ascertaining the affects of cooking.

Krabbe, after cutting up trichinous pork into small pieces, plunged it into water at various temperatures, and observed that the Trichinae ceased to move on a plate when put into water at 55° Cent. for five minutes, at 54° for ten to fifteen minutes, and at 52-5° for twenty to thirty minutes. Flesh so exposed did not produce trichinosis when given to Rabbits. In his experiments, Piana obtained similar results.

The well-conducted experiments of Fjord, of Copenhagen, show that the duration of cooking in water necessary to kill the Trichinae in the centre of a piece of pork, is proportionate to its size; but it may be estimated that thirty to thirty-six minutes is needed for each kilogramme—according to whether it is summer or winter, deducting from this the half of that required to bring the water up to boiling. A ham weighing 5 kilograms, with an initial temperature of 7°, should therefore be boiled 36°×5 = 3 hours if put into boiling water, and two and a half hours only if put into cold water, and if an hour is required to make it boil. In following this rule, during cooking, a temperature of at least 60° is always obtained, and after half an hour or an hour's rest that of 70°, the peripheral heat continuing to penetrate towards the centre. 2

The experiments of Perroncito and Vallin fully confirm these; but those of Colin are very much more precise, as the flesh cooked by him was given to animals, at the autopsy of which it was seen whether the Trichinae had been killed. 3 In these experiments, a piece of trichinous flesh weighing 2 kilograms was boiled for an hour and a half, and a Dog and brown Rat fed on it showed no traces of living or dead

Trichinæ when their bodies were examined. For a piece of 3½ to 4 kilogrammes weight, the same result required four hours’ continuous boiling. An hour and a quarter sufficed for the ears, lips, cheeks and feet. The ordinary duration of boiling is, therefore, a very sure means of rendering trichinous meat inoffensive, provided it is prolonged in proportion to the size of the piece.

Piana has also found that, when the Trichinæ have been exposed to a temperature of 54°, they no longer develop in the intestines of, Rats, Rabbits or Guinea-pigs.

Hurried roasting—such as is usually practised with regard to beef and mutton—leaves in the centre of pieces raw or merely red portions, and consequently does not kill the Trichinae. They are certainly killed if the roasting is complete—which should be the case with pork. A shoulder of pork roasted on the spit before a bright fire for only sixteen minutes was perfectly cooked, and swallows which ate some of the most central portion did not have any living Trichinæ in their intestine (Colin).

The experiments instituted at the Imperial Sanitary Office of Germany have yielded like results.

With regard to the action of cold, which is of less practical importance, Leuckart reports that ‘a mass of flesh was exposed in the open air for three days to the cold of a very severe winter (—20° to —25° Cent.). Completely frozen, it was given to a Rabbit, when it was found to have a noxious influence.’ This observation does not stand alone, for Rupprecht, Fiedler and Kühn give similar reports. Fiedler estimates, however, that the Trichinæ die when the temperature descends below —14° Cent. Kühn states that meat kept for seven weeks in an ice-house still had living Trichinæ, and it did not become inoffensive until after two months.¹

But these statements are contradicted by the experiments instituted, on the one hand, at the Marseilles School of Medicine by Livon, Bouisson and Caillot, of Poncy; and, on the other, by H. Bouley and Gibier. The latter used pieces of trichinous meat, which were placed for two and a half hours in refrigerating apparatuses on the Carré system, and they remarked that exposure to a temperature of —20° and even of —15° was sufficient to kill the Trichinæ. The differences between these two series of experiments are evidently due to the circumstance, that in the second the Trichinæ had been submitted to the more or less prolonged action of salt, as Gibier recognised afterwards.²

The influence of salting on the vitality of Trichinæ is far from being so marked as is supposed. It requires a long time to bring about the

¹ Leuckart. *Die Menschlichen Parasiten*, II., 1876, p. 592.
death of the parasites. According to Colin's\(^1\) experiments, \(\text{ incomplete salting carried out for six, eight or ten days does not kill the Trichina, nor in any way hinder their power of development in the intestine ... complete salting promptly kills those in the superficial parts of pieces placed in brine or powdered with salt, but the parasites in the deeper portion, which are slowly reached by the pickle, live for a long time. ... In the parts of average depth, the ham has no more living Trichinae than in the superficial layers; after two months, with those near the bone or in those less saturated with salt. In the deeper parts of hams of large size, which have not remained for a long time in salt, there are living Trichinae when it is first taken out of the brine, and these may continue to live for a long time—weeks or even months after the more superficial ones, according to the size of the piece and the quantity of salt that has penetrated it. ... In sausages—even those slightly pickled —the Trichinae are killed in about fifteen days, throughout, and more certainly than in the ham, because of the more rapid and complete diffusion of the salt in all parts. These results prove that pickling promptly destroys the Trichinae, and that fifteen days suffice for those in the superficial parts, six weeks for the deeper.'

In the Emersleben epidemic of 1883, it was reported that the ingestion of salted, trichinous hashed meat, eaten one day after the Pig was slaughtered, caused the death of 33 per cent. of those who consumed it; but in six days it caused no harm.

At Paris, Lyons, Rouen, Thionville, Strasburg, Munich, Antwerp, Utrecht, Rotterdam, Bâle, and in Italy, a number of experiments have not succeeded in developing trichinosis in animals which have been fed for various periods on salted trichinous flesh from America.

But the conclusions to be derived from these facts cannot be accepted unreservedly. Girard and Pabst have noticed movements in Trichinae obtained from American salted pork, when they subjected them to a temperature of 40° to 45°; and Schmidt has made similar observations with regard to meat which had been in pickle for a long time. Bouley, André, Johne, Meissner, Duncker, Neumann, and particularly Chatin, have several times succeeded in infesting Guinea-pigs, Rats and Rabbits by feeding them with trichinosed American pork. In an experiment made by Fourment,\(^2\) the flesh was still infestive after fifteen months.

It is therefore proved that salting does not inevitably kill the Trichinae; though, from what is known of the effects of pickled trichinous flesh, it must be admitted that the persistence of vitality in these parasites is exceptional; while the epidemics caused by it have been more benignant than those due to fresh meat, and the number of times in which it has been eaten raw, without any inconvenience cannot be estimated.

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\(^1\) Colin. Bull. de l'Acad. de Médecine (\(2\)), XIII., 1884, p. 229.

With regard to *smoking*, the experiments made by Küchenmeister, in concert with Haubner and Leisering, show that the hot smoking of sausages, continued for twenty-four hours, kills the Trichina; though they resist cold smoking for three days, not longer. Leuckart is disposed to attribute to the action of the smoke more destructive power than salting. The effects of smoking are due to the pyrogenous principles with which the flesh is impregnated, and also to the temperature—60° to 65°—at which hot smoking is conducted. As it is most frequently carried on concurrently with salting, the Trichinae have little chance of escaping destruction in meat so treated. But Benecke found them yet alive in a ham and a sausage which had been in brine for twelve days, then smoked, and which he examined four and nine months afterwards.

These parasites resist agents which are very toxic for other Helminths—the action of a decoction of male shield-fern, santonin, pomegranate-root, and oil of turpentine for more than thirty hours; chloroform five hours; and benzine and Dippel animal oil three hours (Mosler).

**Danger of Trichinous Flesh—Prophylaxis.**—The ingestion of pork containing live Trichinae causes trichinosis in Man, as it does in all animals capable of contracting it.

The intestinal phase is betrayed by great prostration, fever, thirst and anorexia; then ensue heavy perspirations, a sensation of *malaise* and fulness at the epigastrium, sometimes pharyngeal spasm and vomiting, nearly always profuse diarrhoea, and there may be peritonitis.

The symptoms in the muscular phase are puffiness of the face and *œdema* of the limbs, accompanied by pruritus and formication, or more or less marked *anæsthesia*. Soon the muscular regions become painful to the touch, are tumefied, and appear indurated. Contractions supervene, especially in the flexors, whence result abnormal attitudes of the limbs, and even progressive immobility of the trunk. The local invasions give rise to trismus, disturbance of the eyes—and especially of the eyelids—deafness, aphonia, dyspnoea, and—somewhat frequently—broncho-pneumonia, which carries off the patient.

Trichinosis usually appears in the form of more or less extensive epidemics, and ninety of these occurred between 1858 and 1882. They have been observed principally in Germany, less in Denmark, and still less in America and England. The only cases remarked in France were those in the small epidemic at Crespé-en-Valois, Oise, in 1878, reported by Jolivet and Laboulbène, and which was due to the ingestion of the flesh of a French Pig that was afterwards discovered to have been trichinous, and which was probably infested by eating the body of some Rat it had found in its sty. Of twenty people who

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partook of this flesh only four escaped, and these alone had consumed it well cooked. The other sixteen were more or less ill, and one died.

After what has been said, trichinosis can only appear after eating raw or insufficiently cooked pork. The frequency of the disease in Germany—and especially in North Germany—is owing to the habit the people have of eating raw pork in various forms; and in the United States it is the German colonies which have been oftener attacked, as they retain the customs of their forefathers. On the contrary, if the disease is altogether exceptional in France, this must be mainly attributed to the fact that pork is usually well cooked, which renders it white in the middle. A person must take a notable quantity of Trichinae to be seriously inconvenienced. Belfield, of Chicago, swallowed a dozen without being in any way indisposed, notwithstanding the large number of embryos that each of them must have produced in his intestines.

The preparations of the pork-butcher, in which the flesh is raw or only slightly cooked, do not form a sufficient portion of the public aliment to produce a dangerous infestation. It is possible that certain illnesses might be attributed to them; but they are ephemeral, and cease with the definitive encapsulement of the few Trichinae which gave rise to them. As trichinous Rats are not rare in France, trichinosis of the Pig should be much more frequent than the few cases reported would lead us to suppose.

What has chiefly occupied public opinion and authority in France, is the danger that may accompany the consumption of salted pork from the United States of America. We have seen that the Trichinae are very frequent in it, and that salting does not necessarily kill them.

The porcine production of the United States is considerable. In 1879, 11,000,000 were slaughtered there; Chicago alone salted and exported nearly one-half of the number (4,805,000), and in winter from 20,000 to 60,000 Pigs are killed daily—slaughter, salting, smoking, etc., are all carried on by machinery. But these operations are not always conducted with the necessary care; for the lard has sometimes a bad taste, salting is not uniform, and the Trichinae—which are found in the proportion of 8 per cent.—may maintain, though exceptionally, all their vitality.

In presence of the danger which is incurred by the use of this American salted meat, the majority of the European Governments—Germany, Austria, Italy, Portugal, etc.—have interdicted its importation. In France, a decree of February 10, 1881, has done this for the whole of the republic. Before that time there was imported, annually, more than 37,000,000 kilogrammes of pork. In 1882, the Government placed before the Chambers a Bill to regulate, while authorizing this importation. But although adopted by the Chamber
of Deputies, it was rejected by the Senate. Other attempts were made, but the prohibition is still in force.

This question of American pork has given rise to frequent and anxious discussions in the public press and among learned societies; it touches numerous interests—those of commerce, which demands free importation; those of agriculture, which rejoices at prohibition; and those of the consumers, some of whom ask for free imports in order that prices may be lowered, while others cry out for measures that will protect the public health. The latter demand is evidently the most important, and before it all the others should give way. The point is, then, to know if it is necessary—in maintaining prohibition—to suppress that part which the American pork represents in the alimentation of the poorer classes, who are the chief consumers, or if certain measures will not conciliate all interests.

A microscopical examination made on the living animal, on whole carcases, and on pieces, might be made at the ports of embarkation, or the places where they arrive.

With regard to the first, the present inspection does not afford a sufficient guarantee of safety; and, besides, it is scarcely possible to prevent fraud or deception with respect to marking. There then remains inspection at the French ports.

Judging by lot consists in opening here and there, by random, a small number of boxes or barrels, from which some pieces are taken, rejecting the whole if one of these is found infested, or accepting all if the result is negative. But this method of judging is as unfair to trade as it is illusory for public hygiene.

Judging the lot means examining every package and every piece therein, and condemning the whole if one piece is infested. This is the most logical procedure, and the only one to be recommended.

Judging by pieces is examining every piece, and only rejecting those which are trichinous. This, besides the enormous labour it demands, only gives, like the first mode, a deceptive security, as the search may be unsuccessful, although the piece is infested. These chances of error are nearly obviated by the second method.

In fine, it is not possible to establish at the importation ports an inspection service which will not require a large staff, the expenses for maintaining which must be defrayed by the importers. But, however skilled and practised the inspectors may be, their examinations will be frequently and necessarily incomplete. When infestation is moderate, it may happen—and it has happened many times—that no Trichinae are found until after a certain number—sometimes eight, ten, or twenty—negative preparations have been made. In Germany, where trichinosis has necessitated the creation of a considerable corps of inspectors, the disease has on several occasions prevailed epidemically, from the use of pork which had been examined by experts. The
epidemic at Emersleben in 1883, is a recent instance among others. The creation of inspectors does not, therefore, give more than incomplete insecurity.

Absolute prohibition is not justifiable, if the innocuousness of salted pork is demonstrated. But we have seen that the Trichinæ are sometimes alive in it; though it is doubtful if the epidemics of trichinosis in Europe were caused by American salted pork, as many cases have been attributed to it without sufficient inquiry. The epidemic that prevailed on board the Cornwall training-ship in 1879, and which seemed—from etiological considerations, and by the symptoms and lesions—to be trichinosis induced by ingestion of American pork, was found to be something different; the worms discovered in the muscles of the boy who died were not Trichina, but belonged to another quite distinct species—the Pelodera setigera according to Bastian, the Rhabditis Cornwallis of Cobbold, and the Rhabditis terricola of Oerley.¹

What reduces the danger to narrow limits is the habit of thorough cooking, and we have shown that it is easy to obtain the degree that will render trichinous meat inoffensive. But with regard to American sausages, as these are rarely cooked by the consumers, the danger remains, for they are made en bloc with the flesh of several dozens of Pigs; and if among these 2 to 8 per cent. are trichinous—as is the case at Chicago—the Trichinæ must necessarily be in the sausages. All American sausages should therefore be regarded as infested, though the parasites may be difficult to discover. In 1879, in more than 3,600 sausages examined at Hamburg, Trichinæ were found only in nine.

Taking into account all that has been stated, it will be seen that in France, at least, the fears entertained with regard to the use of American pork have been very exaggerated. If it is not innocuous, the danger incurred is exceptional, as the Trichinæ in it are most frequently dead, have but little vitality, or only a few are alive. The danger is further diminished by the culinary habits of the people; and if it is present in sausages, etc., which are little cooked, this does not justify absolute prohibition for all. Create at the port of arrival an inspection service, the cost of which will fall upon the traders themselves; require that all the pork imported shall correspond to what is designated ‘fully cured,’ that is, completely salted, gray externally, firm to the touch, healthy, well preserved, gives to the probe a pleasant nutty smell; and publish instructions for the people with respect to the utility of thorough cooking—such are the measures that would greatly reduce the danger in the use of this flesh, which it would not be wise to make a pretext for absolute prohibition.

It may be mentioned that, as the result of an exhaustive discussion in 1884, the Académie de Médecine and the Société de Médecine

Publique, decided that the introduction into France of American salted pork, of the type 'fully cured,' offered no danger. This opinion is confirmed by the fact that prohibition in France is largely illusory. England and Belgium not being associated in the measures adopted by the other European Governments, the American pork enters France through these two countries, to the detriment of the French ports.

It is necessary, however, to keep a strict watch over the German Pigs which, alive or in quarters, enter France directly, or through Belgium as Belgian Pigs. It is well known how frequently they are trichinosed. Our excellent cooking habits, which give us security, are not so absolute that we can afford to run serious risks from this source.

The trichinous flesh that has been condemned ought to be rendered unfit for consumption, by making incisions in it, and pouring into them empyreumatic substances—such as a mixture of crude carbolic acid, petroleum and empyreumatic oil, or only one of these liquids. If the flesh is simply buried, it may be disinterred and consumed. This has happened.
CHAPTER IV.

PARASITES OF THE BONES (ECHINOCOCCI). 1

Owing to their compactness, bones oppose an almost insurmountable obstacle to the introduction of parasites. These may, nevertheless, penetrate them accidentally, being carried to them by the bloodstream. This explains the presence of Echinococci in the cavity of long bones, and these are the only zoo-parasites which have been met with in them.

Only nine instances of hydatid cysts in the bones of domesticated animals have been recorded up to the present time; two of these concern the Horse, and seven the Ox.

HORSE.—In a case observed by Colin, 'the hydatids formed an enormous tumour situated in the sub-lumbar region; they had invaded the muscles of that region. This tumour was reproduced after two partial ablations; it extended towards the ilium, and Echinococci were found in the diploë of that bone.'

Vachetta found a bony tumour filled with numerous Echinococci vesicles, on the left branch of the inferior maxilla.

OX.—The seven cases of hydatid cysts of the bones in bovine animals are arranged according to their seat as follows: one in the humerus (J. Hunter), one in the ilium (J. Hunter), three in the femur (Gurlt, Wulf, and Morot), one in the tibia (Perrin), and one in a dorsal vertebra (Railliet and Morot).

We have no information with regard to four of these cases, which are limited to necroscopic details, the observations having been made in abattoirs.

In Gurlt's case, the medullary canal of the left femur of a fat Ox contained a great number of hydatids; there were also very many in the liver.

In Perrin's instance of hydatids in the tibia, nothing was observed externally, but the whole of the medullary canal was invaded by the

PARASITES OF THE BONES (ECHINOCOCCI).

725

hydatic tumour, the spongy part of the bone having almost entirely disappeared. The Echinococci belonged to the exogenous variety (see p. 508); the daughter-vesicles had acquired great development, and the scolex was readily recognisable.

In Morot's case, the femur also did not present anything particular externally. The medulla had only partially disappeared, and the hydatids occupied the lower part of the canal for about 5 or 6 cm. of its length. From the little that is said of it, it appears to have belonged to the endogenous type; the size of the daughter-vesicles varied between that of a millet-seed and a hemp-seed. No scolex was found.

In Railliet and Morot's observation, the body of the seventh dorsal vertebra was hollowed out into an irregular cavity communicating with the adjacent adipose mass by means of an opening formed from within to without. This cavity contained the remains of the Echinococcus.
BOOK VII.
PARASITES OF THE NERVE-CENTRES AND SENSORY ORGANS.

CHAPTER I.
PARASITES OF THE NERVE-CENTRES.

Notwithstanding their being protected in a bony cavity, the brain and spinal cord are not exempt from the invasion of parasites. We are the less astonished at this, when it is remembered that the medullary cavity of the long bones may lodge Echinococci. Parasites penetrate to the cerebro-spinal cavity by means of the blood-stream; only the larvae of the Gastrophiles, it may be said, actively introduce themselves into the cranium by one of its openings. All the parasites generally produce fatal lesions. They belong to a small number of species, and, with the exception of the Canurus cerebralis, they are more or less exceptional. They are the larvae of the Cestridæ, the armed Sclerostome, Cysticerci, Echinococci, and the Canurus cerebralis.

ARTICLE 1.—Wandering Helminths.

Cysticerci.—Numerous observations establish the fact that in the brain of the Pig and Dog the Cysticercus cellulose—the parasitic element in measles—may be found. This will be seen by reference to what has been said on this subject (see pp. 675, 687).

Coenures.—In addition to the Canurus cerebralis—the normal habitat of which is in the brain of Ruminants, and the study of which will be found in the Article on 'Gid'—we have to record two observations relative to the Canurus serialis—a parasite of the connective tissue of the Rabbit, which has been found on two occasions in the spinal canal of that animal.¹

The first observation is relative to a wild Rabbit; it was made by Rousseau, and reported by Leblond. The second is due to Railliet, and refers to a domesticated Rabbit, affected to a severe degree with conjunctival coenurosis. It died paraplegic, and in its spinal canal—at the commencement of the lumbar region—was found a very elongated, almost tubular Canurus serialis, which was lodged in the arachnoid,

and made two turns round the spinal cord, which it had somewhat depressed.

**Echinococi.**—The annals of human medicine record a large number of cases of Echinococi in the nerve-centres; but it is not so with those of the domesticated animals. We do not know whether it was not rather to a Coenurus than an Echinococcus, that the case observed by Woodger and reported by Varnell was due. This was a horse affected with a kind of vertigo, which inclined its head strongly to the right, then turned in a circle in the same direction. At the autopsy, there was found in one lateral ventricle (which one?) of the brain a vesicle the size of an orange, which had caused atrophy of the cerebral substance, and which was considered an Acephalocyst. A similar lesion was described by Battledore in 1830.

Gerlach mentions that Oeltjen found an Acephalocyst hydatid in the brain of a Horse that had been affected with vertigo.

We may here cite another observation made by Kirkman, relative to a Horse which had a sub-orbital swelling on the right side, with damaged vision. At the autopsy there was discovered, beneath the right eye and in the temporal fossa, an abscess, the pus of which contained, in suspension, numerous endogenous Echinococi, of the size of a pea to that of a cherry. The temporal and ocular muscles were flaccid, pale, and enveloped in fibrous tissue. A tumour occupied the base of the cranium, and the corresponding hemisphere was atrophied, as well as the first six pairs of cerebral nerves.

**Nematodes.**—The young form of the armed Sclerostome—the aneurismal Sclerostome—is found in various arteries in the Horse, and those of the brain are not exempt. Three observations have been published.  

Albrecht reports the case of a Horse which, during work, suddenly began to stagger; the eyes were fixed, and the respiration was noisy; there were remissions and relapses. Three hours after the first symptoms appeared, the head was carried low and inclined to the left, and there were convulsive movements of the neck and limbs. Soon it fell on the left side, became unconscious, and manifested complete insensibility. In this state it was killed, and at the autopsy there were found diffuse meningitis, haemorrhagic encephalitis, and in the middle lobe of the cerebellum a Sclerostome, which had probably arrived there when an embryo. Van Heill saw a three years old Horse which was suddenly attacked with furious vertigo, that lasted about a quarter of an hour. An autopsy revealed congestion of the brain and choroid plexus, while a free Sclerostome was lodged in the cortical substance of the right hemisphere. Le Bihan found another worm of this kind in the occipital artery; rupture of the aneurism caused the death of the Horse in less than ten minutes.

Abildgaard discovered the *Filaria equina* between the dura-mater and cranial arachnoid of a Horse (Rudolphi).

**Article II.—Hydatido-Cephalus or ‘Gid.’**

This is a disease due to the presence of the *Coenurus cerebralis* in the

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nerve-centres, and particularly in the brain, and the most constant and remarkable symptom of which is the circular movements the affected animal executes.

It is observed in the Sheep, less frequently in the Goat and Ox, and altogether exceptionally in the Horse.

(The malady appears to be less frequent in England than formerly, though in certain seasons it may cause considerable damage, sometimes as many as 35 per cent. of a flock being lost. It has been stated by Youatt, that in France a million of Sheep die from it annually; and Gasparin puts the losses in Germany at 15 per 1,000 in the first year of life—from eight to twelve months being the most critical time—5 in the second year, 2 in the third year, and 1 in the fourth.)

Synonyms.—French: Avertin, Tournoisement, Étourdissement, Vertigo, Lourd, Lourderie, Hydrocéphale; German: Drehen, Drehkrankheit; Italian: Vertigine idatiginosa, Vertigine per cenuro (English: Gid, Turnick, Turnside, Sturdy, Goggles, Turn, Blobwhirl, Giddiness, Punt, Hydatid on the brain, Hydatidio-cephalus).

Etiology.—The sole cause of ‘Gid’ is the Cenuurus cerebralis Rud., the cystic form of the Tænia cenuurus Kiich (see p. 442).

It is a vesicle of variable size, sometimes attaining the volume of a hen’s egg. Its limiting membrane is very thin, translucent and contractile, and more or less distended by a very limpid, colourless fluid. On its surface are white, unequally grouped spots, which are agglomerated and pressed together at certain points and absent on others. These spots correspond to as many invaginations of the membrane and scoleces of the Tænia that project into the interior of the vesicle. The proportion of the scoleces is very variable, and may, in advanced specimens, be as many as 400 and 500. They are not always at the same period of development, some being still rudimentary, and others having all the characters of a scolex of the Tænia cenuurus. The latter may be 4 mm. to 5 mm. long when evaginated, and presents the head of the Tænia followed by a constriction—the neck—then by a body three or four times as long as the head, and studded with calcareous granules.

These scoleces may voluntarily become evaginated, as Davaine has observed; and with this author it might be admitted that the symptoms of the disease are not exclusively due to compression, but often to direct irritation of the cerebral substance by these heads armed with hooks.3

1 The Veterinarian, 1873.)
2 Steel. The Sheep, p. 294.)
The Coenurus is almost exclusively a parasite of Ruminants, but it is
much more frequent in the Sheep than the Goat and Ox; it has also
been met with in the European Mouflon, the Chamois, Roebuck and
Antelope, Reindeer, Dromedary, and even in the Horse (and Man).
Eichler has found it in the connective tissue of a Sheep, Nathusius be-
neath the skin of a Calf, and Engelmayr has seen in the liver of a Cat
a Coenurus of an undetermined species. Rabe says he found vesicles
of the Coenurus cerebralis at the same time in the nerve-centres, thoracic
and abdominal lymphatic glands, the thyroid body, and the muscles of
a Gazelle.\(^1\)

The nature of ‘gid’ was for a long time unknown. It was supposed
to be a serous apoplexy, a dropsy of the ventricles, a serous engage-
ment of the brain, etc. The Coenurus was considered to be a cyst, as
the result of a metamorphosis of the ova of insects deposited beneath
the cranium, etc. The cause was sought for in the régime, cold, heat,
damp, precocious obesity, contusions, etc., although it appeared under
the most diverse conditions. Leske was the first, in 1780, to recognise
the watery bladder as a cystic worm always found in animals affected
with gid, and Goeze soon after made the same observation. But it was
not until the middle of this century that exact notions began to prevail
as to the etiological conditions of this malady.

