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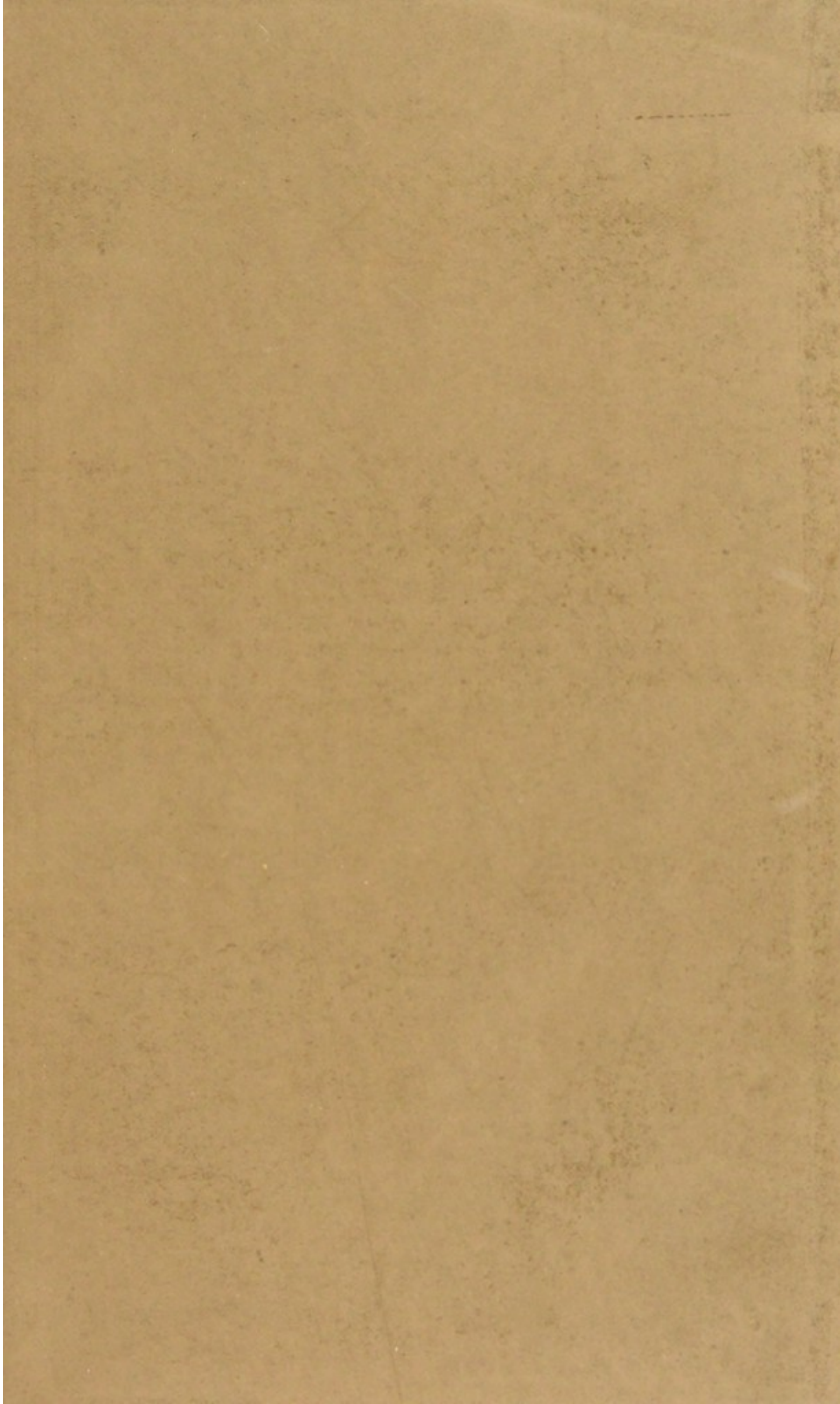
Tapeworms
and
Threadworms
—
COBBOLD

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TAPEWORMS AND THREADWORMS.

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TAPEWORMS AND THREADWORMS

(HUMAN ENTOZOA)

THEIR SOURCES, NATURE, AND TREATMENT.

BY

T. SPENCER COBBOLD, M.D. F.R.S. F.L.S.

LECTURER AT THE MIDDLESEX HOSPITAL.

SECOND EDITION.

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PREFATORY NOTE.



ESSENTIALLY PRACTICAL in its character, this little work is not intended to supersede my larger treatise on 'Entozoa.'

The favourable reception of that work by the profession and by the scientific public leads me to believe that a less expensive volume, free from unnecessary technicalities, may not prove unacceptable.

I have purposely limited my remarks to two groups of the numerous parasites which invade the human body; but to render the work generally useful, I have added a complete list of human entozoa in the introduction.

The Appendix is based upon observations which I publicly communicated to the British Association at Birmingham in the Autumn of 1865.

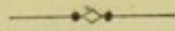
The experience I have acquired in practice has led me to insist strongly on the employment of pure and freshly prepared drugs. In old standing cases of tapeworm and threadworm (*Ascarides*) attention to this point will often command success, even where the same drug has been previously used.

T. S. C.

84 WIMPOLE STREET, CAVENDISH SQUARE:

March 1, 1867.

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TAPEWORMS



INTRODUCTION.

PERSONS entertain remarkably different views respecting the dealings of Providence in relation to the welfare of the human species. It is certainly difficult in every case to trace a direct connection between wrong doing and suffering, and most people believe that, whatever inconveniences they have to put up with here below, all is ordered for the best. Whilst they enjoy good health, and are not troubled with internal parasites, this kind of doctrine is extremely agreeable to them, but when they find themselves constituted as 'hosts' or 'entertainers' of certain well known forms of entozoa, they begin to doubt the need-be for such an arrangement in the parasite's favour. The fiery serpents of the wilderness (*Dracunculus medinensis*)

and the worms which devoured King Herod, assure them that the possession of similar 'guests' must be regarded as a special evidence of Divine displeasure; yet, when they think the matter over more considerately, they cannot understand how it is that all the higher animals are liable to the same or similar verminous disorders. The difficulty of maintaining their original and preconceived opinions becomes considerably enhanced when they further reflect upon the intimate relation subsisting between the forms of parasites dwelling in the human territory and those occupying the bodies of our domestic animals. The difficulty becomes yet further increased when it is found (by the light of modern scientific discovery) that certain of the forms in question are only stages of growth of one and the same parasitic creature, whose welfare and existence is absolutely dependent upon the life of either 'host.' Moreover, as in the case of the so-called common tapeworm, the human 'host' must devour part of the animal 'host,' the migration of the parasite being effected passively and independently of any will on its part. Paradoxical as it may

seem, we human beings are essential to the existence of particular species of tapeworm. It is only by accepting Mr. Darwin's hypothesis that we can escape the undignified conclusion that parasites were specially created to dwell in us, and consequently, also, that we were destined to entertain them. Whatever view we may adhere to, the facts speak for themselves. Undoubtedly the human body, in common with the bodies of animals, constitutes a peculiar territory for entozoa. To reside in this home of theirs, and to enjoy themselves at our expense, is their especial prerogative. The entire organisation of these creatures is admirably contrived for this purpose. Some will resist extremes of heat and cold. Many are furnished with a special cyst or protective covering. Most of the juvenile forms are supplied with a tearing or boring apparatus, the same creatures in their adult condition having remarkable 'hold-fasts' for the purpose of anchorage. For details respecting the varied and singular arrangements which obtain in many of the species, I must refer the reader to my larger treatise; but in order to

convey some general notion of the character, number, and variety of entozoa which have been called into existence, I append a detailed list of those species at present known to infest the human body. Exclusive of external parasites (ectozoa), the following helminthic and other creatures have been recorded as infesting man :—

HUMAN ENTOZOA.

CESTODES.

1. The pork tapeworm—*Tænia solium*, Linneus. *Tænia humana armata*, Brera. *Tænia lata*, Pruner.
2. The beef tapeworm—*Tænia mediocanellata*, Küchenmeister. *Tænia inermis*, Moquin-Tandon. *Tænia cucurbitina grandis saginata*, Goeze.
3. The broad tapeworm—*Bothriocephalus latus*, Bremser. *Tænia lata*, Pallas. *Tænia humana inermis*, Brera.
4. The Greenland or heart-shaped headed tapeworm—*Bothriocephalus cordatus*, Leuckart.
5. The dwarf or Egyptian tapeworm—*Tænia nana*, Siebold. *Tænia ægyptiaca*, Bilharz.
6. The elliptically-jointed tapeworm—*Tænia elliptica*, Batch. *Tænia cucumerina*, Bloch. *Tænia canina*, Pallas.
7. The crested or ridge-jointed tapeworm—*Tænia lophosoma*, Cobbold.
8. The spotted tapeworm—*Tænia flavopuncta*, Weinland. *Tænia flavomaculata*, Molin.

LARVAL CESTODES.

9. The hydatid or acephalocyst—*Echinococcus hominis*, Rudolphi. *Acephalocystis endogena*, Hunter. Juvenile stage of growth of *Tænia echinococcus*, Siebold.
10. The pork or common 'measle'—*Cysticercus cellulosæ*, Rudolphi. *Finna humana*, Werner. An early or so-called scoleciform stage of the *Tænia solium*.
11. The slender-necked hydatid—*Tænia hydatigena*, Pallas. *Cysticercus tenuicollis*, Rudolphi. The larval stage of the *Tænia marginata*, Batsch.
12. The triple-crowned hydatid—*Cysticercus acanthotrias*, Weinland. The larval or scoleciform stage of an undiscovered tapeworm.

NEMATODES.

13. The fleshworm or spiral threadworm—*Trichina spiralis*, Owen. *Pseudalius trichina*, Davaine.
14. The common threadworm or maw-worm—*Oxyuris vermicularis*, Bremser. *Ascaris vermicularis*, Linneus.
15. The common roundworm—*Ascaris lumbricoides*, Linneus. *Lumbricus teres hominis*, Tyson.
16. The moustached roundworm—*Ascaris mystax*, Rudolphi. *Ascaris alata*, Bellingham.
17. The common whipworm—*Trichocephalus dispar*, Rudolphi. *Ascaris trichiura*, Linneus. *Trichocephalus hominis*, Goeze.
18. The human lung-strongle—*Strongylus bronchialis*, Cobbold. *Filaria bronchialis*, Rudolphi. *Strongylus longevaginatus*, Diesing.
19. The human intestinal strongle—*Strongylus quadridentatus*, Siebold. *Sclerostoma duodenale*, Cobbold. *Anchylostoma duodenale*, Dubini.

20. The renal or great strongyle—*Strongylus gigas*, Rudolphi. *Eustrongylus gigas*, Diesing. *Lumbricus in renibus*, Blasius.
21. The guineaworm—*Filaria medinensis*, Gmelin. *Filaria dracunculus*, Bremser. *Dracunculus medinensis*, Cobbold.

LARVAL NEMATODES.

22. The loa—*Filaria oculi*, Gervais and Van Beneden. *Dracunculus oculi*, Diesing. *Dracunculus loa*, Cobbold.
23. The eye threadworm—*Filaria oculi humani*, Nordmann. *Filaria lentis*, Diesing.
24. The tracheal threadworm—*Nematoideum tracheale*, Rainey and Bristowe. *Filaria trachealis*, Cobbold. X

TREMATODES.

25. The common fluke—*Fasciola hepatica*, Linneus. *Distoma hepaticum*, Abildgaard. *Fasciola humana*, Gmelin.
26. The lancet-shaped fluke—*Distoma lanceolatum*, Mehlis. *Distoma hepaticum*, Zeder. *Fasciola hepatica*, Bloch.
27. The broad fluke—*Distoma crassum*, Busk. *Distoma Buskii*, Lankester. *Dicrocælium Buskii*, Weinland.
28. The blood infesting fluke—*Distoma hæmatobium*, Bilharz. *Gynæcophorus hæmatobius*, Diesing. *Bilharzia hæmatobia*, Cobbold.
29. The Egyptian fluke—*Distoma heterophyes*, Siebold and Bilharz. *Dicrocælium heterophyes*, Weinland. *Heterophyes ægyptiaca*, Cobbold.

LARVAL AND DOUBTFUL TREMATODES.

30. The four-suckered fluke—*Tetrastoma renale*, Delle Chiaje. Probably, the sexually immature condition of a *Polystoma*.
31. The fat-infesting fluke—*Polystoma pinguicola*, Zeder. *Hexathyridium pinguicola*, Treutler *Pentastoma denticulatum*, according to Gervais and Van Beneden.
32. The vein-infesting fluke—*Polystoma venarum*, Zeder. *Hexathyridium venarum*, Treutler. The young of *Distoma hepaticum* or of *Distoma lanceolatum*, according to Davaine.
33. The eye-infesting fluke—*Distoma ophthalmobium*, Diesing. *Distoma oculi humani*, Gescheidt. The juvenile condition of *Distoma lanceolatum*, according to Leuckart.

ACARINE PARASITES.

34. The armed pentastome—*Pentastoma denticulatum*, Rudolphi. *Linguatula tænioides*, Lamarck. The young of *Pentastoma tænioides*, according to Leuckart.
35. The smooth pentastome—*Pentastoma constrictum*, Siebold. *Linguatula constricta*, Küchenmeister. *Nematoideum hominis*, Pruner.

PARASITES OF OTHER CLASSES.

36. The vaginal monad—*Trichomonas vaginalis*, Donné, Davaine, Leuckart, Kölliker.
37. The leaping monad—*Cercomonas saltans*, Ehrenberg, Wedl, Leuckart.
38. The urinary monad—*Cercomonas urinarius*, Hassal, Leuckart.

39. The intestinal monad — *Cercomonas hominis*, Davaine. *Cercomonas intestinalis*, Lambl. *Balantidium coli*, Lachmann. *Paramecium coli*, Malmsten.
40. The blood animalcule — *Bacteridium sanguinis*, Davaine, Jamin, and others.
41. The human psorosperm—Eggs of *Distoma hepaticum*, according to Gubler; variously described by Virchow, Dressler, Lindemann, Leuckart, Beale, Cobbold, and others.

Such is the list; yet I have omitted all mention of the numerous forms of insect larvæ which have been recorded as intestinal worms. The Rev. J. F. Hope's catalogue alone enumerates forty-three different kinds or species. Undoubtedly some of them, perhaps the majority, have really come from man; but, since it cannot be shown that the human body is, in any sense, their proper home, habitat, or territory, I do not choose to regard them as entozoa in any technical sense of the word. Their presence is invariably accidental, so to speak.

