NOTICE OF RECENT RESEARCHES

ON THE

ORIGIN OF ENTOZOA,

MORE ESPECIALLY OF TAPE-WORMS.

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RECENT RESEARCHES ON THE ORIGIN OF ENTOZOA.

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The first origin and the subsequent development of the various Entozoa, or internal parasites, which infest the body of man and animals, are subjects of investigation which have always presented great difficulties, partly from the very great changes or metamorphoses in the external form and internal organization which many of the entozoa undergo in the course of their advancement from the embryo to a state of maturity, and partly from the circumstance that the different stages of the same entozoon, which find their appropriate habitations in different animals, or, it may be, in the free as well as in the parasitic condition, have, in many instances, been known only separately. It has, therefore, been the work of great labour and research to establish the relation of affinity subsisting between the different forms in which these animals present themselves in the successive phases of their development.

So lately even as in the present century, at the time of the publication of Rudolphi's systematic work on the Entozoa in 1808, and of Bremser's in 1818, a group of animal forms was recognised as constituting an entire order of the class Entozoa, viz., that of "Cystica," or the vesicular worms, which more recent researches have shown to consist of no more than various larvæ, or earlier stages of the complete or mature entozoa belonging to the order "Cestoidea," or tape-worms.

It cannot be doubted that the researches of physiologists and naturalists within the last fifteen years have produced a very great change in their manner of viewing the organization and mode of life of this remarkable class of beings, and have tended especially to bring some of the phenomena of their origin and reproduction more within the general laws of these functions, as recognised in other animals, than seemed previously to be possible. The obscurity, which for so long hung over the manner in which these animals gained access to the bodies of those they inhabit, has been in some degree removed, and in the more complete history of their origin and modes of life, which is now being opened up, there are given confident grounds for hope that practical means may be suggested for their prevention and removal.

In the earlier part of the present century, previous to the recent discoveries referred to, such was the imperfect knowledge possessed of the organization and habits of the entozoa in general, that by many physiologists of acknowledged learning and accuracy it was believed to be impossible to account for the production of these animals, by the supposition of their ova or young being derived from without, and it was held necessary to have recourse to the hypothesis of their taking origin, in the various seats of their parasitic habitations in the body of man and animals, by a primary or non-parental, or by the so-called spontaneous or equivocal generation. Analogy was, it is true, at all times strongly opposed to such a view; but still, even after it had been abandoned for almost all other animals, some naturalists still adhered to this hypothesis as absolutely necessary for the explanation of the production of the entozoa.

Between the years 1815 and 1840, however, numerous facts with regard to the sexual structure and functions of the principal entozoa were brought to light, which tended greatly to diminish the probability of this hypothetical view; and from that time to the present, the accumulating evidence in favour of the existence of sexual organs in all the entozoa which have arrived at a state of maturity, and of the production of all known forms of entozoa from fecundated ova, has become so convincing as to have caused the hypothesis of a non-parental or spontaneous generation to be entirely abandoned for these as well as for all other animals.

An excellent summary of the state of the evidence and arguments on this subject at the time, was given in an essay by Eschricht of Copenhagen, in Jameson's Edinburgh New Philosophical Journal for 1840. In this essay, Eschricht justly argued in favour of the sexual production of the entozoa, in a manner analogous to that of other animals, from—1st, the constancy of the forms of entozoa; 2d, the completeness of their organization in the mature state; and, 3d, the prodigious fertility ascertained to belong to the greater number in which the ova had been discovered. He argued farther in favour of the view that the ova or young of the entozoa must be introduced into their parasitic habitations from without, from—1st, the known contagious nature of helminthiasis in certain instances; 2d, its occasional epidemic prevalence; 3d, the restriction of some forms of entozoa to certain districts of country; and, 4th, the appearance of imperfect or larva-forms in the blood-vessels and other parts of the organs of animals inhabited by the mature entozoa. And, lastly, he showed satisfactorily that the full explanation of the origin and entrance of these creatures into the bodies of man and animals is to be sought for in a more complete knowledge of their modes of reproduction, in the careful investigation of the metamorphoses of their individual forms, and in the observation of their transmigrations in various stages of their growth from one animal to another—from a free to a parasitic condition, or the converse.

I think it may be interesting to the reader to learn more parti-

cularly to what extent this explanation has been afforded in the case of some of the entozoa by more recent observations, and by various experiments of a novel and conclusive nature, which, within the last few years, have been performed by physiologists on this subject.

It appears necessary, in the first place, to point out the distinction between those entozoa which are known to be sexually complete, and a number of parasitical productions which have long been regarded as distinct animals, but which are destitute of sexual organs. All the sexually mature entozoa are known to inhabit either the alimentary canal of animals, or the cavities of the lungs, or some other parts in immediate or free communication with the external air; or, if only parasitical during the earlier period of their existence, they are ascertained to leave the body of the animal they have previously inhabited, and attain to maturity in the free state. The non-sexual entozoa, on the other hand, while parasitic, all live enclosed in cysts, situated either in the parenchyma of organs, or in close internal cavities, within secreting tubes, blood-vessels, &c. Now these last, or the non-sexual parasites, are all proved to be incomplete animals; that is, the embryoes, larvæ, or earlier forms of entozoa, which attain to sexual maturity by migration from the place of their earlier abode, in some instances into the alimentary canal, pulmonary, or other open cavities of the same animal, but more frequently into those of different animals. In other cases, as already indicated, the larval entozoa leave their parasitic abode, and are developed to a state of maturity in the free or non-parasitic state, that is, in water, in earth, upon moist plants, or in other favourable conditions.