The first experiments in this direction are due to Küchenmeister, in
1853; and they have been many times repeated since, particularly by
Haubner, May, Gurlt, Gerlach, Leuckart, Van Beneden, Eschricht,
C. Baillet, Röll, Fürstenberg, etc. They have established, in the
firmest manner, the etiology of gid, and shown the ontogenic relations
of the Coenurus cerebralis with the Tænia coenurus.

When a Lamb receives the mature segments or ova of the Tænia
cœnurus, the shells of the ova are soon dissolved in the gastric juice, and
the embryos are set free. By means of their six hooks, they pass
through the walls of the stomach or intestine, wander among the tissues,
very probably penetrate some vessel, and are carried by the blood-current
to various parts of the organism. Those which arrive in the nerve-
centres are almost the only ones that pursue their development. They
then lose their hooks, and are transformed into vesicles that gradually
acquire the character of the coenurus.

If several lodge themselves at one time in the cranial cavity, the first
symptoms of gid are usually observed in from the eighth to the
twentieth day; but if there are only one or two, then, as a rule, the
signs of the malady are later in appearing. C. Baillet states that he
did not notice them in two Lambs until 68 and 114 days after these had
ingested the proglottides, and although at the autopsies he found in one
33, and in the other 5, coenures more or less developed.

After the eighth day the brain is extremely congested, and from the
fourteenth day to the thirty-eighth day there are seen on the surface of the

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\(^1\) Rabe. Berl. Thierärztl. Wochenschrift, 1889.
cerebrum sinuous, superficial furrows of a pale-yellow tint, at the termination or in the neighbourhood of which the vesicles are met with. At the end of two or three weeks, the diameter of these varies between 6 mm., 8 mm., 1, 2 or 3 mm.; on the twenty-fourth day they are the size of a pea, but they do not yet give any indication of the formation of scoleces. These appear as opaque depressions on vesicles thirty-eight days old, and which are about the size of a cherry. Those which are fifty or fifty-five days old, and are a little larger, have on their internal surface numerous characteristic scoleces, with hooks and suckers; but they are still incompletely developed, and it is not until the end of two months to two and a half months that perfect scoleces are seen. The vesicles do not the less continue to grow and to throw out new heads, which are found in all degrees of maturity (C. Baillet).

It is not rare to meet with, in an early stage of the experiment, sinuous tracks like those on the surface of the brain, beneath the pulmonary pleurae, visceral layer of the pericardium or endocardium, intestinal serous membrane, between the layers of the omentum, and on the diaphragm and walls of the oesophagus. C. Baillet—to whom we owe these details—has even on one occasion found four vesicles twenty days old—two at the apex of the heart and two on the surface of the lungs; these came from wandering proscoleces which, later, had become atrophied and formed small fibro-calcareous tumours—such as are sometimes met with in animals that die a long time after the commencement of the experiment.

These diverse researches place beyond doubt the etiology of gid; it has its origin in the Taenia coenurus of the Dog, the mature segments of which—gorged with ova—are expelled with the excrements, and fall upon the herbage of pastures where this animal wanders along with the ruminants it guards. It has been nowhere demonstrated—as has been advanced—that the Wolf, Fox and Polecat may harbour this Taenia, and so concur in this infestation.

The proglottides of the Taenia coenurus, dispersed on the ground, decompose there, allow their ova to escape, and the rains disseminate these over the grass or wash them into ditches or ponds from which animals drink. Humidity is essentially favourable to the maintenance of vitality in these ova; so it is that gid is more common in flocks that frequent damp pastures, and also when the spring and summer have been rainy. These two seasons are likewise the two seasons in which the malady generally appears, and which coincide with turning out to graze, and the duration of the kind of incubation that precedes the manifestation of the symptoms.

In the experiments of Röll and Hambner, the proglottides of the Taenia coenurus, after fourteen days' desiccation in the air had lost their infestive power. On the other hand, Gerlaeh was able to communicate the disease to Lambs by means of proglottides kept for three months on damp grass.
Garcin has remarked that the Merinos and half-bred Merinos of Picardy are more readily infested than the native Sheep; because, in eating off the grass close to the ground, they are more certain to take the ova and proglottides than the latter, which do not graze so near the neck of the grass-roots.

The influence of the preceding etiological conditions is subordinate to the age of the animals, for they are nearly all Lambs and Hoggets which pay a large tribute to gid—this disease being exceptional in Sheep more than two years old. Cattle are longer exposed to it, though after their seventh year they certainly escape. It is difficult to explain, by a varied consistency of the tissues, this susceptibility of certain ages and the relative immunity of others.

As in a large number of other parasitic maladies, so in this—attempts have been made to prove that heredity plays a part in the development of gid. Fromage de Feugré, Girou de Buzareingues, Reynal, and others were champions of this notion; but the evidence they invoke can be easily explained by the light of the preceding etiology—though there are a certain number of facts the significance of which is obscure, and is, indeed, only suspected. With regard to the cases of the Côœurus in new-born Lambs—as those cited by Riem and Hering, they might be accounted for by intra-uterine infestation by means of the proscolex, which, leaving the intestine of the mother, finds its way into the circulatory system of the foetus.

The Ténia cóoeurus—the cause of gid—is itself derived from the Côœurus cerebralls, as the above-named experimenters have demonstrated. This is because the heads of Sheep which have died of gid are thrown to the Sheep-dogs, which in this way acquire the Ténia—each scolex separates from the mother-vesicle in their intestines, becomes fixed on the mucous membrane, and develops into a Ténia cóoeurus, the ova of which, dispersed over the ground, become in their turn Côœurs if they find the conditions favourable to their development in a Ruminant.

Symptoms.—Gid varies in its external signs, according as the Côœurus is lodged in the cranial cavity or in the spinal canal.

Cephalic Gid.—The malady often begins with signs of congestion or inflammation of the brain or its membranes; though Müller asserts that these early symptoms of brain invasion are absent in four-fifths of the Sheep which have received the germ of gid. In general, there is at first indiffERENCE and weakness, an abnormal attitude of the head—which is held low and to one side, or carried high, with hyperthermia of the cranium and vascular injection of the sclerotica. Sometimes when

there is simultaneous immigration of a great number of Coenures, these symptoms become exaggerated, and notably the higher temperature of the cranium, pressure on which causes pain; the pulse is more frequent, and acting under irresistible impulse, the animal performs automatic movements forward to the right or left, in a circle or rotatory on one spot—pivoting round a vertical axis passing between the collected four limbs. In other cases, the animal acts as if intoxicated, and often stumbles and falls. At the same time the eyes are deviated inwards or outwards, the neck is contorted, there is grinding of the teeth, the mouth is foamy, and clonic contractions agitate the limbs.

This kind of vertigo—the precursor of gid—is rarely continuous, but most frequently intermittent; in about eight or ten days the animals appear to have recovered their health, and it is altogether exceptional for Lambs to succumb in this first stage. There may even be a definitive return to health, in consequence of a regression of the young Coenures which have invaded the brain; but this fortunate termination occurs in scarcely more than 2 per cent. of those attacked.

Generally, the Cystics continue to grow, and during a period of from four to six months the attentive observer recognises from time to time—and especially in stormy weather—certain signs indicating an abnormal condition and permanent compression, though slight, of the brain. At the end of this period—towards the termination of winter, or in the spring—appear the real symptoms of gid.

There are various disturbances in sensibility, an intermittent automatism, and a special attitude of the head—which is sometimes depressed, sometimes more or less elevated; the animal pushes against walls, its eyes are haggard and fixed, and the pupils are dilated. By an ophthalmoscopic examination, Bouchut noticed a neuro-retinitis, consisting of very marked oedema of the optic nerve and retina, and an exudate that almost entirely masked the papilla of the nerve or one of its sides.¹ The Sheep is feeble and indifferent, gradually loses its appetite, lags behind the flock or does not follow at all. The nature and direction of the automatic movements it exhibits are determined by the situation of the Coenurus.

When the parasite occupies the surface of one of the cerebral hemispheres, the animal describes circles which become smaller and smaller, until at last, pivoting on itself, and with the straw, hay or grass twisted around its feet in consequence, it falls down. In other instances, the circles become extended. As a rule, the Sheep turns towards the same side as that on which the brain is compressed. If the parasite occupies a ventricle, or if it presses upon one of the optic thalami, the Sheep turns towards the opposite side; but if there are two or more Coenures infesting both hemispheres, it moves sometimes to the right, sometimes to the left.

Some Sheep go straight forward, lifting their feet high and holding their head low and close to the chest—these are named trotteurs in France, traberen in Germany. The hydatid is then localized in the anterior part of the brain—either in the olfactory lobes or the corpora striata. If it is seated in the cerebellum, and particularly in the lateral lobes or in the posterior part of the mastoid lobes, the animals are depressed, can scarcely stand, are uncertain in their movements, fall frequently, and usually on the same side, but get up again immediately. If the Coenurus makes pressure on one of the crura cerebri, the Sheep often falls, and then has convulsions, accompanied by grinding of the teeth and the ejection of foamy saliva from the mouth.

It sometimes happens—though very rarely—that the Sheep executes rapid rolling movements; then the Coenurus is lodged at the base of the cerebellum, or, because of its large size, if compresses at the same time the corpus striatum and the posterior lobe of the brain. If the pressure is exercised on the corpora quadrigemina, the eyes pirouette in the orbits, and the animal moves about as if blind.

There may be association of several of these movements, when there are several parasites, or when only one has become considerably extended. The disturbances are manifested by more or less repeated attacks in the course of the day; and the disease may last from four to six weeks. The animals gradually become weaker, and succumb either to cerebral paralysis or to debility and exhaustion.

Medullary Gid.—The Coenurus may be localized in the spinal cord, chiefly in the lumbar region, and its symptomatic manifestation is then designated lumbar gid (tournis lombaire)1 or hydatic paraplegia (Röll).

The first signs noticed are paresis of one of the hind-limbs, or a particular weakness of the loins—the hind-quarters sway during walking, and nearly descend to the ground when the animal ascends a slope; it staggers and rocks from right to left, sometimes convulsively jerks up its hind-legs like a Horse with stringhalt, or pushes them under its body as far as the fore-legs, and often ends by tumbling over. It has much difficulty in following the flock, and slight pressure on the loins will cause it to fall. Gradually the lumbar weakness increases, and at last the Sheep sits down, and in order to move it drags its body along by means of its forefeet. Complete paraplegia at last supervenes. During this evolution of the malady, paralysis of the rectum and bladder commences, and all the apparent signs of cachexia—paleness of the mucous membranes, infiltrations, shedding of the wool, and

progressive emaciation, notwithstanding retention of the appetite and the abnormal consumption of forage. The malady may be prolonged for several months, if slaughter does not intervene to prevent a natural death by extreme exhaustion.

_Gid in the Ox._1—Though much less common in Cattle than in Sheep, gid appears in them more particularly during the course of the first or second year, and may—though less exceptionally than in the ovine species—be observed at adult age, from four to six years. It is marked at first by diminished appetite, sluggishness, by the head being carried a little elevated and to the right or left, and executing often-repeated lateral spasmodic movements. In certain Cattle, the head is kept constantly depressed without any convulsive jerks, and if the animal is at liberty it performs rotatory movements, like Sheep affected with the same malady. Or it pushes irresistibly forward, pressing the head so firmly against the walls of the cow-house that it is difficult to drive it back. The forehead and base of the horns are hot, the pupils are dilated, there is photophobia, and the respirations are quickened. The creature is very impressionable, starts at a sudden noise, tries to run away, and sometimes falls to the ground. The appetite disappears altogether, or the animal only munches what is put into its mouth, or holds it between its lips—unconscious that anything is there. Percussion on the points of the cranium corresponding to the situation of the Coenurus causes pain, and elicits a duller sound than on the healthy side. Death is the termination of the disease, and results from the same causes as in the Sheep, though generally in a shorter period—sometimes in a few days (Hering), but ordinarily two or three weeks, and exceptionally two or three months (Maillet), or even eight months (Gières).

_Gid in the Horse._2—We possess three observations with regard to gid in the Horse. Frenzel saw a Horse, two years old, which, for nearly a year, was affected with a kind of intermittent gid, with feebleness, languor, anemia, and dilatation of the pupils. At the autopsy, there was found between the cerebellum and cerebrum a Coenurus weighing about 10 grammes. The second observation was made by the veterinary surgeons of the Haras at Trakehnen, on a thoroughbred Horse, ten years old. The disease commenced with double amaurosis, with a grayish reflection—bordering on red—at the fundus of the eye. Three months afterwards, the animal began to be unsteady in its gait during exercise, and sought to support itself against something by always

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backing, and carrying the head spasmodically to the left. These attacks were repeated about every eight days, and the Horse could not turn to the right. One day, a month later, it fell suddenly on its right side, inert and insensible, and died in the evening. At the autopsy there was discovered, a little below the anterior extremity of the right cerebral hemisphere, a Cœnurus (?) containing about 35 grammes of serum. The adjoining cerebral substance was completely softened, the dura mater and sphenoid bone were also absorbed in this situation—the bone showing an opening with a sharp border, closed only by a thin pellicle. The other observation—too briefly reported—concerns a carriage Horse that died suddenly of acute vertigo, and on examining it after death Schwanefeldt found a Cœnurus containing about 65 grammes of serum; it was situated on the surface of the brain, and was compressed by the cranial bones.

*Gid in the Goose.*—This case was observed by Hering, the Goose presenting symptoms analogous to those noticed in Sheep affected with gid—head inclined to the left, and one eye looking outwards, the other downwards; later, the head was so much thrown backwards that the throat was directed upwards and the forehead inclined towards the ground; finally, the head was brought entirely beneath the left wing, the creature lost its equilibrium, and lay on its back with its feet in the air. At the commencement, it moved in a circle to the left; later, there was complete immobility, but without loss of consciousness. On making an autopsy, a hard, yellow tumour, the size of a peppercorn, was found on the surface of the left cerebral lobe; it was non-adherent, had no definite structure, and was considered a dead and atrophied hydatid. The meninges and substance of the brain were greatly injected; but the cranial bones, as well as the spinal cord, were healthy.

**Diagnosis.**—Gid in the Sheep offers symptomatic resemblances to the other affections of the brain or neighbouring parts.

**Vertigo,** meningo-cephalitis due to the influence of solar heat or a prolonged sojourn in the fold in summer, is distinguished from gid by the redness of the nasal, buccal and conjunctival mucous membrane, by the heat of the body, and rapid pulling and breathing; the animal rarely circles round, pushes its head against the walls and rack, bleats almost continually, and soon dies.

**Epilepsy** is recognised by the perfect state of health, except for the fits, and the absence of turning.

**Blindness,** which is sometimes witnessed in Lambs, renders them uncertain in their progression, and causes them to run against surrounding objects. An examination of the eyes should dispel all doubts.

The presence of the larvæ of the *Oestrus ovis* in the frontal sinuses (see p. 570) has sometimes given rise to mistakes, especially in confounding the symptoms with those of gid. This *false gid* is, however, rarely accompanied with circular movements, while the symptoms special to it, and particularly the nasal discharge, sneezing, and ejection of the larvæ, are very distinctive.

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An inflammation of the sinuses, with purulent collection and alteration in the bony walls, may react on the cranium, and give rise to symptoms analogous to those of gid. But the nasal discharge here, again, sometimes the age of the animal, and the rapid manifestation of giddiness, may serve as a differential diagnostic. 

Medullary gid is distinguished from the trembling disease (the Scotch lamming-ill), or lumbar prurigo, by the absence of itching, rubbing, and bites on the skin.

Pathological Anatomy.—At the autopsy of animals which have died of gid, one or more Coenures are found in the cranium, as much more developed as the disease has been prolonged. When speaking of its etiology, and of the experiments which have established this, the developmental phases of the parasitic vesicle were described. In practice, the number of Coenures is generally limited, though Huzard has counted more than thirty in the head of a Lamb. Their size and development are generally in inverse proportion to their number. Huzard has seen some which occupied nearly one-half of the cranial cavity.

These vesicles are found at various parts of the brain. When they are small and deeply situated, they are surrounded by a pseudo-purulent exudate, which is yellow and creamy in places. If the Coenurus is voluminous, the brain substance in its vicinity is depressed, atrophied, wasted, and forms a more or less regular pouch, the wall of which is formed of flexuous, interrupted, or broken nerve-tubes, that are less numerous than in the normal substance; by nerve-cells which are no longer in communication with the nerve-tubes; by a large quantity of amorphous substance and molecular granules; and, lastly, by calcareous, crystalline particles. Capillary vessels traverse this layer, and are continuous with those of the cerebral substance (Robin, quoted by Reynal). This pouch contains a grumous purulent matter, and the peripheral cerebral substance is inflamed, dense, and granular.

When the Coenurus is in a ventricle, the roof of this is thinned, and sometimes reduced to its envelopes; the septum lucidum, posterior pillar of the fornix and the corpus callosum are also thinned, and even perforated, and pushed towards the hemisphere, or into the opposite ventricle, into which the vesicle sometimes protrudes.

The old and voluminous Coenures, situated on the superficial parts of the brain, have—by compression—caused absorption and attenuation of the roof of the cranium, which yields to pressure of the fingers.

In medullary gid, the Coenurus is elongated, fusiform, and from 3 cm. to 5 cm., and even a foot, long (Numan). Usually there is only one, and it is lodged in the lumbar region; it may, however, occupy the cervical region (May), or the posterior part of the medulla oblongata.

(Störing). In some cases, it has undergone calcareous degeneration, and is only recognisable by its hooks, which have persisted (Röll). It sometimes only occupies one-half of the spinal cord, sometimes the two divisions, or it is intermediate, and completely separates them (Yvart). It may be situated deeply, or only be beneath the arachnoid. The medullary substance is atrophied and hyperemic where it is located, or it is softened. The muscles of the hind-quarters are wasted, and otherwise show the alterations of cachexia.

In a large number of animals, there are found in various organs—and especially the heart, lungs, liver, spleen, mesentery, and muscles—some round or ovoid greenish corpuscles, from 1 mm. to 4 mm. in diameter; they are composed of an enveloping membrane and granular contents, rich in fat globules. These are atrophied and degenerated Cœnures—the remains of erratic embryos which have not met with the conditions favourable for their development. Nathusius and Eichler have seen somewhat large Cœnures in the subcutaneous connective tissue of the Calf and Sheep.

The malady having generally a chronic course, there are observed more or less everywhere the lesions of pronounced cachexia.

**Prophylaxis.**—It is superfluous to advise keeping Dogs apart from the flocks, as this promiscuousness is a condition of Sheep and Cattle rearing; but they ought to be as few as are necessary. What is possible, is to free the Dogs from their Tæniae by the means already indicated (p. 453). This step should be undertaken at least once a year, at the return of springtime. Hager—quoted by Zürn—recommends, with this view, the black oxide of calcined copper, in 5 centigramme doses three times a day for ten days; it may be given in bread or meat, or in the form of pills. It is well, during this anthelmintic treatment, to keep the Dog tied up, in order that the expelled Tæniae may be collected and destroyed by fire.

The Wolf, Fox, and Pole-cat, which have been accused of also harbouring the *Tænia Cœnurus*, are already actively hunted down; so it is needless to recommend this treatment for them.

The heads of Sheep which had been affected with gid should be burned or boiled, and never left for Dogs to devour. If they must be buried, precautions should be taken against Dogs and Foxes, which are likely to disinter them.

It might be also useful to prohibit the use of certain wet pastures, where the germs of gid are more particularly preserved.

Lastly, it has been recommended to give young animals of the flock, from time to time during the summer, when the disease is enzootic, tonic or anthelmintic preparations. Those which have been recommended in distomatosis will answer perfectly well for this malady.

**Treatment.**—In consequence of the serious nature of the disease and the unsatisfactory results of treatment, nothing is done to cure the
animals, which are generally sent to the butcher. This is the least expensive course to adopt, and it is the only one to follow in lumbar gid. But special reasons—chiefly related to the value of individual animals—may present themselves in favour of attempting curative treatment.

Many remedies have been recommended, but there are none which—administered internally—can reach the parasite, and with the more energetic drugs there is risk of killing the patient; so that it is by acting directly on the seat of the disease—on the cranium—that beneficial results may be hoped for. Of the numerous modes of treatment advised, those of trephining and continued irrigation have yielded the best results.

The object of trephining is extraction of the hydatid.

Before operating, it should be ascertained whether the Cœnurus is single, as, if there are several, the operation will have no chance of success, and it is the same if the Cœnurus is deep-seated in the brain or medulla oblongata. It must be immediately beneath the meninges, and its site must be ascertained—this is the first difficulty, and it is a serious one; but it may be frequently solved by a consideration of the symptoms, especially the turning. We have seen that, generally, the side towards which the Sheep inclines is that on which the parasite is situated; but this is not always the case. The inclination of the summit of the head is, according to Lafosse, an infallible guide. 'When this summit inclines to one side in such a way that the ear or horn attached to that side is lower than the opposite one, that is the side on which the worm will be found. This inclined position is always observed when the worm is lodged in one side of the cranium, or even when it occupies the middle plane, but is rather more prolonged to one side than the other.' Another sign—which is not constant—is tumefaction of the cranium at the part corresponding to the hydatid. The local thinness of the bone—which yields to pressure of the finger—as well as the pain caused by this pressure, or percussion after the skin has been clipped, will sometimes serve as a guide. When there is no reason for preferring one side to another, the operation is performed in the middle—slightly to one side of it, however, to avoid the falx cerebri and its venous sinus. In the Sheep and Goat, the puncture should be made at one or two centimetres in front of the imaginary transverse line drawn between the anterior part of the base of the horns or the sinus that takes its place.

The part being decided upon, the animal is made to fast from the previous evening, and it is bled if plethoric. The anterior surface of the cranium is shaved; the animal is placed on a table, the side to be operated upon being uppermost. A V-shaped incision is made through the skin—the point downwards—large enough to allow the trephine to

1 Lafosse. _Traité de Pathologie Vétérinaire_, III., 1867, p. 71.
move easily. This skin is dissected off, and the periosteum scraped away from the bone.

Perforation of the bone is often made with a drill, a trocar, etc., but it is more speedy and sure if effected by means of a trephine, 7 mm. to 8 mm. in diameter, the point of which is as little salient as possible. The dura mater must be protected by covering the opening with a piece of lint. It often happens that pressure of the hydatid distends this meninge, so that the reflux of blood takes place gradually. If in about ten to fifteen minutes the dura mater does not protrude, a crucial incision is made in it with the bistoury.

When the opening has been made at the right spot, the Coenurus projects itself from it, and it must not be punctured until movement has ceased; the puncture should be so fine as to allow the fluid to escape from the vesicle drop by drop. It is preferable not to empty the vesicle at once, as the resulting depression may produce fatal apoplexy. When two or three centilitres are extracted, the opening in the cranium is closed by a piece of lint, on which is placed a fine pledge of tow; the flap of skin is placed over this, and another pad of lint laid over all and maintained by a band or cap tied round the head, and kept wet with cold water. The hydatid is emptied in four or five times, at intervals of six to ten hours. When this is completed, then the Coenurus is removed by seizing it with forceps, turning it round and round so as to twist it into a kind of cord, and pulling it gradually outwards; or a long goose-quill may be employed—the borders being notched on the side next the barbs—and manipulated in the same way as the forceps. The operation being terminated, a similar dressing is again applied, when, if the case does well, in a few days the coma and somnolence resulting from extraction of the Coenurus will disappear, and the animal regain its health.

With cattle a similar procedure may be followed, only a few variations being observed. The animal is laid on a bed of straw, on the diseased side, and in a place sheltered from the wind. As the frontal sinuses extend on the cranium, the first table of the bone is perforated, when the sinus is opened; then the inner table is perforated. The vesicle being removed, the outer opening is closed by the flap of skin, which is maintained by a pitch plaster, and the whole is covered by a wide-tailed bandage, that is tied around the head and the horns. Then the animal may be allowed to rise, or be permitted to lie if it is too weak. If it can stand, it should be fastened between two posts for fifteen or twenty days, to prevent the head being rubbed—the length of the two cords allowing it to rest, and food and water being placed on the ground before it. The indifference and difficulty in masticating observed before the operation persists, and even increases after it, especially during the reaction fever. Certain animals are so feeble that it is necessary—for several days—to put food easy to eat into their mouths, and sometimes
to feed them on soup or boiled roots. But after eight or ten days their strength returns, and they can then attend to themselves. In eighteen or twenty days after the operation the dressings are removed, and the animal can go out. Not unfrequently, when first exposed to the day-light, it makes certain circling movements, but these only continue for a few minutes if no Cœnures have been left in the cranium (Maillet).

Notwithstanding the numerous more or less perfected procedures proposed for gid, trephining only inspires a moderate degree of confidence. This is due to the difficulty in fixing on the exact situation of the hydatid, and the possibility of there being several others, as well as the frequent complications that follow the operation, and—to sum up—the small proportion of recoveries obtained.

If the hopes entertained with regard to hydrotherapy be realized, then it should soon supplant the various effraction procedures just mentioned. Hartenstein,1 of Charleville, instituted the mode of treatment by refrigeration of the cranium, which had been already indicated by Gières for gid in cattle. It is justified by what is known as to the influence of cold in preventing the development of inferior organisms, or destroying them. By means of it Hartenstein has cured a foal, a heifer, and five Sheep. Nocard has also been successful with two Lambs, and the successes appear to be more frequent than the failures. What confirms the value of this method is the result of autopsies. In one case in which the treatment was suspended before recovery was complete, and the animal was slaughtered eight days afterwards, the lateral ventricles of the brain were found to be very much dilated, and in the left was a Cœnurus the size of a billiard-ball, having ten to twelve scoloes still alive. In other instances, the Cœnures are dead, and shrivelled and reduced to the size of a hemp-seed, or they have disappeared altogether.

The application of the treatment is very simple. A vessel of any kind is filled with cold water, which an indiarubber tube conveys to the head of the Sheep, the animal being fixed in a narrow box from which the head alone projects, so that while the head is saturated the body is kept dry. At the commencement of irrigation the animal struggles violently, but it soon becomes calm, and after fifteen or twenty minutes may be left to itself. This irrigation is continued without interruption for three days, except during feeding. Then it may be reduced, but the treatment should be prolonged. Frequently after the first day there is an amelioration, that becomes more and more marked. A cure is complete in about fifteen to twenty days, and sooner if, for the irrigation, crushed ice in a cloth bag be applied.