Again, none of those parasites which infest or penetrate the skin are included in the above list. The *Entozoon* or *Demodex folliculorum* and its allies are therefore omitted. In like

matter, I have had still less hesitation in rejecting a variety of reputed entozoa, which, in truth, either do not belong to the human body, or, as most frequently happens, are no parasites at all. Amongst these may be mentioned the *Spiroptera hominis*, which is the common *Filaria* of fishes; Farre's *Diplosoma crenatum*; Curling's *Dactylius aculeatus*; De Gland's *Nematoideum hominis*, which is the common hair-worm or *Gordius aquaticus*, so frequently employed to deceive the medical practitioner; Cloquet's *Acephalocystis racemosa*, or hydatigenous formations connected with the chorion; Sultzer's *Ditrachyceras rudis*, and such-like matters, which, when carefully investigated, have turned out to be extraneous substances, macerated and deprived of their original character during their passage through the alimentary canal. Scarcely a week passes that I do not receive reputed worms of this nature, either from patients or their medical advisers. Sometimes these pseudelminths are really so worm-like that a mere naked eye examination is insufficient to determine their nature. In such cases, the expressed opinion

of a well-informed helminthologist is occasionally of great value, as a subsidiary means of diagnosis and prognosis, often, at the same time, bringing great relief to the patient's mind.

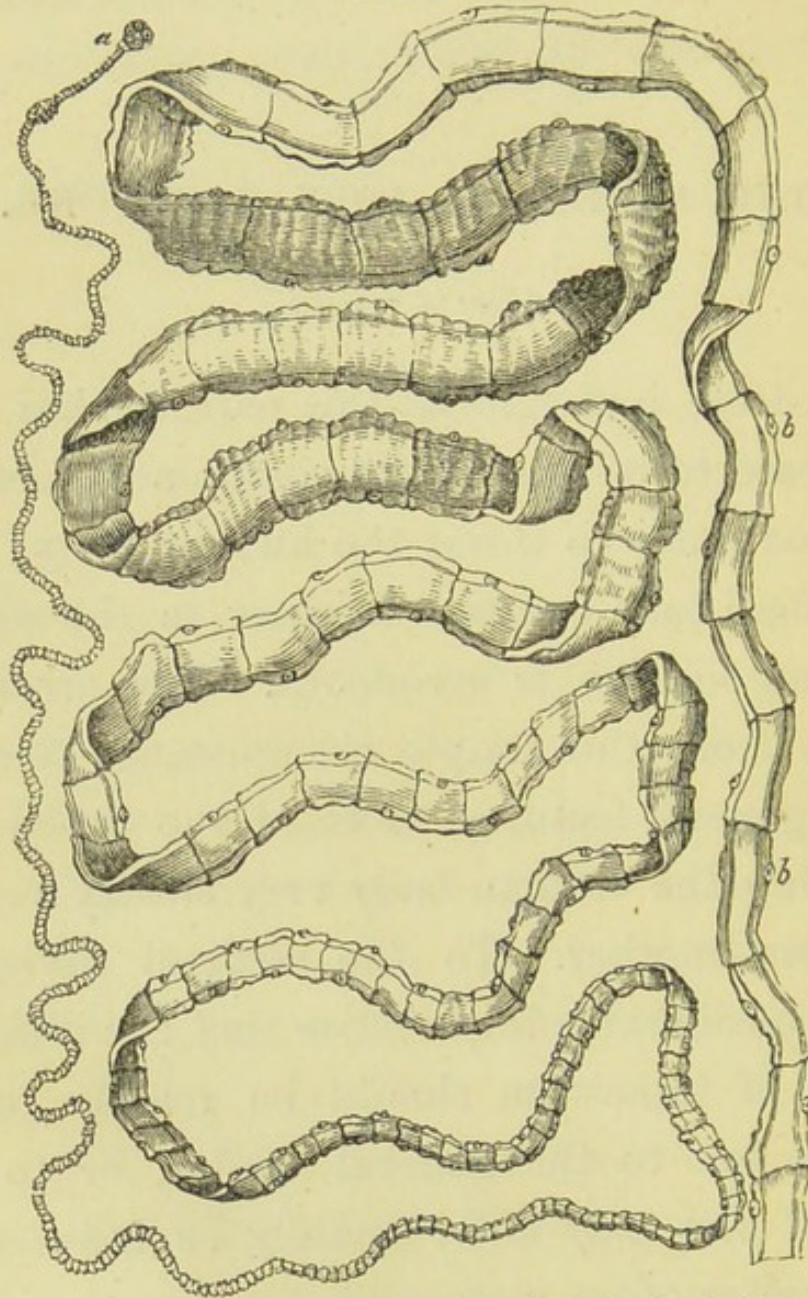
THE ARMED, OR PORK TAPEWORM.

(*Tænia solium*.)

FROM time immemorial this parasite has been supposed to be one of the commonest forms of entozoa liable to infest the human body; but, as I shall take occasion to show in the sequel, this supposition is erroneous. The error has arisen from the simple circumstance that, in their general features, most of the tapeworms infesting the human body very closely resemble one another. To the medical adviser it is of considerable importance that the different forms of tapeworm should be readily recognised; but to the general reader, or to the patient who may unfortunately be infested, it is a matter of no very great consequence. To enter minutely into the differences subsisting between the two commonest forms of human tapeworm is not my present purpose, since to

render these distinctions clear, it would be necessary to supply a series of illustrations.

FIG. 1.



The Pork Tapeworm (*Taenia solium*), showing the head (*a*), neck, and part of the body (*b*). Reduced to one half the natural size.

Those, therefore, who on professional or scientific grounds desire to make themselves masters

of the subject should consult the larger treatise referred to in my preface.

The armed tapeworm, as has now been known for many years past, is derived from pork; or rather, in other words, we obtain it by eating the so-called 'measly' flesh of swine. A general impression prevails, that all human tapeworms have a similar origin, but without entering into particulars, I may state, once for all, that such a notion is entirely groundless. Every tapeworm has its own special form of larva, and the larva itself is as distinctive as is its own peculiar adult parent. Every full-grown tapeworm has an appetite, so to say, for a certain kind of residence, and, as in the species under consideration, usually confines itself to one particular kind of bearer. It may almost be said that every tapeworm has its own 'host' or 'bearer,' and consequently also, that every bearer carries, or is liable to carry, his own tapeworm. Very contrary, indeed, does it appear to the presumed dignity of the human species, that man should be, as it were, singled out as the legitimate home and territory of a tapeworm; but not only is this the case, but

science almost teaches us to aver that, so far as this life is concerned, man appears to have been made expressly for the accommodation of certain tapeworms. At all events, without man, two apparently distinct species of tapeworm could not, it would seem, exist. The armed tapeworm has never yet been found in any 'host' save man, and the same may be said of the unarmed human species. Of course, in making the above statement as regards cause and effect, I am only, for the time, adopting the ordinary mode of teleological reasoning; but however logical the deduction may at first sight appear, I need not say that I can hardly bring myself to believe in the correctness of such a conclusion.

The perfect armed tapeworm, as it is usually presented to the observer, is a long, soft, whitish, jointed animal, which, when alive, elongates and contracts itself with great facility. Though commonly spoken of as a single animal, it is in truth a compound of many individuals. These individuals are called 'cucurbitini,' 'zooids,' or 'proglottides,' by scientific persons, and they are likewise occasionally termed links,

or joints. By whatever name they are called they represent so many distinct segments of the body, and, when fully grown, they are capable of detaching themselves and of enjoying a free and independent existence. Very annoying it is to the human bearer to be continually reminded by his unwelcome 'guests' that, for their own pleasure or life-necessities, they desire to quit his interior. Not, indeed, do they oblige him by departing all at once; but their habit is to wander, solitarily and in succession as it were, as if purposely 'to plague his very life out.' This expression is one which is not uncommonly used by persons thus afflicted; and I have seen one or two individuals so emaciated by the discomforts arising from the presence of tapeworm, that in reality life itself had almost been 'plagued out.' To say the least, such individuals have wished themselves deprived of existence.

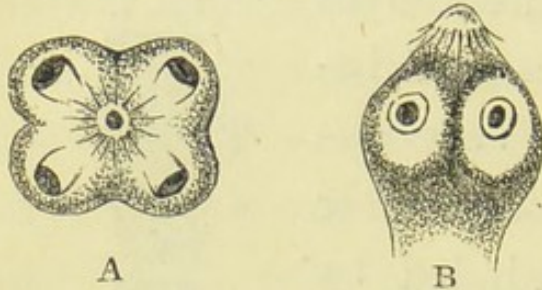
FIG. 2.



Portion of the body of *Tænia solium*, with a naturally produced knot.
(b) Reproductive papilla.

The head of the armed tapeworm is characterised by the possession of four sucking disks

FIG. 3.



Head of *Tænia solium* viewed from above (A) and in front (B). Enlarged, and drawn with the aid of a camera. Original.

or cups and a proboscis or rostellum armed with hooks.

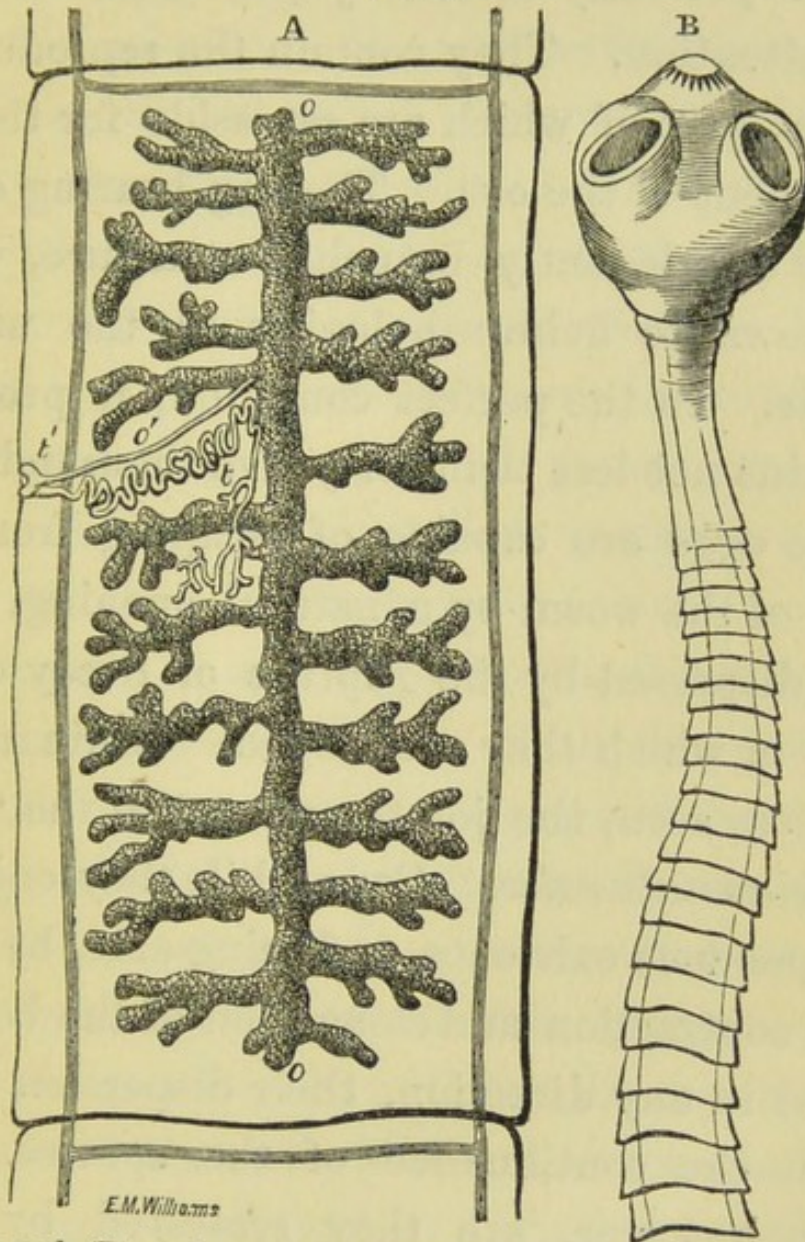
The suckers are placed at the corners of the somewhat

square-shaped head, the rostellum being situated at the cen-

tre and summit. In the projected state this process has the form of a cone whose base supports two rows of hooks. Each row carries from twelve to fourteen hooks, so that there are usually twenty-four or twenty-eight altogether. The size of the head is equal to that of a small pin-cap. It is succeeded by a long narrow neck, finely striated transversely. These striæ represent the future segments of the body, and at a distance of about one inch and a half from the head, their joint-like character can be detected with the aid of a pocket lens. Further down, the joints soon acquire their characteristic individuality, and at about the four-

hundred and fiftieth segment their internal sexual organs become fully developed. In a

FIG. 4.



Head and neck (B), and one of the sexually mature joints (A) of *Tania solium* (after figures by Blanchard), showing more particularly the branched egg-bearing organ (*o*) filled with ova. It also shows the oviducal canal (*o'*), the cirrus (*t*), and the external outlet (*t'*). Enlarged.

fully grown worm we may count as many as twelve hundred segments, that is, including the

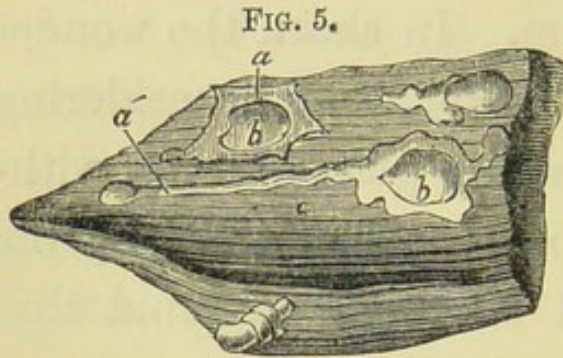
immature or imperfectly formed joints of the attenuated neck.

The perfectly formed joints demand separate attention. They contain the reproductive organs, part of which are set aside for the development of the ova. The egg-bearing organ forms an elegantly branched structure, which is known to helminthologists as the uterine rosette. In the perfect condition, it probably contains not less than forty-five thousand eggs. These eggs are capable of escaping from the body of the worm by a natural opening, being also dispersed by the rupture or decay of the joint in which they are lodged. Ordinarily, as we have seen, the joints pass out of the 'host' *per vias naturales*. For a while they enjoy an independent existence, and being able, by alternate contraction and elongation of the body, to travel in any direction, their dispersion brings about the continuance of the species. Not only, however, are they scattered by these natural means, but they are also, passively as it were, transported by sewage distributors and other benevolent persons. Various agencies in earth, air, and water, lend a helping hand.