The cystic or vesicular entozoa, established by Rudolphi as a separate order of this class, belong entirely to the division of incomplete or larva forms, and some of them may probably be regarded rather as pathologically altered conditions of these organisms. But it has now been shown that many, and probably all, of these owe their origin to ova produced by entozoa sexually mature, which ova are capable of being developed, in some cases, directly, in others only by passing through the cystic or some other transitory stages, into the complete or sexual entozoa.

The cystic or vesicular entozoa are to be looked upon, therefore, only as incomplete forms of other entozoa, which have had, or must hereafter have, their places assigned to them in the zoological classification; and the order "Cystica" should no longer have a place in this class.

It would also be proper to distinguish, in a more accurate manner than has been previously done, between the cystic worms of a vesicular form, or what may strictly be called the vesicular entozoa, and those which, without having themselves the vesicular form, are enclosed in a cyst, and which ought to be termed the Encysted Entozoa; as it appears that many kinds of entozoa, round worms as well as others, are capable, in certain circumstances, of assuming the encysted condition; and it is important to remark, that in

scarcely any instance has the encysted entozoon been known to attain to sexual perfection, whatever its kind, and however full its growth may otherwise appear, so long as it remains within the cyst.

It appears, therefore, that all entozoa, however various their forms in intermediate stages of existence, come at last to acquire sexual organs, and exercise the function of sexual reproduction when they have arrived at maturity. The number of fecundated ova which most of them produce is enormous; in a tape-worm, or ascaris, there are many millions. The process of fecundation, and the development of the embryo from the ovum, have been carefully observed in a considerable number of these animals. It is a remarkable fact, however, that the development of the ova rarely takes place in the same animal, or in the same part of an animal, in which the parasitic entozoon has passed its life, and has exercised the generative function: there is either migration from the parasitic to the free condition for a time, or from one animal to another, the free condition sometimes intervening, or the change of place may be from one part to another of the same animal. Some entozoa, known only as incomplete or immature animals in the parasitic mode of life, attain sexual maturity in the free state; others, perhaps a greater number, after living free for a time, become sexually complete in the parasitic condition; this is probably the case in the common ascaris.

The migrations, or changes of habitation of the entozoa, or their ova or embryoes, appear to take place in a variety of ways: first, by their being passed out of the body of the inhabited animal along with the fæces or other excretions; second, by their being introduced into the bodies of inhabited animals along with their food or drink; third, by their directly piercing the integument or other tissues; fourth, by their piercing the membranes and parenchyma, entering the blood-vessels, being distributed through them, and subsequently piercing their coats to attain other situations.

It is also important to notice that there is the greatest difference in the degree of complication of the process of formation among the different kinds of entozoa. Some of them are directly developed from their ova, without undergoing more remarkable changes than those which are known in many other animals usually to accompany the process of embryonic evolution. Other entozoa are subject to individual metamorphoses, or the embryo passes through successive stages of development of so remarkable a character, as to mask the regular sequence of the phenomena of progressive formation. There are others of the entozoa which are subject to still greater changes in the progress of their existence, changes upon which great light has recently been thrown in other animals as well as in the entozoa, by the remarkable researches of Steenstrup and others, in regard to what has been called alternate generation or metagenesis. Thus some of the entozoa undergo that peculiar form of multiplication by a non-sexual process, in which the immediate progeny of development from the

ovum is dissimilar from the parent, but produces, without the aid of sexual organs, another progeny, which either itself, or by repetition of an analogous process, returns to the parental form. This is a process of the nature of an internal or external gemmation, which is often attended with a prodigious multiplication of the number of individuals. In some entozoa, again, metamorphosis and metagenesis are combined. It is obvious that the external conditions necessary to maintain these varieties of the vital states must be different.

As the number of ova produced by the sexual individuals of entozoa is in most of them enormous, and the number of adult individuals which inhabit other animals is comparatively small, it is obvious that a very large proportion of the ova or embryoes produced must be abortive, or must never pass beyond the earliest stages of their existence; and it is, at the same time, to be kept in mind that some kinds of the entozoa, like many of the external parasites, very probably pass into aberrant forms, and that some also reach parasitic situations unsuited to their further progress. The introduction of the entozoa, then, into the bodies of other animals, though so far a natural process, and one which does not, when to a small extent, occasion serious inconvenience to the inhabited animals, may be looked upon, in some measure, as a fortuitous occurrence; a circumstance which, in our imperfect knowledge of the true relation of the different phenomena of organic nature, is apt to strike us as surprising, or, at least, as contrasting strongly with the great care in the preservation of ova and offspring generally provided for throughout almost all the rest of organic nature.