ARTICLE III.—Larvae of the Cestridæ.

ENCEPHALON.1—Some observations demonstrate that the larvae of the Cestridæ may penetrate to the brain of Equines.

The presence of these parasites is betrayed by circular movements or difficulty in standing; an abnormal position of the head, which is carried obliquely; the pupils are dilated, there is tetanic contraction of one or two limbs, convulsive agitation of one or two others, and all the symptoms of encephalitis. Sometimes the malady runs its course with the rapidity of acute apoplexy (Lourdel), or almost acute (Franchi); in other cases, the animal takes three or four days in dying (Sirodot, Siedamgrotzky).

The diagnosis of such a disease is always very difficult, and can scarcely be established until after death. It, fortunately, has little importance, as a fatal termination rapidly supervenes.

At the autopsy, the larvae of the Cestridæ are found, not only in the stomach, but also in the pharyngeal opening of the Eustachian tubes, in the nasal cavities, and in the cranium (Franchi). The brain is lacerated, and is also the seat of active inflammation that extends some distance beyond the point occupied by the parasite; there is likewise violent meningitis. A single larva has usually entered the cranium; but Bruckmüller has seen two, and Franchi several, which were at various depths. In all these instances, the lower surface of the medulla oblongata was attacked, with the exception of Franchi’s case, in which the base of the cerebrum and cerebellum were involved; and in that of Boas, in which the larva was between the left anterior corpus quadrigeminus and the corresponding cerebral hemisphere. It was the left side of the pons Varolii in Bruckmüller’s case; the left lateral fasciculus of the medulla oblongata, behind the calamus scriptorius, in that of Sirodot; the anterior part of the right restiform body in that of Siedamgrotzky; the crura cerebri in that of Lourdel; and the medulla oblongata and pons Varolii in that of Dieckerhoff.

The kind of Cestridæ, the larva of which may thus penetrate, is still very uncertain. A priori, it is natural to suppose that it is the Gastrophilus haemorrhoidalis, which, more than any other, sometimes remains fixed in the post-buccal regions. Nevertheless, Bruckmüller thought he had to do with the Gastrophilus nasalis, Boas the Hypoderma bosis; Mégnin states the larva found by Lourdel belonged to the latter species; while the description Siedamgrotzky gives of the one he discovered does not appear to be that of one of the Cestridæ.

The situation occupied by the parasite allows of the course it followed through the interior of the cranium being traced. It is probable that the larva, on arriving in the guttural pouch from the pharynx, passes through the walls of the pouch to pass into the foramen lacerum at the base of the cranium, and so finds itself at the under surface of the brain.

The larvæ collected by Rose in the brain of a foal in 1828, doubtless belonged to the Gistridæ.

Spinal Cord.—In 1827, Tombs found a larva—belonging to the Gistridæ, no doubt—in the spinal cord of a pony.

In 14 cattle—generally young—of 39 he examined, Hinrichsen saw larvæ lodged in the fat between the spinal canal and dura mater. Their number varied from one to twenty, and they were from 8 mm. to 13 mm. long, by 1 mm. to 2 mm. in diameter. Their presence was not revealed during life, nor at the autopsy, by any appreciable sign.

Hinrichsen was inclined to consider them—though without sufficient reason—as larvæ of the Hypoderma bovis in the first stage.¹

CHAPTER II.

PARASITES OF THE SENSORY ORGANS.

Parasitism of the organs of taste and smell is naturally that of the mouth and nasal cavities. This chapter will, therefore, only comprise the parasites of the ear and eye.

Article I.—Parasites of the Ear.¹

Parasitism of the ear commences with the external ear. The only exception to this rule that we know of is the observation of Gellé. At the autopsy of a Dog, he found a *Linguatula tenioides* in the middle ear, the mucous membrane of which was red, thickened, and covered with pus. The parasite was supposed to have penetrated by the Eustachian tube, as another individual of the same species occupied the corresponding nasal cavity.²

All the parasites of the skin may attack the external ear, as they do the other parts of the integument. Some of them localize themselves voluntarily there—such as the *Simulium* on Horses (p. 27), the larvae of the *Sarcocephaga magnifica* on Dogs (p. 41). Pradal says that when Pigs are exposed to the hot sun, their ears become cracked and the larvae of Flies soon burrow in the wounds thus formed. In the larger Herbivora, Lice often seek the downy interior of the concha.

Among the Acarina, the Ixodes and Harvest Bugs are frequent in the ears of Dogs (pp. 95, 107).

They were also probably Harvest Bugs which Zundel states he met with in the ear of a badly-kept Heifer belonging to a wood-keeper, as Acari visible to the naked eye and agglomerated in small yellowish patches.³

Troltsch, reported by Gassner, found in the external auditory canal and near the tympanum of an Ox a great number of Dermanysses mixed up with the secretions; the mucous and tympanic membranes were red and tumefied. A similar case relating to a Cow was published


by Schümacber. The symptoms were: violent agitation of the head, pruritus of the right side of the head, and madness. The animal had to be killed. At the autopsy, nothing was found except a great quantity of Acari, which were described as the *Dermanyssus gallinae*. They covered the external surface of the tympanum of the right ear, and had invaded the neighbouring parts and the mastoid cells. A perforation of about 5 mm. traversed the membrane, and through this the Acari had passed to the internal ear, where they had set up inflammation. The shed in which this Cow was kept was only separated from a hen-roost by a plank partition. Ostertag made an analogous observation on a Cow, in the two auditory canals of which were Acari—probably *Dermanysses*. The animal showed no other symptoms than frequent shaking of the head, which would sometimes continue for more than an hour.¹

Leidy has described by the name of *Gamasus auris*, Acari found on several occasions, and in great numbers, by Turnbull, in the external auditory canal of the Ox, and particularly on the tympanum. Their body was white, transparent, smooth, shining, and oval; legs and abdomen brown and provided with bristles; palpi with six joints; mandibles terminating in a didactylous forceps, the movable branch of which was bi-dented at the extremity, the other being small and hooked; tarsi ending in a pair of claws, and a five-lobed caruncle. They were about 1 mm. long by 0.8 mm. wide. According to Pagenstecher, this Acarus is really a Gamaside, and perhaps it was some wanderer of that species derived from forage.²

In those forms of scabies which develop more particularly on the head—as the sarcoptic scabies of the Sheep (p. 163), Goat (p. 192), Pig (p. 195), Rabbit (p. 198), and Cat (p. 208), the ears are often invaded. The follicular scabies of the Dog may also extend to the ears, an occurrence witnessed in two Cats by Méggin, in which the *Demodex folliculorum* was found.

Favus in the Dog, Cat, and Rabbit often commences at the ears. Parasitic otitis caused by various fungi, but especially by the *Aspergillus*, has often been noticed in Man. Beyond the four cases of this 'Gutturonomycosis' of Equines already alluded to (p. 340), we have only one other observation on this subject, due to Gotti.³ This was the case of a Dog affected with auricular catarrh, in the purulent and foetid discharge of which he found an abundant and complicated network of jointed filaments, many of which terminated in an ovoid vesicle surrounded by spores. This was probably an *Aspergillus*.

So long as the parasites of the ear are limited to the concha and auditory canal, they only produce local inflammatory phenomena. But if they come in contact with the membrane of the tympanum, or if the cerumen or pathological product which they cause to be formed

presses on the tympanum, and this pushes the internal ear to one side, epileptiform symptoms often appear. The physiological pathology of this otopiesis (*o*ōs, ear; *πίερις*, compression) has been particularly studied by Boucheron.¹ 'The auricular epilepsies observed in Man and Animals,' he says, 'should be classed with Brown-Séquard's epilepsy, produced by stimulation of a cutaneous sensitive nerve. They are caused by direct or reflex stimulation of the auricular nerves, either at their termination in the ear, along their intra-cranial course, at their bulbar origin, or perhaps in their intra-cerebral track, in predisposed individuals and under certain conditions. Stimulation of the sensorial nerves of the ear is transmitted to the mesocephalon, and acts upon the motor centres of this region—thus producing the convulsive epileptiform crisis.'

The parasites special to the ear are Acari. These *Otacariases*, or auricular acariases, are due to the *Psoroptes communis* (var. *cuniculi* and *capre*), and to the *Symbiotes auricularum* (var. *canis*, *felis* and *furonis*).

1.—*Psoroptic Otacariases.*

These auricular acariases are generally troublesome, but are scarcely manifested by other than local symptoms. They have only been observed in the Rabbit and Goat.

**A.—Psoroptic Otacariasis of the Rabbit.**

This affection was reported for the first time by Delafond,² at a meeting of the Société Centrale de Médecine Vétérinaire, on December 9, 1858. On this discovery, he made inquiry among the rabbit-dealers in Paris, who informed him that the affection was frequent, and interfered with the growth of the animals. It is, in fact, very common, and nearly all those who have perseveringly looked for it have found it.

**Symptoms.**—The malady is exclusively localized in the interior of the ear. It commences at the bottom of the concha, and first manifests itself by pruritus—the animal vigorously tosses its head, shakes its ears from before to behind, and scratches at them with its hind-feet. It betrays pain when the ears are squeezed. In fifteen to thirty days there is seen at the bottom of the concha a yellowish, thick, soft matter, in which the *Psoroptes* can be seen with the naked eye, by means of the pocket-lens, or, better, the microscope. Later, the bottom of the ear is full of a morbid, yellow, and foetid product, rich in parasites. At its base the organ is swollen, hard, and painful. The Rabbit keeps its ears back or low, and shakes and often scratches them.

If the ear is cleared of the morbid matter, the skin lining it is found

¹ Boucheron. *Épilepsie d’Origine Auriculaire; Contribution à l’Étude de l’Otopiésis.* Comp. Rend. Acad. des Sciences, Cl., 1885, p. 92.

to be red, painful, thickened, denuded of its epithelium, and slightly ulcerated, while a red, irregular border limits the diseased and the healthy parts.

When this acariasis goes on for two or three months, it has invaded the inferior third, and even the half of the interior of the ear, which is then occupied by a yellow, foetid, half-dried matter in layers, or a more or less dense mass, which contains very numerous Psoroptes. This matter is, in addition, composed of epidermic cells, fat granules, old and recent pus corpuscles, and various foreign bodies.

The parasites are never installed elsewhere than in the concha, nor do they cause scabies in the neighbouring parts.

When the malady is chronic, the Rabbits become emaciated, although they continue to eat; then the appetite diminishes. The females abort, and do not again enter into oestrus; the limbs become infiltrated, and

Fig. 360.—*Psoroptes communis*, var. *equi*, male and female coupled, dorsal surface; magnified 100 diameters.—Delafond.
a profound cachexia slowly declares itself; a serous diarrhoea appears, and the Rabbits finally die in a state of emaciation bordering on marasmus.

A possible termination observed by Møller, then by Zürn,\(^1\) is due to the penetration of the Psoroptes to the internal ear. The auricular muscles are partially paralyzed, and the ears hang pendulous on each side; symptoms of vertigo appear chiefly when the affection extends to the meninges or the brain. Railliet has seen Rabbits in which this form of scabies caused such a degree of torsion of the head on the neck, that the lower jaw was uppermost; yet the animal lived for some months. We have made a similar observation on a Rabbit, in the mastoid cells of which there were numerous Psoroptes; the brain and its meninges were intact.

**Etiology, Contagion.**—The unique cause of the disease is the presence of the *Psoroptes communis var. cuniculi*. The male is 520 μ to 620 μ long, by 310 μ to 400 μ broad. The ovigerous female measures 670 μ to 780 μ long, and 400 μ to 480 μ broad.

Among 155 tame Rabbits of different ages, and in very variable degrees of fatness, Delafond found 45 affected with auricular scabies—or 25 per cent. This high proportion was no doubt due to the animals living in contaminated quarters, like the hutches of dealers, or the cages in which those intended for experiment are kept.

He always succeeded in transmitting the disease to healthy Rabbits, and so placed its contagiousness beyond doubt. From a fact mentioned by Lucet, it would appear, however, that certain individuals or families offer a special resistance to the transmission of this acariasis.\(^2\)

Hosœus\(^3\) unsuccessfully attempted to transmit the Psoropt of the Rabbit to Dogs, Cats, Sheep, and Horses. Mathieu,\(^4\) however, saw pimples similar to those observed at the commencement of psoroptic scabies, produced by depositing the Rabbit Psoroptes on a Horse.

The facts published by Cagny\(^5\) are more demonstrative. A Horse contracted very extensive scabies in a stable where there was a hutch full of Rabbits; these were removed, and the disease disappeared after a few days' treatment. With another Horse, the affection was localized on the points where the pad and other articles of harness rested on the skin; there were also some disseminated patches. The harness in question was usually laid on a hutch containing Rabbits affected with psoroptic scabies. When the latter were taken away and the stable was disinfected, the malady was speedily cured. Cadeac remarked at

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\(^3\) Hosœus. *Bericht über das Veterinarw. in Sachsen für 1875*, p. 60.


the Toulouse Veterinary School, that Rabbits became affected with auricular scabies when Horses suffering from psoroptic scabies were introduced into the stable in which their cage was kept.

These few facts, notwithstanding the absence of precision in their details, seem to prove that the Psoropt of the Rabbit and that of the Horse are identical, as might have been predicted from their external characters; and that these two species of domesticated Mammal may be reciprocally contagiferous. Zürn says he has also met with Symbiotes in the otacariasis of the Rabbit; but he does not give a description of them.

Treatment.—Clean the ear thoroughly and deeply at several times, with soap and water; after each washing soften the morbid products by dropping a little olive-oil into the concha. Then scoop out the matter with a small curette, and cleanse the cavity carefully by means of a piece of rag attached to the end of a stick. This rag will also serve to spread over the diseased part either Helmerich’s ointment, or a liniment composed of benzine and oil in equal parts.

Andrée, of Fleurus,¹ has successfully employed a liniment composed of:

- Glycerin
- Crystallized carbolic acid
- Oil of turpentine
- Laudanum

\[
\text{of each 1 gramme.}
\]

\[
100 \text{ grammes.} \\
2
\]

B.—Psoroptic Otacariasis of the Goat.²

This acariasis should be more frequent than the only two observations published would lead us to suppose. These observations were quite fortuitous, so that it might be concluded that the affection is very benign and may pass unperceived. The two Goats in which it was seen formed part of a wandering flock from the Western Pyrenees. By chance, Pesas and Morot examined the cerumen from the ears and found the Psoroptes in it. There was no local irritation.

The *Psoroptes communis* var. *capre* of this acariasis measures—the male 470 \( \mu \) to 640 \( \mu \) long, by 270 \( \mu \) to 400 \( \mu \) broad; the ovigerous female is 680 \( \mu \) to 850 \( \mu \), by 390 \( \mu \) to 550 \( \mu \).

2.—Symbiotic Otacariases.

These otacariases are special to the domesticated Carnivora—Dog, Cat, and Ferret—and are caused by the *Symbiotes auricularum*.

They are more serious than the psoroptic acariases.

A.—Symbiotic Otacariasis of the Dog.³

Synonyms.—Auricular scabies, Symbiotic scabies, Chorioptic auricular prurigo, Parasitic otitis, Epileptiform disease of sporting Dogs.

¹ Andrée. Annales de Méd. Vétérinaire de Bruxelles, 1872.
History.—Hering, of Stuttgart, was the first—in 1834—to remark a parasitic disease in the ear of the Dog; in an ulcer he found among the pus an Acarus which he named Sarcopes cynotis. In 1849, the same parasite was again found in the ear of a Dog by Sallé, and described by Lucas, assistant naturalist to the Paris Museum; the drawing of the female, made by Nicolet for the museum, shows that it was a Symbiot. Lucas and Nicolet named it the Sarcopes auricularum. In 1862, Bendz, of Copenhagen, described and figured this parasite of the Dog’s ear, and distinctly recognised its zoological place, as he named it Symbiotes canis. In 1874, Schirmer, of Potsdam, also observed this parasitic otitis, the Symbiot of which was described by Zürn. The malady has been more particularly studied by Guzzoni, then by Mégnin and Nocard, who have clearly shown the relationship between the presence of the Symbiotes in the ear, and the epileptiform symptoms with which packs of Dogs are often attacked.

(In 1891, A. J. Sewell, of London, described this otacariasis, though he attributed it to a Psoropt—the Psoroptes auricularis canis. He found the same parasite in the ears of Cats.)

Etiology.—The sole cause of this affection is the Symbiotes auricularum var. canis (see p. 129). The male is 350 \( \mu \) to 380 \( \mu \) long by 250 \( \mu \) to 280 \( \mu \) broad; the ovigerous female is 460 \( \mu \) to 530 \( \mu \) long by 280 \( \mu \) to 350 \( \mu \) broad.

Although this otacariasis has been more particularly observed in

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Fig. 361.—Symbiotes auricularum of the Dog, ventral surface; magnified 100 diameters. — Railliet.
packs of Hounds, yet breed does not predispose to it; for it has also been seen in setters (Weber), pointers (Mégnin), terriers, Maltese terriers, and poodles (Guzzoni).

The experiments of Guzzoni and Nocard demonstrate the part played by contagion, irrespective of age and sex, and explain the frequency of the disease in kennels. There is nothing to prove that the *Symbiotes auricularum* can live elsewhere than in the ear of the Dog.

**Symptoms.**—Hering found this parasite in an ulcer of the concha of a Dog brought under his observation; this ulcer coincided, no doubt, with deep-seated otitis which remained unperceived. Bendz only noticed an abundance of a brownish, flaky matter at the bottom of the aural cavity; and Schirmer has strongly insisted on the connection that exists between the presence of the *Symbiot* and auricular catarrh. It is probable that symbiotic acariasis, by the local irritation with which it is accompanied, facilitates the development and extension of chancre and catarrh of the ear which so often attacks sporting Dogs; but the symptoms of the parasitic affection are of another kind, and to Guzzoni, Mégnin and Nocard we are indebted for the knowledge we possess on this point.

They have observed the disease chiefly in packs, among which, by reason of its contagiousness, it sometimes prevails as an epizooty. According to Nocard, when in the kennel at rest, as well as during the first few minutes in hunting, there is nothing to indicate the existence of the disease. Guzzoni and Mégnin assert that the animals often flap their ears, and sometimes the only symptom is that of itching. But, as a general rule, that which attracts attention are the epileptiform fits that usually occur after a walk, says Mégnin—exclusively during hunting, asserts Nocard. 'The Hound attacked,' says the latter, 'goes away with as much vigour and eagerness as usual; then in about half an hour, or sometimes less, all at once it utters a violent cry, most husky and acute; it bounds across the furrows as if mad, the eyes haggard and mouth full of foam, howling every time it runs against an obstacle; then, after turning two or three times in a circle, it falls down in a fit of epilepsy. Soon it gets up stupefied and exhausted from fatigue, and if the attack has not been too violent and the disease not too chronic, it may—after fifteen to thirty minutes' rest—emerge from its apathy, and start off hunting with as much ardour as if nothing had occurred.'

For a long time there is nothing to distinguish the diseased from the healthy animals in the kennel; then, as the disease becomes more chronic, and the epileptiform seizures are more frequent, intense and long, the affected animals grow sullen, cowardly and savage; later still, the attacks are so grave and so numerous, that the Hounds have scarcely begun to run when they are seized, and when the fit is over they obstinately refuse to resume hunting. They become unfit for service, stupid, and
sometimes completely deaf. They may die during an attack, though they have rarely one in the kennel.

The auditory canal is found to be lined with an abundant covering of soot or chocolate-coloured, and slightly foetid, cerumen, the consistency of mastic, which obstructs the opening. A microscopical examination of it reveals a multitude of Symbiotes auricularum of all ages and sexes. By its abundance, this substance compresses and pushes back the membrane of the tympanum, which projects into the internal ear.

(In some cases, according to Sewell, who has had a large experience among all kinds of Dogs, there is little to be seen, the ear looking merely as if slightly dirty. 'If, instead of giving a hurried look into the ear in these cases, the parts are well examined, and the canal leading into the ear is carefully watched, tiny white specks—oval in shape, and about the size of the head of an ordinary small sewing-needle—will be observed. These are parasites, and are in my opinion the cause of that disease called "canker" of the ear. . . . These parasites . . . are extremely active in their movements, and if the ear be carefully watched for a few moments, they may be seen running about the skin, and also along the hairs in the ear, at a fairly rapid rate, considering their minute size; and the irritation they cause is due in a measure, I believe, to the tickling sensation caused by their movements, and partly the result of their biting. . . . The skin lining the ear is thin and soft, and here, I believe, the mites do bite, and, as a result, there is an exudation which, I consider, accounts for that somewhat dry discharge so often seen in some ordinary cases of canker.')
The convulsive epileptiform seizure is caused by the ceruminous plug which ‘is carried against the tympanic membrane by the pressure and scratching on the cartilage of the ear when the Dog is at rest; or when the animal is running, by the violent movements, and the beating and slipping about of the ceruminous mass. For Nocard, the cerebro-spinal excitement of the hunting animal will be a predisposing cause of the convulsive crisis. The stimulation of the filaments of the trigeminal and pneumogastric nerves in the external auditory canals by the Acari, may also be brought into operation, and there will then be established a cutaneous epileptogenous zone’ (Boucheron).

Diagnosis.—Auricular acariasis can only be mistaken for epilepsy; it is distinguished from it, however, by its disappearance on the adoption of an acaricide treatment, by the deafness that often accompanies it, but which can only be ascertained if it is bilateral. Besides, the acarian crisis is ushered in by some plaintive cries, which are not heard in epilepsy, and it is not accompanied by emission of urine or involuntary defecation, which nearly always occur in real epileptic seizures. The presence of the Symbiot in the cerumen, when this is not deeply lodged, also fixes the diagnosis; while the contagious properties of the disease contribute to remove all doubts.

The epileptiform attacks of verminous origin are seldom seen in other than young Dogs, but this disease attacks those of all ages.

Some sportsmen have mistaken the malady for rabies; but it is not accompanied by the mental prodroma of the latter, and its attacks are essentially transitory; while there is not the furious madness and viciousness of rabies.

Lastly, auricular catarrh and chancre on the ear have nothing more in common with acarian epilepsy than their seat, though they may coincide with it.

Prognosis.—Parasitic otitis has only serious consequences when it is not properly treated; it yields readily, in fact, to parasiticide agents, and ignorance as to its nature often leads to aggravation of its effects and death. Its contagiousness gives a serious character to the prognosis; but here, again, it is sufficient to know this to be able to prevent its propagation.

Treatment.—Avert contagion by carefully disinfecting the kennels, etc., where the disease has appeared.

Curative treatment consists in keeping the ears very clean, in removing all visible cerumen, and in using detersive injections. Guzzoni has obtained a good result with the formula of Andrée, of Fleurus, for auricular acariasis of the Rabbit (see p. 748). Méggin recommends repeated injections of sulphuret of potass, 1 to 20, twice a day for three days; and Nocard has had numerous successes—even in very advanced and serious cases—with the following:
Olive-oil : 100 grammes.
Naphthol : 19
Ether : 90

*Keep in a well-stoppered bottle.*

Every day inject some of this liniment into the external auditory canal, which is then closed for ten to fifteen minutes by a pledget of cotton wool to prevent the evaporation of the ether.

Of all the acaricides, naphthol is the one which has given Nocard the best results; it is very soluble in oil, and more efficacious, less irritating, and much less odorous than carbolic acid. Ether added to the oily solution causes the liniment to penetrate the mass of cerumen—often thick and consistent—which contains the Symbiotes.

(Sewell remarks that, when the acari are destroyed, the irritation at once ceases. He found the following liniment to answer the purpose admirably both in Dogs and Cats:

<table>
<thead>
<tr>
<th>Component</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ointment of the nitrate of mercury</td>
<td>1 drachm.</td>
</tr>
<tr>
<td>Olive-oil</td>
<td>1 ounce.</td>
</tr>
</tbody>
</table>

Well mix.

This should be applied all over the internal surface of the ear daily with a camel's hair brush, or a few drops may be poured into the ear. After a week the ear should be syringed out with tepid water and methylated spirit, about 1 to 10.)

**B.—Symbiotic Otacariasis of the Cat.**

This acariasis—also named *auricular scabies*—was observed for the first time in 1860, by Huber of Memmingen, who recognised the Symbiot as the cause. This was again observed in 1876, by Broquet, and particularly studied by Mégnin, who distinguished this Symbiot from the common Symbiot by the name of *Symbiotes ecaudatus*. It is the *S. auricularum var. cati*. (Sewell, in the paper referred to, says he found the same parasite he described as infesting the ear of the Dog, in that of the Cat. 'I have also frequently found these same parasites in Cats' ears, and in some cases they induce rather extraordinary symptoms, the Cat being almost unable to walk; in fact, when it attempts to do so it rolls about as if intoxicated, frequently falling over on its side. I have never seen the Acarus cause the same symptoms in the Dog.')

The *male* is 300 \( \mu \) to 320 \( \mu \) long, by 200 \( \mu \) to 250 \( \mu \) broad; the ovigerous *female* is 450 \( \mu \) to 475 \( \mu \) long, and 250 \( \mu \) to 300 \( \mu \) broad.

The two Cats Mégnin observed were the victims of such a degree of itching that they could not rest, and had even attacks of frenzy. There were only some superficial excoriations—the result of scratching with the hind-feet on the posterior surface of the concha. On examining the interior of the ear, we could find no wound or ulcer, but the cerumen was very abundant, and showed on its surface small, white, moving spots,' which were the Symbiotes.

We have found these Symbiotes in abundance in the ears of a Cat that had been killed as rabid. Two Dogs were inoculated with its

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medulla oblongata, with a negative result; thus proving it had not been
affected with rabies.

This otitis is in every respect analogous to the parasitic otitis of the
Dog. We therefore refer to what has been already said as to the
pathological physiology and treatment of the latter.

C.—Symbiotic Otacariosis of the Ferret.\(^1\)

This affection—which is also designated *auricular scabies* and *para-
sitic otitis*—as well as the parasite causing it, has been described by
Mégnin. It is due to the *Symbiotes auricularum* var. *furonis*.