In consequence of this distribution, swine

experience little difficulty in picking up more or less of the eggs; and as these eggs measure only the $\frac{1}{700}$ of an inch in diameter, it is easy to understand how we ourselves may be liable to swallow them. In short, the wonder is that we escape infection at all, considering that scores might exist in a glass of water without our being able to see any of them by the naked eye. It must be borne in mind that every perfect egg contains a young tapeworm larva. This larva or embryo measures about $\frac{1}{1250}$ of an inch in breadth; and in place of a crown of anchorage-hooks, it carries six small weapons arranged in three pairs, one central and two lateral. The central pair are simple stilettos for boring, the lateral being used as tearing and locomotive agencies. At all events, by means of this apparatus, the little creature is able to thrust its way through soft animal tissues. When, therefore, a tapeworm egg is swallowed by a pig and transferred to the stomach, the gastric juice dissolves the egg-shell, and the little embryo is set free. The juvenile parasite immediately thereafter proceeds to bore through the walls of the

stomach, and travels onward until it reaches a convenient resting-place. Usually it selects the intermuscular cellular tissue, but, not being very particular in its choice, it may prefer the



Portion of muscle with 'measles' in its substance: *a a'*, the cysts; *b b*, the tapeworm larvæ.

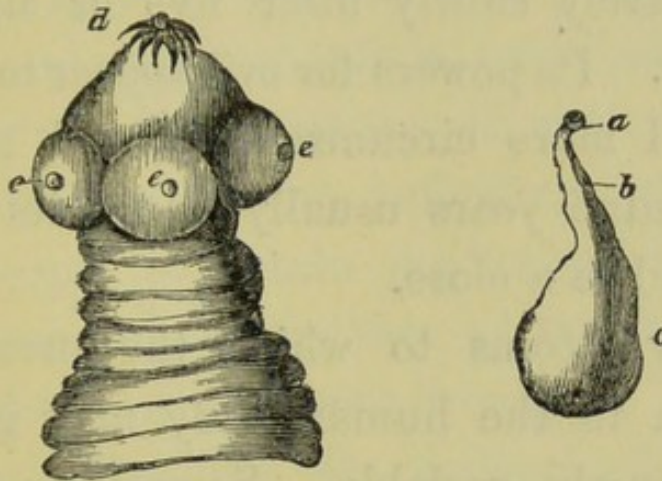
substance of the muscles themselves, or may take up its abode in the liver, brain, or other organs of the body of the animal. The

pig is thus, in common parlance, 'measled.'

Measly pork is probably not so common as formerly; nevertheless it is sufficiently abundant to produce tapeworms, more especially amongst the poorer class, whose meat is not always too carefully inspected before it is purchased. Moreover, it should be borne in mind that a pig might contain many measles, and yet be properly deemed a healthy animal; nay, more, if only a few measles existed, the most careful meat inspector would be almost sure to overlook their presence. As a rule, it may be said that pigs reared in the neighbourhood of thickly populated districts are very likely to

be measly, whilst those reared in country districts are seldom or never so. This explains why so large a part of the community resident in the country escape infection.

FIG. 6.



Cysticercus (telæ) cellulosæ; *a b c*, head, neck, and body of the natural size; *d e*, the crown of hooks and suckers magnified.

The ingestion of measly pork which is not thoroughly cooked gives rise to the formation of the armed tapeworm in the intestinal canal. The larva being set free from its capsule by the action of the gastric juice, attaches itself to the lining membrane of the bowel. For many weeks, or even months, no indication of the presence of the tapeworm is perceptible, but after the expiration of from twelve to sixteen weeks fragments of the worm may be discovered to have passed *per anum*. By this

time, at least, the tapeworm reaches its adult condition, and if nothing be done to dislodge it, the worm may remain within the bearer for six, eight, ten, or even twelve years. So far as my observation extends, the worm grows comparatively slowly after five or six years' residence. Its powers for evil appear to become more and more circumscribed, and probably eight or nine years usually brings its natural life-period to a close.

The symptoms to which the presence of tapeworm in the human body may give rise are extremely variable. Sometimes, indeed, the bearer is fortunate enough to be little inconvenienced by his guest; but even in such instances the immunity from injury is rather apparent than real. It is apparent, inasmuch as the parasite gradually, and to the bearer unknowingly, steals away a portion of his health. The trifling feelings of weariness and lassitude are usually set down to other causes, and it is only when these indications are succeeded by restlessness, nervous irritability, and headache, that proper attention is paid to the true source of these symptoms. Rather than let any fellow-

creature know the fact of their having tapeworm, many persons will not only endure any of these troubles, but even submit to the still more annoying inconveniences arising from the constant passage of the worm-segments. So revolting is it to human nature, especially to refined and educated minds, to be called upon to entertain the presence of such creatures, that only the gravest sufferings will induce some people to obtain medical advice. This applies not only in the case of tapeworms, but also to many other human parasites. Happily, but few individuals are dangerously affected by these unwelcome guests.

In bad cases the foregoing symptoms become greatly aggravated. The headache is much increased, and often accompanied with vertigo or giddiness. The sight and hearing may be affected. Noises in the head, itchings at the nose and anus, obscure pains about the body and limbs, loss of appetite, and other dyspeptic symptoms show themselves in greater or less degree in different cases. One of the most common symptoms, however, which I have noticed, is the tendency to faintness. This

is sometimes so marked as to create much alarm, and a person uninformed as to the true cause of the disorder, might be led to treat the symptom as arising from a totally different source. In female patients, the nervous symptoms display features more or less peculiar to the sex. The restlessness and anxiety is excessive, and at times accompanied with chorea and fits of hysteria. In the worst cases, in both sexes, the cerebral disturbance may show itself in convulsions and epileptiform seizures. I regret to have to add, that in not a few instances even mania itself has been entirely attributable to the presence of tapeworms in the intestinal canal.

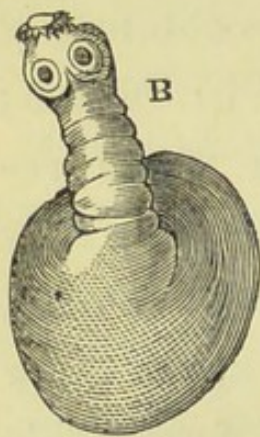
Amongst the more remarkable, I may mention three anonymously reported cases: one of amaurosis, one of convulsions, and one of epilepsy. Another case of amaurosis from tapeworm is recorded by Burgiss. Of those presenting very peculiar features, the case with 'masked symptoms' by W. D. Moore, a case by Steinbeck, and that attended with 'irritability of the bladder and stricture of the urethra' by Tuffnell, are worthy of espe-

cial notice. Mr. J. F. Streatfield publishes a case where tapeworm appears to have caused squint; and Ettmüller records an example of hysteria produced by no less than eighteen tapeworms in one single patient. Cases of insanity arising from tapeworm are more or less fully reported by W. Wood, Ferrus, Ryan, Davey, and Winslow. One case of mania of eight years duration was completely cured by the evacuation of the offending parasite, and a similar happy result followed treatment in Mr. Hutchings' example of convulsions arising from the same cause. In all severe cases the evacuation of the worm is commonly attended with perfect restoration to health; but in those instances where the worm redevelopes itself, the return of the malady may be expected. It by no means follows, however, that the identical symptoms will again show themselves, although, in the less formidable attacks, this not unfrequently takes place.

In regard to the evils produced by the larvæ of the armed tapeworm, comparatively little need be said; and yet, some sixty or seventy cases are on record where these measles or

cysticerci in the human body have caused death. My reason for now saying little on the subject arises from the circumstance that I have already treated of it at very considerable length in my larger work. It is also worthy of remark that when these larvæ occasion any mischief to man, they do so by reason of their presence in the brain. In this organ they are totally beyond our reach; and though in a few cases their existence in this situation has been successfully diagnosed during life, yet we have no means in our power to cure the

FIG. 7.



'Measle' removed from the human eye by Dr. Mackenzie. B, the head and neck, magnified five diameters.

disorder. I believe cases of epilepsy, epileptiform seizures, and convulsions arising solely from this cause, are much more common than is generally supposed. I have seen several measles taken post mortem from the human brain; and in some cases the presence of these parasites during life was, naturally enough, not even suspected. Occasionally, cysticerci are found in various other parts of the body, but it is seldom

that they give rise to any marked symptoms. The explanation of their occurrence in any part of the human body seems sufficiently simple. Either they are introduced in the egg condition from without with food, or, by regurgitation, patients may infect themselves. What I mean is this;—the embryos of a tapeworm, when brought in contact with the gastric juice, are liberated from their egg-coverings by chemical decomposition of the latter. Two or three instances have come to my knowledge of tapeworms being passed by the mouth, i. e. by regurgitation. No doubt in the particular case reported in the French journals, where upwards of two thousand ‘measles’ were found in the human body after death, the larvæ had been liberated in this manner. The six-hooked embryos escaping their shells, migrated, as it were, on their own account. Thus, we see, it is possible for an individual having tapeworm to infect himself with the so-called pork-measle.

Apart from the comparative rarity of their occurrence, so extremely diverse are the symptoms produced by the presence of larval tapeworms in the brain, that a correct diag-

nosis becomes extremely difficult. Successful prognostications have, however, been made in one or two cases. Occasionally, these brain-guests afford no indication whatever of their presence during life. At other times there is only slight cerebral irritation, with more or less headache. Griesinger, who has collected records of upwards of fifty cases of cysticerci in the brain, avers that as a rule the physical disturbances have nothing characteristic about them. You may have epileptiform seizures, with or without permanent mental perturbation. There may be more or less complete imbecility, or, on the other hand, true maniacal symptoms. In place of, or at times associated with, these formidable indications, one may encounter a very peculiar set of symptoms, such as squinting, alteration in the pupils, avoidance of light, coma, and anomalous sensations in the limbs. In the case recorded by Mr. Ottley, the parasite gave rise to distressing fits, convulsions, and death; whilst in that which occurred in King's College Hospital in 1855, the poor sufferer's epileptic fits were amongst the most formidable which Dr. Duffin ever witnessed. Illustrations

of the post-mortem appearances in this case, from Mr. Hulke's pencil, are given in my larger work.

In regard to *treatment* it is satisfactory to be able to say that, in so far as the full grown worm is concerned, we have entire mastery over the parasite. We may not, it is true, in every instance, succeed in curing the patient at once, but in the majority of instances this ought to be accomplished. Probably at least half a dozen different drugs will effect the purpose equally well, provided only due regard be had to the mode in which it is administered. Above all, it is most essential that the drug itself be perfectly pure. Cases have come under my knowledge where the successful result manifestly depended upon the source whence the drug was procured, previous administrations of the same remedy from a different druggist having proved entirely useless. Attention to recorded facts bearing on this subject will also, to some extent, explain how it is that different prescribers have arrived at such various conclusions respecting the power of particular remedies. The unsuccessful employment of a particular

remedy is not always attributable to the nature of the prescription itself, but rather to the quality of the article supplied. On the other hand, it must be allowed that there are not a few instances in which the unsuccessful exhibition of the best drugs is dependant upon causes over which we cannot exercise a perfect control.

The remedies for tapeworm are, *par excellence*, male-fern, kousso, kamala, turpentine, panna, pumpkin seeds, and pomegranate-root bark. The right administration of any one of these is likely to produce the desired result, but many others might be mentioned as having been recommended more or less strongly. Some persons seem to think that one vermifuge is just as good as another. Because they find santonine a highly useful remedy for threadworms, it by no means follows that the same drug is effective, or even useful, in tapeworm. Santonine is an excellent oxyuricide and lumbricide; but I agree with Dr. Charles West, that it is of little use in tapeworm. When so many admirable remedies abound, it were a waste of time to dwell upon the virtues of

second and third rate drugs, such as oxide of silver, tin, scammony, and other drastic purgatives, which do not appear to exert any poisonous influence on the worm itself.

Supposing it were necessary to try a variety of drugs in one or more particular cases, the order in which I have placed the seven best remedies above, is that in which I should be disposed to try them successively. Of course in no individual case is one ever likely to be called upon to adopt such a practice. Not that I regard the first-mentioned drugs as tæniacides superior to the others, but that, all things being considered, I should prefer them in the order they there stand. Probably there is no better remedy for tapeworm than oil of turpentine, and yet its nauseous character, combined with the fact that it not unfrequently produces irregular and violent effects, are circumstances which always induce me to recommend other remedies in the first instance. From cases which have come under my notice, as well as from the laudations bestowed upon turpentine by various writers, I have no doubt whatever as to the anthelmintic virtues of this drug.

The mode of administration of the different tæniacides is not altogether a mere matter of taste. True, if your drug is good, you are not unlikely to succeed with any form employed; but of this one point you may be quite certain, that some preparations of the same article are infinitely preferable to others. Thus:—never administer the powdered male-fern root if you can get the properly prepared ethereal extract. The powder is very liable to lose its strength by long keeping, and it is, perhaps, more easily adulterated than the extract. This rule applies to other anthelmintics in the powdered form. I have found the happiest results follow the administration of the oil of male-fern, where the powdered root was absolutely useless. Herein also lies, partly, the objections raised against kousso. In itself, it is a first-rate vermifuge, but the great quantity required to be swallowed is highly objectionable, especially in the case of young children. Even decoctions, as in the instance of pomegranate-root bark, are open to a similar objection on account of the quantity necessary to be exhibited.

THE UNARMED, OR BEEF TAPEWORM.

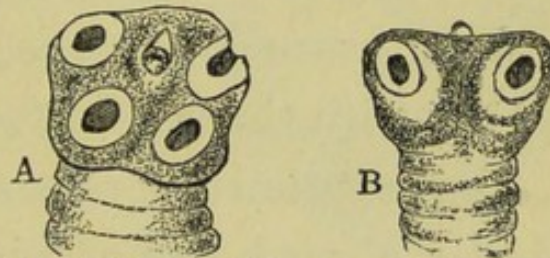
(Tænia mediocanellata.)

IF I were to speak of this parasite as the common tapeworm the majority of people would suppose that I was referring to the species previously described; and yet the facts of the case would warrant me in styling this worm as the most common of all tæniæ liable to invade the human body. In general appearance, it is very similar to the armed form, at least, when viewed by the naked eye. Commonly it is a larger and broader animal, being at the same time rather stouter.

It varies usually from ten to fifteen feet in length, but specimens have been described as attaining double that extent.