From what has now been stated, it is apparent that the following general conclusions result:—1st, That all the entozoa are produced, more or less directly, from fecundated ova, and that they afford no evidence, therefore, in favour of the hypothesis of spontaneous generation; 2d, That migrations are necessary, alike for the introduction of entozoa into the animals they inhabit in the parasitic condition, and for the occurrence of the series of changes by which they reach maturity; and, 3d, That, as the entozoa of several genera and species, previously supposed to constitute distinct animals, are now shown to be only the early or transitory states of those which reach maturity in other forms, a revision of the zoological arrangement of the members of this class is called for. This revision will have the effect of abolishing entirely the order of "Cystica," all of which are incomplete, and must affect, also, a considerable number of recognised genera and species in other orders. But it is obvious that the zoological classification and enumeration of these parasites can only be complete, when the investigation of the mode of reproduction, the metamorphoses, the migrations and the modes of life of all their varied forms, have been exhausted; and when we consider the very different aspects which in successive stages some of these animals are capable of assuming, and the great and often unexpected migrations which

they are liable to undergo, it will easily be understood that it may be long before the progress of discovery shall have enabled helminthologists to assign their right places to the different kinds that have been observed. What has already been done, however, has pointed out sufficiently clearly the direction which future inquiries must take in order to lead to a correct classification of the entozoa, founded on their internal organization and functions.

Among the recent authors whose researches and writings have contributed in the greatest degree to the establishment of the general facts now referred to, Von Siebold of Munich, probably the most learned helminthologist of our time, may be mentioned as holding a very prominent place; but, along with him, the names of Eschricht, Nordmann, Dujardin, Van Beneden, Blanchard, and Kuchenmeister, ought to be stated as having made many valuable additions to our knowledge of this class of animals. An admirable sketch of the present state of information on the subject, has been given in a small work recently published by Von Siebold, entitled, "On Tape and Vesicular Worms; with an introduction on the production of Entozoa."* From this, and from some other sources, I purpose to select some notice of the most recent and interesting discoveries that have been made by Von Siebold and by others.

From what has already been said, the reader will have inferred that the department of our subject on which the greatest amount of light has been thrown by recent researches, is that connected with the history of the origin and transformations of the Cestoid or tape-worms. Some very interesting facts have also been ascertained, however, with regard to the Trematode and Nematoid entozoa. To these last two orders I will refer shortly, before proceeding to state more in detail the observations and experiments relating to the Cestoid and Cystic kinds.

1. *Nematoidea.*—The round worms, among which I refer particularly to the Ascarides or allied genera, are all of separate sexes, and, in their mature state, inhabit the alimentary canal, or pulmonary tubes of man and animals. The ova are generally fecundated within the body of the female Ascaris, and, in circumstances favourable to development, the young are formed directly from the germinal part of the ovum by a process of great simplicity, which admits of easy observation.

It is to be remarked, however, that the ova are seldom developed in the intestinal canal of the animal inhabited; and it is a fact worthy of notice,† that so long as the ova of some Nematoid worms remain in the intestinal mucus, they show little disposition to undergo development, while, on the contrary, the formation of the embryo proceeds with great rapidity when they are placed in water.

The source of the various Ascarides which inhabit the human

* Uber die Band und Blasenwürmer, nebst einer Einleitung über die Entstehung der Eingeweidewürmer, Von Carl Theodor Von Siebold, &c., Leipzig, 1854.

† Observed by Ercolani and Louis Vella, see Ann. des Scien. Nat., 1854.

intestine has not yet been fully ascertained; but many concurring circumstances tend to show that they are most frequently introduced, as minute embryoes, along with water, or with fresh uncooked vegetable food, more rarely along with that of an animal kind.

I was recently made acquainted with an interesting observation bearing on this point, which was made some time ago by my friend Dr. Robert Paterson of Leith, and which, in the absence of more precise information and a fuller investigation of the subject, is worthy of being recorded. It is this, that in the town of Leith Dr. Paterson had found that, in a particular street, certain families who drew their water from the public well, placed at one end of the street, were very subject to be affected with the common Ascaris lumbricoides; while, towards the other end of the street, in which the water was supplied from the Crawley Spring, the inhabitants were free from the verminous affection. The water of the public well, it appeared, was derived from the small lake, named Lochend, in the neighbourhood, part of which is by no means clean, and there had frequently been remarked swimming in this water a number of small animalculæ, such as might be supposed to be the embryoes of the Ascaris.*

It has been ascertained that the Gordius aquaticus, which is allied to the Ascarides—a long hair-like worm, familiarly known in pools of water—is in that state sexually perfect, and that it produces its young while inhabiting the water; but that it has previously, in its earlier embryonic condition, inhabited parasitically the abdominal cavity of beetles, grasshoppers, &c., enclosed in cysts, and without the possession of the sexual organs, which are only developed when it passes into the free mode of life.

The manner in which the young of such entozoa may gain access to their parasitic habitation, is well illustrated by some observations made by Meissner and Von Siebold on an allied genus, the Mermis albicans. The young of this Gordian entozoon inhabit the abdominal cavity of certain caterpillars, enclosed in cysts, and destitute of sexual organs. When approaching maturity, these worms leave the bodies of the caterpillars, making a passage for themselves through the walls of the abdomen; they then remain for a considerable time living in the moist earth near the plants on which the caterpillars had been feeding, and there reproduce their young. The embryoes of the Mermis, when still very small, penetrate the bodies of the young caterpillars, boring through the abdominal wall, and thus attain their first or parasitic abode.