The *male* is 270 \(\mu\) to 340 \(\mu\) long, and 210 \(\mu\) to 250 \(\mu\) broad; the
*ovigerous female* is 380 \(\mu\) to 450 \(\mu\) long, by 240 \(\mu\) to 280 \(\mu\) broad.

In 1884 this otacariosis prevailed in a serious epizootic form in the
North of France, and particularly in the environs of Calais.

By multiplying in the external auditory canal of the Ferret, the
Symbiotes cause the destruction of the tympanic membrane, give rise
to violent inflammation of the middle ear, then caries of the petrous
temporal bone, and death not only from extension of the inflammation
to the brain, but also from the pain and abstinence from food.

The malady is not accompanied by the epileptiform symptoms or fits
of frenzy witnessed in the Dog and Cat. The Ferret suffers silently,
and there is only observed a stupefaction, interrupted moments of
wakening up, during which the animal tries to scratch its ears; it dies
without exhibiting any very characteristic symptoms.

At the autopsy there is found an abundance of brown cerumen in the
ears, which obstructs the auditory canal and encloses the numerous
male and female Symbiotes, isolated or coupled. The tympanum is
destroyed, the middle ear full of pus, and its essential portions more or
less altered.

This disease is very contagious among Ferrets, and may last three or
four weeks before causing death.

By reason of its tranquil course, it often passes unperceived; for it is
scarce discoverable by an examination of the ears, and attention is
not attracted to it until it has caused some loss. A cure is then
affected by the same means that are successful in the parasitic otitis of
the Dog and Cat. The places in which the Ferrets are kept should
also be disinfected, as some stray Symbiotes may be lingering about
them.

**Article II.—Parasites of the Eye.**\(^2\)

All the parasites of the skin which have no strictly limited localization,
may lodge in or on, or extend themselves to, the eyelids—such are the
Diptera (and especially the *Chrysops ecectiens*), the Pediculidae, Ixodes,
Sarcoptes, and Demodex. We have seen elsewhere that the *Demodex*

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\(^1\) Mégnin. *Soc. Centr. de Méd. Vétérinaire; Rec. de Méd. Vétérinaire, 1878, p. 209,
p. 244.

Vétérinaire, XIV., 1887, p. 459. This very complete article gives an excellent bibli-
ography of the parasitism of the eye. We have only to add some indications, and at first
the following, taken from Gurilt’s *Lehrbuch d'Patholog. Anatomie*, I., 1887. — Frenzel.
folliculorum has been found by Wilson in the Meibomian glands of the Horse, and by Oschatz exclusively in those of the Sheep.

Van Setten, a veterinary surgeon at Onderdenham, Holland, extracted from the anterior chamber of a Horse—by keratotomy—a parasite that Numan described under the name of *Monostoma Setteni*, and which Diesing, with doubt, classed among the Pentastomes (*Pentostoma Setteni*). The Horse from which this parasite was obtained had the right eye very sensitive to the light, the eyelids were tumefied, conjunctiva injected, and the cornea almost opaque. After the operation, the condition of the eye became satisfactory. In interpreting the erroneous and incomplete description given by Numan, Blanchard and Railliet only see in this pretended *Monostoma Setteni* a larva of the *Ostrida*, probably of the *Hypoderma*.

The *Haemopis sanguisuga* has been met with by Bizard on the conjunctiva of a Horse in Algiers.

Trichinae may lodge themselves in the ocular muscles, as in the striped muscles generally; it is the same with the Sarcosporidiae, which have been seen by Krause, in 1863, in the Ox, Dog, and Cat.

All the other parasites of the eye are Cestodes in the cystic form, or Nematodes of the genus *Filaria*. Their presence is always more or less exceptional.
I.—Ocular Cysticercosis and Echinococcosis.

The principal, if not the only one of the cystic worms observed in the eye of the domesticated animals, is the *Cysticercus cellulosae*—the parasite of Pig measles, and otherwise the only one met with in the eye of this animal. The first and, perhaps, almost the only observations published are due to Van der Heven, Nordmann, and Gescheidt. ‘Nordmann,’ says Davaine, ‘on four occasions met with the Cysticercus in eighteen eyes he examined;’ Gescheidt twice in forty-six eyes. In each animal only one eye was invaded. At Paris, Rayer found none in the forty-five eyes he examined. Of the four cases observed by Nordmann, in two the worm was in the anterior chamber, in another it was in the posterior chamber, the crystalline lens being affected with cataract;’ in the fourth case there were six Cysticerci in the vitreous humour, which was marked by irregular brownish bodies formed of coagulated blood, while the sclerotica was ossified on its inner surface, which was in contact with six other Cysticerci. ‘In Gescheidt’s two cases, the Cysticercus was in the anterior chamber of one, and in the other between the choroid and retina.’ In the latter, it was surrounded by a trifling exudate, which was slightly vascularized.

In the Pig, the measles Cysticercus is frequently seen in the muscles of the eye, beneath the conjunctiva, etc.

Cunier once met with it beneath the conjunctiva of a Dog, at the external angle of the eye. Heinke also found a Cysticercus lodged in the orbit of a foal fourteen days old, the eye being atrophied.

Hutchinson, in 1857, saw the eye of a Horse of unknown origin, the anterior chamber of which was entirely occupied by a cyst with very thin transparent walls and limpid contents, and which he qualified as ‘a hydatid cyst.’ He could not discover any Tænia heads by a microscropical examination. The different parts of the eye were the seat of very marked inflammation.

2.—Intra-Ocular Filariosis.

This affection, which is most frequently named *Verminous ophthalmia*, is due to the presence of *Filaria* in the globe of the eye, and is observed more particularly in Equines and Bovines. Some very exceptional instances have been recorded as occurring in the Sheep, Dog, Fowl, and Goose.

A. Equidæ.—This helminthiasis is somewhat frequent in horses in India, but is exceptionally seen in Europe and America. We are inclined to consider these worms as a young form of *Filaria papillosa* Rud. (see p. 547), and not as a distinct species—the *F. pellucida* Kennedy. Davaine, who received specimens from the Madras Presidency, gives them the following characters:

Body capillary, reddish-white or chestnut in colour, and a little expanded towards the first quarter of its length; integument smooth; mouth provided with three (?) salient, triangular lips; tail acute, with two long and strong papillæ at the sides, a little in advance of the end, and directed backwards. *Male*: 30 mm. to 35 mm. long, tail spiral, and having, between the two caudal papillæ, six papillæ on each side—three
PARASITES OF THE SENSORY ORGANS.

pre-anal and three post-anal; two short spicule, with an accessory piece. *Female*: 22 mm. to 32 mm, long, genital tube still destitute of ova.

Grassi designates as *F. inermis*, a worm of which he has had six female specimens—three found respectively in the eye of a Man, a Woman, and an Ass, and three in the non-mentioned organs of a Horse. The description he gives of this species, does not appear to us to be sufficient to warrant its being classed with the *Filaria* found in the eyes of Equidae by various observers.

The presence of a worm in the interior of the eye of a Horse was reported for the first time in 1622, by Spigel. A century and a half later, in 1773, a letter from a Spanish veterinary surgeon, Domingo Rayo, mentions such an occurrence in a Mule and a Horse. Morgan and Hopkinson state that, in 1782, there was exhibited at Philadelphia a Horse which had, it was reported, 'a living serpent' in its eye. In 1804, Sick made a similar observation at Vienna; and since then, intra-ocular helminthiasis has been noted on several occasions in various parts of Europe and North America.

The first mention of worm in the eyes of Horses in India, is due to Kennedy. It has been very often observed more recently, and details as to the ophthamia it occasions have been furnished by Atkinson, Breton, Grellies, Twining and Gibb, Percivall, Molyneux, Macnamara, Adams, etc.

These worms are known in Bengal as *sanp*, or serpent of the eye. They are common there, as well as in Upper India, at Madras, Ceylon, etc., and up to the borders of Burma. They are observed mostly during the cold season, and when the rains have been abundant; they are also more frequent in certain localities than others, and in young than adult Horses.

Usually only one eye is affected, and there may be one, two, or even three worms in the anterior chamber—swimming about freely in the aqueous humour, where they can be seen through the cornea, moving more or less rapidly. It may happen that the worm will die there, and be absorbed; but usually its presence produces much irritation—epiphora, photophobia, and conjunctivitis; the iris is inflamed, the aqueous humour loses its transparency and assumes a milky tint, the cornea becomes thickened and gradually opaque; then the inflammatory phenomena subside, but vision is destroyed. There has often been remarked in India, in Horses so affected, a peculiar weakness of the loins called *kumree* and *ah-drung* by the natives, and which appears after the commencement of the ophthamia; its nature is not known, and several veterinary surgeons see in it a mere coincidence, and having no relation to ocular filariosis. This loin weakness has never been seen anywhere else than in India.

Nearly all who have had to do with this parasitic ophthamia of the Horse, have treated it by puncturing the cornea; and they recommend this operation being performed at the commencement, in order to avert opacity. Some operate upon the Horse in a standing position, which facilitates the escape of the worm; others lay the
animal down, and administer an anaesthetic. The keratotomy is made with a cataract-needle or a small lancet, at the inferior part of the cornea. The sudden expulsion of the aqueous humour carries the worm towards the wound, where it is seized the moment it appears. After the operation cold dressings are applied, and, if necessary, bleeding and purging are resorted to. (The operation is best performed upon the Horse standing, cocaine being, if procurable, applied previously—a 4 per cent. solution being sufficiently strong.)

An observation by Paszotta proves that the eye Filaria may die sur place, and be absorbed in five or six weeks. Jiménez Alberca has published a case of recovery through the use of an ointment of the red oxide of mercury—eight parts, to lard ten parts. He placed a piece about the size of a pea beneath the eyelid, twice in the course of eight days.

Ox.—The intra-ocular Filaria of the Ox was observed by Grisoni in 1429 (Ercolani); but the affection to which it gives rise was first described by Deguilléme in 1812, then some years afterwards by Santin, of Dorgue, Tarn. In 1827, Chaignaud published an interesting work on the subject, based on more than 150 observations, and since that time many practitioners have had to deal with the affection.

The worm which produces it is capillary, and from 2 cm. to 3 cm. long. It has not yet been studied by a helminthologist, and provisionally it might be considered as a larval form of Filaria cervina which, in the adult state, infests the serous membranes of the Ox.

This verminous ophthalmia may prevail in an epizootic form. Chaignaud has only seen it from June to November; but Durréchou has observed it in March, and Faure in April.

Usually only one eye is affected, and it is exceptional for both to be involved at one time. There is one worm, rarely two or three; but Roche-Lubin has extracted seven, which were intertwined in a bundle. They are situated in the anterior chamber, and swim about in the aqueous humour. Chaignaud states, that in the three to ten first days they are coiled up on themselves, immovable, and appear as whitish-red bodies the size of a vetch-seed to that of a pea, lying in the lower part of the anterior chamber. Later, they are seen to move behind the cornea. The signs of inflammation of the eye are the same as in the Horse.

Keratotomy, which has succeeded in some hands, is rejected by others as dangerous. Bleeding, emollients, and anodynes have not yielded satisfactory results; Chaignaud employed tincture of aloes diluted with an equal weight of water, and instilled between the eyelids three times a day. After three or four days, and sometimes from the first day, the worm ceases to move about, 'falls to the bottom of the anterior chamber of the eye,' and is absorbed at a period more or less remote. When the alterations in the media are advanced, the progress towards formation of cataract cannot be checked.
The disease may last from two to four months, with long intermissions (Durrechou). Ancèze has seen it coincide with verminous conjunctivitis, without remarking any differences between the external and internal worms. Claes and Brouwier have seen, in two localities in Belgium, an epizooty of verminous ophthalmia that attacked nearly all the animals on a farm, and was followed soon after by an attack of bronchial strongylosis.

Sheep.—Haselback has observed, in the eye of a Ram, a filiform worm that gave rise to internal ophthalmia, and which disappeared—perhaps under the influence of treatment.

Dog.—Gescheidt on one occasion found, in the vitreous humour of a Dog, a female worm about 7 mm. long, with an orbicular mouth surrounded with three small round papillae. This was the *Filaria trispinulosa* Diesing. Cobbold considered it to be a larva.

Fowl.—Cobbold mentions the existence of a *Filaria Mansoni* in the eyes of Poultry in China. The Filariae of the blood are otherwise very common in the Ravens and Magpies of Eastern Asia.

Goose.—Small has witnessed, in a large number of Geese in the neighbourhood of Dublin, a unilateral ophthalmia, with opacity of the cornea and increase in volume of the eye. Incision of the cornea in one of them allowed the escape of a black filiform worm, resembling a young Leech, and which was perhaps a Filaria.

3.—Extra-Ocular Filariosis.

Filariae have been seen several times beneath the eyelids of the Horse and Ox, and even in the lachrymal canal of the Horse. They often cause conjunctivitis.

According to Ercolani, those of the Ox were observed in 1429, as well as the intra-ocular Filariae of this species of animal, by Bartolomeo Grisoni, who, in an unpublished manuscript, speaks of the diseases of the Ox. The first description of them we owe to Gurlt, in 1831, who named them *Filaria lachrymalis*. C. Baillet has recognised that the Filaria of the eyelids of the Horse differs somewhat from that of the Ox. The latter should therefore retain the name of *F. lachrymalis*, that of the Horse being designated *F. palpebralis* Wilson.

A. Horse.—The Filaria of the Horse’s eyelids has rarely been seen, and Gurlt, Kliem, Goubaux, Baillet and Railliet have furnished the principal contributions to its history.

*Filaria palpebralis* (Wilson).—Body filiform, white, attenuated at both ends. Mouth terminal and nude. Male 8 mm. long, tail turned crossways; two unequal spicules 120 μ to 170 μ long. Female 14 mm. to 16 mm. long; tail straight; ovoviviparous.

Gurlt often saw the worm, either beneath the eyelids, or more especially in the lachrymal canals of Horses which were being dissected; its presence had not been suspected during life. It was also in the dissecting-room that Goubaux met with 54 of these worms.
in the two eyes of a Horse, though these organs were quite healthy. Kliem, however, saw a Horse suffering from epiphora, photophobia, and great tenderness—*verminous conjunctivitis*—with persistent opacity of the cornea. There were five *Filariae* beneath the eyelid of the affected eye. In the case observed by Railliet, the conjunctivitis was accompanied by slight decortication of the cornea. Goubaux has noticed a dilatation of the lacrymal canals.

The origin of these *Filariae* is unknown. Railliet deposited on the surface of the healthy eye of a Horse, a female full of embryos, but these did not develop into adult worms.

The treatment of this verminous conjunctivitis evidently consists in removal of the worms.

B. Ox.—The *Filaria lachrymalis* of the Ox (Gurlt) appears to have been first seen by Rhodes, of Plaisance, Gers; it was afterwards referred to by Coulom, Ancêze, Serres, C. Baillet, Randanne, etc. It is more common than that of the Horse—at least, in the South of France; in summer and autumn it is most frequently met with.

It differs from that of the Horse more especially in its length, which is in the *male* from 10 mm. to 14 mm., and in the *female* 20 mm. to 24 mm., as well as by the dimensions of the spicule of the male, one of which measures 115 μ long by 10 μ in diameter, the other 750 μ by 4 μ.

The symptoms of this conjunctivitis are the same as in the Horse. We can see where the worms crawl on the surface of the globe of the eye, and glide between the folds of mucous membrane, nearly always towards the inner angle of the eyelids; often they interlace with each other into a small bundle, which is usually lodged beneath the membrana nictitans. If the inflammation extends to the cornea, it may result in more or less deep and dangerous ulceration.

When the worms are numerous—and Guittard says he has seen more than 100 in one case—there is difficulty in extracting them all with the finger. We may then proceed as Randanne successfully did—separate the eyelids by means of flat retractors or a blepharostat, then inject as much as possible, on the cornea and beneath the membrana nictitans, of a watery dilution of tincture of camphor. The worms are in this way washed out of the eye, and a few applications of astringent lotion complete the cure. It may be useful to pass nitrate of silver lightly over the corneal ulcerations.
BOOK VIII.

PARASITES OF THE GENITO-URINARY ORGANS.

CHAPTER I.

PARASITES OF THE URINARY ORGANS. ¹

The kidneys and bladder are the only organs of the urinary system in which parasitism is manifested. It is furnished by three varied groups.

A. FUNGI.—We have mentioned (p. 617) the Fungus—Mucorimyces—found by Rivolta in the kidneys, lungs, spleen and uterus of a bitch.

B. COCCIDIA.—Pachinger found on three occasions, in the kidneys of the horse, Coccidia which he considered identical with the Eimeria falciformis of the intestinal epithelium of the mouse. In each case the alterations in the kidneys were such that death could evidently be attributed to them.

In the oesophagus, stomach and entire intestinal canal of a cat, and in the kidneys of a dog, the same authority observed a new coccidium, distinct from the Orthospora of the Triton, but, like it, belonging to the monosporean coccidia, with four falciform corpuscles.

Railliet and Lucet have described by the name of renal Coccidiosis, a parasitic affection of the goose, which first shows itself by progressive wasting without any apparent cause. After a somewhat long period, the Geese are almost incapable of walking, stand with difficulty, and generally lie immovable on their abdomen; some lie on their back with the legs apart, and if put on their feet they make some steps, fall, and resume this singular position. In every case they cease to eat, and soon thereafter die.

At the autopsy, the kidneys are found full of small whitish nodules, about the size of a pin's head; more rarely the lesions are diffused.

These nodules are formed of a considerable mass of coccidia, some of which are free, others encysted, and which have much analogy with the oviform coccidium of the rabbit's liver. They are, however, a little rounder and smaller—being 20 µ to 22 µ in their greatest diameter, and

³ Railliet and Lucet. Une Nouvelle Maladie Parasitaire de l'Oie Domestique, déterminée par des Coccidies. Comp. Rend. Soc. de Biologie (9), II., 1890, p. 293.
13 μ to 16 μ in their smallest. At the narrowest pole there is a very apparent micropyle. A certain number of these Coccidia contain a uniformly granular mass throughout the cyst; in others, the contents are gathered into a ball towards the centre.

Thin sections of the invaded kidneys show that these Coccidia are developed in the uriniferous tubes, and allow of their evolution being followed. They appear at first as round, granular, nucleated bodies, situated in the epithelial cells, the nuclei of which they push towards the base. Sometimes only one of these bodies occupies a cell, but most frequently two or three, or even more, are observed at the same time. In the latter case, it seems that a multiplication of the Coccidium—by repeated fission—occurs in the same situation; and these multiple bodies, often rendered polyhedral by reciprocal compression, form ray-like series. When accidentally removed, there is left an alveolus limited by a kind of granular matrix, which might be taken for a cell proper; but a nucleus is never observed. At other points, the epithelium of the uriniferous tube has disappeared, and in its place are Coccidia, which are already surrounded by a double-contoured envelope. Elsewhere also, well-formed Coccidia are observed in the cavity of the tubes, where the epithelium is still intact; these are evidently parasites which have been developed higher up, and are being thrown out.

Railliet and Lucet have assured themselves that these Coccidia follow the course of the urine, and are expelled in the same course, to continue their evolution. By keeping them a certain time in water, they remarked that the protoplasmic mass divides into four round sporoblasts, and that therefore they belong to the tetrasporous Coccidia of Aimé Schneider.

C. CESTODES.1—The *Cysticercus cellulose* may be found in the kidneys of the measly Pig, or in Dogs suffering from the same malady. It is only in small number, and then only when the measles is localized.

The Echinococci may also develop in the kidneys of the Pig and Ruminants, and especially in the Sheep, though they are less common than in the liver and lungs. The internal surface of the cyst is often corrugated, and its cavity traversed by bands that render it multilocular. The wall is frequently calcified on its surface or in its substance, and sometimes it appears to be ossified to a variable extent. Atheromatous deposits compress the hydatid, which is flaccid and wrinkled. The cyst may open by fissures on the surface, or into the pelves of the kidney (Rayer).

Perroncito has observed a hydatid cyst in the right kidney of a bull Zebu, and Ostertag has found three small multilocular Echinococci in the left kidney of a Bull; while Dupuy has seen them in the kidneys of

a sow. Cadéac and Malet have published a remarkable case of Echinococcus in the kidney of a Horse; they classed it with both the exogenous and endogenous types; the renal tissue had disappeared at different points, where the cyst was confounded with the enveloping tunic. Perroncito met with an Echinococcus cyst, the size of a large nut, in a Dog's kidney.

In a Dog, killed after showing rhabdomyosymptoms, Wolpert found a Tænia in the oesophagus, several in the intestines, another coiled around the left kidney and adherent to its surface; and in the pelves of each kidney a coiled up Tænia 10 to 12 cm. long. The organs were almost double their normal volume, and nearly all the medullary layer of the renal substance was destroyed and reduced into a magma of blood and pus, in the midst of which was found the parasite and the débris of the mucous membrane of the pelves. The Tæniae in the kidneys were the Tænia serrata.

D. TREMATODES.—We have seen (p. 633) that the ova of the Bilharzia crassa, found in an Ox and Sheep in Egypt, may be carried by the vessels into the bladder, whence they are expelled along with the urine.
E. NEMATODES.—Among the Nematodes of the urinary passages, some have their normal habitat there, while others are only present by accident. Some which are only met with in the larval form are, consequently, undetermined.

1. Eustrongylus visceralis (Gmelin, Strongylus gigas Rud.).—The giant Eustrongyle is, in the domesticated animals, the only representative of the tribe of Eustrongylines in the family of Strongylides. Its name is given to it because of its really gigantic dimensions.

It is generally a blood-red worm, 1 slightly tapering at the extremities, and finely striped transversely; the mouth is triangular, and surrounded by six small papillæ. Male, 13 cm. to 40 cm. long, and 4 mm. to 6 mm. broad; tail obtuse, terminated by a patelliform, membranous, entire pouch without radiæ, and traversed by a very slender, single spicule. Female, 20 cm. to 1 m. long, and 5 mm. to 12 mm. broad; tail obtuse and slightly curved; a single ovary; vulva very near the mouth. Oviparous. Ova ovoid and brownish, 68 \( \mu \) to 80 \( \mu \) long, and 40 \( \mu \) to 43 \( \mu \) broad.

The giant Eustrongle, the largest of the Nematodes, is a parasite of the kidneys, and is met with in Man, and in the Horse, Ox, Dog, Wolf, Mink, Marten, Otter, Seal, etc. It is much more frequent in the Carnivora, and especially in the Dog; but it is only exceptionally met with, though Silvestrini observed it very often at Pistoja, Tuscany, and environs, principally in sporting Dogs — setters, retrievers, pointers, spaniels, or mongrels.

The phases of its existence are not yet known. As it is perhaps not so rare among the ichthyophagous mammals, it is possible that it lives in Fish during the early period of its life. This opinion is rendered more probable by the discovery of Schneider, who has found in exotic fishes the encysted Nematodes already described by Rudolphi by the name of Filaria cystica, and which are the larvae of a Eustrongylus. Schneider inclines to class it with E. gigas, though without sufficient reason, according to Leuckart.

Balbiani 2 has recognised that the development of the ovum commences in the uterus of the female, but is soon arrested, and cannot be completed until after it has been expelled from the body of the host, and brought in contact with water or damp soil. Between this later period and the appearance of the embryo, there elapse five or six months if winter intervenes, but it is probably shorter if summer is included. The embryo may remain for more than a year without perishing. When put into pure water and hatched artificially, this embryo rapidly undergoes change; as it does not thrive well except in albuminous fluids, and will not resist more than a few days' desiccation. It is 240 \( \mu \) long and

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1 This colour appears to be due to the fluid in which the worm lies, and on which it subsists; for Chabert has found it to be white among pus.

14 μ broad, cylindrical, and gradually tapering posteriorly; the head is pointed, mouth terminal and having no papille, but it is provided (?) with a small protractile chitinous dart, which doubtless serves the young worm as an organ of penetration. Balbiani has not succeeded in hatching these ova in the digestive canal of the Dog, various Fishes, Snakes and Tritons, nor in river Prawns.

The Dog, Horse, and Ox are the only domesticated animals in which the giant Eustrongle has been found. The majority of observations have reference to the Dog.

Dog.1—It might be supposed that the presence of a giant Eustrongle in the urinary passages would cause acute pain, but in many of the observations this parasitism was not revealed by any symptom during the life of the animal, and was a surprise at the autopsy. In other instances, however, the parasite has often caused grave disturbance in the health of its host. Sometimes it has been a continued wasting, terminating in consumption (Cesalpin, De Sillo); at other times the suffering has been betrayed by cries and howlings uttered night and day (Kerckring, Boirel, Liefmann, Heucher, Van Swieten); or the Dog has walked with its body curved to one side—that corresponding to the invaded kidney. It is probable that, at a certain period, the urine is sanguinolent or purulent. When the worm is in the ureter, it causes retention of the urine and distension of the kidney (Redi); when in the bladder, it acts as a foreign body, and micturition is effected drop by drop (Fr. Franck); and when it has penetrated to the peritoneal cavity, there are indications of peritonitis. In a case reported by Magnié,2 the only symptoms were vomiting and asphyxia, five minutes before death; the worm was in the left pleura.

In several cases, the presence of the giant Eustrongle has caused such a degree of nervous disturbance as to raise suspicions of rabies; indeed, in Boerhaave’s time that malady was attributed to invasion of the kidney by this parasite. In a case observed by Mathis, a setter was seized in the field with great uneasiness, gave out cries of pain, had convulsions, attempted to bite, refused to eat, and gave strong evidence of rabies. It died two days afterwards; the Eustrongle had escaped from the right kidney, and lay in the peritoneal cavity among the intestinal convolutions. Two cases almost identical are reported by Cusa; in each, the worm was in the left kidney. Lissizin has seen in a Dog drowsiness, automatic movements, foaming at the mouth, champing of the jaws, grinding of the teeth, marked increase in the pulse and respiration, and convulsions at intervals. Death occurred at the end of the third day, when it was discovered that the Eustrongle was lodged


in the left lobe of the liver.\textsuperscript{1} Silvestrini has seen several cases of this kind, and has remarked that the animal's expression is somewhat different to that observed in rabies; the physiognomy expresses intense suffering rather than ferocity, and the eye is not salient and sparkling as in the mad dog, but retracted and partially covered by the membrana nictitans.