It is called the unarmed tapeworm, in consequence of the absence of any coronet of hooks on the head, and consequently, also, from there being no prominent rostellum or proboscis.

FIG. 8.



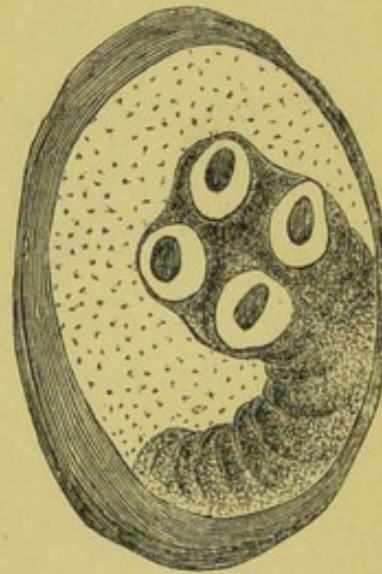
Head of the Beef Tapeworm : A, viewed from above ; B, seen from the front. Drawn from a fresh specimen by the aid of a camera. Original.

The place of this last-named structure, however, is supplied by a small rudimentary disk, which I have seen protruded on pressure. Usually this disk forms a more or less conspicuous cup-shaped circular depression, which has been compared to and described as a fifth sucker. That it is not, in any structural sense, comparable to the true suckers, I have had abundant opportunities of ascertaining; nevertheless I do not doubt that it is to a slight extent capable of being used by the parasite as a supernumerary hold-fast. The anchorage thus secured, however, is by no means equal to that obtained by the armed species, a circumstance which explains the comparative difficulty we find in procuring a specimen of the armed species with the head attached.

The experimental researches of Leuckart and Mosler abroad, and of Simonds and myself in this country, have satisfactorily determined the origin of this parasite. We have incontestably proved that the human body becomes infested in consequence of our eating veal and beef. It seems strange to speak of measly beef, and yet, probably, more diseased beef exists in this

country than similarly affected pork. I mean to say that the flesh of cattle used as food is more commonly infested with the larvæ of tapeworms, than is the flesh of swine. But the larvæ in the one case are essentially different from the larvæ in the other. The cysticerci, as they are more properly termed, differ relatively both as regards size and structure. Those in beef are comparatively small, scarcely so large as a pea, and are readily overlooked by the flesher. Those in pork are sometimes as much as nine-tenths of an inch in length, and always sufficiently conspicuous to the naked eye. The beef measle, like its adult representative, has a rather large and unarmed head, whilst the pork measle has a smaller head, surmounted by a double crown of hooks. There is no need therefore to confound the two species either in their larva or adult conditions.

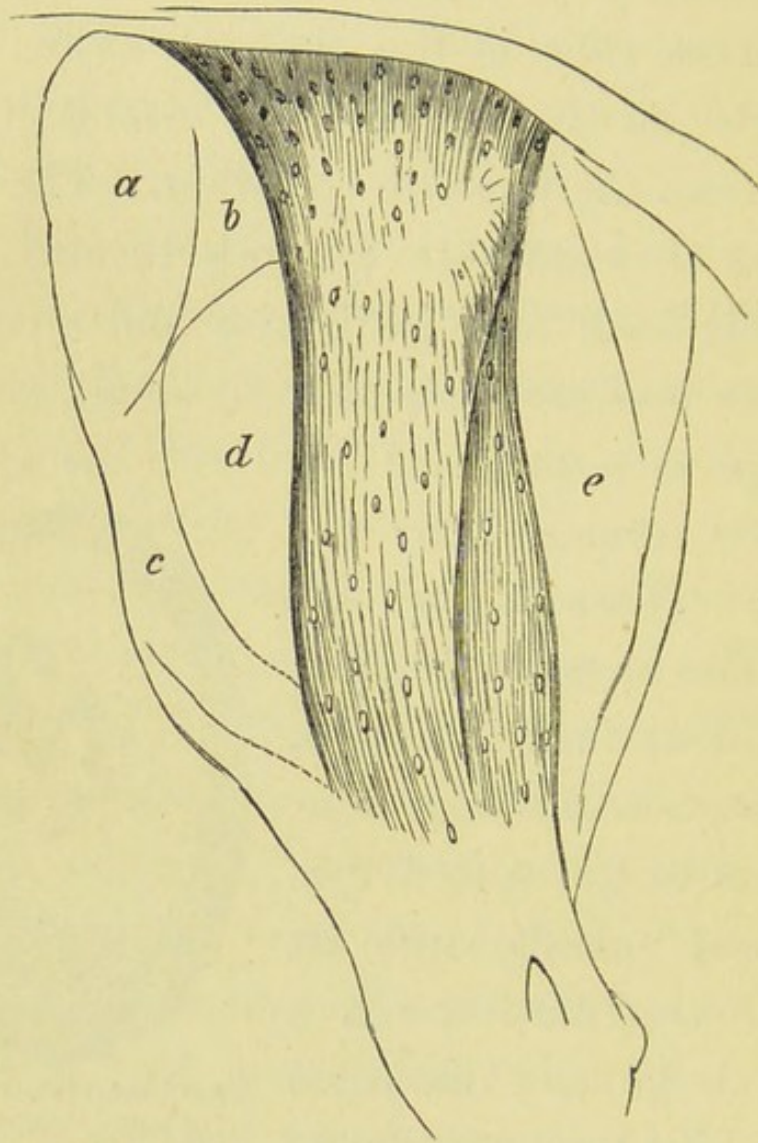
FIG. 9.



Magnified view of one of the beef 'measles' reared by experiment in a calf; showing the head, neck, caudal vesicle (or body) and enveloping cyst. Original.

It may interest the reader to explain briefly the nature and circumstances attending one of

FIG. 10.



Representation of the hinder part of the body of the left side of the calf after removal of the skin: *a b c d e* the muscles (*tensor vaginae*, *gluteus externus*, *rectus femoris*, *vastus externus*, and *biceps rotator tibialis*) still covered with *fascia*, and surrounding the large muscle (*vastus externus* of Bourgelat) here exposed. The surface of this muscle displayed upwards of 130 separate 'measles,' part of which are here shown *in situ*. Original.

our experiments. In the case of the calf, I procured a quantity of the ripe or sexually

mature segments of the unarmed tapeworm. These were immersed in warm milk, and introduced by the mouth. Sixteen days after the worm feeding, some symptoms of infection showed themselves, but in a few days more they entirely subsided. A second administration of the worm-segments was therefore decided on. Again, fifteen days after the second feeding, fresh symptoms of irritability supervened; and for a few days the distress of the animal seemed to forebode the likelihood of a fatal result. However, after a while its condition improved; the general expression of the face indicated returning health; the breathing and pulse improved; the tremors subsided, and the appetite returned. Convalescence being perfectly re-established, the animal quickly gained flesh, and in two months' time it might have been sold to a butcher as a perfectly healthy and well nourished animal. In truth it was healthy. Only, as we shall presently see, its body was full of parasites resulting from the worm feeding. About three months after the date of the first administration the calf was slaughtered. The flesh was carefully examined, and according

to my estimate it contained no less than eight thousand measles. These measles were undoubtedly the young of the unarmed tapeworm, presenting as they did all the essential characteristics which I have already described. The experiment was a perfect success. It proved the source whence the human body derives the unarmed tapeworm; and also whence cattle derive the eggs necessary for the development of the measles. As it is by such means that our science is advanced and the welfare of the human race is provided for, no person can fairly object to the legitimate employment of these experiments.

Although, up to the present time, no one has recorded the occurrence of the beef-measle in the human body, yet it is by no means improbable that it will sooner or later be recognised as an occasional visitant. Very probably it has frequently been seen, but has hitherto escaped recognition; and no wonder either, seeing that it has not even been recognised in butcher's meat in this country save by myself in the first instance, and by Mr. Simonds subsequently. The symptoms to which its presence

would give rise in the human body, will doubtless be found to correspond with those produced by the pork-measle. These I have already described. In like manner, the presence of the unarmed tapeworm in the intestinal canal gives rise to morbid phenomena which, so far as our present means of diagnosis allow us to judge, are in no way distinguishable from those occasioned by the armed species. It is not improbable that the symptoms produced by the armed tapeworm are more persistent than those of the species under consideration; nevertheless, it should be borne in mind that the greater bulk of the unarmed form may be the cause of more severe irritation. It does not seem likely that the anchorage-hooks of the former species are materially concerned in the production of unpleasant symptoms, though they undoubtedly render the total expulsion of the parasite a matter of comparative difficulty.

The *treatment* for this species is the same as that employed in the case of the armed form; nevertheless, it is highly important to ascertain previously which parasite you have to battle against. If the practitioner is satisfied that he

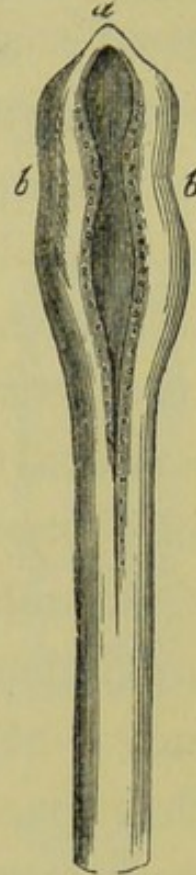
has to deal with the unarmed form, he may express himself much more hopefully as regards the final result of his efforts to effect a cure. If the armed form be present he is exceedingly unlikely to procure the head of the worm, but in the present case success is just about as likely as not to attend his treatment, provided, of course, he employs the best remedies. Out of upwards of one hundred fresh or recently passed tapeworms which I have examined, only one of them displayed a perfect armed head, whilst ten presented the unarmed head, characteristic of the species just described. If, in any particular case, the head of the worm has not been discovered by the patient's attendant, the practitioner would never conclude on such evidence that the head had not been removed. It requires, indeed, no inconsiderable amount of knowledge and experience to settle this point accurately. However, the patient's mind is always greatly relieved when you can say positively that the head, neck, and body of the worm have passed either separately or in their entirety.

THE PIT-HEADED OR BROAD TAPEWORM.

(Bothriocephalus latus.)

THIS species, though seldom seen in England, is sometimes brought hither by persons who have been residing for a time in foreign countries. Curiously enough, however, it is indigenous in Ireland; though, as compared with the two former species, it is by no means common. It has been called the Irish tapeworm, but is much better known as the Swiss or Russian tapeworm. It is especially prevalent in Russia and Switzerland, being likewise a native of other parts of Europe, and especially of Sweden and Germany. It is endemic in the countries bordering the shores of the Gulf of Bothnia.

FIG. 11.



Lateral view of the head of *Bothriocephalus latus*, showing the pointed crown (*a*) and the fossa or depression (*b b*) on one side.

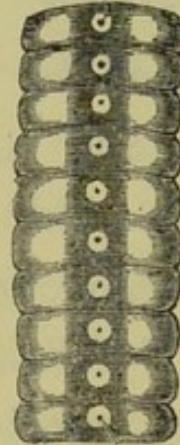
The broad tapeworm is readily distinguishable from the other species. Its remarkable breadth, associated with extremely numerous

and closely packed joints, having a very small vertical diameter, is alone sufficiently distinctive. A full grown specimen attains the length of twenty-five feet, and may carry no less than four thousand segments. It has generally a more or less strongly marked brownish-yellow tint, due to the presence of coloured eggs in the interior of the segments. The reproductive apertures, instead of being placed at the margin of the joints, are situated in the centres of the successive segments on the ventral aspect of the body. Unlike the ordinary tapeworms, the joints of this animal do not naturally separate themselves so as to become independent organisms. This circumstance is highly favourable to the patient, who is thus spared the continual annoyance usually arising from the daily passage of worm-joints. On the other hand, the presence of so formidable a parasite is seldom unproductive of disagreeable effects. The head of the worm is perhaps even more distinctive, specifically, than any other part. It is somewhat flattened from before backwards, having two long, slit-like depressions at the sides, which by means of

muscular action, afford a tolerably efficient anchorage.

The source and development of this parasite are points of considerable interest. The eggs are of comparatively large size, and after expulsion and immersion in water give passage to beautifully ciliated embryos, which latter, again, give birth, as it were, to larvæ furnished with a boring apparatus. This consists of six hooks fashioned after the manner of those existing in the mature eggs of other tapeworms. In what animals the larvæ subsequently develop themselves is not ascertained with certainty, but it seems probable that persons become infested themselves by eating certain kinds of imperfectly cooked fresh-water fish. Leuckart has suggested that the intermediary bearers are probably certain species of the salmon and trout family. Dr. Knoch, of Petersburg, seems to think that there is no need of

FIG. 12.

B *b*

C



Section of the body (B) and the eggs (C) of the Broad tapeworm. The reproductive pores (*b b*) are also shown.

the intermediate host. He believed that he had succeeded in rearing young broad tapeworms in the intestines of dogs. In this he was mistaken. In Russia this species is not very uncommon in the dog, especially in the more southern districts.

The symptoms occasioned by this parasite do not differ much from those produced by the foregoing species. According to Odier, as quoted by Davaine, there is not unfrequently a tumid condition of the abdomen, with sickness, giddiness, and various hysterical phenomena occurring at night. Pain in the region of the heart, palpitations, and faintness, are also mentioned. The *treatment* is similar to that employed in other tapeworms.

THE GREENLAND TAPEWORM.

(*Bothriocephalus cordatus*.)

THIS species, though comparatively new to science under the title above given, may nevertheless turn out to be identical with a worm long ago described by Pallas and Linneus. At

present it is only known for certain to infest the residents of North Greenland, but it is by no means improbable that its area of distribution may be found to embrace the regions of the north generally. It is, as it were, a sort of miniature representative of the species last described. It attains the length of about one foot, and has a small heart-shaped head, whose apex is directed forwards. The neck is so obscure that it may be said to be altogether wanting; the segmentation of the body being well marked immediately below the head. Though so small a species, Leuckart, who first described it, counted between six and seven hundred joints. As in the broad tapeworm, the reproductive orifices are serially disposed along the centre of the ventral line, but a close inspection of the organs themselves shows that the foldings of the egg-bearing organ are comparatively more numerous. This worm is therefore very readily distinguishable from all other known tapeworms. It does not appear to be a very frequent resident in the human body, though it is by no means uncommon in the dog. Possibly, this species may yet be found

in the inhabitants of some of our northern and western islands. From the smallness of its size, it does not appear to occasion much inconvenience to its bearers, whether human or canine; nevertheless, in the dog it exists sometimes in very considerable numbers. My private collection contains some preparations of this parasite, which I owe to the kindness of Professor Leuckart.