The Guinea worm (Filaria medinensis) has recently been shown by Mr. Busk† to pass through several changes of form before it reaches maturity in the human body. It is generally believed to

* Dr. Paterson has not yet had the opportunity of following out all the details of this very interesting observation, which seems to point out a subject of investigation likely to be attended with fruitful results.

† Trans. of the Microscop. Soc., vol. ii.

penetrate the tissues, and establish itself, in the encysted condition, in the subcutaneous substance. From a statement made by Eschricht, it would appear that this entozoon may remain a very long time before being developed, as he relates the case of a boy, in Copenhagen, in whom the worm only became apparent two years after he had left the coast of Africa, where no doubt he had received the germs or embryoes of the parasites.

A considerable number of instances of encysted round worms have now been observed. Thus, the common mole is infested by an immature Ascaris (A. incisa), which inhabits the peritoneal cavity, enclosed in small membraneous cysts, which are attached by short pedicles to the surface of the intestine and other viscera. A remarkable example of an enclosed immature round worm is not unfrequently observed in the horse, in a mass of immature non-sexual worms of the genus Strongylus, situated in an aneurismal dilatation of the principal mesenteric artery. These worms appear to be the embryo, or young state, of the mature Strongylus armatus, which inhabits the alimentary canal of the same animal. The Strongylus inflexus, which, in its mature state, inhabits the bronchia of the lung of the porpoise, is found, in its earlier and imperfect form, in the encysted condition, and its embryoes have been also observed in the blood-vessels of the same cetacean.

In some instances, it is probable that among the Nematoid entozoa, the change from the encysted to the open mode of life takes place by migration from one animal to another. Thus, the imperfect round worm, Ascaris incisa, already referred to as inhabiting, in cysts, the peritoneal cavity of the mole, is never found in that animal in the mature condition; and it is probable that it only attains to its mature form by passing into the alimentary canal of some other animal which preys upon the mole, and consumes it for food.

The encysted Filaria piscium, which is common in the peritoneum and other organs of fishes, is probably the young of a sexual Ascaris, which inhabits the intestine of seals, cormorants, and predaceous fishes, which prey upon those fishes in which the immature worms have had their previous abode. The minute Trichina spiralis, which has now been repeatedly found, in large numbers, encysted in the muscular substance of man and animals, appears to be an imperfect animal, and probably the early stage of a Nematoid worm. Its development does not, in the muscles, appear to advance beyond a certain point; and it rather seems disposed to undergo a retrograde change, or to become abortive in these situations. Farther observations are required to indicate the source from which the ova or embryoes of the Trichina are derived, as well as to point out whether they belong to any other known Ascaris, or other round worm, and in what situations this form of it arrives at sexual completeness. An experiment of Herbst, relating to this entozoon, is deserving of being mentioned in this place. Finding that the muscles of a badger, which had lived in his anatomical establishment for some time, were affected with

the Trichina, he caused two young dogs to be fed with a part of the flesh of the badger; and he found, on examining them some time afterwards, that the whole of their muscles were beset with the Trichina. It does not appear clear how this transmission had occurred, but it is probable that the Trichinæ of the badger's flesh, on being taken as food by the dogs, were freed from their cysts by digestion (as we shall see to be the case with other entozoa), and attained sexual maturity in the alimentary canal of the dogs, whence the embryoes developed from the ova had penetrated into the blood-vessels and muscular tissues. With regard to this, however, farther observations will be required.

Several circumstances appear to show that the young of some of the round worms, as well as of other entozoa, may, when once introduced into the body of an animal, reach the seat of their parasitic habitation in the close parenchyma of its organs by means of the blood-vessels. That the young of a number of entozoa are capable of piercing the tissues of animals, has now been proved by a variety of observations, more especially on the Trematode and Cestoid worms; and although there are wanting equally direct observations on the Nematoid worms, it is extremely probable that the same occurs with the embryoes of a certain number of these entozoa.

Various observations made by Schmitz, Baer, Valentin, Remak, and others, between the years 1826 and 1842, had shown the existence of filaria, trematode, and infusoria-like animalcules, or larvæ, in the blood of several animals; such as frogs, some fishes, and mollusca. In 1843, Gruby and Delafond observed a large number of filaria-like worms in the blood of dogs, and since that time they have confirmed and extended their observations in an interesting manner.* By these and other observations, it has been ascertained that such Hæmatozoa exist in the blood of various animals besides the dog, in which they are quite common; viz., several kinds of rats, various birds and fishes, in the crab, river mussel, earth-worm, silk-worm, &c. It has not been ascertained that these minute entozoa attain to any farther stage of development in the blood; but it can scarcely be doubted that the blood-vessels must serve as very ready channels of distribution for the minute embryoes of various forms of the entozoa to other parts of the bodies of animals.

2. *Trematoda.*—Most of these entozoa are, in the mature state, hermaphrodite, the ova being fecundated in each individual. In a few only has the process of development of the embryo been traced. In some—those, viz., with large ova—this process appears to be simple and direct; in others, having small ova, it is complicated, and is attended with great metamorphosis of structure, and more than one change of habitation or migration.