It is not possible to foretell what will be the result of renal eustrongylosis, but it would appear to be the tendency of the worm to quit the kidney when it has destroyed its substance—as with those which have been found in the peritoneal and pleural cavities, or lodged in the ureter or bladder. The worm may pass into the urethra, but there it is stopped by the penial bone; it then perforates the canal, and locates itself in the connective tissue. U. Leblanc has observed three cases of this kind, in which the worm was not manifested by any other symptom than the rapid formation of a tumour the size of the fist in the perineal region, close to, but behind, the testicle. The obstacle offered by the constriction of the urethra is not absolutely insurmountable, as Lacoste has seen a Dog evacuate a giant Eustrongle by this canal—the expulsion being preceded and accompanied by acute pain, and followed by the discharge of 'about two spoonfuls of blood.' Recovery ensued almost immediately.\textsuperscript{2}

Mégnin has witnessed an exceptional mode of expulsion. A Bitch presented a mammary tumour in the neighbourhood of the umbilicus, which, on being incised, gave exit to a giant Eustrongle. Recovery in this case was also rapid.\textsuperscript{3}

The giant Eustrongle is developed in the kidney, probably occupying at first the pelves or calices, and its presence there causes grave disorders. The tissue of the organ is gradually destroyed; the vessels—which resist for a long time—are damaged, and this leads to frequent haemorrhages, and the worm is usually immersed in a sanguinolent fluid. At last the vessels disappear, and the enveloping tunic of the kidney forms the only wall of the tumour, which has acquired a varied, but always considerable, volume, and the fluid contents of which is chiefly blood. This tunic of the kidney, in being distended, becomes thickened, and assumes the appearance of the perinephritic fat. Partial ossification of the internal membrane of the renal pouch has been twice noted by Miller, in the Mink of America. The pelves undergo the same dilatation as the kidney, as may also the ureter; though Drelincourt and Sperling have found that canal obliterated. In a case described by Ruysch, besides two Eustrongles, there was a calculus that completely closed up the pelves.


\textsuperscript{3} Mégnin. Comp. Rend. de la Soc. de Biologie, 1889, p. 304.
PARASITES OF THE URINARY ORGANS.

It has never happened, says Davaine, that more than one kidney has been invaded, and the size of the healthy one is usually more considerable than in the normal state. Most frequently there is only one Eustrongle—rarely are there two. Verney, however, has found four in a Dog, and Klein eight—six males and two females—in a Wolf.

The Eustrongle may be met with elsewhere than in the kidney, as has been said when dealing with the symptoms. Redi has found one occupying the kidney and part of the ureter; Kerckring, another extending the whole length of the ureter; and Franck, one lodged in the bladder. When met with outside these organs, it has been generally in their vicinity, and it is probable that the worm has primarily developed in the urinary passages. Such was Mégmin's case and the three cases of U. Leblanc already referred to. In one of the latter the verminous tumour had a pedicle, manifestly indicating a previous communication of its cavity with the ureter. Plasse found three giant Eustrongles which had found their way into the peritoneal cavity, after breaking through the shell of the kidney, which still partly enveloped that organ; the other two remained in the kidney—or rather in the place of that organ—as it had completely disappeared. Stratton, in Canada, had already observed a similar case; as had Peuch, Mathis,
and Méggin.

In the case of the latter, it was remarkable that the kidneys were still healthy. There are also the cases observed by Rivolta (giant Eustrongles on the surface of the liver), Lissizin (Eustrongle in the left lobe of the liver), Magnié (Eustrongle in the pleurae), Gréhant, quoted by Balbiani (three Eustrongles in the peritoneum). In a case reported by Silvestrini, two Eustrongles were developed in the abdominal cavity, but they had caused intense hyperaemia of the kidneys, which they appear to have sucked by fixing themselves on their surface. And there is the doubtful case given by Jones (p. 636), who found the same (?) worm in the right ventricle of the heart of a Dog.

The diagnosis of the giant Eustrongle in the urinary apparatus offers great difficulties, generally. Suspicion should be aroused, however, by the emission of blood-coloured urine or blood-clots, coincidently with the manifestation of rabiform symptoms; and the suspicion would be confirmed if, on a microscopical examination of the urine, the ova of the Eustrongle, with all their essential characteristics, were found in it.

If the diagnosis were established, then perhaps the administration of oil of turpentine would cause the worm to emigrate. Silvestrini thought extirpation of the worm might be attempted. If it were decided that the parasite was located in the bladder, then urethrotomy could be practised. Finally, if it caused the formation of perineal or mammary tumours—as in the cases of Leblanc and Méggin—nothing could be simpler than puncturing them and extracting the Eustrongle.

**Horse and Ox.**—Chabert describes having found a giant Eustrongle in the left kidney of a Mare; the gland was very voluminous, full of a purulent fluid, and the worm was white. Rudolphi also had a specimen obtained from a Horse; 1. Leblanc met with one in the kidney of a Horse, and Labat discovered another in the kidney of a Mare, which had not shown any symptoms during life that could lead to a suspicion of its presence.

Rudolphi says he had a giant Eustrongle that came from an Ox. Diesing alludes to a specimen in the Museum of the Alfort Veterinary School, which had the same origin. Greve observed a Bull which, for nearly a year, had suffered from dysuria, and later the urine was mixed with flakes of mucus; the left kidney of this animal was transformed into an enormous cyst filled with a foetid purulent fluid, in which was a giant Eustrongle.

**11. Armed Sclerostome** (Sclerostoma equinum Müll., Strongylus armatus Rud.). 3—The agamous form of this worm, which lives in the

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branches of the posterior aorta in the Equidae, may be found in the renal arteries. The verminous aneurisms of these arteries or of the aorta may, according to Lustig, be the starting-point of nephritis by embolism.

Sclerostomes may also be met with even in the kidney. Walters found two in each kidney of a paraplegic Mare, and Bowler has made several observations of the same kind in Mules. These worms may be likewise encountered in the neighbourhood of the kidneys, in the adipose mass surrounding them, where they are sometimes in large quantity (Harvey, Couchman, Meyrick, Lienaux, and Colson, who found them at the same time in the pelves of the kidneys).

III. Stephanurus dentatus (Dies.). — This worm, already described as a parasite of the peritoneum of the Pig (p. 551), and especially in America, where it infests the adipose tissue around the kidneys, may enter these organs and the supra-renal capsules, and produces purulent cavities in them.  

IV. Trichosoma plica (Rud.). — This lives in the urinary bladder of the Fox and Wolf; and Bellingham has also found it in the Dog in Ireland. It is probably the same worm that Bochicha-Nigris encountered, to the number of fifty, fixed on the mucous membrane of the bladder of an experimental Dog, which during life passed a sedimentary urine that contained numerous ova of the Trichotrachellidae. Besides the characters of the genus (see p. 658), the Trichosoma plica shows the following: the male is 13 mm. to 30 mm. long, scarcely tapers behind, where it terminates in a point, and has a very long spicule in a sheath that is transversely ridged. The female is 30 mm. to 60 mm. long, has an obtuse tail, the anus is terminal, and the vulva is situated in the anterior part of the body.

V. Trichosome of the Cat (Trichosoma Felis cati, Belling.). — This Trichosome was discovered by Bellingham in the bladder of a wild Cat. Wedl has met with it in a domesticated Cat; only females were found, and they were from 14 mm. to 16 mm. long, scarcely tapering behind; the majority of them were coiled in a spiral manner, and were difficult to recognise without the aid of a pocket-lens.

VI. Larvae of Indetermined Nematodes. — These larvae of Nematodes were observed for the first time by Vulpian in 1866, and again studied by Bochefontaine. In the kidneys of the Dog they cause the formation of small pearly-white tumours about the size of a tobacco-seed to that of a hemp-seed, and which are spherical or flattened. They are situated beneath the proper capsule of the kidney, in the cortical substance, and do not usually project beyond the surface. In Vulpian's case there were from 80 to 100 of these tumours in each kidney; and Bochefontaine found them in ten of thirteen Dogs, in numbers varying from 4 to 38. They were formed of a small hollow sphere, the wall of which was made up of concentric layers of connective tissue, and was generally surrounded by the uniriniferous tubes and glomeruli of Malpighi; the latter were dragged away with the small tumours when these were enucleated, which was otherwise easy. In only a small

number of the tumours was found a Nematode about 3 mm. long (Vulpian), 140 μ to 210 μ long, by 10 μ to 15 μ broad (Bochefontaine). Cylindrical in its anterior moiety, tapering for a long distance posteriorly, and the mouth surrounded by mammillated prominences, this was twisted in a ring-like form, and was destitute of sexual organs. It had certainly been destroyed in the majority of the nodules, by regressive phenomena.

Ebstein and Nicolaier have made a more complete study of these granules. Their size did not exceed that of a pin’s head, and by their histological constitution, dimensions, external appearance, and the regressive phenomena of which they were the seat, they had the same formation as tubercles, properly so called. The worms extracted from them had very distinct movements; they were 363 μ long and 15 μ in diameter at their anterior extremity. Ebstein and Nicolaier found similar nodules in the lungs, where Bochefontaine had also seen them.

The situation of the nodules in the cortical substance compels us to admit, along with Bochefontaine, that the parasites had been brought there by the blood, as it is not the ordinary seat of small infarcts caused by emboli. The genus to which larvae of these Nematodes belonged could not be determined.

The other larval Nematodes found by Ebertz in the muscles, kidneys, and lungs of a Sheep may here be recalled to memory (see p. 585).

F. ACARI.—Mention has been made (p. 244) of the tubercles of Cytodites nudus found by Holzendorff in the kidneys, at the same time as in the lungs, liver, etc., of diseased Fowls.

G. LARVAE OF THE CESTRIDÆ.—At the autopsy of a Norman Stallion, which died in thirty-two hours from violent colic, Pagliero found nothing abnormal except thickening of the parietes of the bladder near the cervix; two larvae were deeply implanted in the mucous membrane, which was injected in red streaks. These larvae were stated to be those of the Gastrophilus haemorrhoidalis Linn., which, in its primary state, is parasitic in the gastro-intestinal canal. To explain the very unusual situation of these two larvae, it would be necessary to admit that they must have crawled from the anus, while the Horse was lying down, to the urethral opening, and, wandering along that tube, have reached the bladder.¹

CHAPTER II.

PARASITES OF THE GENERATIVE ORGANS.

We have here only to notice some cases of accidental parasitism.

Mammalia.—A. Males.—Sclerostoma armatum Rud.1—The agamous form of this worm has been encountered more frequently in the spermatic than in the renal arteries of the Horse. Gurlt had already noticed the presence of these worms in the vaginal sheath. Aitken once saw an armed Sclerostome in the spermatic artery of a Foal, and Baird found one in the testicle of a Horse. Clancy met with thirteen on the surface of the testicle of a three-years-old Horse; the gland was indurated, and the envelopes infiltrated. Brodie published a similar case. At the London Veterinary College one worm was found in the spermatic artery of the Ass, and another in a funiculitis consecutive to castration. It is remarkable the frequency with which these worms occur in the abnormal testicles of Horses affected with abdominal cryptorchidism. We met with a case of this kind in May, 1883; and Simonin and Jacoulet encountered three in the space of two months, the testicles having undergone fibrous degeneration. On incising the testicle of a cryptorchid which was normal in structure, Degive met with an armed Sclerostome. It would be interesting to ascertain the relation in frequency between cryptorchidism and testicular parasitism. What is certain, is that the concealed testicles of Horses affected with abdominal cryptorchidism often exhibit such alterations as fibrous tumours or serous cysts.

Filaria equina Abild. (F. papillosa Rud.).2—In Stallions affected with hydrocele, Schmidt and Pottinger have remarked one or two specimens of this worm in the vaginal sheath. Their presence is easily explained by the communication that exists between the abdominal cavity and that sheath.

B. Females.—The Mucorymynces of Rivolta (see p. 617) is found in the uterus, kidneys, spleen, and lungs of the Bitch.

There was probably some mistake or insufficiency in Girard’s observation of a case, in which undetermined Tamiae were found in the uterine cavity of a Mare affected with metritis.3


During the summer we may find in the orifice of the prepuce, or in the labia of the vulva—even without a wound—larvae which have been deposited by species of Diptera capable of developing cutaneous myiasis, and which has been already noticed (p. 40). This occurrence is frequent at the Chalons camp in Horses and Mares, but the species which is thus provisionally parasitic has not been determined. In a pregnant Cow, Awde found in the walls of the vagina, about 8 cm. from the vulva, asperities due to a quantity of larvae which were imbedded as deeply as the muscular layer.¹

Birds.—The *Distoma cuneatum*, Rud., which is a parasite of the intestine of the Bustard, has been found in the oviduct of the Peacock by Gurlt (Diesing). It is a white worm with brown spots, from 3 mm. to 7 mm. long, tapering in front in the form of a cone, and the ventral sucker is nearly twice as wide as the oral one. Rudolphi saw in this worm a great affinity to the *Distoma ovatum* (see p. 481).

Parasitism of the oviduct, which is quite accidental, more particularly leads to the presence of vegetable or animal parasites in the interior of the ovum; but for details on this subject we must refer to the special memoirs which have been published with regard to it, and in which all the facts are enumerated and analyzed.²

Suffice it to say here, that on many occasions there have been found in the air-chamber—and even in the albumen—of Fowls' eggs, various of the lower Fungi more or less closely related to the *Aspergillus glaucus*, *Penicillium glaucum*, *Mucor solonifer*, *Botrytis*, *Styronas*, *Macrosorium*, *Leptomitus*, *Sporotrichum*, *Dactylium*, *Hatoephora*, etc. There they form various coloured groups, and produce an alteration in the substance of the egg. They may gain admission to it through the pores of the shell, but more probably they are there before the shell is formed, having passed from the rectum into the oviduct.

Fragments of *Tenia* (Noll, quoted by Zürn), the *Distoma ovatum* (Hanow, Perkinje, Escholtz, Shelling, etc.), and the *Heterakis inflexa* (Krabbe, Zürn, Zembelli, Benci, Grosoli, Meloni, etc.), have been found under the same conditions.

Bonnet has on two occasions remarked on the presence of the ova of a Distome in the albumen of Fowls' eggs, without the parasite being found in the oviduct.³

Podwysszokzi⁴ has often seen in the white of the Fowl's eggs, after being cooked, small gray or black spots, composed of masses of encysted Coccidia, or of their free spores. He has noticed them more in eggs produced in summer, and in certain localities. These parasites may cause eggs which have been kept for a long time to appear as if rotten.

It is not known if they are due to a coccidiosis of the oviduct, where they incorporate themselves with the albumen, or if they originate from intestinal Coccidia which have ascended by the cloaca.

In any case, Podwyssozki believes them to be identical with the Coccidia that are found in the hepatic cells of Man, and which he has described under the designation of *Kariophagus hominis*.

Human infestation is due to eating such eggs insufficiently cooked, as the gastric juice only dissolves the capsule of the Coccidia, setting the spores at liberty.
ALPHABETICAL INDEX OF AUTHORITIES REFERRED TO.

Abildgaard, 14, 114, 168, 560
Abou Bekr Ibn Bedr, 325, 331
Adams, 262, 331, 755, 757
Adenot, 541
Atkén, 771
Alberca, Jiménez, 755
Albrecht, 727
Alessandrini, 470, 551, 634
Alibert, 115
Alíx, 634, 688
Alt, 231, 232
Am-Pach, 166
Ancze, 760
Anderson, 399
Andrá, 347
André, 718
Andréé, 748
Andréux, 630
Androsthenes, 668
Andry, 13
Anel, 538
Araujo, Silva, 370, 639, 646
Archigenes, 668
Artéus, 668
Aristophanes, 668
Aristotle, 668
Arloing, 478, 677
Arnould, 689
Atkinson, 757
Aubé, 115
Aubert, 308
Audouy, 289
Anreggio, 291
Anstruy, 43
Avéline, 114
Avenzoar, 112, 113, 168, 265
Awde, 772