THE ELLIPTIC TAPEWORM.

(*Tænia elliptica.*)

THIS parasite is readily recognised, not merely by its delicate form and small size generally, but also by the circumstance of its supporting two sets of reproductive organs in each mature joint; these structures communicating with separate outlets which are situated at the centre of the lateral margin of the segment, one on either side. This parasite ordinarily infests the cat, but there is reason to believe that it is identical with the *Tænia canina* or *T. cucumerina* so common in the dog. At

all events, from the evidence put forth by Eschricht, seconded as it is by Leuckart, there is every reason for believing that one or either of these closely allied forms (be they identical or not) is liable to infest the human body. It was originally stated by Eschricht that he had received a *Tænia canina* which had been passed by a negro slave at St. Thomas, Antilles. Probably the species is very rare in the human body, and possibly may only occur in the negro race. So delicate a worm, unless present in very considerable numbers, would not be likely to occasion any bad symptoms; hence also, its presence would often either be overlooked or disregarded.

THE MARGINED TAPEWORM.

(*Tænia marginata*.)

THIS species is very common in the dog, and is only known in the human body in its larval condition. As I have remarked in my larger work, the principal evidence which we have as to the occurrence of its larvæ (*cysticercus tenui-*

collis) in man, rests upon two cases recorded in Schleissner's *Nosography of Iceland*. One of these cases, however, has been proved by Küchenmeister, and also by Eschricht's distinguished follower, Dr. Krabbe, to be that of an echinococcus; so that, after all, there only remains the solitary case, observed by Schleissner himself, in which this parasite can, with any degree of certainty, be regarded as a true *cysticercus tenuicollis*. To this may probably be added a specimen contained in the anatomical collection at King's College. If I remember rightly it was found connected with an ovarian cyst. It is apparently well authenticated. There ought to be little difficulty in recognising this parasite in its larval condition; nevertheless many errors have been made. Fortunately, its presence is not likely to lead to any untoward results, but the possibility of its doing so should not be overlooked. As we have seen, it may be mistaken for an ordinary hydatid; indeed, it is not at all improbable that many of the calcified cysts hitherto regarded as referable to hydatids may, after all, have resulted from the presence of the larva of the margined tapeworm.

THE TRIPLE-CROWNED TAPEWORM.

(*Tænia acanthotrias.*)

THE existence of this species is founded upon the circumstance of a cestoid larva, with three rows of hooks, having been detected in the human body. Dr. Weinland, of Frankfort, when visiting America in 1858, examined a specimen of supposed *cysticercus cellulosa* preserved in the collection of the Boston Society for Medical Improvement. This parasite was taken 'from a woman about fifty years of age, who died of phthisis, [being afterwards] a dissecting-room subject at Richmond, Virginia. About a dozen or fifteen of the cysts were found in the cellular membrane of the muscles, and in the integuments, besides one which hung free from the inner surface of the dura mater, near the *crista galli*. In the same subject there were also numerous specimens of *Trichina spiralis*.' This specimen was presented by Dr. Jeffries Wyman, and an account of the case was first published in 1857. It remained, however, for Dr. Weinland to make the curious

discovery, that the parasite in question was probably referable to a new and distinct species of tapeworm. If, however, subsequent discoveries should show that it constituted only a variety of the *Tænia solium*, the mere existence of such an abnormal condition of the so-called common tapeworm is in itself a very interesting circumstance. Probably, however, for reasons which I need not here discuss, Dr. Weinland's conjectures will turn out to be correct.

THE SPOTTED TAPEWORM.

(*Tænia flavopuncta.*)

THE discovery of this interesting little tapeworm is also due to the investigations of Dr. Weinland. In Dr. J. B. S. Jackson's catalogue of the collection of the Boston Medical Improvement Society, an account of the contents of a phial is recorded as follows:—'Specimen of *Bothriocephalus*, three feet in length, and from half a line to one line and a quarter in width; from an infant. The joints are very

regular, except at one extremity, where they approach the triangular form, are very delicate, and but slightly connected, as shown in a drawing by Dr. Wyman.' It is further stated that the infant was nineteen months old, and that the worm was discharged without medicine, its presence having never been suspected. It was presented by Dr. Ezra Palmer, in the year 1842. On examining the above-described fragments, Dr. Weinland found, instead of a solitary specimen, at least six different tapeworms; all of them being referable to a totally distinct and hitherto undescribed species. Unfortunately, none of the heads were present in the phial; nevertheless, it was ascertained that the worms varied from eight to twelve inches in length, the joints or segments being very broad laterally, and at the same time correspondingly narrow from above downwards. It has been named 'the spotted tapeworm,' in consequence of the presence of yellow spots lying near the middle line in each successive joint. They represent the male reproductive organs. The genital orifices are serially disposed all along one side of the worm at the

margin. The eggs, for the most part, resemble those of ordinary tapeworms. Except they should exist in very large numbers, it is not likely that their presence would give rise to very serious symptoms.

THE RIDGED TAPEWORM.

(*Tænia lophosoma.*)

IN the museum of the Middlesex Hospital there is a tapeworm which when complete must have measured about eight feet in length. It is characterised by the presence of a ridge extending throughout the entire length of the body, imparting to most of the segments a pentagonal figure when viewed from the front. The individual segments are much smaller than those of the full grown pork tapeworms, and they are further characterised, collectively, by the presence of uniserially disposed reproductive papillæ, extending along the left margin throughout the entire chain. The papillæ are very prominent, being placed at the centre

of each joint. The ordinary segments give an average breadth of one-fifth of an inch, those at the caudal end stretching to as much as three-quarters of an inch in length. Their greatest thickness does not exceed the one-thirteenth of an inch. The eggs resemble those of other tapeworms, and offer a diameter of about $\frac{1}{850}$ of an inch. The size of the segments and the uniform disposition of the reproductive papillæ show that this parasite is distinct not only from *Tænia solium*, but also from *T. mediocanellata*, whilst the large size of the worm, as contrasted with the foregoing species, shows that it cannot be referred to Weinland's *Tænia flavopuncta*. At all events it is a totally distinct form, and if a variety only, is remarkably divergent from the ordinary species. I have provisionally named it *Tænia lophosoma*, to indicate the presence of the crest or ridge extending the whole length of the body. Küchenmeister's ridged variety of *Tænia solium* or *T. mediocanellata*, from the Cape of Good Hope, showed an alternation of the papillæ which does not exist in this specimen. It is therefore a new and quite distinct species.

Possibly it may be derived from mutton, in which meat I have recently discovered 'armed' measles apparently quite distinct from the cysticercus found in pork.

THE EGYPTIAN OR DWARF TAPEWORM.

(*Tenia nana.*)

So far as I am aware, there is but one solitary instance on record of the occurrence of this minute tapeworm in the human body; and up to the present time we have no evidence of its having existed in any other host. It was discovered by Dr. Bilharz of Cairo at the post-mortem examination of a boy who died from inflammation of the cerebral membranes. Prodigious numbers existed. The largest specimens measured only one inch in length. As in the two foregoing species the reproductive outlets are uniserially placed along the margin of the body. The joints are about one hundred and fifty in number, the last twenty or thirty carrying ripe eggs, being at the same time about

four times as long as they are broad. To the naked eye these worms resemble short threads, and consequently might very readily be overlooked. The head is broad and furnished with a formidable rostellum armed with a crown of hooks. These hooks have large anterior root-processes, which, extending unusually forward, impart to the individual hooks a bifid character. The structure, however, is essentially the same as obtains in other tapeworms. The cysticercal source of this cestode is at present unknown. Though interesting physiologically, it is not likely that this parasite will ever become a formidable enemy to the welfare of the human species.

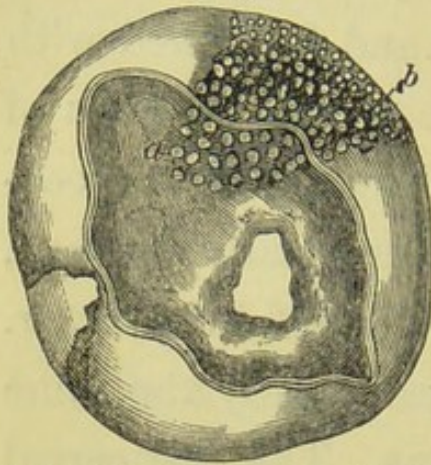
THE HYDATID-FORMING TAPEWORM.

(*Tænia echinococcus.*)

THIS remarkably minute parasite, though not resident in man in its adult condition, is nevertheless, in one of its larval stages, of frequent occurrence in the human body. Whilst the full grown creature seldom attains the fourth

of an inch in length, the larvæ, on the other hand, acquire a prodigious size. The latter

FIG. 13.



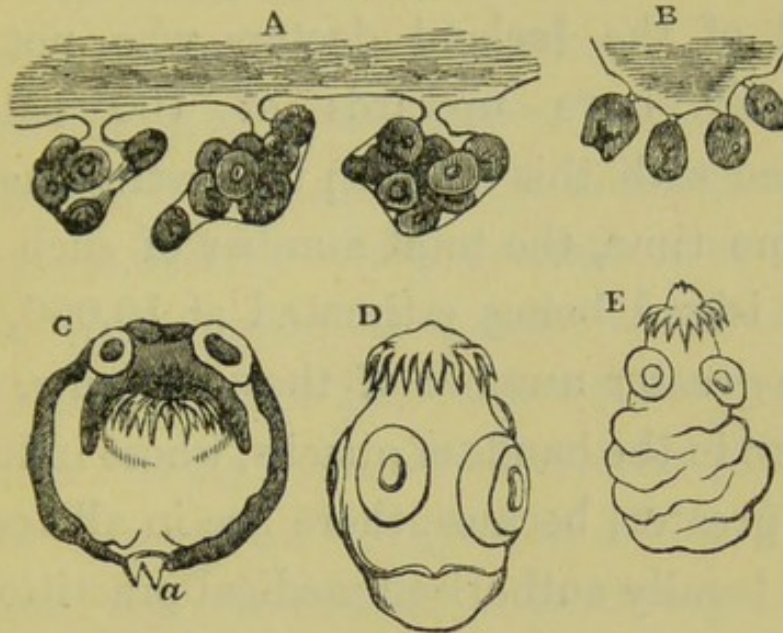
A small hydatid or acephalocyst, with granular processes (*a*) or 'brood-capsules' attached to the inner wall.

are familiarly known to the profession under the name of *hydatids*. The tapeworm itself resides in the intestines of the dog and wolf; and it is from this source that we become infested. Much space might be devoted to an explanation of the various

possible ways in which the little tapeworm eggs and their embryos gain access to the human body; but, for all practical purposes, it is sufficient to remark, that they commonly enter the mouth along with food and drink, more particularly with the latter. They may also be transported as dust, by wind and other agencies, and thus be carried directly into the mouth; or they may be brushed against the lips, adhering there for a time before being swallowed. Residence in densely populated districts, where dogs at the same time abound, is eminently favourable to the introduction of these creatures into the

human body. Thus, though not unfrequently attacking the wealthy, they are very much

FIG. 14.



Echinococci, or larvæ of the hydatid-forming tapeworm, in course of development; A, B, sections of the inner wall of the hydatid, showing the brood-capsules and their contents; C, D, E, the loose echinococcus-heads separated from their capsules, and showing their hooks and suckers. From Wilson.

more common among the poor. The prevalence of hydatids in some countries is notorious, but it is in Iceland that this so-called echinococcus disease attains its maximum degree of development. There, the conditions to which I have alluded, are eminently favourable for the development and propagation of the disorder. On the authority of Krabbe, it has been stated by Leuckart, that 'for every 100 inhabitants of Iceland there are 1100 head of

horned cattle, and every peasant has, on an average, six dogs. In Denmark there are 180 cattle to every 100 of the people. There are several of the Iceland doctors who not unfrequently have upwards of 100 patients (afflicted with this disease) under treatment at the same time, the total number of such cases in the island being estimated at 10,000. By far the greater number of these patients, however, are in the hands of quacks, whose influence is the greater, because there are in all Iceland but six legally authorised medical practitioners, each of whom presides over a district of about 1500 square (English) miles, embracing a population of about 10,000 individuals. The treatment of the quacks is exactly suited to keep up the epidemic, for, amongst their remedies, the urine and excrement of dogs play a conspicuous part.' Probably, the poor afflicted creatures think themselves the objects of a special divine chastisement; yet by the observance of cleanly habits, and by ridding themselves of the quacks who thrive on their credulity, the rapid diminution of the disease would show that the remedy is in their own

hands, and, further, that 'Providence helps those who help themselves.'

In England, as I have said, the hydatid disease is by no means uncommon. To afford some criterion of its frequency, I may mention, that out of 377 cases of human helminthiasis (as represented by 632 preparations contained in ten pathological museums which I have visited) no less than 199 cases were referable to hydatids. In my 'Notes on Entozoa,' published in the *Lancet* for May 13, 1865, I have tabulated them somewhat as follows:—

Museums	No. of Cases of Entozoa represented	Cases of Hydatids only	No. of Preparations of Entozoa
Guy's	113	70	169
College of Surgeons	51	27	166
King's College	45	16	60
St. George's	42	22	45
St. Bartholomew's	32	25	44
University College	27	15	42
Middlesex	24	11	54
St. Mary's	17	5	22
Charing Cross	17	4	18
Brighton	9	4	12
Totals	377	199	632

It thus appears that considerably more than half of the entire number of *cases* of entozoa represented by the pathological specimens in our museums are attributable to hydatids. For further particulars illustrating the value or otherwise of these tables in a statistical point of view, I must refer to the paper itself, my present object being merely to show how prevalent hydatids are in this country.