The first observations bearing upon the metamorphosis of the Trematoda were made about the years 1818 and 1820, by Bojanus and Baer, in connection with small and imperfect worms

* See Comptes Rendus for 1852, p. 9.

(Cercariæ), belonging to this order, which commonly infest the water-snail. These observations were, however, of so isolated a character, that they did not lead to any general conclusion as to the reproduction of the Trematoda, but at first rather appeared mysterious and inexplicable. The incomplete embryoes or larvæ of certain Distomata had thus long been known as Cercariæ, when, towards the year 1842, further observations brought to light other phases of their existence. The Cercariæ are small active caudate animalcules, which were perceived in great numbers in the water, near and upon the bodies of some species of Limneus. It was observed that they made their appearance by issuing from the bodies of the water-snails, and, after swimming actively in water for a time, they settled upon and pierced the bodies of water insects, so as to establish themselves in their substance. There they became encysted, lost their caudal appendage, and underwent other changes, by which they were gradually converted into Distomata. In the encysted condition, these creatures never reached sexual maturity, but in all other respects were found to correspond exactly with some perfect Distomata, known to inhabit various water fowls, fishes, and other vertebrata, which made prey of the water insects and snails. The manner in which the Cercaria animals are descended from the Distomata formed the subject of farther interesting observations by Steenstrup, Von Siebold, and others; but it cannot be regarded as having yet been fully explained. It appears that the Cercariæ are not formed directly by development from the ova of Distomata, but are produced by a non-sexual process of multiplication from a peculiar body, which may be termed the Sporocyst or Cercaria-case. In some instances, these sporocysts are no more than living bags, within which the Cercariæ are developed by internal gemmation; in other instances, they have more or less of the form, internal structure, and motions of independent animals. It appears, too, that the sporocyst, which gives birth to the Cercariæ, is not the immediate descendant from an ovum, but may be formed by multiple internal gemmation from a body of a similar nature with itself. But the origin of the first sporocyst has not yet been fully ascertained. An observation of Von Siebold's, made on the Monostomum mutabile, an animal of an allied kind, seemed to give the clue to the explanation; but farther researches will be required to determine directly the manner in which the ova of the Distomata are developed. In the meantime it is sufficient to state, that in the Monostomum mutabile, Von Siebold found that from the ovum there was first developed a ciliated animalcule or embryo, and that, secondarily, within this there was produced a body corresponding very closely with some of the sporocysts, of which the successive progenies had been traced into Distomata. Should the view taken of this process by Von Siebold be correct, which is still doubted by some, the successive stages of development and transformation in these Distomata may be shortly stated thus:—

1. Fecundated ovum of Distoma.
2. Ciliated embryo, developed from the ovum.
3. Sporocyst, or Cercaria-case. 1st series, 2d series, &c.
4. Cercariæ.
5. Encysted Cercaria, or Distoma larva.
6. Perfect or sexual Distoma.

These views may possibly be modified by future inquiries, and there may be various other modes in which the Distomata are developed; but enough has been already ascertained to show that some genera of this order of entozoa are subject to very remarkable metamorphoses, as well as, in some instances, to multiple metagenesis; and that, as these changes are accompanied with repeated migrations, the explanation of the entrance of the Distomata, and other Trematodes, into the bodies of the animals which they inhabit parasitically, is extremely difficult, and will require a long and laborious investigation.

The Hepatic Fluke, which occasionally is found, as a parasite, in man, but which more frequently attacks the lower animals, is well known, from the great ravages which in certain seasons, and in some districts of country, especially marshy ones, it produces among sheep and cattle. The exact manner of the introduction of these entozoa into the bodies of sheep is not fully known; but the belief prevails universally among those who have witnessed the affection in flocks, that they are derived from the herbage on which the sheep have grazed. And it is a well-known precaution among the shepherds, in those districts in which the affection is liable to occur, not to allow the sheep to go upon the pasture ground till after the morning dew has been dried from the grass. In certain marshy districts of Tuscany, where the sheep are extremely liable to this affection, it has attracted considerable attention, and the general belief prevails that the larvæ, or young of the fluke, are derived from the grass, or from water near it.

3. *Cestoid, or Tape-Worms.*—There are four principal kinds of these entozoa; viz., 1. Those similar to the common tape-worm, or Tænia solium, or solitary tape-worm of man. 2. Those of the nature of the Bothriocephalus latus, or broad tape-worm, which occurs in the human body in eastern Germany, Russia, &c. Species of both of these genera are also common in Mammalia. 3. The Rynchobothrius, and its incomplete form, the commonest of which is known under the name of Tetrarhynchus, principally met with in fishes. And, 4. Ligula, or undivided tape-worm, occurring also in fishes in its imperfect state, and in its mature state inhabiting water-fowls, and other vertebrate animals which prey upon fishes.