Babes, 342, 567
Baillot, C., 348, 364, 389, 407, 427, 447, 469, 497, 554, 641, 651, 729, 759, 760
Baillot, L., 668, 684
Baird, 771
Bakewell, 523
Bakody, 375
Balbián, 4, 437, 501, 619, 659, 764, 768
Balzer, 271, 282, 304, 305
Bancroft, 103, 638
Barat, 142
Barausprung, 213
Barron, 482
Barrucello, 261
Bary, De, 1, 10
Baseau, 668, 664
Bass, 340, 457, 658
Bastian, 722
Bateman, 197, 299
Batsch, 448
Batteford, 727
Baumgarten, 657
Baur, 35
Bay, 634
Bazin, 275, 291, 295, 299, 301, 312
Beale, 663
Beattie, 535
Beaumais, 663
Bechstein, 87
Beisswanger, 634
Belfield, 720
Bell, 210
Bellingham, 596, 769
Belon, 167
Benci, 772
Bendz, 749
Benecke, 719
Beneden, E. Van, 692
Beneden, P. J. von, 1, 95, 231, 460, 560, 657, 677, 729
Bénion, 487
Benjamin, 452
Bennett, 300
Beorelia-Nigris, 769
Bérenger-Féraud, 201
Berg, 336
Bergemann, 289
Bergeon, 652
Berlese, 110
Bernard, Ch., 503
Bernard, L., 255
Bertheraude, 646
Berthold, 211
Berto, 657
Bertholus, 418, 419, 500, 681
Bertuetti, 694
Besnier, 143, 231, 292, 306
Beucler, 179
Beugnot, 396
Bewley, 584
Biet, 199, 205, 299
Biggs, 691
Bilharz, 632
Bizzarı, 755
Blaise, 108, 261, 331, 401, 421
Blainville, De, 652
Blanchard, 619
Blanchard, K., 44, 62, 163, 228, 229, 231, 263, 394, 430, 488, 558, 617, 632, 659, 699, 755
Blavette, 331, 482
Bleiwiss, 657
Bloch, 494
Blumberg, 396, 404, 554, 598
Boas, 741
Bobe-Moreau, 639, 641
Bochefontaine, 769
Drum, 411
Bogdanoff, 163
Bogren, 379
Bohemian, 354
Bohler, 703
Boire, 765
Bollinger, 268, 451, 510, 517, 579, 580, 623, 634
Bomford, 633
Bonizzi, 613
Bonnard, 630
Bonné, 202
Bonnet, 772
Bonomo, 113
Bonteke, 197
Bovinici, 534
Bory de Saint-Vincent, 231
Bosc, 151, 168, 202
Bosculte, 228, 229
Bosis, 644
Bouchard, 231
Boucher, 289
Boucheron, 745
Boucot, 792
Bondeau, 197
Bouisson, 717
Bouley, 233, 257, 287, 717
Bouman, 42
Bourgiquignon, 84, 107, 112, 116, 118, 208, 215, 233
Briuuer, 778
Bracey Clark, 14, 50, 53, 55, 351, 568, 571
Brand, 755
Brauer, F., 44, 46, 348, 568
Bräuer, 280
Braun, 457, 490
Bremser, 9, 513, 560, 632, 726
Brenneman, 755
Breton, 757
Brin steiner, 510
Brôdie, 771
Broquet, 653, 753
Brossard-Mirsillac, 685
Brousson, 547
Brouvier, 755, 759
Brown, 756
Brown Sequard, 745
Bruckmeill, 470, 560, 630, 634, 741
Brunet, 728
Brunswig, 254
Buruafcro, 534, 576, 663, 668, 672
Brussee, 223
Burlet, 85
Bugnon, 583
Bunck, 551
Burchart, 118
Burdach, 9
Burke, 246, 257, 580, 619
Burkli, 244, 397
Buquet, 397
Butler, 410
Cadet, 153, 452, 520, 747, 762
Cadot, 123, 124, 208, 247, 301, 314
Calaspin, 755
Cagnat, 181
Cagny, 153, 343, 452, 747
Caillet de Poncey, 717
Calandruccio, 357, 431, 446, 637
Calemeil, 745
Calvo, 331
Canberquere, 509
Canbron, 359
Camper, 591
Capanini, 241, 453, 646, 687
Carita, 427
Carnet, 583
Carpet, 201
Carrère, 142, 275, 276, 289
Carswell, 501
Carter, 521
Cartwright, 512
Carucio, 772
Cato, 167
Cassé, 233
Cauvet, 335
Cazenave, 289
Celii, 621
Celsius, 112, 167
Cer live, 360
Cestoni, 113
Chaboux, 289
Chaignaud, 758
Chaintre, 398
Chandelle, 289
Chantenesse, 343, 615
Chardin, 583
Chatelin, 229
Chatin, 596, 606, 698, 699, 706
Chaucer, 167
Chauliac, Guy de, 271
Chatouc, 596
Chaussier, 142
Chavevau, 448, 449, 500
Chavrat, 564, 565, 599
Chavassie d'Andebert, 142, 205
Chevalier, 200
Clais, 755, 759
Clancy, 771
Clarkson, 224
Claver, 221
Clément, 178
Cloquet, 433
Closs, 694
Clois-Bey, 263
Clot, 606
Cockrill, 566
Cohnheim, 703
Colin (of Auxerre), 560
Colin (of Alfort), 125, 300, 371, 392, 401, 106, 561, 564, 583, 603, 653, 704, 705, 710, 716, 718
Collias, 639
Colson, 763
Colucci, 500
Colomella, 157, 167
Conche, 313
Condamine, 255, 401
Cone, 570
Cormon-Houl, 360
Cornevin, 216, 221, 224, 677, 687
Cornil, 396, 477
Couchman, 768
Coulon, 760
Court, 616
Courtin, 599
Couss, 101, 192, 397
Cox, 422
Crépin, 355
Creplin, 453, 470, 561
Creutzburg, 530
Crisp, 606
Crookshank, 619
Cross, 422
Cruveilhier, 578
Cruzel, 108, 734
Csokor, 189, 222, 224, 225, 235, 249, 296, 355, 367, 569, 662, 704
Cunier, 756
Cunningham, 639
Curtece, 51, 366, 419, 423, 426, 473, 579, 584
Cusa, 765, 766
Cuvier, 560
Damat, 398
Dammann, 665
Danilewsky, 847
Danxbenton, 175, 356, 363, 353
Davaine, 10, 11, 370, 389, 396, 473, 475, 502, 517, 560, 596, 639, 646, 653, 724, 728, 755, 765, 767
De Bury, 1, 272
Decroly, 623
Deffke, 433, 639
Defrance, 107
Degive, 771
Deguilláne, 597, 758
Dekors, 503
Delabère-Blaine, 142, 454
Delamotte, 279, 358, 399, 454, 577
Del Chiappa, 553
Delpré, 501
Delorme, 541
Delpesch, 668, 712
Delprato, 87, 226, 241, 244, 268, 302, 374, 458, 496, 612
Delwart, 210, 233, 341
Demarbaix, 42
Demetrius, 623
Dennily, 233
Demontigny, 641
Demons, 309
Denny, 77
Descomps, 414
Deslongchamps, 491
Despallens, 591
Dick, 565
Didry, 521
Dieckhoff, 356, 393, 516, 623, 711
Diving, 410, 425, 491, 561, 595, 695, 757, 768
Dieu, 291
Dieulafay, 343, 615
Dobell, 515
Dorssel, 263
Dorfeville, 115, 158
Doyon, 143, 231, 306
Draper, 309
Dracre, V., 425
Dreilincourt, 796
Dreschler, 417
Dresser, 503
Dronon, 456, 457
Drosier, 654
Drouilly, 253, 255
Dubreuilh, 612
Dubuisson, 398
Duckworth, 280
Duchaux, 273, 283, 296, 311
Dufour, 565
Dufour, L., 687
Dugès, Al., 103, 105
Duges, Ant., 100
Duguid, 579
Dujardin, 151, 389, 404, 433, 500, 561, 596
Duméril, 107
Dun, 148, 454
Duncan, 304
Duncia, 654, 711
Dupont, 142
Dupuy, 566, 513, 523, 687, 723, 756, 762
Durieux, 623
Durréchon, 755
Dutriex, 57
Eassie, 511, 576
East, 511, 512
Ebel, 596
Eberth, 339, 603
Ebertz, 585, 770
Eboin, 604, 769
Eggeling, 337
Ehlers, 606
Eichenerger, 694
Eichler, 593, 729
Eichstedt, 115, 118
Eckehart, 115, 118
Eckekrantz, 430
Eletti, 358
Eellenberger, 207, 327
Eloire, 109, 233, 594
Emert, 613
Enaux, 142
Engelman, 197
Eppe, 299
Erolani, 253, 359, 315, 347, 457, 459, 470, 541, 634, 639, 657, 679
Erdl, 231
Erickson, 213
Ernst, 275, 289
Escholtz, 772
Essrich, 898, 729
Ettmüller, 113, 158
Evans, 619, 632
Evvard, 279
Fabricius, Otto, 669
Fadyean, Me, 511
Falk, 536
Farez, 235
Faure, 758
Fauret, 142
Faxon, 226
Fedeschko, 265, 367, 396, 483
Fehr, 275, 289, 298
Feltti, 648
Feltz, 627
Fenger, 205, 250, 288, 292
Fornbach, 313
Ferrarin, 694
Ferrara, 457
Fessler, 712
Feulard, 271
Fedler, 794
Filippi, De, 490
Finck, 457
Fisched, 515
Fioreniti, 360, 392
Fischer, 410, 522
Fjord, 716
Flaubert, 200
Fleming, J., 690
Flesch, 392
Florman, 561, 675
Forbes, 263
Forster, 733
Forthomme, 331
Foucher, 675
Fournier, 718
Fox, T., 289, 291
Franchi, 741
Franck, F., 765, 767
Franck, L., 411
Frank, L., 201
Frank (of Preyer), 315, 410
Frenimont, 398
Frenzel, 734, 735
Fresenius, 613
Friedberg, 107, 145, 172, 205, 216, 217, 222, 241, 249, 250, 279, 288, 401, 427, 432, 455, 517, 623
Friedreich, 309
Friedrich, 703
Frisch, 492
Franier, 145, 172, 206, 217, 279, 282, 423, 623
Frohlich, 561
Fromage de Fréger, 108, 550, 731
Frommann, 521
Fuchs, 233
Fulk, 212
Fünfstock, 289
Fürbinger, 208
Fürstenberg, 112, 113, 116, 118, 173, 193, 198, 203, 208, 248, 729
Gacon, 687
Gaffet de la Brifardière, 207
Gallieon, 289
Galeb, 638, 639
Galès, 115
Galligo, 291
Galtier, 639, 685
Gammes, 423
Gangolph, 724
Garcin, 731
Gasparin, 168, 176, 542, 728
Gassner, 235
Gavard, 399
Gayon, 772
Geber, 231, 233
Gee, De, 103, 114
Gellé (of Paris), 561, 743
Gelle (of Toulouse), 275, 276
Gomma, 521
Gammern, Von, 197
Generali, 399, 457, 458, 544, 612, 623
Gerard, 156
Gerard, 142
Gerlach, 42, 113, 116, 118, 158, 164, 198, 203, 208, 211, 216, 243, 275, 276, 279, 286, 283, 300, 302, 398, 517, 687, 727, 729
Gerlier, 289, 291
Germain, 32
Gervais, 92, 121, 199, 212, 213, 230, 231, 636
Geschiedt, 750, 759
Ghilitani, 228
Giard, 655
Gibb, 757
Gibier, 717
Gieres, 734
Gigard, 298, 314
Girard, 512, 771
Girard, C., 718
Girard, M., 397
Giron, 142, 731
Giron de Buzarengue, 731
Girtanner, 208
Gluge, 309
Godine, Jun., 178
Goze, 14, 451, 494, 596, 729
Gohier, 114, 151, 155, 160, 168, 192, 202, 208, 597
Goldsmith, 231, 233
Golgi, 357, 291
Goodall, 42, 595
Got Nerie, 142, 205
Gotti, 744
Goubaux, 363, 632, 634, 653, 759
Goudot, 50, 56
Goujon, 704, 712
Gourdon, 200
Grancher, 706
Gras, 115
Gratia, 597, 672
Gratzwitz, 337
Green, 63
Gregory, 511, 512
Grehant, 765
Grelhes, 757
Greve, 142, 396, 560, 765
Grey, 588
Griffith, 263
Grimm, 226, 510, 634
Grisoni, 758, 759
Grognie, 142, 158, 205, 275, 287, 521
Gros, 214, 215, 226
Grosoli, 772
Gruby, 212, 213, 214, 216, 219, 275, 276, 299, 360, 393, 636
Gsell, 182
Guardia, 668
Gubler, 503
Gudden, 118
Guillard, 25
Guillebeau, 510, 691
Guinard, 222, 223
Guittard, 415, 755, 760
Gunn, 262
Gunther, 855
Gurth, 116, 203, 233, 561, 579, 634, 636, 724, 729, 759, 772
Guyon, 531
Guyot, 397
Guizzoni, 123, 623, 749
Haas, 292
Hable, 192
Hadinger, 338
Hafner, 289
Hager, 737
Hahn, 214, 536
Hake, 289
Hall, 590
Halle, 106
Hallez, 395
Haller, 272
Hamann, 447
Hamon, 201
Hamont, 520, 522
Hannibal, 112
Hannover, 299
Hanow, 772
Hanyet, 754
Hapfen, 654
Hardy, 310, 312
Harms, 366, 510, 634
Hartenstein, 577, 740
Hartmann, 422, 555
Harvey, 656, 768
Haselbach, 759
Haslam, 200
Haubner, 173, 216, 222, 719, 729
Hauptmann, 113
Hausmann, 634
Havemann, 115
Hayem, 610, 612
Hebra, 183, 203, 270
Hekmeyer, 197, 205
Hedley, 579
Heill (Van), 727
Heincke, 755, 756
Heller, A., 236, 246, 658, 681
Heller, G., 236
Henderson, 192, 233
Hengst, 694
Henle, 212, 603
Henning, 570
Herbet, 223, 224
Herbst, 659, 702, 712
Hering, 110, 162, 175, 202, 205, 211, 396, 461, 623, 630, 734, 735, 748
Herrmann (of Strasbourg), 93, 567
Herrmann (of Vienne), 561
Hertwig, 50, 117, 142, 202, 205, 211, 520, 671, 689, 711
Hervieux, 680
Hess, 654
Hessling, Von, 663
Heucher, 765
Hewlett, 690
Hildegarde, Saint, 113
Hilton, 700
Hirxichen, 741
Hintermüller, 289
Hodgson, 623
Hoven, Von de, 756
Hoffer, 224
Hoffmann, 272
Hofmeister, 207, 677
Hogg, 311
Hohenleitner, 182
Hokmayer, 733
Hollenbach, 581
Holzendorf, 243, 770
Hope, 40
Hopkinson, 757
Horand, 286, 309, 313
Horning, 299
Hosseus, 153, 747
Houlès, 289
Howard, 34
Howell the Good, 168
Hoysted, 641
Huber, 510, 753
Huet, 668
Humbert, 681
Humbold, 412
Hunter, 724
Hürlimann, 396
Hurtel d'Arboval, 274, 432, 680
Hussem, 263
Hutchinson, 756
Hulton, 594
Huard, 55, 198, 330
Ijima, 545
Imbert, 200
Innes, 263
Herbet, 223
Isaac, 639
Israel, 711
Itzigsohn, 231
Jacoby, 173
Jacoulet, 771
Jacquemart, 300
Jäger, 614
Jailard, 695
Jakinoff, 622
Janiére, 271
Janné, 593
Janze, 176
Jehan de Brie, 164, 517
Jenner, 513
Jennes, 42
John, 162, 501, 663, 711
Jolicoeur, 693
Jolivet, 719
Joly, 48, 55, 56, 351
Jolyet, 635
Jones, H., 506
Jones (of Philadelphia), 636, 641, 768
Jong, De, 544
Jongh, 666
Joseph, 531
Judas, 689
Judec, 231
Jubel-Renoü, 274
Julien, 62
Juvenal, 167
Kaiser, 434
Kallmann, 689
Kalm, 103
Kaposi, 231, 306
Karschin, 696
Kaschin, 516
Kauffmann, 502, 561
Kay Lees, 36
Kegelaar, 162
Kehm, 181
Kummerer, 86
Kennedy, 755, 756, 757
Kerckring, 765, 767
Kersing, 114
Kienert, 601
Kipp, 755
Kirby, 92
Kirkman, 653, 727
Kitt, 650
Kitt, T., 547, 612
Klebs, 172
Klein, 767
Klien, 759
Klingau, 192
Kloepch, 708
Kuebelsch, 679
Knock, 659
Knox, 695
Kobner, 310
Koch, 585, 585
Kocourek, 196, 432
Kohler, 433
Kolliker, 472, 707
Kollreuter, 275, 289
Königsdörffer, 703
Korzil, 367
Kowack, 290
Kowalewsky, 590
Kraatz, 703
Krabbe, 396, 399, 404, 438, 447, 449, 457, 458, 461, 469, 470, 515, 639, 716, 772
Kral, 273
Kramer, 231, 233
Krans, 411, 660, 755
Krionogow, 379, 394
Kruilikowski, 219
Küchenmiller, 213, 561, 681, 719, 729
Kühn, 272, 710
Kühn, J., 660
Künckel, 229
Künstler, 430, 475, 635
Labarrère, 512
Labat, 646, 786
Laboulbène, 23, 35, 41, 62, 104, 209, 691, 719
Lacoste, 785
Lennec, 497
Lafon, 755
Lafore, 53, 108, 275, 276
Lafosse, 142
Lafosse, 216, 221, 274, 359, 644, 675, 728, 738
Lagrange, 90
La Guérinière, 151
Lahogue, 452
Laillier, 293
Lamarcq, 590
Lamy, 254
Lancereaux, 292
Lang, 501
Lange, 628
Lanquetin, 115, 247
Lanzillotti-Buonsanti, 639
La Peyronnie, 639
Larger, 291
Latreille, 228
Laudon, 560
Laulanié, 216, 220, 257, 498, 594, 600, 692, 903, 645, 660
Laveran, 621
Lavergne, 142, 275, 289
Lax, 230
Lebert, 299
Le Bisban, 727
Leblanc, C., 657
Leblanc, U., 205, 623, 687, 766, 768
Leblond, 726
Leclainche, 511, 576
Lefèvre, 556
Legallois, 561
Legge, 713
Legros, 375, 603, 638, 704
Leidy, 106, 433, 470, 471, 639, 702, 744
Leisering, 300, 302, 451, 636, 665, 687, 719
Lejtényi, 397
Lemaître, 293
Lemichel, 331, 334
Lemke, 596
Lendelfeld, 270
Lenoir, 43
Léniez, 477
Leonhard, 205
Leroy, 90
Lesbre, 687
Leske, 729
Lespèes, 434
Lespiau, 289
Lessonna, 559
Letenneur, 289
Letort, 731
Leunis, 654
Leuwenhoek, 13
Levi, 594
Lewis, 632, 636
Leydig, 213, 214, 215
Leymacher, 253
Liard, 606
Liautard, 254
Lichtenstein, 451
Liebkühn, 472, 502
Liefmann, 765
Liénaux, 547, 575, 576, 656, 768
Ligustini, 43
Lindemann, 663
Lindgäst, 224, 225, 579
Link, 299
Linnæus, 33, 114, 158, 168, 457
Linossier, 336
Linstow, Von, 374, 410, 416, 483, 491
Lippold, 675
Lissizin, 765, 766, 768
List, 361
Litt., 361
Littlewood, 371, 580
Littroc, 205
Livingston, 35, 639
Livon, 717
Lloyd, 105
Loiset, 55
Loisel, 606
Longobardini, 634
Longchamps, 143
Longuet, 291
Lonting, 151
Lourdal, 741
Lowe, 272, 311
Lucas, 102, 202, 749
Lucet, 61, 235, 241, 289, 375, 437, 438, 493, 545, 579, 747, 761
Lullin, 175
Luschka, 702
Lustig, 765
Lutz, 372, 496, 553, 769
Lydyt, 469, 579, 583
McDougall, 185
McFadyean, 511
Macgillivray, 548
Mackh, 579
Macnamar, 757
Macords, 239, 298
Maequist, 29, 71
Madeung, 515
Magne, 174
Magné, 765, 768
Maillet, 734
Malassez, 501
Malet, 762
Malherbe, 289
Malmsten, 281, 430
Malpighi, 669
Mangin, 521
Manson, 637, 639, 646
Manz, 660
Marchiafava, 612
Marchais, De, 265
Marcorne, 290
Mari, 634
Marrel, 142, 205, 211
Marriott, 755
Marremmucci, 220
Martin, 339, 616
Masse, 691
Mather, 355, 623
Mathieu, 107, 153, 181, 639, 747
Mathis, 785, 786, 767
Matozzi, 421
Mauri, 600
May, 729
Mazzanti, 346, 485, 500, 616, 617, 622, 649
Mehlis, 579, 596
Meissner, 603
Melnickow, 445
Meloni, 772
Menges, 548
Meier, 510, 612
Meyrick, 656, 768
Michelson, 292
Middeldorpf, 707
Miescher, 213
Miller, E., 766
Miller, J., 653
Minette, 257
Miram, 560
Mitscherlich, 411
Möbius, 235
Rull, 215, 392, 510, 729, 733
Romanet, De, 541
Romano, 468
Roudani, 37
Rose, 560, 652, 742
Rossignol, 178, 179, 254, 482
Toulain, 55
Rousseau, 613
Roux, 336
Rovelli, 457, 478, 479, 633
Rudofsky, 734
Rudolph, 9, 404, 410, 425, 488, 560, 572, 649, 675, 768
Ruffert, 289
Rupprecht, 660
Ratus, 668
Ruyach, 591, 622, 766
Saake, 417
Sabatier, 205
Saint-Cyr, 216, 217, 224, 300, 301, 307, 508
Saint-Didier, 114, 151
Sajous, 208
Salle, 103
Salle, 253
Salle, 749
Salmon, 606
Sandie, 583
Sanson, 174
Santin, 758
Sappay, 697
Sarciron, 396, 397
Sautius, 289
Sauvages, 114, 158
Scherer, 517
Schell, 579
Scheuerle, 181
Schéremetewsky, 163
Sichern, 768
Schleg, 191
Schleicher, 51
Schlepe, 371
Schlesse, 358
Schlothhauber, 410
Schmidt, 579, 771
Schmidt-Mülheim, 673
Schneider, Ant., 433, 491, 632, 636, 639, 762, 764
Schneider, F., 89
Schomburg, 482
Schönauer, 28
Schöne, 438, 449, 458
Schönle, 634
Schönlein, 299
Schrader, 309
Schrack, 493
Schubart, 500
Schuberg, 369
Schumacher, 235, 741
Schulze, 623, 665
Schuppert, 639
Schutt, 623
Schütz, 302, 612, 711
Schwabel, 634
Schwanefeldt, 734
Scott, 488
Ségré, 428
Semmer, 259, 497, 623
Sinac, 639
Sequens, 84
Serres, 644, 760
Serrurier, 618
Setten, Von, 755
Sewell, A. J., 749, 753
Seynes, 339
Shelling, 772
Sibald, 256
Sick, 142, 757
Sibennaz, 614
Siebold, Von, 9, 213, 389, 457, 605
Siedamgrotzky, 222, 223, 266, 280, 288, 299, 297, 301, 668, 677, 687, 741
Sillol, De, 765
Silvestri, De, 639
Silvestrini, 764, 765, 766, 768
Simon, 231, 309
Simon, G., 212
Simon, J., 335
Simonds, 216, 368, 522, 540
Simonin, 771
Sirodot, 741
Slocock, 405
Slosarski, 240
Slowak, 510
Small, 759
Smith, 755
Smith, W., 310
Smytian, 263
Sobotta, 639
Somerville, 765
Sonsino, 363, 397, 447, 481, 482, 454, 543, 544, 622, 633, 637, 646
Sousa, 103
Soulé, 142
Sourdillac, 565
Soupigny, 334
Sparks, 216
Spence, 92
Sperling, 766
Spigel, 757
Spinola, 26, 116, 286, 338
Stadler, 235
Stahl, 495
Stauly, 391
Steel, 188, 200, 355, 422, 475, 476, 520, 549, 570, 574, 598, 619, 728
Steenstrup, 9
Stein, 360, 430
Steinbach, 233
Stephen, 590
ALPHABETICAL INDEX OF AUTHORITIES REFERRED TO.

Stephens, 87
Sticker, 663
Stiles, 364, 396, 437
Stirling, 693
Stirling, 737
Stow, 167
Stratton, 767
Straub, 173
Straub-Dureckheim, 201
Stütz, 142, 205
Stricker, 52
Swieten, Van, 765
Symonds, 755
Taburin, 298
Taiche, 521
Talairach, 521
Taruffi, 344
Tardieu, 357
Talairach, 388
Swieten, 394
Strieker, 429
Stiles, 443
Stieda, 450
Tennent, 313
Taiche, 363
Syraonds, 382
Stutz, 406
Stiiriug, 431
Troltsch, 158
Treutler, 363
Trevisan, 694
Triggle, Van, 544, 584, 592
Trilliberta, 160
Trinchera, 734
Tripier, 309
Troltsch, 744
Trouessart, 110, 127, 237, 238, 241
Trousseau, 623
Tschulowski, 657
Tulasne, 10, 272
Tulk, 213
Tüngel, 707
Tarnbull, 196, 744, 755
Tausen, 185
Twining, 757
Ukedem, 309
Unna, 282, 306
Unterberger, 223, 243, 486
Vachetta, 724
Vailant, 448
Valenciennes, 347, 733
Valentin, 213, 624
Vallada, 541
Vallin, 683, 722
Vallisneri, 55, 356, 414
Vallon, 200
Van Heil, 727
Van der Heeven, 756
Van Laer, 42
Varnell, 727
Vegetins, 157, 167
Veith, 541
Véret, 400
Verheyen, 112, 134, 215, 276, 289, 352, 355, 623,
Verloren, 389
Verney, Du, 767
Verril, 552
Veruji, 273, 296
Viborg, 185, 196, 205
Vidal, 289
Viebeldutt, 114
Vigezzi, 658
Vigney, 591, 593
Villain, 688, 684
Villa, 414
Villate, 653
Villemain, 576, 603
Villeroy, 87
Villot, 331
Vincent, 286
Viehöns, 315, 503, 660, 677, 702, 707, 711
Virgil, 50, 187
Visser, 603
Viseux, 279
Vitry, 355
Vittu, 655
Viziot, 213
Vogel, 687
Voigtlander, 246, 309
Voit, 677
Vulpian, 769
Wagener, 481, 529
Waldenburg, 472, 502
Waldeyer, 660
Waldinger, 583
Waldeuter, 452
Walley, 494
Wallraff, 141, 158, 192
Walters, 768
Waiz, 114, 168, 183
Watts, 223
Weber (of Germany), 230
Weber (of Paris), 218, 279
Wedel, Wedelins, 113, 208
Weld, 213, 426, 480, 622, 769
Weinland, 525
Weiss, 216, 218
Welch, 633
Weilhöfer, 168
Wernicke, 365, 522
Westwood, 63
White, 552
Wiaue, 114, 168
Widal, 313, 615
Wiesenthal, 605, 606
Willab, 408
Willan, 299
Willemoes-Suhm, 529
Williams, 314, 394, 405
Williams, 521
Wilson, 213, 755
Winckler, 665
Wira, 399
Wising, 430
Wolff, 655, 656
Wolpert, 368, 762
Wolstein, 754
Woodger, 293, 727
Wormall, 792
Wright, 224, 225
Wrisberg, 560
Wulf, 724
Wyman, 133
Yersin, 341
Youatt, 728
Young, 523
Yvart, 733
Zander, 300, 309
Zeder, 481, 493
Zembelli, 772
Zemker, 702, 712
Zeviani, 639, 641
Zieberkähn, 660
Zimmer, 158
Zimmermann, 772
Ziunla, 400
Zopf, 650
Zorn, 309
Zschokke, E., 214, 213, 396, 447, 449, 469, 470, 612
Zschokke, F., 457
Zuchinetti, 397
Zundel, 173, 183, 223, 213, 516, 517, 679, 687, 734, 743
Zwaardemaker, 544
A
Acanthia columbaria, 91
pectularia, 91
Acanthocephales, 5, 383
Acari, 5, 92; psoric, 7
Acariases of Domesticated Birds, 226
Acariases, 23
auricular, 74
dermanyssic, 144, 230
non-psoric, 95, 227
psoric, 112, 246
Acaricides, 134
Acarina, 5, 23, 92, 112
Acarnix follicularis, 213
Acephaiocyst, 507
Achorion Arloini, 309
keratophagus, 315
Schoutenii, 3, 299, 304
Aeluromyces boris, 3, 710
muscorum suis, 711
Acnea sebacea, 213
Simonon, 215
Alastropes, 274
Age, influence of, 12
Ah-dhrung, 757
Albuminiferous canals, 320
Algerian Ixode, 101
Allolohophora fottida, 478
Allopecia, 163
Alternate generation, 8
Ambulacrae, 92
Ambulacrum, 117
American Ixode, 103
Ameba, 3
croupogena, 269
parasitica, 270
princeps, 270
Amorphous matrix of Achorion, 304
Ambipolous leeches, 328
Amphistoma, 323
Collinsiae, 397
conicum, 363
crumeniferum, 363
explanatum, 500
Hauckei, 476
tuberculatum, 414
Anaemia, essential, of Dogs, 464
intertropical, 462
miners, 462
pernicious, 31
of Cats, 470
of Dogs, 463
of Sheep, 365

Analgesia, 238
Analgesine, 237, 244
Anbrichlichkeit, 517
Anders, Andersens, 275
Aneurisms, verminous, 623
Anguiulata, 384
intestinalis, 237, 388
auricularis, 387, 484
Anguillula of the Rabbit, 474
Anguillulidae, 384
Animal Parasites, 3
Annelide, 4
Ankylostoma, see Uncinaria
Ankylostomiasis, 463
Anoplodontians, 382
Antagonistic symbiosis, 2
Antennal sinus, 67
orbital, 68
Anthemintics, 20
Antipsoric charge, 147
Antipsorics, 134
Aphaniptera, 22, 58
Apotheca, 322
Aptera, 22
Aqueous cachexia, 517
ictero-verminous, 517
Aquiferous vessels, 379
Arachnidae, 5
Arugas, 96, 104
marinatus, 227
Murridaus, 227
Megajini, 105
persicus, 104
releus, 227
Tholozanii, 105
turcicata, 105
Arugasina, 96
Arics, 34
Arthropodes, 5
Ascaride, 325
Ascaride of the Sheep, 424
of the Pig, 434
Ascarides, 325, 384
Ascaris, 325
crasa, 491
gibbosa, 481
tumbricoides, 434
marinata, 460
megalocephala, 398, 500, 501
mystax, 460, 470
oris, 424
pellicoides, 7, 755
suilla, 434, 500
civuli, 414
GENERAL INDEX.

Ascomycetes, 612
Asilides, 320
Asillus, 320
Aspergillar dermomycosis, 304
Aspergillary pneumycosis, 616
Asperillus, 3, 272, 612, 744
candidus, 613
glaucus, 613
fumigatus, 343, 411, 613
niger, 613
microsporus, 304
nigricans, 613
replens, 613

Aulastoma Gulo, 330

Aviarian phthiriasis, 233
Bacillus malarus, 622
Bacteria, 2
Bacteriacea, 2, 369
Bacteriulonas porifera, 475
Bakonyer, 679
Balancers, 22
Balantidium colt, 430, 576
Bear, 2
Bedellide, 93
Beequerian, 164
Bicho Colorado, 106
Bilharzia, 414, 633
boris, 633
crassa, 632
hemotobia, 632
Bands of Ricinidae, 670
Bandwurmseuche, 422
Barrelled pupa, 40
Barsatti, 260
Baths, antipsoric, 177
arsenical, 179, 181
Clement's, 178
codex, 144
creolin, 182
Matthieu's, 178
Scheuerle's, 181
Tessier's, 177
Trasbot's, 178
Walz's, 183
Zundel's, 183
Bear, 2
Bedellide, 93
Beequerian, 164
Bicho Colorado, 106
Bilharzia, 414, 633
boris, 633
crassa, 632
hemotobia, 632
Birds, scabies of, 246
Bisciuola, 517
Biseriated Menopon, 79
Bissa, 52
Black mange, 215
Black-mouthed Menopon, 78
Bladerry Rabbits, 652
Blanc, 247
Blastema of the Achorlon, 304
Blinding Chrysops, 31
Blue-fly, 40
Bonnet, 38
Bordered Argas, 227
Bothria, 353
Bothrida, 383
Bothrioccephala, 455
Bothrioccephalides, 383
Bothrioccephalus, 383, 455
canis, 457
cordatus, 457
decipiens, 470
dubius, 458
felis, 470
fuscus, 458
latus, 457, 470
longicollis, 450
ricticulatus, 458
serratus, 457
Botryis, 772
Boule, 503
Boule d'eau, 497, 533, 550
Bourse, 503
Bouteille, 517, 533
Bovinc hypoderma, 48
Brachyceles, 22, 24, 29
Brachycelium, 322
Brachyplanaus, 322
Breeze-flies, 29
autuminal, 30
black, 30
blinding, small, 31
great, 30
noisy, 30
Ox, 30
rain, small, 31
rustic, 30
tawny, 30
white-footed, 30
Brillants, 275
Broad Menopon, 80
Bronchial strongylosis, 580
Bronchitis, verminous of bovines, 591
Camel, 594
Dog, 598
Equidoe, 595
Goat, 583
Pig, 596
Rabbit, 598
Sheep, 583
Bronchomyoses, 612
Broncho-pneumonia, verminous, 583
Broom, 572
Bristols, 26
Bugs, 7, 91
bed, 91
dove-cot, 91
May, 433
miana, 104
Sheep, 105
Buphaga, 57
Africana, 57
erthrorhyncha, 57
Buratis, 516
Bittschia, 361
C
Cachexia aqua verminosa, 517
hydatiforma, 667
Cade oil, 155
Carophygnas echinopus, 110, 315
Cafard, 371
Calf ascaride, 414
Calliphora vomitoria, 40
Calodium tenue, 487
Camel Bot, 574
xvode, 101
erustus of, 99
camerostoma, 92, 116
insects, 116
Candida gynecomphorus, 633
Candona rostrata, 488
Cancer, alveolar colloid, 510
oestrus of, 208
Catter-worm, 57
Caudal foramen, 379
pouch, 324
vesicle, 381
Cayor-fly, 43
worm, 43, 44
Cavicoles, 46
Choralide, 113
Cirrons, 113
Cirrhos, 320
Cirrhos, poueh of, 329, 379
Coccidium, 322, 518
Clypeus, 67
Coccidia, 4, 269, 318, 780
Coccidiosis, hepatic, 496
intestinal of the Calf, 111
Dog, 437
Fowl, 477
Rabbit, 472
of eggs, 772
pulmonary, 575
renal, 761
Coccidium bigeninum, 438
oviforme, 269
perforans, 437
Revital, 167
Cochin-China diarrhoea, 484
Centurus, 382, 496, 727, 729
cerebralis, 650, 727
serialis, 651, 726
Colorada, 109
Colescephahum, 68
longicaudum, 79
Colpode, 361
Commensalism, 1
Common Tick, 98
Companion Gonioote, 79
Conidian spores, 274, 281, 305
Conjugation, 3
Conjunctivitis, verminous, 760
Constant parasitism, 6
Constitution, 13
Corps oviformes, 501
Corpuscles, falciform, 269, 502
of Laveran, 648
of Rainey, 659
Countries, influence of, 133
Coxa of Acari, 117
Creole Tick, 103
Creolin, 182
Crinons, 623
Crossodora, 322
Crustacea, 5
Cryptococcus guttulatus, 411
Cryptocystis, 382
trichodectis, 415
Cucurbitans, 381
Cutex, 24
equidens, 25
mosquito, 643
pipiens, 24
Culicide, 24, 25
Cultures of dermatophytes, 273
Cuniculus, 131
Cups of Favus, 300
Cutaneous helminthiases, 252
myiasis, 41
psorospermosis, 268
Cuterebra, 46
Cuticles, 46
Cyrtomi, 66
Dermatitis, 381
Cysticeroides, 382
Cysticerocosis, 668
Cysticerus, 382
Cysticercus, Baillelt, 553
bothriopilis, 479
bosis, 633, 667, 688
celldwver, 667, 668
corduitis, 554
eolongatus, 553, 554
fusioidarlis, 468
fusolaris, 547, 668
medioanellata, 688
oris, 697
pisiformis, 410, 441, 497, 553, 668
tarandi, 667
tenuicolli-, 441, 442, 497, 551, 576, 634
Cystis, 381
Cyst of Coccidia, 269
Cysto-flagellata, 318
Cystogeneous cells, 528
Cystoidoteniens, 381, 382
Cystotaenians, 381
Cysts, hydatid, of bones, 653, 724
muscles, 653
Cytos serum, 572,
Cytodites, 243
nudus, 243
Cytodiphone, 243
Cytoleichus, 243
Cytomyces, 612
Cytospermum, 412
tilluum, 437
Zornii, 412