The proof as to the relation subsisting between hydatids and the so-called *Tænia echinococcus* is based upon experimental research and general scientific enquiry. Those who desire evidence on this point must consult the best and most recent standard treatises on helminthology. The details respecting the mode of development of hydatids are extremely curious, whether we refer to their early or later stages of growth. In my larger treatise I have endeavoured to give a condensed account of the phenomena observable, and also a brief description of the principal varieties liable to be met with. For obvious reasons, therefore, I deem it unadvisable to repeat or explain my views on this department of the subject;

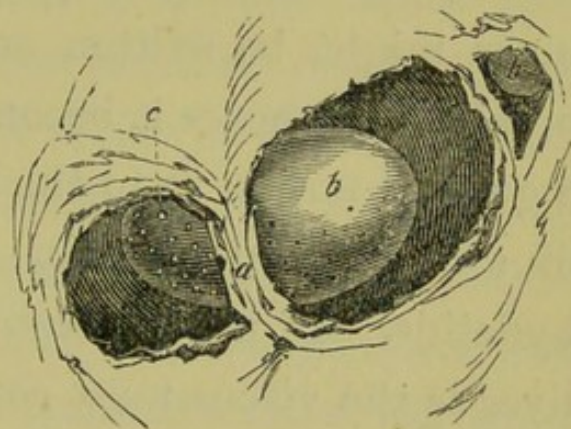
especially, also, since they have little or no practical bearing upon the diagnosis and treatment of these formations. In a prophylactic point of view, it is certainly desirable to be acquainted with the leading results of modern research; but into the details of the processes thus opened up, the non-scientific or, even, professional reader can hardly be expected to enter. Undoubtedly we are now in a position to check the prevalence of hydatids, and the same may be said of many other less formidable parasitic diseases. The end in question may be accomplished by enforcing a more general cleanliness amongst the poor, and by promoting all good sanitary measures. Despite our care, however, many parasites will gain access to the human frame, under circumstances which no amount of caution, foresight, or cleanliness, could prevent. The connection between uncleanly habits and parasitic disease is by no means invariable, nay it is exceptional. In the case of hydatids it would be very unfair to suppose that any patient is suffering from hydatids because he has neglected to take due care of his person; nevertheless, there are some people who are

apt to think thus, and who are even prepared to go further than this, and to assert that because Herod was 'eaten up of worms,' it must be a peculiar disgrace for any one to harbour entozoa. Time and a better education will show the fallacy of entertaining such ridiculous preconceived opinions.

To make a correct diagnosis of hydatids is a matter of essential importance; for it is truly surprising how often their presence has been overlooked even in cases where these organisms attained an enormous development, and have ultimately occasioned death. I have seen instances in the dead-house and dissecting-room, where hundreds of these creatures were present, and yet not the slightest suspicion of their existence during life had occurred to any one. In obscure cases of abdominal or thoracic disease, the possibility of the presence of hydatids should always be borne in mind by the physician. Attention to the history of anomalous symptoms complained of by a patient, will not unfrequently suggest the true cause of his complaint, although there may be no external indication whatever of these formations. Of

course, the presence of a fluctuating tumour unaccompanied by any inflammatory symptoms would at once lead an intelligent surgeon to suspect hydatids; and this suspicion would almost ripen into certainty if the tumour was stated to have been of very slow growth. The situation of the swelling, and the absence of any marked functional disturbance of the general system, would afford additional information. The so-called hydatid 'fremitus' of Piorri is of little moment; since, as I have elsewhere remarked, it 'scarcely differs from the ordinary impulse communicated by fluid within any other kind of tumour.' My experience on this

FIG. 15.



Hydatid cyst (*a*) containing a secondary vesicle or daughter hydatid (*b*), with granules (*c*) or brood-capsules in course of formation.

point is confirmed by Dr. Murchison, who not only finds the peculiar 'vibration' occasionally wanting, but, when present, he regards it as of no great diagnostic value. Dr. Mur-

chison altogether denies that its exceptional character enables the manipulator to predict 'the existence of secondary cysts in the interior' of the tumour.* Except in severe cases, where hydatid growths press upon important viscera, these parasites are mostly overlooked; and it is often only when one or more such vesicles are discharged from the lungs or bowels that the nature of the case becomes apparent.

I have already remarked on the diagnostic assistance to be obtained from a consideration of the seat of any suspicious growth. Much more might be written on this head; but for practical purposes it becomes sufficient to have a general notion as to the comparative liability of any particular organ or part to harbour hydatids. It is well known, indeed, that the liver is the viscus most commonly affected, but the practitioner should not be content with this limited knowledge. From data collected by Davaine and myself, we find that out of a total of 508 examples of hydatid disease, 216 were

* 'Hydatid Tumours of the Liver; their Dangers, Diagnosis, and Treatment.' By Charles Murchison, M.D. F.R.C.P. 'Edinburgh Medical Journal' for December, 1865.

strictly liver cases. It should be mentioned, however, that the actual number of instances in which they had originated from this organ was in all probability much greater; for, besides the above, we must take into account 86 cases where they occupied various regions of the abdominal cavity. According to the records of the individual reporters, we might place certain of these, more or less accurately, as severally referable to the peritoneum and intestines, to the kidneys and bladder, or to the pelvis. At all events, I do not doubt that nearly one-third of the number originated in the liver; and thus I arrive at the conclusion, that of all the hydatid cases on record, about one half of them have had their primary seat in the liver. It should also be borne in mind that many so-called lung cases are from the same seat. In the total above given, there were forty-eight examples of this kind, several of which undoubtedly originated in the liver. Respecting the remaining more or less frequent situations of hydatid formation, I will only mention, in their relative order of frequency, the brain and spinal cord, the muscles of the

trunk and extremities, the bones, the neck, face, orbit, and globe of the eye, the mammæ, and the internal female organs of generation. In certain rare cases, any other part of the body is liable to be invaded.

Having made good our diagnosis, respecting which additional remarks will be found further on, it only remains for us to consider the best methods of *treatment*. Here I can only repeat with additional emphasis what I have stated in my general treatise. Where interference is necessary, it simply resolves itself into the question as to the time for evacuating the contents of the cyst or cysts. To determine this point, and also the amount of risk to the patient's life, requires considerable care on the part of the physician and surgeon. These are just the kind of cases where professional responsibility should be divided. I think the general practitioner should call to his aid at least a second opinion before he thrusts a trochar through the abdominal parietes of his confiding patient. Even under the most favourable circumstances, the operation of paracentesis is not

unattended with danger; and it occasionally happens that a patient who is benefited by a first operation, succumbs to a repetition of the ordeal. Where several independent cysts exist, a third or even a fourth operation may be necessary.

After performing the operation of tapping, many have insisted upon the necessity of injecting iodine or other medicated solutions. Undoubtedly, many patients make a good recovery after these internal applications; yet I believe they do so rather in spite of, than on account of, any chemical or mechanical action of the drug. As to the injection of a saline solution, that in effect would be something like restoring the parasite to its normal condition. In like manner the internal exhibition of drugs is worse than useless, except they are merely intended to support an already weakened constitution. Much nonsense has been written concerning the value of particular remedies, and even the employment of electricity has been needlessly recommended. The experience of Dr. Todd has been amply confirmed by

Murchison, MacGillivray,* and other writers on this subject. In his own words, I may also say that 'I know of no cure for hydatids but the evacuation of them. There is a popular notion that salt will kill the hydatid. Iodide of potassium has also been frequently tried, but I have never seen any real benefit from the use of these remedies.' Of course, it is here understood, that in certain exceptional cases nature herself is able to effect a cure, and also that it is not necessary for the surgeon to bring away, through his trochar, the actual vesicles themselves. It would seem, indeed, that in cases where only a part of the fluid contents is evacuated, a cure is effected by the assistance thus rendered to nature's curative powers. The injection of medicated solutions is contraindicated not only by the teachings of nature herself, but also by the circumstance that the irritation thus set up is likely to end in ex-

* See an able paper in the Australian 'Medical Journal' for August, 1865, entitled:—'On a case of Hydatids in the Orbit; with an abstract of (twenty) cases of Hydatid Disease treated at the Bendigo Hospital.' By P. H. MacGillivray, A.M., M.R.C.S.

tensive inflammation and suppuration. Should this not prove fatal, the patient has further sufferings to endure whilst the surgeon is subsequently treating the case as one of abscess. The ordinary operation, however, in the hands of a judicious surgeon who is careful to employ a small trochar, is attended with very little danger, whilst the prior use of an exploratory needle for diagnostic purposes seldom occasions any inconvenience.

I believe it is to Dr. Murchison that we are indebted for a clear exposition of the value of testing the evacuated fluid of hydatid cysts as an additional means of diagnosis. He has remarked (*l. c.* p. 13), that 'if the sac be not inflamed, it is limpid, has a specific gravity of 1007 or 1009, and contains no albumen, but throws down a copious precipitate with a solution of nitrate of silver, owing to its strong impregnation with common salt. These characters apply to no other fluid in the body, whether healthy or morbid.' This being the case, the employment of the exploratory needle or a fine trochar should be invariably insisted on some time before the operation is actually undertaken.

Even the inconvenience arising from the use of the grooved needle may be obviated by using Dr. Richardson's apparatus for the induction of local anæsthesia. Except in sensitive and delicately nurtured persons, however, one would hardly think it necessary to recommend this generally valuable aid.

As I have before hinted, there are some cases in which it may be advisable to abstain altogether from any operation. Instances when an undoubted hydatid tumour has ceased growing, or has even diminished in size, are of this kind; for in such cases it is clear nature is effecting a cure by herself in one of two ways. Either the parasite is dead and the fluid contents are being absorbed, the hydatid collapsing and folding upon itself so as ultimately to form a small hard tumour; or, as is more usually the case, it is undergoing the slower process of pultaceous or calcareous degeneration. All cystic entozoa have a tendency to secrete calcareous matter, the quantity thus ultimately deposited sometimes weighing, in cases of hydatids, several ounces. Should it happen that a hydatid tumour, say, in the region of

the liver, has attained a large size, I would advise the evacuation of its contents, although it may have ceased to grow for a lengthened period. My judgment would to some extent, of course, be guided by the character of the tumour, and the age of the patient. In illustration of the dangers arising from a tumour in this region, I may refer to the case of a school-boy who was placed under the care of the late Mr. Crosse of Norwich, in a moribund condition. The little patient received a slight blow from a playfellow on the right side. An unsuspected hydatid was ruptured, and death was the result not long afterwards. I made a drawing of the parts concerned in this case. On inspecting it, one is almost surprised to reflect how large a tumour of this kind may exist, without any suspicion being entertained by the infested person of its presence. If the blow in this case had been violent, or had been directed by a hostile hand, one could easily understand that the tumour would give way; but I understood that it was both slight and accidental. By parity of reasoning, it follows, that a person going about with such formations affecting any of the abdominal

viscera is in constant danger from rupture of the cyst.

At a recent meeting of the Medico-Chirurgical Society of London, Dr. John Harley brought forward a remarkable case of hydatids, where no less than nineteen pints of fluid were drawn off by successive tappings. In this case the distention of the abdomen was very extreme. The operation was very long, and perhaps needlessly, delayed; nevertheless the patient not only escaped the dangers of rupture from accident, but also (in spite of the tedious evacuation of the contents of the cyst, the employment of a large trochar, and the suppuration which followed the operation) made a good recovery.

APPENDIX.



ON BEEF, PORK, AND MUTTON IN RELATION TO TAPEWORMS.

IN the July number of the 'Natural History Review' for 1865 there appeared an able article on the subject of Entozoa, and in it there occurs the following passage:—'Of all animals, feral or domestic, the common pig is beyond all doubt the most fertile source of human entozoa; at least, of important parasites, *Trichina spiralis* and the tapeworm would, there is good reason to believe, cease to infest us, did not this favourite quadruped act the part of a communicating medium.'

I quote this passage as a prefix to the concluding remarks I am about to offer, partly with the view of showing that the sense of it affords an admirable

exposition of the notions currently received by the public, and more particularly with the intention of showing that it fails to convey the whole truth, whilst, in some respects it is even calculated to mislead those who are not accurately informed in helminthological matters.

As regards the microscopic fleshworm (*Trichina spiralis*) it is only fair to admit that, in so far as our present experience extends, pork has been the almost exclusive source whence we have obtained this parasite; nevertheless, it must be borne in mind that the flesh of most of the mammalia is liable to harbour the *Trichina*. Possibly the pig may constitute an original 'creative centre' whence the parasite has spread to other regions; yet, as obtains in the case of the origin of any other animal or vegetable species, all speculations on this score lead to no certain or definite conclusion. Unquestionably, the *Trichina* seems to us to be more 'at home' in the flesh of the pig than in that of any other animal; yet, for all we know to the contrary, its original habitat may have been the flesh of some mammal which flourished in times long antecedent to the race of swine. Dr. Krabbe, of Copenhagen, informs me that he has found it normally present in the rat, and the same thing has been noticed in Germany. If insuperable obstacles stand in the way of explaining the origin, or

so-called 'ordained becoming' of ordinary specific forms of animal and vegetable life, it requires no great amount of penetration to perceive that these obstacles become equally formidable, and perhaps even more numerous, when we come to deal with the antecedents of a group of creatures whose very existence within our frames suggests to some persons the notion that they have invaded us by accident, or, at least, that they have no right to invade us. It is 'incompatible with the dignity of man,' remarks Von Siebold, 'that these parasites should be originally intended to take up a temporary abode in the human body.' However, if we would read Nature's teachings rightly, we must reject these preconceived opinions; for, in the case before us, I think all candid investigators will in future admit that the human body is the exclusive home and legitimate territory of at least two species of entozoa—one of these forms being procured, as is generally allowed, by our eating pork, the other, as is not generally known, by our eating beef. On the present occasion I propose to dwell chiefly on the practical bearings of this subject.

When once, on apparently good grounds, a belief has become deeply rooted in our minds, we all know how extremely difficult it is to get rid of it, even though the grounds of our persuasion are shown to be fallacious. Here is a case in point: most people,

and even, as we have seen, some excellent authorities, are impressed with the belief that pork, and pork alone, is the source of those peculiarly uninviting forms of human entozoa—the tapeworms. This notion is entirely at variance with the facts enunciated by recent discovery. As a counter-proposition it may be safely averred that the majority of human tapeworms are derived from eating beef, the remainder being chiefly obtained from pork and mutton.

What are the facts, and what is the explanation of the facts enabling us to advance this general statement of the case with confidence? They are these: Putting aside the rarer tapeworm-forms just described, we have still two species left to consider. One is the *Tænia solium*, whose head is armed with a coronet of hooks, the other the *Tænia mediocanellata*, in which this cephalic armature is wanting. The larval origin of the first species has long been known to experimental helminthologists. I need scarcely repeat that the *Tænia solium* is derived from the pork measles, or so-called *Cysticercus cellulosæ*. The larval origin of the second species has only very recently been determined. Up to the present time, so far as I am aware, only four persons have experimented on animals with the view of deciding the question as to the source of the *Tænia mediocanellata*.