In the three first of these families, which are all more or less jointed in their mature state, each joint is of hermaphrodite structure, or contains at once male and female reproductive organs, and produces fecundated ova. In Ligula, which is also hermaphrodite, these organs are repeated in several sets along the body,

but without manifest division into segments. In all of them the ova are fecundated before being discharged, and may often, in the common Tænia, be perceived to have undergone the first stage of their development before they are excluded. In the common tape-worm, while the head continues to adhere, by its circle of hooklets and oscula, to the mucous membrane of the intestine, the last or caudal joints, when they have arrived at sexual maturity, are separated one by one, or in numbers together, and new joints are, at the same time, gradually formed towards the head. After living for some time, which is very variable in different instances, in this condition, and having produced often a very large number of joints, and an enormous quantity of ova, the existence of the parasitic animal is terminated by the separation of the head from its attachment to the intestinal membrane. When this separation occurs naturally, it appears probable that the circle of hooklets has been lost, indicating the natural term of its existence.

It is only in the alimentary canal of animals that the Cestoid entozoa attain to sexual maturity. Many of them pass the earlier stages of their existence as encysted parasites, and a few even acquire the jointed form, or become partially divided into segments, while still within their close cysts. A well-known example of this, in the Tænia fasciata, or Cysticercus fasciolaris, inhabiting cysts in the liver of the rat and mouse, has been the means of leading Von Siebold and others to a discovery of the remarkable relation now proved to exist between the Cystic or Vesicular entozoa and the Cestoid or Tape-worms. These entozoa are found in the liver of the mouse and rat in every stage of development, from the simplest vesicular form of the true Cysticercus, to that which, from the number and external form of the joints, has all the appearance of a true tape-worm, from which, in fact, it only differs in the absence of sexual organs within the joints. A careful comparison of the form of the head, its circle of hooklets, the four oscula or suckers, and other parts in the Cysticercus of the rat or mouse, with those of the Tænia crassicollis commonly inhabiting the intestine of the cat, has shown an exact resemblance between them. In fact, no difference whatever is perceptible, excepting in the absence of the sexual organs in the most developed examples of the Cysticercus fasciolaris, and in the last joint having still appended to it the caudal vesicle belonging to the cysticercus condition.

Dr. Henry Nelson made the same observations, without a knowledge of Von Siebold's views, and I repeated them with the same result; and Dr. Nelson came to the same conclusion, now generally regarded as established, that the cat receives its Tænia crassicollis along with the flesh of the mouse or rat of which it has made prey.* The cysticercus head and body, resisting the action of digestion in the stomach of the cat, are freed from its cyst, and then becoming attached to the mucous membrane of the cat's

* See notice of this fact in the article "Ovum," in the Cyclopædia of Anatomy and Physiology, supplement.

intestine, its segments undergo their full development, and acquire the sexual organs.

There are a number of other instances in which it has now been made extremely probable, that the various perfect Tæniæ of carnivorous or predaceous animals are introduced into their alimentary canal along with their food, consisting of the flesh of other animals, in which the larvæ or younger encysted forms of these Tæniæ have existed in the parasitic condition. Examples of this have been particularly noted among fishes and aquatic animals. Thus, the complete sexual Rhynchobothrius inhabits the intestine exclusively of predaceous fishes, such as the shark or skate, while the Tetrarhynchus, or incomplete stage of the same kind of Cestoid, inhabits a variety of other fishes, the cuttlefish, &c., on which the shark and skate prey. The common stickleback, Gasterosteus, is infested with an incomplete or non-sexual tape-worm, which lives in the encysted condition in its peritoneal cavity, and this parasite assumes the complete and sexual form in the intestine of various water-fowls which prey on the stickleback, constituting in them the Bothriocephalus nodosus, or Schistocephalus dimorphus. In the same manner, the Ligula simplicissima, inhabiting the abdominal cavity of the carp, seems to be the undeveloped form of the sexually complete Ligula which occurs in the alimentary canal of geese, divers, herons, and other water-fowls. Again, the Triænophorus nodulosus is incomplete, as it inhabits, in the encysted condition, the peritoneal cavity and liver of the trout, and becomes sexually complete only in the alimentary canal of the pike and perch. It seems certain that the ova of this Tænia do not undergo development in the alimentary canal of these predaceous fishes, and we must conclude that they are passed out of their bodies with the fæces, and undergo the first stage of their development, either free in water, or in the encysted condition in the organs of those fishes which fall a prey to the pike. In passing along with food into the alimentary canal of the pike or other predaceous fishes, the young or larva-tæniæ are set free from their cysts by digestion, and afterwards attain to maturity in the favourable conditions presented by their new host.

Adopting the view suggested by these and other instances, that the development of the tænia-like entozoa generally requires their parasitic residence in more than one state in different animals, it is obvious that the migrations by which they reach the situations favourable for their evolution are of two different kinds; the one set being along with food, from the larva or earlier condition, to the alimentary canal of the animal in which full maturity is attained; the other set being that of the ova, or of very small embryoes into the body, close cavities, or solid substance of the first host, in which the encysted condition is passed through.

The development of the majority of the tænia-like worms is attended with remarkable metamorphoses, and has been observed with the greatest accuracy in the Tæniæ of fishes, which are of the Tetrarhynchus or Rhyncobothrius kind, more especially by

Van Beneden, as described in his interesting memoirs on the Cestoid entozoa.* Our space here does not admit of my describing this process at length, but, for the right explanation of the facts immediately to be related, it is necessary for me to state very shortly its general nature.