D

Dactylium, 772
Dark Menopon, 81
Dart, maxillo-labial, 94
Dartre croisseuse, 275
farineuse, 204
furfuracée, 275
humide, 204
pustulo-croisseuse, 275
secche, 204
vive, 204
Dasytricha, 361
Daughter Redife, 528
Dehane, 31
Definitive host, 8
Degrees of parasitism, 8
Demodectic scabies, 204, 212
of the Cat, 215
Dog, 214, 215
Goat, 215, 225
Horse, 215
Man, 214
Ox, 215, 226
Pig, 215, 224
Sheep, 215
Demodectide, 95, 94, 95, 212
Demodectic scabies, 113
Demodex, 212
foliculorum, 212
phyloides, 224
Demanyssis of Birds, 229
of the Fowl, 229
of Swallows, 229
Demanyssic acarasis, 234

Dermatomyositis, 21
Dermatophagoides, 21
Dermatophytes, 3, 6, 271
Dermatorkytes, 121, 216
Dermatorrhagia, 253
Dematozoon, 21, 23
Dematozoon, 22
Dematozoon, 21
Dermites tardairies, 91
Dermites Granulares, 257
Dermatomycosis, aspergillar, 304
Dermatophytes, 271
Deutoscoles, 381
Diagnosis of parasitic diseases, 16
Diarrhöea, Cochin-China, 484
Dicotylus torquatus, 431
Dicrocalium, 518
Digeneisis, heterogeneous, 8
Diphteria, 341
Diplopinum, 362, 392, 575
bursa, 362
Cattanei, 362
caudatum, 362
dentatum, 362
ecaudatum, 362
maggi, 362
maimonum, 362
rostratum, 362
vacinatum, 393
voeix, 362, 575
Dipping of Sheep, 185
Diphyllidia, 382
Diplogaster, 636
Diptera, 7, 22
Dipylidians, 382
Dipylidium, 473
lotissimum, 473
Leucarka, 473
pectinatum, 473
Disease of Oxen, 265
Dispharynx, 326, 374
nasutus, 375
spiralis, 483
Disroma, 322
armatum, 481
campaanulatum, 544
carrier, 544
columbus, 486
communatum, 181
conjectum, 544
conus, 544
cuneatum, 772
dilatatum, 481
echinatum, 458, 481, 490, 493, 494
felineum, 544
ferox, 494
Echinococcus, polymorphus, 506

Distoma hepaticum, 500, 501, 517, 546, 551, 654

Dock, 517

Echinococcus, 382, 444, 496

Dock, 517

Distomoides, 321, 633

Doximia, see Echinaria

Distomosis, of the Carnivora, 518, 544

Doxophorus, 67, 65, 80, 81

Doxinaria, 728

Dynamitaria, 547

Dry mange, 136

Dry measles, 672

Echinococci, 382, 444, 496

Echinococcus, 382, 444, 496

Echinostoma, 5, 319

Echinostomatosis, 516

Distomosis of the Carnivora, 518, 544

Herdvora, 517

Ass, 520

Camel, 543

Cattle, 543

Elephant, 543

Guinea-pig, 543

Horse, 518, 520

Distomiana, 5, 320

Distomiasis, 541

Endoparasites, 5

Endoparasiticides, 20

Ectophyte, 271

Ectozoa, 6

Eczea impetiginosa, 314

Ectoparasites, 6

Ectoparasiticides, 20

Ectoparasites, 5, 6

Ectoparasiticides, 20

Entodinium, 362

Bursa, 362

Eradatum, 362

minimum, 362

rostratum, 362

Enterox, 5, 6

Enterox follicularum, 213

Epaphellet Oxode, 101

Epidermophytes, 271

Epidermophyton gallinulae, 304

Epidermoptes, 241, 271

bifurcatus, 241

biliobatus, 241

Epidermoptes, 241

Epideroptes, 241

Epipharynx, pseudo or false, 451, 585, 725

Epileptic disease of Sporting Dogs, 750

Epimere, 92, 116

Epidermopph, 674

Epipharynx, 271

Episcop, 271

Epistoma, 92

Epitheliuma contagiosum, 285

Epizoa, 6, 22

Epizootic mange, 136

Equine, scabies of the, 136

Erratic parasites, 7

Eustal sores, 257

Etiology of parasitic diseases, 9

Euderidation, 725

Encolops, Erophillus, 604

Erythroccella, 318

Eusarcoptes, 613

herbarium, 613

Eusarcoptes, 121
**GENERAL INDEX.**

787

*Eustrongylus gigas*, 501, 636, 764

*E. visceralis*, 764

Europion, 216

Facultative parasitism, 6

Falciform corpuscles, 269, 502

spores, 502

Falcifer, 238

rostratus, 240

False gid, 570, 735

Farcy of the Ox, 103

Fascioliasis, 516, 517

*F. hepatica*, 516

Favus, 299

of the Cat, 300

Dog, 301

Fleas of Dog, 60

Hare, 60

Leporides, 60

Man, 60

Sand, 62

Fleas, 22, 32, 33

black, 26

bovine, 32

blue, 40

breeze, 29

Cayor, 43

common, 32

cow, 32

crow, 32

executioner, 33

flat, 57

gray, 40

Kolumbats, 27

meteoric, 34

spider, 37

stinging, 33

vagabond, 32

vitripener, 22

warble, 53

Fluke, 516

Fluke disease, 517

Follicular dermatitis, 221

mange, 215

scabies, 216

Forked worm, 607

Fournia in ngombe, 57

Frevina, 238

Fusoraeule, 155

Galea, 94

Gale épizootique, 167

Gamadure, 516

Gamaeridur, 93, 94, 105, 229

Gamaexus, 105

auris, 741

Gammarus pulex, 490

Ganache, 517

Gapes, 608

Garapattes, 103

Gastricoles Estres, 46

Gastrodiscus, 316

Sonniello, 397

Gastrophilus, 348

equi, 349, 350, 371

elephantix, 355

flavipes, 349, 355

hemorrhoidalis, 349, 353, 711, 770

inermis, 349

lativentris, 350

nasalis, 349, 354, 741

nigricornis, 350

pecorum, 349, 354

salutaris, 355

sulfiturus, 355

Generation, alternate, 8

spontaneous, 9

Germinal membrane, 507

Germinative cercarigerous sac, 320

Gid, 727, 728

in the Goose, 725

50—2
Gid, in the Horse, 734
Ox, 734
Sheep, 727
encephalic, 727, 731
medullary, 733
lumbar, 733
Glair of Achorion, 304
Glandine, 668
(‘lobidium Leuckartii, 393
Globoce/ialux, 385
Iloixjemucronatus, 435
GloKnina viorsiians, 34
Glycipliayxis, 110
curnor, 110
Gnathastoma, 326
hispiditan, 367
Gnathites, 5
Giialhobdellidce, 328
Gnatliostomidv, 326
Gnats, 24
common, 24
Goat, scabies of the, 192
Goniocoten, 67, 68
chi-ijHocephalus, 79
compar, 79
i)i(jas, 76
hologaster, 76
rectaiHjidatus, 77, 78
Gonioden, 67, 68
Burnetti, 76
eolchicus, 78
dimmilis, 75
Jakicornis, 78	ninor, 79
numidicnvm, 77
parvkepa, 78
ntylifer, 77
truncatus, 78
(iortiheid, 667
Gonlomon, 517
Grainerie, 668
(iranular dermatitis, 257
Granular sores, 257
Grappe, 247
Grater of Daubenton, 177
Gray-fly, 40
Gray Simulium, 26
Great Shield Ixode, 101
Gregarina avium intestinalis, 477
Gregarina, 4
Grind, 167
Grub in the head, 570
Guadeloupe farcy, 102
Guanine, 677
Guinea-fowl Goniodes, 77
Guinea worm, 263
in the Dog, 263
Horse, 264
Ox, 265
Gusano, 56
Gutteromyces equi, 340
Guturomycosis, 340
Gyropus, 68
grailis, 74
oralis, 74

H
Hemadipsa Ceylonica, 333
Hematie filariasis, 639
Hemathydroysis, 253
Hemotobia, 7, 33
Hemato-chyluria, 643
Hematomonas Krausi, 619
Hematoephages, 16
Hematojpinus, 66
Cameli, 72
colorata, 69
eurysternus, 70
macrocephalus, 69
pitiferus, 73, 638
stenopsis, 71
sets, 73
tenirostris, 70
urius, 73
ventricosis, 74
Hematozoa, 16, 618
of Birds, 648
Dogs, 636
Horses, 619
Lewis, 636
Rodents, 635
Ruminants, 632
Hematozoan Lewis, 636
sublatum, 636
Haemopsis sanquins, 328, 755
Haemorrhagic pimplles, 254
Hatophora, 772
Halacaride, 93
Hanging Helophilus, 410
Haplococcus reticulatus, 3, 650
Harpirkynchus, 235
niuhans, 235
Harponeage, 709
Harvest Bug, 107
Haunch of Sarcoptinae, 117
Hematopota, 31
pluvialis, 31
Helix carthusiana, 530
hortensis, 434
yomatio, 434
Helminthiasis, cutaneous, 252
intestinal, 379
of air-passages of Cat, 602
Dog, 598
Helminthopsylla, 63
Aladart, 63
Helminths, 4
Helophillus pendulus, 410
Hemiptera, 22, 65
Hemistoma, 321
alatum, 458
Hepatic coccidiosis, 503
cysticeriosis, 499
distomatosis, 517
echinococcosis, 506
Hepes circinatus, 278, 290
tonaurans, 273
of strangles, 255
Heterakis, 373
columba, 486
compressa, 482
differens, 482
dispar, 493
GENERAL INDEX.

Heterakis, *inflexa*, 482, 484, 485, 491, 772
  *lineata*, 491
  *maculosa*, 486
  *papillosa*, 481, 484, 491
  *perspicillum*, 484
  *vesicularis*, 481, 485

Heterogeneous digenesis, 8

Heteroptera, 22

Heterotriches, *infusoria*, 319

Heteroxenes, *parasites*, 8

Hexacanthus *embryo*, 380

Hexamita *diiodenalis*, 473

Hippobosca *canina*, 37
  *equina*, 37
  *taurina*, 37

Hippoboscidie, 36

Hirudina, 328

Hirudo, 328

Ceylonica, 333
  *medicinalis*, 330, 333
  *officinalis*, 333
  *tagalla*, 333
  *trockina*, 333

Holostoma, 321

erraticum, 490

Holotrichie, 319

Horse hypoderma, 55

Host, 2
  accidental, 9
  definitive, 8
  foreign, 9
  intermediate, 8
  transitory, 8

Host organs, 517

Hydatic membrane, 507

Hydatidocephalus. See Gid

Hydatids, 506
  of the circulation, 633

Hydrachnidae, 93

Hydrocephalus, 728

Hydrophoria, 34

Hydrotaea, 34

Hydromedusae, 340

Hydroderma, 48, 755

Acteon, 50
  *bovis*, 48, 51, 366, 741
  *Diana*, 51
  *equi*, 55, 56
  *lineata*, 48
  *Silenus*, 56
  *tarsandi*, 48

Hyphophus nymph, 240

Hyptotrichia, *Infusoria*, 319

Hystrichis, 326

I

Imago, 23, 333

Inderes, 275

Indigestion, ingluvial, 376

Infusoria, 3, 318

Infusiform embryos, 320

Ingluvial indigestion, 376

Insects, 5, 6

Intermediate host, 8

Intermittent parasitism, 7

Intestinal helminthiasis, 379

Isotricha, 360, 374

Ixode *Nigua*, 103

Ixodes, 6, 96

Ægyptius, 101

Algeriensis, 101

Americanus, 103

autumnalis, 101

bovis, 163

camelinus, 101

cleifer, 101

Diquest, 100

Fabricii, 101

marmoratus, 101

megathyreus, 101

redivivus, 99

ricinus, 98

rotundatus, 103

Rugica, 103

Savignyi, 101

scapulatus, 101

Ixodidae, 93, 94, 95, 226

Ixodine, 96

Jaundice, 517

Jigger, 62

K

Kahn, 335

Kariophagus *hominis*, 773

Kéné, 105

Klaufenfaule, 267

Kuemidokoptes, 121

Keilkeria, 322

Kolumbatz-fly, 27

Krabbe’s Tenia, 442

Kritze, 112, 167

Kritzasschlag, 112

Kumres, 757

Kunkurs, 260

L

Lambia, 318

intestinalis, 418, 436, 467, 473

Lamioptcrptes galdinarum, 245

Land leeches, 333

Languyage, 673

Languyeurs, 673

jurés, 673

Larbisch, 201

Larve of the Diptera, 40, 348, 567, 741, 772

Larve of the Muscids, 40

(Gastricoles, 348

Clavicoles, 567

Clavicoles, 348

Lauber, vesicle of, 319

Laveran’s corpuscles or bodies, 648

Leberegelkrankheit, 517

Leeches, 328

black, 330

dragon, 333

grey, 333

green, 333

Horse, 328, 330

land, 333, 334

medicinal, 333

of Ceylon, 333
GENERAL INDEX.

Leeches, trout, 333
Leg of Sarcoptidae, 116
Leprosy, 667
Leptotrichis, 2, 327
baccalis, 326
Leptus autumnalis, 107
Lesions, 13
Lice, 65
Liguia, 494
Limax maximus, 434
Limina humilin, 526
minuta, 525
palustris, 539
truncatula, 525, 526, 528
viator, 526
Limopxoron, 112
Limpnata, 556, 558, 561, 562
rhinaria, 559, 561, 564
teniodes, 559, 561, 564
"dentikata, 556, 561, 562
"rhinaria, 569
"teniodes, 569, 576
Linguatules in the Cat, 567
Dog, 561, 567
Horse, 567
Ox, 567
Sheep, 566
Linguatulide, 558
Liothezium, 67, 68
Lipeurus, 67
ausseris, 80
baculis, 79
heterographus, 76
jejunnus, 80
numide, 77
polytrapezis, 77
"qualidus, 81
"varabilis, 76, 79
Listrophorinae, 110
Listrophorus, 111
Liver, flake in, 517
Liverrot, 517
Long Menopon, 79
Long-tailed Colpocephalus, 79
"Oxyuris, 401
"Louping-ill, 736
"Lourd, Lourderie, 728
"Lousiness, 112
Lumbrici, 384
Lungen, 476
Lycopoderid favus, 302
"Lycoperdon, 302
Lymphivores, Estres, 46
Macaw Fly, 56
Macrogaster platypus, 213
Macrosporium, 772
Magenwurmseuche, 364
Maggot, 43
Mal-de-poix, 517
Mal de St. Lazare, 667
Malophages, 65
Malt-grain eczema, 274
Mange, 112
Mange, dry, 204
humid, 204
red, 204
Marciilja, 517
Maryaritiferi, Tenié, 448
Masern, 667
Mausuri, 397
Marbled Ixode, 101
Matrix of the Achorion, 304
Maulschwimmchen, 335
Mauritius Argas, 227
May Bug, 433
Maxillo-labial spoon, Insect's, 116
McDougall's Sheep-dip, 185
Mesasles, 667, 668
"of Dog, 687
"Ox, 688
"Pig, 686, 756
"Sheep, 697
Megninia, 238
"asterinalis, 239
"cubitalis, 239
Melolontha vulgaris, 433
Melophagus, 71
ovinus, 71
Menopon, 68
"biseriatum, 76, 79
eextraneum, 76
latum, 80
numidum, 78
obscurum, 81
"pallidum, 76
"phorostrum, 78
"productum, 79
"stramineum, 77
Mentagra, 295
Mesceria, 667
Mesocelidoides litteratus, 418
Mesogonimus, 323
"commutatus, 481, 484, 486
"pellucidus, 374
Meteorie Fly, 34
Microbes, 2
"Micrococcus, 3
"Microsporida, 4
Microsporon mentagrophytes, 296
Miescheria, 659
Migation of Distomes, 530
Mite, 92
"of cheese, 115
"red, 167
"Modes of parasitism, 6
"Mollusca e contagiosum, 268, 369
"Monocercomonas, 318
"anatis, 487
"cavia, 475
"canis, 368
"canis, 475
gallina, 342
hepatica, 496, 501
Monas anatis, 487
canis, 475
Monera, 3
"Monodonta Wedli, 427
"Monostoma, 321
"attenuatum, 492
eyrophytium, 489
teporis, 553
Monostoma, mutabile, 321, 695
Setteni, 755

Monostomidae, 321
Monoxenes, Parasites, 7
Morpion, 66
Mornia, 527
Mosquitoes, 25, 643
Mother-vesicle, 507
Moulda, 271, 612
Monquin, 109
Movement de manège, 452
Moyoquill worm, 56

Mus, 336

Muscorum, 271
racesmosus, 315
solonifer, 772

Muscorum canis familiaris, 611

Muscorum, 3, 270
Muguet, 327, 335
Muscarial, 164

Musca, 32
bicornis, 32
carniifer, 33
ceratina, 32
domestica, 32
holorum, 33
stimulus, 33
eccina, 32
vagatoria, 32
vitripennis, 33

Muscidae, 33
Muscular distomatosis, 654
psorospermosis, 660

Mutualism, 1
Mutualistic symbiosis, 1
Myelican spores, 274
tubes, 281, 304
Myosis of the Air-passages, 612
in Birds, 612
Mammalia, 615
Myiasis, 40
Mycoptes, 111
Myxosporide, 4

N

Necrophorus, 91
Nematelminths, 5
Nematodes, 5
Nematodoeum equi caballi, 410
or is psoromelis, 581
Nemecera, 24
Niaibi, 109
Nigra Ixode, 103
Nirum namidai, 77
Niva, 65
Noctiluca, 318
Noir-museau, 164, 193
Nomenclature of parasitic diseases, 17
Noña, 667
Norwegian itch, 203
Noseleria, 687
Noseleria, 687
Notocotyle triseriata, 180
Nuche, 56
Nymphia of the Sarcoptine, 119

O

Obligatory parasitism, 6
Occasional parasitism, 6
Ocelli, 65
Ochronia anthropophaga, 65
Odemagenus, 48
O'sophagostoma, 385
Colubridae, 126
deutatum, 435, 500
indatum, 415
sublatum, 435
evulvorum, 426, 429

Estral vertigo, 570
Estrie, 6, 7, 45, 348, 558, 567
in the brain, 741
bladder, 770

E'strongyia, 46

E'strus canell, 573
crococel, 527
cuticola, 55
oris, 508

Oidium, 292, 336
albicans, 3, 296, 336, 339
lactus, 296, 339

Ointment of Helmerich, 147
sulphur, 147

Oleum cadum, 155
Omphalaisis, 372, 603
Omphalais tricuspis, 8, 372, 602, 655
Onchocerca reticulata, 656
Ongle de Chabert, 177
Onichomycosis of Equidae, 315
Ophyrocoleidae, 361
Ophthalmia, verminous, 759

Oribatides, 93

Ornithobia, 67
encephalus, 81

Orthuspora, 761

 Oscula sectoria, 380
Oscariases, 745
Otitis, parasitic, of the Dog, 748
Otopiasis, 745
Oval gyropus, 74
Oviriform corpuscles, 501
Oviscap of O'estrus, 50
Ovulating vulva, 118
Ox hypoderma, 48
Ox, scabies of the, 157

Oxyuridae, 325

Oxyurus, 385
ambigu, 473
compac, 462, 470
corrulata, 400, 401
mastigodes, 401
vermiculata, 401, 461
virepera, 403, 410

P

Pale triton, 81
Pangonia, 32
Paniculata, 667
Paraplegia, hypodermatic, 733
Parasitica, 2
Parasitic otitis, 754
Parasitism, 1, 2, 6
Parasitology, 1
Parasites of the bones, 651
bronchi, 578
circulatory apparatus, 618
connective tissue, 651
digestive apparatus, 316
intestines, 378
larynx, 558
liver, 494
lungs, 575
mouth, 327
muscles, 651
nasal cavities, 558
cesophagus, 345
pancreas, 546
pharynx, 327
respiratory apparatus, 557
serous membranes, 547
skin, 40
spleen, 546
stomach, 345
trachea, 575

Parasiticides, 20

Passalurus ambiguus, 473
Pathogenic microbes, 2
Pediculoid disease, 65
Pediculidae, 65
Pediculinae, 65, 66
Perliniini, 65, 66
Peri, 70
Pellada, 274
Pellivores, 66
Pedodera seligera, 722
Penicillium glaucum, 337
Pennivores, 66
Penastoma, 556, 558, 559
denticulatum, 561
evansianum, 561
monoliforme, 556
serration, 561
Setiensi, 785
terioidea, 660

Periplaneta orientalis, 371
Perisporiaceae, 3, 612
Peristome of infusoria, 430
Peritreme of the Acari, 92
Peritricha, infusoria, 319
Permanent parasitism, 6
Pharyngolobus Africanus, 355
Pharyngoma, 573

Pheidolemur, 67

Phthiriases, 29, 65, 66, 144, 160, 163
of the Ass, 69, 82
Camel, 72, 84
Dog, 73, 84
Ferret, 73, 84
Goat, 72, 84
Guinea-pig, 74
Horse, 69, 82

of the Ox, 70, 83
Pig, 73, 84
Rabbit, 74
Sheep, 71, 83
of Birds, 74, 85
Duck, 81
Fowls, 74
Goose, 80
Guinea-fowl, 77

Phthiriases of the Peacock, 78
Pheasant, 78
Pigeon, 79
Swan, 81
Turkey, 76
Phthirius, 66
Phthisis, verminous, of the liver, 517
lungs, 587
Physaloptera, 325, 373, 375
digitata, 373
truncata, 375
Phytoparasites, 2
Phytotoolidae, 93
Picobia, 235
bicuspata, 235
Heeri, 236
varicata, 236
Piexycystid, 554
Pig measles, 688, 689
seabirds of the, 195
Pigiris reticulata, 410
Fincer Ixode, 101
Pinion, 23
Pisseneum, 155
Pittyriasae, 151, 204, 271
Planorbis marginatus, 529
Plasmodium matlariae, 621, 648
Pastrons, 116
Phthelminths, 5
Platodes, 5
Platrocalcle Baillei, 553
Plica polonica, 274
Pneumococcoses, 575
Pneumonia, verminous, 586
Pneumomyocoses, 575, 612
Poac, 164
Podocotyle, 322
Polikilocytosis, 365
Polystoma leucoides, 560
Pomade of Helmerich, 147
Porc lepso, 667
Porroga asbestina, 275
furcata, 299
lupinosa, 299
Poultry Louse, 233
Poutrriture, 517, 667
Prickers, 103
Prickings, 674
Prionodermia rhinarium, 560
Proboscis, 380
Proctophylloides, 238
Proctophyloides, 238
Proglottis, 231
Prognosis of parasitic diseases, 18
Proliyginous vesicle, 382, 508
Prophylaxis of parasitic diseases, 18
Prosoex, 381
Protopholides, 381
Protoplasm, 271
Protozoa, 3
Prurigo, auricular, 748
lumbar, 736
of the Ox, 160
Pseudalcalus ovis pseudonalis, 581, 586
Pseudo-follicles, 691
Pseudo-tuberculosis of the Cat, 694
Pseudo-nascula, 311, 471
Psora, 95, 110
Psoriasis circinata, 285
Psoroptes, 126
Psoroptic scabies, 126
Psoroptes communis, 127
Psorosperma crouposum, 269
Psorospermi, 4
Psorospermosis, 268
Psorospermose, 4
Psorospermia, 4
Psorospermic scabies, 126
Pterolicui, 238
Pterolichns, 238
Pterophuius, 238
Ptychophysa, 448
Pulmonary echinococcosis, 576
Pulmonary distomatosis, 579
Pulmonary dropsy, 517
Pulmonary ictero-verminous, 517
Pulmonary Wohlfarti, 41
Pulmonary Sarcopha, 41
Pulmonary Sarcopsylla, 62
Pulmonary Sarcoptes, 124
Psorospermose, 4
Psorospermia, 4
Psorospermic scabies, 126
Psorosperma crouposum, 269
Psorospermi, 4
Psorospermose, 4
Psorospermia, 4
Psorospermic scabies, 126
Pterolicui, 238
Pterolichns, 238
Pterophuius, 238
Ptychophysa, 448
Puff-ball, 502
Pulex, 60
Pulex avium, 61
Pulex irritans, 60, 446
Pulex penetrans, 60, 61, 446
Pulex serraticeps, 60, 61, 446
Punipara, 36
Purivores, oestres, 48
Purivores, oestres, 48
Purivores, oestres, 48
Purivores, oestres, 48
Purivores, oestres, 48
Purivores, oestres, 48
Purivores, oestres, 48
Saccharomyces albicans, 3, 336, 338, 339
guttulatus, 3, 411, 418, 472, 496
Saccharomyces, 3, 336
Salping of Sheep, 185
Sam, 757
Samir, 667
Sarothamus, 572
Sarcina, 3
Sarcodermatodectes, 121
Sarcophaga, 40
carnaria, 40
magnifica, 41
Sarcophila, 41
Wohlfiarti, 41
Sarcopsylla, 62
gallinacea, 63
punctata, 62
Sarcoptes, 121
notevedra, 124
Sarcoptes of the Camel, 124
Capybara, 124
Dog, 124
Goat, 123
Horse, 123
Pig, 123
Sheep, 123
Wolf, 123
Sarcoptes, 124
auricularum, 129, 208, 749
axicola, 246
camel, 124
canis, 124, 203
capra, 123, 193
cati, 123, 208
communis, 121
cuniculi, 125, 198
eynotis, 129, 749
cytotica, 244
equi, 123
Gerlachi, 243
Ringworm, 275
Rod-shaped Lipeurus, 79
Rogna, Rogne, Roña, 112, 167, 204
Rostellum, 380
Rot, 517
dropsy, 517
ictero-verminous, 517
Rouge, rouget, mal, 204
Rouget, Acarien, 107, 218
Rouviex of the Horse, 151
Dog, 204
Rüh, 167
Saccharomyces albicans, 3, 336, 338, 339
Sarcopt, 121
notedra, 124
Sarcoptes of the Camel, 124
Capybara, 124
Dog, 124
Goat, 123
Horse, 123
Pig, 123
Sheep, 123
Wolf, 123
Sarcoptes, 124
auricularum, 129, 208, 749
axicola, 246
camel, 124
canis, 124, 203
capra, 123, 193
cati, 123, 208
communis, 121
cuniculi, 125, 198
eynotis, 129, 749
cytotica, 244
equi, 123
Gerlachi, 243
Scabies of the body of Poultry, 250
legs of Poultry, 247
Norwegian, 203
psoroptic, of Equines, 151
of the Goat, 748
Ox, 158
Rabbit, 745
Sheep, 167
red, 204
Scabious, of Birds, 246
of the Cat, 208
Camel, 199
Dog, 202
Dromedary, 199
Equidae, 155
Perret, 211
Goat, 192
Horse, 136
Ox, 158
Pig, 195
Rabbit, 198
Sheep, 164
Symiotic, of the Cat, 753
Dog, 748
Equidae, 155
Horse, 136
Ox, 158
Rabbit, 194
Ox, 162
Sheep, 191
Symptomatic, 136
Scald, 112
Scalesiasia, 667
Schizomyctes, 2
Sclerostoma, 385
aneurymismaticum, 626
minor, 626
armatum, equinum, 403, 500, 516,
611, 622, 656, 768, 771
hypostomum, 427, 429
pinicola, 552
tracheale, 409
trachael, 610
Sclerostominae, 325
Scolex, 381
Scouring in Lambs, 422
Scrub Tick of Australia, 103
Seasons, influence of, 13
Sebaceous glands, inflammation of, 172
Seedy toe, 315
Senegal Tick, 102
Seminal receptacle, 350
Scorator, 110
Sheep Bug, 105
Sheep-dipping, 185
Sheep, scabies of, the, 163
Shell gland, 320
Silpha, 91
Simondsia paradoxa, 367, 368
Simonsa folliculorum, 213
Simplicidium, 24
Sindicium, 25
borax, 26
cinerm, 26
Columbuscheuse, 26
maculatum, 27
Sinus, antennal, 67
orbital, 68