On the continent, Profs. Leuckart and Mosler, of Giessen, have succeeded in rearing 'measles' in the calf by the administration of the eggs of this unarmed tapeworm; whilst, at home (and partly by the aid of funds placed at my disposal by the Council of the British Association), Prof. J. B. Simonds and myself have in two separate instances obtained similar results. We have seen that the veal and beef 'measle,' which, for convenience sake, I call the *Cysticercus bovis*, differs as much from the pork 'measle' (*Cysticercus cellulosæ*), as the adult and corresponding *Tænia mediocanellata* specifically differs from the *Tænia solium*. In the one case the larva is unarmed, while in the other it is furnished with hooks. Having already (in these pages and in No. 76, vol. xiv. of the Proceedings of the Royal Society, pp. 214-220) given a detailed account of the results of our experiments upon the calf, I will here only further call attention to one practical point. It is this: the meat which we eat may contain a very large number of larval parasites, and yet the animal whence the flesh was obtained shall have appeared perfectly healthy on the day that it was slaughtered. In our calf I calculated that there were between seven and eight thousand measles in the flesh; but, even to skilled veterinary eyes, at the time of slaughtering this animal appeared perfectly sound

and in good condition. We might have sold this animal to a butcher, and have enjoyed the satisfaction of knowing that we had done our best to ensure the development of *Tænia mediocanellata* in a considerable number of his customers. Those muscles usually forming the choicest parts offered by the salesman were just those portions which were most abundantly infested. Any person dining moderately off an imperfectly cooked 'fillet' from this source would unquestionably have found himself the future entertainer of at least a dozen tapeworm 'guests.'

It takes about one year for the 'measles' to lose their power of doing harm to the consumer. In this time a natural death of the larva results from calcareous degeneration. This is proved by our experiments upon a young cow, the particulars of which are not yet published.

Under ordinary circumstances it is most probable that the flesh of young cattle is seldom affected with 'measles,' simply because they have enjoyed a less number of chances of swallowing the eggs of tapeworms than obtains in the case of full-grown animals. Hence it may be safely concluded, as a general rule, that veal is less liable to harbour 'measles' than beef. Again, considering the possible methods of egg dispersion, it may also be safely asserted that the nearer cattle are reared in the neighbourhood of

large towns, the more likely will they be (especially where sewage is freely distributed) to harbour tapeworm larvæ. Thus, also, we are enabled to explain how it is that certain fortunate persons may even persevere in eating underdone meat, and yet escape infection. It all resolves itself into a question of chances—at least, as regards that portion of the community who prefer underdone meat. Those who habitually eat their meat well cooked cannot have been predestined to suffer from the tapeworm malady; rather has it, I presume, been willed that we should exercise our senses and have our meat well cooked, for thus we can avoid those unpleasant contingencies, whose relations I have sought to explain.

If the reader has followed me thus far, and if he is satisfied that helminthologists have clearly established the relations subsisting between the unarmed tapeworm of the human body and the beef measles—in other words, between *Tænia mediocanellata* and *Cysticercus bovis*—then he will be ready to maintain, as I now do, that it is not correct to say that the tapeworm ‘would cease to infest us, did not that favourite quadruped, the pig, act the part of a communicating medium.’

The next and final question which I proceed to determine is as to whether the *Tænia mediocanellata*, or unarmed tapeworm, be, or be not, the more pre-

valent of the two forms. To solve this problem as regards the human race in general would require a mass of data not readily procurable; but as far as our evidence goes (whether we deal with the world at large, with our own limited portion of it, or with yet more limited areas within the British territory itself), I think it will be found to point pretty nearly all one way. Thus, the unarmed human tapeworm is known to be extremely, if not exclusively, prevalent in Abyssinia, in Caffreland, and probably also throughout the western coast of Africa. In Java, Schmidt-müller observed 148 specimens of tapeworms, not one of which was furnished with hooks; but it would appear that most of these were imported by negroes from Guinea coast. In Russian Asia, all the cases reported by Kaschin as occurring amongst the Birates, or Baikal Cossacks, seem to be referable to this species. The testimony of Wawruch and Bremser, as well as that of others, seems to show that the armed form seldom or never occurs in Vienna. In parts of Würtemberg and Bavaria, according to the testimony of Weisshaar, the *Tænia solium* is seldom seen; but in Copenhagen Dr. Krabbe found that, out of thirteen in his possession, six were of the armed form, the remaining seven being examples of *Tænia mediocanellata*.

In our own country, Dr. Aitken found the unarmed

species the more abundant of the two amongst the soldiers stationed at Fort Pitt. Out of eleven specimens placed in my hands by Dr. Greenhow, of the Middlesex Hospital, only one was a *Tænia solium*; and out of one dozen specimens transmitted by Dr. Alexander Fleming, of the Queen's Hospital, Birmingham, four only were not referable to the *Tænia mediocanellata*. In June 1865, Dr. M'Kendrick, Physician to the Eastern Dispensary, Leman Street, London, wrote me as follows:—'I have treated at this dispensary during the past seven months thirty-two cases of tapeworm, and twenty-five of the specimens have been of the species *mediocanellata*. Two of these cases (since published) are interesting from the fact that one was a case of reflex paraplegia, and the other of epileptiform convulsions; the exciting cause in both being the presence of *Tænia*.' This independent testimony I regard as extremely valuable, for it shows that even in a locality where the poorer classes abound the *Tænia mediocanellata* is the more common of the two species. Lastly, out of ninety-four other specimens which I have examined with the view of determining the relative prevalence of the two species, not less than three-fourths were of the unarmed kind. Rather more than one-half were specimens preserved in the pathological museums of the metropolis, a large proportion having

no history attached; in a few cases their fragmentary character rendered it impossible to diagnose the species with certainty. Putting aside doubtful forms, I may say that out of a total of 120 human tapeworms submitted to my examination, not less than 95 were examples of the *Tænia mediocanellata*.

From the foregoing data, therefore, it becomes tolerably certain that, generally speaking, the hookless tapeworm derived from eating beef is much more common than the hooked tapeworm obtained from pork; and, in so far as the propagation of the human cestode entozoa is concerned, we must award to beef the greater merit as a medium; whilst as regards *Trichina spiralis* it cannot be truly asserted that the fleshworm 'would cease to infest us,' did not pork play the part of a communicating agency.

I may also remark, from cases which have come under my own observation and treatment, that by employing the proper remedies the *Tænia mediocanellata* may very readily be got rid of. In the case of *Tænia solium* the head is very apt to be left attached to the walls of the intestine. I have obtained twelve *heads* of the unarmed species, but only one of the armed species. I have seen more than twenty of the former, but only four of the latter. All my experiences with human cestodes point to the

comparative prevalence of the tapeworm derived from beef.

In conclusion, I have one word to say respecting the possibility of getting tapeworms from eating mutton. On this score I no longer entertain any doubt. Some months ago I called public attention to the fact that I had (on three separate occasions) noticed small hydatid-like cysts in joints of mutton brought to my own table. I mentioned it also, last winter, to my friend Dr. Kirk, who assured me he had noticed similar appearances. Subsequently I exhibited specimens of such measles (in a calcified condition) to the Pathological Society, and, still more recently, I have received from Mr. Heisch a perfect specimen of an armed cysticercus taken from the interior of a mutton chop. I believe this measles to represent a distinct form of tapeworm, but whether it will turn out to be my *Tænia lophosoma*, or a species altogether new to helminthologists, is a point which I hope to solve very shortly. Meanwhile, it should be known that even mutton, hitherto supposed to be perfectly innocuous, is liable to harbour larval tapeworms. It may turn out that the adult worm belongs, so to speak, to one of the carnivora. I think this highly probable.

THREADWORMS.

THE FLESHWORM OR SPIRAL THREADWORM.

(*Trichina spiralis.*)

THIS minute parasite has recently acquired great notoriety in consequence of the so-called *Trichina* epidemics in Germany. It is, as almost everyone now knows, a minute microscopic parasite, which during a part of its life-period resides in the flesh or muscular tissue. The disease to which it gives rise is termed *Trichiniasis*, and in not a few instances it has proved fatal. Probably, in Germany alone, not less than 4,000 cases of death have resulted from this parasite. Its presence in animals is not attended with such grave consequences to the 'bearer' as obtains in man. A cat, on which I experimented, almost died under the irritative

effects produced by the migrating worms, but many other animals which I infected to a similar extent seemed to suffer little inconvenience. One of my pigs harboured some *sixteen millions* of these worms, yet it exhibited no symptoms of pain or discomfort. With man, however, the distress thus occasioned is frequently extreme.

The original discovery of this entozoon, as a veritable fleshworm, is undoubtedly due to Mr. Paget, F.R.S. On the evening of the 6th of February, 1835, that gentleman, then a student, described the parasite at a meeting of the Abernethian Society—an institution connected with St. Bartholomew's Hospital. The specimens were obtained from the body of an Italian who had died in the Hospital. Mr. Paget gave an accurate account of the general characters of the worm; the parasite being very shortly afterwards more fully described, and scientifically named by Professor Owen at a meeting of the Zoological Society of London. So early as the year 1833, Mr. Hilton had noticed at Guy's Hospital the occurrence of gritty specks in human muscle,

but though recognising their parasitic nature, he erroneously described the little bodies as 'probably depending upon the formation of very small crysticeri.' The practical significance, however, of this discovery is of much more recent date. In 1850, Herbst reared capsuled fleshworms in the muscles of dogs, and Virchow obtained intestinal or mature *Trichinæ* in 1859. It remained for Zenker, of Dresden, to open up a new epoch in the history of trichinal discoveries, since, as I have stated elsewhere, 'he was the first to demonstrate that these parasites were capable of giving rise to a violent disease in the human body.'

Symptoms and Treatment, &c.—The *Trichina*, as we have seen, is introduced into the human body by the ingestion of meat. When taken in sufficient numbers, many unpleasant symptoms show themselves in the trichinised person. There is first of all, restlessness, loss of appetite, and more or less prostration. This is succeeded by rheumatoid pains in the limbs, being frequently accompanied by considerable swelling. The pain is not situated in the joints,

but in the intermediate soft parts. In severe cases, the limbs are drawn up and half bent, as in cases of severe and continued cramp. Sometimes the suffering is excruciating beyond measure, and patients have been known to request the surgeons to put an end to their lives. In the worst forms of the malady death ensues from diarrhœa and exhaustion.

In England, up to the present time, no case has yet been observed in the living human subject; yet in probably not less than thirty instances *Trichinæ* have been discovered *post mortem*. I have myself seen several trichinised subjects. Fortunately, there is little likelihood of the disease becoming prevalent in this country. Our swine are singularly free from this parasite, and the same may be said of the flesh of other animals used as food. Still, precautions are necessary. The introduction of prepared meats from the Continent is a source of danger, especially if such food be not very carefully cooked before use.

Prophylactically, the treatment consists in avoiding uncooked meat of all kinds. The flesh of birds and fish, however, as far as this

entozoon is concerned, may be eaten with impunity. When once the parasite has gained admission to our muscles, all hopes of destroying it are at an end; but if a patient suspects himself to have eaten diseased or trichinised meat, he should at once lose no time. Immediate advice followed by a suitable anthelmintic, might save a life, where a few days' delay might prove fatal. Whilst the worms are in the intestines we can get rid of them; but once the brood have migrated into the flesh, remedies are of little avail. Even in bad cases, however, if the system is properly supported, patients will recover, who otherwise would undoubtedly have perished. Various drugs, and especially the picronitrate of potash, have been tried; but they have failed to effect any material good. They have even perhaps done harm; for it should be borne in mind that any drug sufficiently powerful to poison this entozoon could scarcely fail, when introduced into the human body, to act injuriously upon the system.

The great point is, in bad cases, to support the system at all hazards. In the early stage of the malady, before the embryos have com-

menced migrating, all the parasites may be dislodged from the intestinal canal, and all serious consequences be prevented. It will be understood, of course, that unpleasant symptoms do not show themselves until at least a week after the ingestion of the diseased meat—that is, at a period corresponding with the birth and development of the migrating progeny.

THE COMMON THREADWORM OR MAW-WORM.

(*Oxyuris vermicularis*.)

ALTHOUGH the presence of this parasite within the human body is seldom attended with fatal results, there is no entozoon more universally distributed amongst the younger members of our race. It may, emphatically, be called ‘the children’s pest.’ Its prevalence is not confined to either hemisphere, but it is rather more abundant in warm than in cold climates. In this country the *Oxyuris* is not so frequent as on the Continent; nevertheless, probably about one-tenth of our entire population are infested by it. Out of this large number I should say

scarcely one-fourth suffer inconvenience from its presence, yet on the other hand, it may safely be said that in very many instances its presence is attended with much distress and even very grave symptoms.

The general appearance of this little parasite is so well known to most people, especially to mothers, that I need not minutely describe it. A detailed account of the natural history and the anatomical peculiarities will be found in my larger treatise. I may here remark, however, that usually the females only are seen. This arises in the first place from the circumstance of their larger size, and secondly on account of their much greater abundance as compared with the males. The females sometimes attain a length of very nearly half an inch, but the males seldom, if ever, exceed one-sixth of an inch.

If an ordinary full-grown female oxyuris be submitted to a microscopic examination with low powers, the interior of its body will be found to be crowded with eggs. These same eggs, if separately viewed by higher magnifying glasses, will display their contents in various

stages of development. In the most advanced stages embryos will be distinctly visible in the interior. These embryos do not exhibit the ordinary vermiform characters presented by most worms of this class (Nematodes). Long ago I pointed out the fact that the embryos whilst still within the egg-shell were tadpole-shaped; but even in the standard treatise of Küchenmeister they will be found to be otherwise represented.

One of the points which it would be most desirable to solve refers to the mode of development of these creatures. All sorts of absurd notions are entertained in this regard by persons who have not pursued original and scientific methods of research. Some of them will tell you, with oracular confidence, that the entire developmental processes are accomplished within the human body—that the ova are deposited within the mucus of the intestinal canal, and that the young, resembling their parents in all respects save that of size, are duly hatched, and grow up into their respective male and female forms. This is the common notion, even with professional men. In opposition to this

view, I have to remark, first, that no one has yet demonstrated the existence of these young oxyurides in the human bowel; and secondly, the course of development thus assumed to take place is a method entirely at variance with all that we know of the life-economy of the creatures most closely allied to this species. Our experimental researches have shown that for the complete development of nematode worms it is necessary that the ova be extruded from the 'bearer' in which the full-grown parasite dwells, that the larvæ gain access to the outer world, so to speak, and that before they again finally occupy their ultimate host they must have undergone a series of more or less complex changes.