Within the fecundated ovum of the Tænia, the first process of development gives rise to a small embryo of the simplest structure, consisting of little more than a highly contractile vesicle of the same size as the yolk of the ovum, on one side of which are placed three pairs of hooklets, one pair looking forwards, and the other two pairs placed one towards each side, or at right angles to the anterior pair. The second stage of development consists in the formation, from a determinate part of the first or hexacanth embryo, of a head, with proboscis, a circle of hooklets, and four oscula, precisely as in the head of a Cysticercus, or Echinococcus, or Tænia. The body remains as yet without segmentation, having the form of a more or less elongated vesicle, upon which, at first, there are sometimes to be perceived the remains of the three pairs of primary hooklets. This second embryo is the form which in the Tetrarhynchus tribe has received the name of Scolex, and it has been proposed, therefore, to call the first Proscolex. It is this scolex which so frequently becomes encysted. The third stage in the natural progress of the Tænia is the formation of segments, or the change of the scolex into a compound animal, which, if we adopt a term from the multiple polype stock of the Medusa, may be termed the Strobila. The entozoa in this stage may or may not be encysted; but the joints are not yet complete, as they do not yet possess the sexual organs. The formation of these last within each of the segments, which only takes place when the Tænia has passed into the alimentary canal of its proper host, and the separation of the perfect joints, are the last stages of this process of development.

There are many varieties in different Tæniæ, in regard to the number of joints formed before and after sexual maturity has been attained, and also in the form of these joints, and in the degree of perfection of their organization before and after separation. In some Tæniæ the separate segments exhibit some points of structure, motion, and other phenomena resembling those of independent life; and many naturalists are disposed to look upon them as distinct individuals, formed by a non-sexual process of multiplication on the Tænia stock. The name of Proglottis, following Dujardin, has been applied to each perfect joint when separated.

Without entering, however, into details, as to which there are considerable varieties among the different kinds of Tæniæ, the following may be stated to be in general the several stages of progression of a Cestoid entozoon, viz.:—

1. Fecundated ovum.

2. First or hexacanth embryo, with three pairs of hooklets; Proscolex.

* Memoires de l'Acad. de Bruxelles, 1852.

3. Second or cyclacanth embryo, with circle of hooklets and oscula; Scolex; often encysted.

4. Incomplete segmented Tænia; Strobila.

5. Complete sexual segments, each being hermaphrodite, and tending to separate; Proglottis.

There are not wanting observations, also, which illustrate, in a clear and interesting manner, the process, hitherto inexplicable, by which the Proscolex, or first Tænia-embryo, gains a passage through membranes, walls of vessels, and solid textures of animals, so as to reach its encysted situation. The researches of Stein* on this point are particularly interesting. They were made on Tænia-embryoes from the stomach of the larvæ of Tenebrio molitor, or meal-worm, which he found in every stage of progression from the cavity of the stomach, through its coats, into the abdominal cavity. The Tænia-embryo makes its way by a peculiar succession of movements of its body and hooks, which may be easily observed. In this the three pairs of hooklets are first brought close together while the animal advances and pierces the tissues, and then the lateral pairs of hooklets are bent backwards to their rectangular position, so as to secure the farther advancement, and by a rapid repetition of these successive motions, the minute and apparently delicately-formed embryo forces its way through the substance.

From these and other observations, afterwards to be referred to, there can be no doubt that the first embryo from the ovum of the Tænia is capable of passing readily through the entire softer tissues of animals, so as to reach those deeper and close situations in which they afterwards become encysted.

4. *Cystic Entozoa.*—I have already remarked that the Cystic or Vesicular worms have recently been shown to be, not complete animals, as was previously supposed, when they were arranged by Rudolphi under a distinct order of the class Entozoa, but only immature, and in some instances aberrant, and even pathologically altered forms of the earlier stages or larvæ of different kinds of Tænia. The Cystic entozoa all inhabit the close cavities of animals, or are enclosed in cysts in the more solid parenchyma of their organs. They correspond in some measure with the Scolex, or second stage of a Cestoid entozoon, or they consist of a tænia-head, provided with the same circle of hooklets and four oscula, and this head is united by a neck to a vesicular body of variable size. Of the three forms familiarly known, the Cysticercus possesses only a single head on an entire vesicular body. In the other two genera of Cœnurus and Echinococcus the heads are numerous, having undergone considerable multiplication by a process of non-sexual gemmation; in the first, the heads projecting on the exterior of the common vesicle; in the second, towards its interior. The vesicle, at the same time, undergoes a great enlargement in both, and thus may be the means of inducing extensive pathological changes in the organs in which it is situated. The Echinococcus differs also from the Cœnurus in the circumstance,

* Zeitsch. für Wissen. Zool., vol. iv., p. 207.

that after a time the budding heads come to be separated from the parent individual, and afterwards remain suspended and alive within the fluid of the vesicle, in a form not more advanced than the Scolex, or second stage of the Tænia-embryo; in truth, it is like a Cysticercus with a proportionately small vesicle.