Scabies of Bovines, 158
Camel, 199
Cat, 208
Dog, 202
Equines, 136
Perret, 211
Goat, 192
Pig, 195
Rabbit, 198
Sheep, 164

Scabies, 93, 94, 109
cycticoles, 109, 243
detricoles, 109
epidermicoles, 109, 241
glyricoles, 109
insecticoles, 110
plumi coles, 109
psorica, 109, 110

Sarcoptic, 112
Sarcoptotic scabies, 112
Sarcoctyosis, 659
hiraeta, 664
Miescheri, 659, 660, 663
tenella, 659, 663, 664

Sarcoспорide, 659
Sarna, 112
Scab, 167
Scabby, 167
scabies, 112

Scabies, 95, 112, 227, 246
auriculair, of the Cat, 208, 753
Dog, 748
Perret, 754
Goat, 748
Rabbit, 745
black, 215
by acari, 112
chori optic, 182
demodicic, 212
of the Dog, 215
Goat, 225
Ox, 226
Pig, 224
depluming, 250
dermatoceptic, 151, 158
dermatodectie, 151, 158
dermatophagic, 182
dry, 206, 204
Dog, of the, 202
epizoictic, 167
Equines, of, 136
feet, of the, 155
follicular, 215
head, of the, 164
humid, 204
Skin, parasites of, 21
Small-headed Goniodes, 78
Smearing of Sheep, 185
Soab, 112
Soor, 335
Sous-brillants, 275
Spermiduct, 379
Spider-fly, 37
Spirillum, 327, 620
Solanum, 2
Sporoblasts, 502
Spirocheate, 2
Evaasi, 619
Spiradulium, 392
Spirina, 345, 374, 386
cincinnati, 656
hamulosa, 375
leporus, 373
megastoma, 346
microstoma, 317
reticulata, 631, 655
sanguinolenta, 369, 599, 638, 646
scutata, 366, 367
strongylana, 367
ucinata, 376, 377
Spontaneous generation, 9
Spoon or pinion, 23
Spores, 4
of Coccidia, 269
Dermatophytes, 271
Sporiferous tubes, 271
Sporocyst, 320, 526
Sporophores, 271, 305
Sporotrichum, 772
Sporozoa, 3
Sporuzoites, 244
Stigmatite, 92
Stomatitis acarosa, 327
Stomaxys, 7, 33, 41
Striped Hyposerma, 48
Strobila, 381
Stroma of the Achorion, 304
Strong, giant, 501
Stronges, 315
Strongylidae, 325
Strongylinae, 325
Strongylinae, 580
bronchial, 580
of abomasum, 364
vessels, 644
pulmonary, 580
Strongylus, 345, 385
armatus, 403, 522
Arnfeldi, 582, 595
Azizi, 346
bronchialis canis, 599
commutatus, 582
contortus, 364, 426
convolutus, 365
europapathus, 582
flavus, 581, 585, 594
filicolaus, 365, 426, 429
figus, 764
infatus, 415
Strongylus micrurus, 581, 593, 595, 632
minusculus, 346
minutissimus, 580
nodularis, 377
ovis pulmonialis, 581
paradoxus, 582, 585
pulmonaris, 582, 593
parasiticus, 471
rufescens, 580, 581, 585
stripus, 373, 471
sublatus, 636
tenuis, 493
tenuissimus, 346
tubiformis, 471
vagorum, 399, 645
ventricicosus, 415, 426
Sturly, 728
Styranus, 772
Sectorial grooves, 383
Sectorials, 58
Summer sores of Horses, 257
Suren, 113
Surra, 619
Symboites, 121, 127
auricularium, 129, 748, 750
avium, 241
canis, 749
communis, 128
ecaudatus, 129, 753
setifer, 127
spatiferus, 128
Symbiosis, 1
Symbiotic scabies, 128, 155
of Bovines, 162
Equines, 155
Goats, 194
Sheep, 191
Symplecotes, 244
Symptomatic mange, 136
Symptoms of parasitism, 13
Syngamus, 606
bronchialis, 610
primitivus, 606
Sclerothornum, 610
trachalii, 494, 606
Syringophilus, 236
Syringospora robustia, 336
Tabanidae, 7, 29
Tuc, 167
Tabanus, 30
albinacis, 31
albipes, 30
autumnalis, 30
borinuus, 30
bronius, 30
fulces, 30
moris, 30
rusticus, 30
Torina, 378, 380
aculeata, 419
equinolus, 494
alba, 412, 418
anatina, 488
GENERAL INDEX.

Taenia, Benedeni, 418
boktricecephalus longicollis, 480
bothrioccephalus, 479

canina, 382, 445
canis, 447
canis lupis, 447
cantiana, 484
capre, 429
centripunctata, 419
cesticillus, 478, 485
cervins, 442, 728
conica, 488
corundula, 488
cressicollis, 372, 467
crusula, 485
cucumera, 382, 445
cunicula, 382, 445
cuniculata, 441
cysticeri tenuicollis, 441
deuticula, 412, 429
echinobotrida, 479
echinococcus, 444
echinothrida, 479
elliptica, 469
exilis, 478
expansa, 412, 418, 429
fasciata, 492
fasciolaris, 478, 488
fimbriata, 419
friedbergi, 485
giardi, 419
globipunctata, 420
gracilis, 488
hydatigena, 669
imbutiformis, 489
insumbuhiformis, 478, 484, 488
Krabbei, 442, 679
lanceolata, 492
latisimia, 473
leuckarti, 473
lineata, 447
literata, 383, 447, 469
malleus, 478
mamillana, 395
marginata, 441
mediocanellata, 688
megalojs, 488
murina, 394
ovilla, 419
oripunctata, 420
pectinata, 473, 553
perfoliata, 394
plioca, 395
proglottina, 479
pseudo-cucumera, 447, 469
pseudo-elliptica, 469
rhinaria, 360
rhopalocephala, 473
rhopalocephala, 473
saginata, 692, 697
semteres, 469
serialis, 443
serrata, 439
setigera, 492, 494
sinuosa, 488, 492
solium, 677
tenella, 697
tetragnata, 478
vogli, 419
villoa, 494

Taenia Wimerosa, 473
Taenia of the Sheep, 419
Taeniades, 380
Tawni, 380
margaritifera, 448
Taenida, 380
Tajacu, 431
Tal, 607
Tape-worms, 379
Tarsus of Acari, 117
the Sarcoptes, 117
Tavins, 30
Teigue, scabies, 164
Tenelirio molitor, 91
Tentacolifer, 4
Tetter, 167, 204
Tetracotyle, 490
Tetranychus, 106
Tetrexyctida, 106
Thallus, 271
Thrash, 327, 235
in Calves, 335
Feals, 335
Poultry, 339
Tibia of Acari, 117
Tick, 96
common, 98
Dog, 98
of Senegal, 102
Tinea by a dermatophyte, 271
diffusa, 314
favosa, 290
tonsurans, 274
Tinea, scabies, 164
Tinea tonsurans in the bovine species, 276
Cat, 281
Dog, 279
Goat, 280
Horse, 277
Pig, 280
Sheep, 280
contagiousness of, 286
Tlalsahuate, 109
Tobacco, 183
To Costome, 118
Tournis, 728
Torcel, 56
Tracheo-bronchitis, verminous, 606
Traberens, 728
Transitory host, 6
Transmigration, 8
Treatment of parasitic diseases, 20
Troubling disease, 736
Tremaotes, 5
Trephining, 573, 738
Trichacium, 392
Trichina, 329, 386, 699
papillosa, 374
spiralis, 8, 11, 386, 417, 436, 699
Trichiniasis, 699
Trichinida, 699
Trichinosis, 699
Trichonomyosisis, 275
Trichophytes, 271
Trichoedectes, 67
capra, 72
climax, 72

Trichodectes, 67
capra, 72
GENERAL INDEX. 797

Trichodectes crassipes, 72
latus, 73, 445
limbatus, 72
mambriecus, 72
parumpilosus, 69
penicillatus, 72
pilosus, 69
pubescens, 69
quadricornis, 69
scalartis, 70, 72
solidus, 72
sphroceplalus, 71
subrostratus, 73, see Addenda

Trichomes, 92
Trichomonas, 318, 342
cavi, 475
columbe, 485
Eberthi, 488
Ecoasi, 620
suis, 387, 430

Trichonema A^-ciiata, 410
Trichophytie, 275
Trichophyton, 274
decalvans, 295
c/5j7aMS, 283, 294
Schumleinii, 299
Tallosurans, 3, 294

Trichosoma, 326, 375, 386
epilans, 283, 294
Schneleinii, 299
tonsurans, 3, 294

Trichosoma, 326, 375, 386
epilans, 283, 294
Schneleinii, 299
tonsurans, 3, 294

Trichosoma, 326, 375, 386
epilans, 283, 294
Schneleinii, 299
tonsurans, 3, 294

Trichosoma, 326, 375, 386
epilans, 283, 294
Schneleinii, 299
tonsurans, 3, 294

Trichosoma, 326, 375, 386
epilans, 283, 294
Schneleinii, 299
tonsurans, 3, 294

Tricho-trachelidie, 325
Trichocephalus, 376
a^hins, 415, 428
cenurus, 435
depressiusculus, 466
dispar, 11, 415
unycutculus, 474

Trilocoured worm, 367
Trinoton, 68
cospurcatum, 80
continuum, 81
luridum, 81

Trockhanter of the Sarcoptinae, 117
Trombidian acariss, 294
Trombidium, 93, 94, 106, 235
Trombidinae, 106
Trombidium, 107
Tropiarius, 326
Trypanosoma, 635
Evansi, 619
sanguinis avium, 619

Tsatsaya, 35
Tschesotka, 167
Tse-tec fly, 35
Tuberculo-diphtheria, 477
Tuberculosis, pseudo, cutaneous, 220
hepatic, 513

Tuberculosis, pulmonary, 567, 578, 601
Turbellaria, 5
Turicatas, 105
Turnsick, 728
Turpis scabies, 112
Tuson's Sheep-dip, 185
Tyrophylus, 109, 110
Tyrophylus, 110
echinopus, 315
sara, 327
Tyrosine, 677
Tze-tze, 35

U
Uncinaria, 386
Balsami, 471
cerna, 427, 429
dauodenalis, 441, 462
radialis, 415
stenocephala, 464
trigoniceps, 441, 464, 470, 471
Uncinariosis, 463
Ura, 56
Utricles of Miescher, 659

V
Vampyrellae, 3
Vegetable parasites, 2
Vegetating follicular psorospermosis, 270
Vermicides, 391
Vermifuges, 391
Verminous broncho-pneumonia of Bovines, 591
of Camel, 598
of Equines, 595
of Goats, 583
of Pig, 596
of Rabbit, 585
of Sheep, 583
Verminous foot-rot of Sheep, 267
ophthalmia, 759
phthisis of the liver, 517
lungs, 587
pneumonia, 586
trachea-bronchitis, 606

Vermipylia, 62
Vertigo, 728, 735
hydatiginosa, 728
cased by the cenurus, 728

Vesicle, daughter, 508, 509
grand-daughter, 509
Laureat, of, 319
mother, 508
proligerous, 508
secondary, 508

Vibrions, 327
Vidards, 398
Vidragon, 164
Vitelloducts, 320
Vitellogen, 320
Vorans, 328
Vulva-anal slit, 118

Vulva, ovulatory, 118

Walz's bath, 183
ERRATA ET ADDENDA.

Page 4, line 16 from above, for 'flagellata,' read 'flagello.'

Page 23, "7" "'pruritis,' read 'pruritus.'

Page 28. (In the forest regions of Korea, insect pests abound in the summer months. Mosquitoes, gnats, and gadflies make the lives of the settlers perfectly burdensome for two or three months of the year, and ponies and bulls quickly succumb to their attacks. The houses are kept constantly filled with birch-smoke to drive them off; cattle are protected by fires of three green wood in the open; and men working the clearings carry coils of rope made from dried artemesia, which burns slowly and emits a pungent odour, for the same purpose.—C. W. Campbell. "A Journey through North Korea to the Chang-pia Shan. Journal of the Royal Geographical Society, March, 1892, p. 155.)

Page 55, line 32 from above, for 'Wallisneri,' read 'Wallisneri.'

Page 73, after Doc. add: Cat. The Cat has only one kind of Louse, the Trichochotus subrostratus Nitzsch (Fig. 39). Head sub-pentagonal, longer than it is wide, acuminate in front, with a shallow notch; antenna alike in the two sexes. Abdomen larger in the female and notched behind; in the male it has rather the shape of a horizontal cone, terminating in a very salient, conical, and downy ninth segment. Abdomen whitish; head and thorax bright-yellow, with the bands and spots darker. Length: female 1'3 mm., male 1'2 mm.

Page 93, line 31 from above, for 'Bellide.' read 'Bstellide.'

Page 103. (With regard to the Itodes boris Riley, of Texas—and for which Cooper Curtice has recently created a new genus, Boophilus, though it bears a very close resemblance to, if it is not quite identical with the Itodes Dupesi—it has just been announced that it plays a prominent part in the production of the very serious disease of Cattle—Texas fever. After clinical and experimental investigations on an extensive scale during 1888 and 1889, in the United States, the following preliminary conclusions have been formulated: 1. Texas fever is a disease not caused by Bacteria. Its nature cannot be understood by supposing a simple transfer of Bacteria from Southern Cattle to pastures, and from pastures to Northern Cattle; 2. The cause is probably a protozoan, with a more complex life history, living for a time within the red corpuscles of infected animals; 3. Southern Cattle without Ticks cannot infect a pasture; 1. Ticks alone on a pasture will produce the disease. It is surmised that the Ticks are the bearers of the corpuscles found in the blood, and which are supposed to produce the disease. Ticks taken from Southern Cattle and placed upon pastures which could have been infected in no other way, so infected these grounds that susceptible Cattle placed upon them contracted the disease in the same length of time as Cattle placed upon pastures along with Southern Cattle. Again, young ticks that were hatched from the eggs of adult ticks gathered from Southern Cattle, were placed upon susceptible animals and produced the disease.

There are, consequently, two factors in the production of Southern or Texas fever: first, the Tick; second, the protozoal micro-organism that lives in and destroys the red corpuscles of the blood of the affected Cattle. Where the insect obtains the protozoan is not yet ascertained, but that the latter can be transmitted from one generation of ticks to another, through the ova, has been demonstrated. It is important to learn through how many generations of Ticks the germ can be conveyed without losing its virulence, and whether there is any other means by which it gains access to the blood of Cattle, in addition to being introduced through the punctures made by the insect. There are evidently Ticks which do not harbour the micro-organism, as Cattle susceptible to Southern fever are frequently badly infested with the vermin, without showing any signs of disturbed health. The adult Ticks from Texas drop from the bodies of Southern Cattle and deposit their ova upon the pastures; there these are hatched, and in time
ERRATA ET ADDENDA.

799

the young ticks get upon susceptible bovines and produce the disease in them, thus playing a similar part to the mosquito in the production of chyluria in Man.—Sixth and Seventh Annual Reports of the Bureau of Animal Industry, for the years 1889 and 1890, Washington, 1891.)

Page 113, line 10 from above, for 'A.D. 1200,' read 'A.D. 1150.'

Page 136, 19, 'pruritus,' read 'pruritus.'

Page 137, 2 from below, 'pruritus,' read 'pruritus.'

Page 224. (Wallmann gives the following formula for a dressing to cure follicular scabies, two applications of which, he asserts, will prove successful):

Sosoidal of mercury ...... 5 grammes.

Vaselin ...... 100 grm.

Page 235, Note 2, add: Railliet and Lucet have remarked the presence of the Harvest-bug on Fowls, especially Chickens. The parasite is somewhat common on Chickens which have been hatched towards the end of summer and in the autumn, and sometimes causes a considerable mortality. The Acari fix themselves by their rostrum to the root of the feathers, and set up so much irritation as to produce a sort of epilip-form affection, that terminates fatally in a few days. The insufflation of flowers of sulphur among the feathers appears to have yielded good results.—Bull. Soc. Centr. de Méd. Vétérinaire, 1891, p. 249.

Page 236, Note 1, for 'G. Haller,' read 'G. Heller.'

Page 263, line 29 from above, for 'W. Jans,' read 'W. James,' the same correction to be made in Note 1.

Page 304, line 11 from top, for 'dermomycosis aspergilltus,' read 'aspergillar dermomycosis.'

Page 329, lines 2 and 3 from above, for 'cirrus,' read 'cirrus.'

Page 325, line 9 from top, for 'filaridès,' read 'Filarides.'

Page 360, 361, (C. W. Stiles states that Müller's Spiropera scutata osophaga boris is quite frequent at Washington, U.S.A., and, upon studying it, he has found such differences in its anatomy, from that described in text-books, as to exclude it from the genera Filaria and Spiropera in which it is generally placed, and compel him to create a new genus for it under the name Myzomimus, the typical specimen he describes being designated Myzomimus scutata. This description is given in the American 'Journal of Comparative Medicine and Veterinary Archives' for February, 1892.)

Page 361, line 4 from top, for 'differs,' read 'differ.'

Page 382, line 1 at top, for 'Edinococci,' read 'Echinococci.'

Page 382, line 1 at bottom, for 'Diplidians,' read 'Diplydians.'

Page 386, lines 9 and 10 from bottom, for 'Filaria,' read 'Filarie.'

Page 403, line 6 from top, for 'p. 399,' read 'p. 410.'

Page 416, in Fig. 190, the middle illustration (anterior extremity) should be lettered B.

Page 435, at Fig. 209, for 'Caudal porch,' read 'Caudal pouch.'

Page 440, line 7 from bottom, for 'pisiformes,' read 'pisiformis.'

Page 448, foot note, for 'Berthold,' read 'Bertolus.'

Page 465, Figs. 241, 242, for 'stenoocephala,' read 'stenoocephalus.'

Page 466. (Tricocephalus depressivusculus, Helminthologists give the exclusive habitat of this entozoon as the cecum of the Dog and Fox, and regard it as inoffensive. At the autopsy of two sporting Dogs which had been reduced to skeletons by a deadly anemia, Mégnin found the mucous membrane of the cecum as well as that of all the large intestine as far as the anus, literally lined by myriads of Trichocephales. All the other organs were healthy; the small intestine was even destitute of the entozoa—Tenia and Ascarides—usually found therein, and there were no traces of Uncinaria, nor yet of Coccidia in the villi. In the course of the malady in these animals, there was none of the bleeding from the nose which is rarely absent in the pernicious anemia of sporting Dogs, and which is caused by the Uncinaria trigonocephala.—Société de Biologie, Science, Dec. 26th, 1891. Revue Vétérinaire, March, 1892, p. 162.)

Page 473, line 20 from top, for 'T. rhopaloccephala,' read 'T. rhopaloccephala.'

Page 475, line 6 from top, for 'flagellated,' read 'flagellate.'

Page 494, line 6 from bottom, for 'sygnanns,' read 'sygnannus.'


Page 689. (Hertwig states in the Journal alluded to, that in 1890 the Cysticercus bovis was met with in the Berlin Abattoir much more frequently than in the previous year, being found in 390 animals (one being a calf); whereas, in 1889, only 277 animals were found infested. He noticed that the situation of the cysticerci in the bodies of the cattle was as follows:—

In the masseter muscles ...... 316 instances.

and heart ...... 39

and brain ...... 1

and tongue ...... 4
In the cervical muscles and tongue 1 instances
  "  "  "  "  tongue 2
  "  "  "  "  and heart 2
  "  "  "  "  muscles of thorax and tongue 1
  "  "  "  "  internal muscles 22

Excluding the 22 instances in which the parasites were found in the interior of the body, the following shows their proportional distribution in the external muscles:

- Masseter muscles ... ... in 360 instances.
- Heart ... ... 41
- Tongue ... ... 10
- Cervical muscles ... ... 3
- Thoracic muscles ... ... 1

From this it may be concluded that the masseter muscles are by far the most favourable habitat of the bovine cysticercus.

The stage at which the cysticerci were found, varied from the earliest to the complete development, calcified, and dead condition; and it is worthy of note that it was repeatedly observed, that while the worm would be found in a young stage in one part, in another situation it was more fully developed. In similar instances the cyst was as long as a centimetre or more, and the hydatigenous membrane was thickened, and contained a greenish or yellowish powder, in which the body of the cysticercus was hidden.

Page 727. (With regard to cerebral echinococcosis, in Il Moderno Zool. V, January 10th and 25th, and February 10th, 1892, F. Boscheti describes an instance of this affection in a Cow, and gives a good historical, clinical, and anatomical description of this affection.)

Page 744. (With reference to oitis caused by the Aspergillus, Goodall, in Veterinary Journal for March, 1892, describes the case of a Horse which presented peculiar symptoms—somewhat akin to those of auricular vertigo, and which he attributes to the presence of the Aspergillus nigericus. Cleaning out the ear, and employing sulphur-powder, effected a cure.)

Page 748. (In the Recueil de Méd. Vétérinaire for February 15th, 1892, Railliet and Cadiot make some important observations on Symbiotic otacariasis in Carnivora, as result of experiments. They show that epileptic convulsions of auricular origin in a Dog and Cat are manifested independently of a direct stimulation of the sensory nerve of the ear, as the internal, and even the middle, ear may remain unaltered. Such as they think, are allied to the epilepsy of Brown-Séquard. The results of their experiments with those of Nocard, mentioned in this work, tend to show: 1. That otacariasis is readily transmissible from an affected animal to healthy animals of the same species. 2. That transmission is more difficult between the Cat and Dog; 3. That it does not take place between the Ferret and Dog. These results are in conformity with the morphological data pertaining to auricular Symbiosis, as will be seen by the following table, which gives the respective dimensions of the Symbiotes—Cyno/otis auricularum—of Dog, Cat, and Ferret, in micro-millimetres.

<table>
<thead>
<tr>
<th></th>
<th>Var. Canis</th>
<th>Var. Cati</th>
<th>Var. Ferunis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egg-laying Female</td>
<td>400-530</td>
<td>280-350</td>
<td>430-480</td>
</tr>
<tr>
<td>Sexual Female</td>
<td>340-380</td>
<td>210-260</td>
<td>310-360</td>
</tr>
<tr>
<td>Egg</td>
<td>200-210</td>
<td>90-120</td>
<td>160-190</td>
</tr>
</tbody>
</table>

Now, if one compares the parasite of the Dog with that of the Cat, and that of Cat with that of the Ferret, it will be observed that nearly all these dimensions overlap one another; so that certain species taken from the cat may be of the same size as others taken from the Dog, and similarly with the Symbiotes of the Ferret and Cat.

However, the differences in size between the parasite of the Ferret and that of Dog are always very distinct and well marked.

According to this distinction, it is very easy to understand that the species proper the Cat could live on the Dog, whilst that of the Ferret ought only to very slightly accustom itself to its new habitat on that animal. It is probable, also, that transmission is possible from the Ferret to the Cat.)

Bailliére, Tindall & Cox, 20 and 21, King William Street, Strand.