So far as I am aware, no one has yet noticed all the genetic phenomena of growth and development as they obtain in *Oxyuris vermicularis*. In common with myself, a few investigators on the Continent have sought to rear this species experimentally. I have tried in vain to rear this parasite in a variety of animals, including the monkey; and I have likewise introduced the embryo-bearing ova into a great

variety of media, in the hope of observing the subsequent stages of larval growth. In all cases, however, the results have been of a negative character. But we need not despair of success, as similar difficulties have been overcome in regard to the changes which accrue in other closely allied species. If no males had been observed in the human body, we might infer that our oxyurides were, after all, only the parasitic forms of a worm which assumes an entirely distinct form in the so-called 'free' state. Without, however, at this stage of our knowledge, further theorising on the matter, the general conclusions to which I have come are these. 1. The embryos are hatched after long extrusion of the eggs from the parasite, and after they have gained access to the outer world. 2. If the embryos are retained in water, or are exposed to other conditions favourable to their life, they speedily acquire an altered form, but do not acquire sexual maturity until they are conveyed to their ultimate or human 'bearer.' 3. It is possible that all the intermediate stages of larval growth may be accomplished during their sojourn in water, but it is

more probable that prior to their final invasion of man they accomplish their full larval growth either in the soil, in vegetables, or in the flesh of animals used as food, and acting therefore in the capacity of intermediary bearers.

In whatever precise way the development of these creatures is accomplished, there can be little doubt that they are introduced into the human body along with food or drink. If it were true that they accomplished all their stages of growth within the human intestine, then their numbers in some persons would be so prodigious that they would block up the entire alimentary canal, from the cæcum to the rectum. As it is, many thousands in their adult condition are found in one and the same bearer. Each female itself contains several thousands of eggs, and these latter if capable of arriving at maturity within the human body would soon reproduce such multitudes that the distress occasioned by their presence would be infinitely greater than it at present is.

Symptoms and Treatment.—The great point is how to get rid of these pests. Why they came into being, what use they are, or why

permitted to exist — these are questions of little practical value, except in so far as they afford material for philosophers wherewith to construct a non-providence theory.* The symptoms produced by their presence are occasionally very serious. Oxyurides are by no means confined to young people, and it may even be said that they occasion less inconvenience to children than they do to adults. As I have remarked in my general treatise, the unpleasant sensations ‘chiefly develop themselves in the evening and at night-time, consisting ordinarily of a painful sense of heat and irritation within and around the anus. The symptoms frequently become excessively distressing, especially when they are accompanied by itching in the neighbouring genito-urinary passages, produced by migration of the worms about these parts. The local inflammatory symptoms thus set up, occasionally superinduce various sympathetic phenomena, which show themselves in restlessness, general nervousness, itchings at the nose, involuntary twitchings, chorea, convulsions, and sometimes

* See Herbert Spencer's ‘Principles of Biology,’ vol. i.

epileptiform seizures. Many other local disorders are also set up, especially in cases where they occur at early puberty.' The nature of these will be readily understood when it is mentioned that masturbation, onanism, and other disordered phenomena of sexual irritation, are thus readily superinduced. In young females, pruritus, leucorrhœa, and various local disorders, are apt to show themselves, and these again in their turn produce symptoms of hysteria and other concomitant evils, upon which I deem it unnecessary to enlarge. Even in advanced age oxyurides are from time to time encountered. Several such cases have come under my professional care, and they have, after a while, yielded to the same treatment which I have pursued in other instances. This consists, for the most part, in the administration of oft-repeated enemata. These injections, as I have elsewhere said, 'may consist of cold or slightly tepid water, to which it will be well to add either a little salt, or a few drops of anise oil.' Previous to ordering these exhibitions, I am in the habit of employing various vermifuges by the mouth, and there is

not one in which at present I have more faith than santonin in combination with podophyllin. Three grains of the former, to one-fourth of a grain of the latter, produce a succession of soft evacuations, which usually bring away a few of the parasites. But the real advantage of the remedy is not so much on account of any supposed oxyuricide properties it might be thought to possess, as upon the fact that repeated doses succeed in driving the worms from the arch and upper part of the colon down into the lower bowel. Undoubtedly the santonin is highly obnoxious to the worms, but one cannot give enough of the drug to produce more than a disagreeable effect upon the parasite. This, however, is sufficient. Once we have succeeded in getting the oxyurides into the rectum, it is a comparatively easy task to dislodge them altogether. Even in this locality, however, they are apt to remain concealed behind certain folds of the bowel, especial within the sigmoid flexure higher up. Repeated enemata, however, will succeed if they are not administered at intervals of less than three or four days. I deprecate the employ-

ment of powerful drugs in association with the injections. Large doses of aloes, salt, or iron, are quite unnecessary: they are even hurtful. In small doses, however, not only these, but many other drugs, may be advantageously combined with the enema menstruum. For my own part, I give preference to preparations of ether, but I frequently employ them in combination with other drugs. Infusions of quassia and other bitters, and occasionally lime-water injections, have their several merits. A few drops of some essential oil, such as anise or rue, may be added to the above menstrua with advantage, or they may be used in combination with simple olive-oil enemata.

Perseverance with the above remedial agents will sometimes obtain a radical cure, and, at all events, considerable relief is sure to be experienced. I have occasionally employed some of the older remedies (such as sulphur), but have not found them so efficacious as they have been represented to be. I am yet hopeful that we shall procure a true oxyuricide, such as the *aristolochia bracteata* may turn out to be, if we are to believe the representations of Dr.

Bradley, as quoted by Waring. Meanwhile, assistance may also be obtained by attention to diet. All green vegetables should especially be avoided. The stomachal contents of these little parasites consist, in great measure, of vegetable particles which they have obtained from the indigestible matters rejected during the process of assimilation. Obviously the more vegetable food the patient swallows, the more lively and thriving will the oxyurides become. Uncooked vegetables are on no account to be taken, and even the use of cooked vegetables is to a certain extent contra-indicated. Potatoes, Jerusalem artichokes, and some others are comparatively, if not entirely harmless; but celery, onions, cabbages, cauliflower, broccoli, carrots, parsnips, secale, and the like, are best avoided. In like manner, uncooked and unripe fruit should not be indulged in; nevertheless, it is an error to suppose that these creatures are generated by eating clean, fresh, and wholesome ripe fruit. Market-garden fruits and vegetables, not properly cleaned, may undoubtedly convey the larvæ of oxyuris into the human body; but all

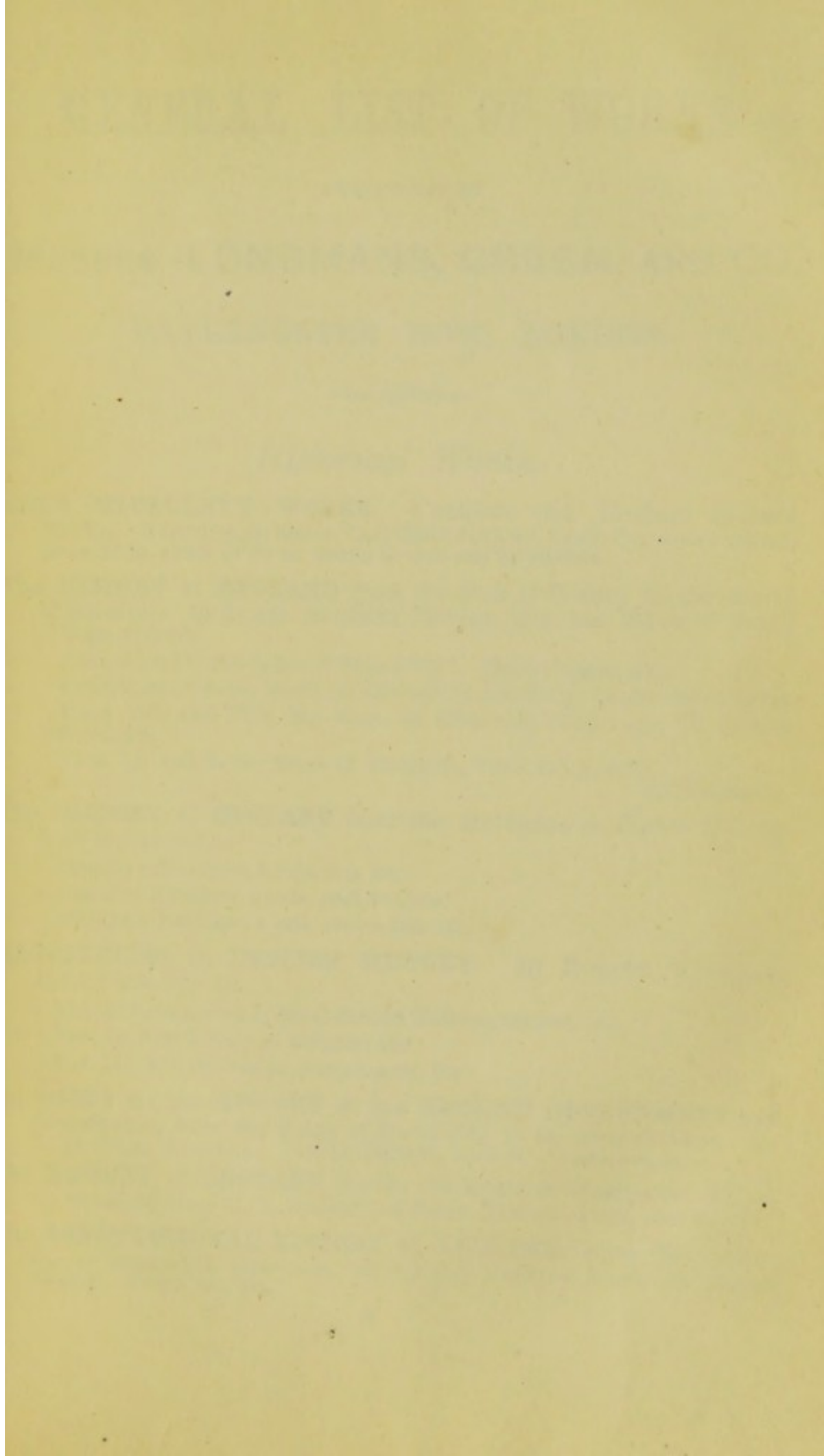
my efforts to rear embryonic larvæ within apples and pears have proved ineffectual. I therefore conclude that the young of these entozoa do not normally reside within these fruits.

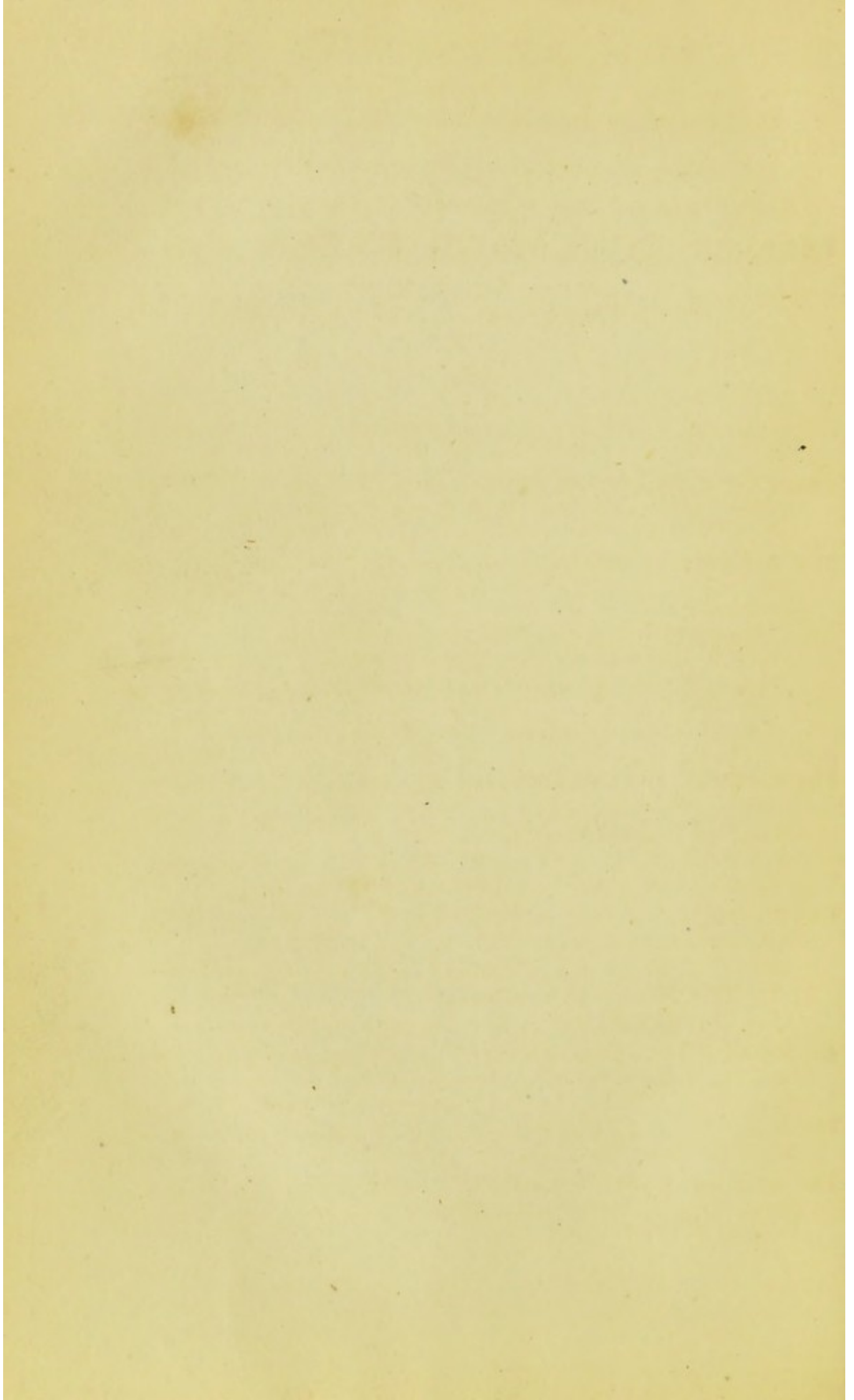
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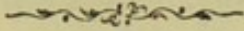


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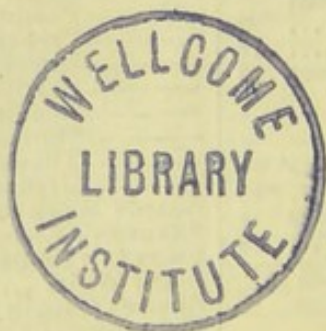
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