Relation between Cystic and Cestoid Entozoa.—The most novel and remarkable facts to which I have now to direct the reader's attention, refer to the conversion of these various kinds of vesicular entozoa into tape-worms, when they are placed in the appropriate conditions for the attainment of this stage of development, as ascertained by experiments which have recently been performed on a variety of animals, and in one instance also on the human body. These experiments all consist more or less in observing the effects of feeding an animal which it is designed to affect with the entozoa with their ova or larvæ. The first experiment of this kind with which I am acquainted was performed by Dr. Kuchenmeister of Littau, in 1851, who, having caused young dogs to eat along with their food a number of the Cysticercus pisiformis of the rabbit and hare, found that after some weeks these were converted, in the intestine of the dogs, into the Tænia serrata. Similar experiments were subsequently performed by Lewald, under Von Siebold's direction, and later they were repeated by Van Beneden, and by Kuchenmeister himself, with the same result.

The following is a short notice of the most important of the experiments devised and performed by Von Siebold, as described by him in his Essay on Tape-worms before referred to:—

*First Series.**—Ten young dogs were fed with the Cysticercus pisiformis from the rabbit, and being killed and opened at different successive periods afterwards, the gradual progress of the conversion of the Cysticerci into Tæniæ was carefully observed in their intestines. It appeared that, by the action of the gastric fluid in digestion, first the cyst and then the caudal vesicle of the Cysticercus were dissolved in the dog's stomach; but the head and neck, resisting entirely the solvent action, passed into the duodenum. Here they soon became attached to the mucous membrane; and after a short interval of only two or three days, they were seen to enlarge, the head and neck undergoing little change, but the body elongating, and very soon the transverse grooves appearing, which afterwards become more marked, and divide the body into its segments. In less than two months these Tæniæ had attained a length of ten and twelve inches, and in three months they were from twenty to thirty inches long, and the reproductive organs were fully developed in the last or caudal joints, which now began to separate as the proglottides.

The most common tape-worm of the domestic dog is the Tænia cucumerina, with oval-shaped segments; it is only when it has access to the rabbit or hare as food that it acquires the Tænia serrata, with

* These experiments were first described in Lewald's Inaug. Dissert. (Berlin, 1852), and in the Zeitsch. für Wissen. Zool., vol. iv., p. 400.

angular segments, and accordingly this last more frequently affects hunting dogs. Von Siebold ascertained that in other young dogs in the same circumstances, but which had not received any Cysticerci, no Tænia serrata was found, and it was fair to conclude, therefore, that the embryoes of the Tæniæ had, in the first set, proceeded from the Cysticercus.

Second Series.—These experiments were made by feeding young dogs with the Cysticercus tenuicollis, which is common in domestic cattle, and of which the vesicle often attains a large size. Having found that the vesicle was invariably destroyed by digestion, V. Siebold contented himself thereafter with giving the heads only, or scolices, to the dogs, removing artificially the vesicle. Six young dogs were the subjects of this experiment, which was conducted in a manner similar to the first, and with the same result of the formation of tape-worms, which reached their full development in forty-eight days, and corresponded exactly with T. serrata.

In a fox which was fed upon the same Cysticerci, no Tæniæ were found.

Third Series.—In this set of experiments, the Cysticercus cellulosæ, from the flesh of the hog, was employed. Four young dogs received, at different times, a number of these Cysticerci along with their food, and on being opened at different intervals afterwards, there were found in their intestine, in various stages of advancement, corresponding to the length of time that had elapsed, tape-worms which resembled exactly the Tænia serrata. V. Siebold was struck with the close resemblance of this Tænia serrata of the dog to the common Tænia solium of man, and after an accurate comparison of various examples of these entozoa, concludes that they are identical, and not to be specifically distinguished, or that at most they are varieties of the same species dependent only on the difference of their parasitic habitations.

Fourth Series.—This series of experiments was performed in the same manner as the last, but with the heads or scolices of the Cænurus cerebralis, the entozoon so well known in connection with the disease of sturdy and staggers, which it produces when infesting the brain of sheep and cattle. In order that the Cænurus might be procured alive, the dogs experimented on were carried to a part of the country where a number of sheep were affected with the sturdy. In the intestine of five out of seven dogs fed with the Cænurus, great numbers of Tæniæ were found, at successive periods, in different degrees of advancement; in thirty-eight days the Tæniæ had arrived at maturity, and appeared, like those in the previous experiments, to correspond exactly with T. serrata and T. solium; in two other dogs the experiment was rendered nugatory by the dogs being ill of distemper at the time.

Fifth Series.—The last of the experiments related by V. Siebold were made with Echinococcus-animalcules (E. veterinorum) of domestic cattle, which is probably not specifically different from that of man. As many as twelve young dogs, and also a fox, received a quantity of the small echinococci in milk, and on being

examined at various periods from the commencement up to twenty-six days, there were found, in all different stages of development, a small tænia totally different from any observed in the previous experiments, or indeed from any one accurately distinguished or described by helminthologists. This V. Siebold proposes to call Tænia echinococcus. It is remarkable for its very small size, and for the small number of its joints, which never amounted to more than three, and for the circumstance that the reproductive organs, which are confined to the two last joints, become perfect, and the caudal joint separates as a proglottis at a very early period.

From these experiments, therefore, it appeared that all the vesicular entozoa, Cysticercus, Cænurus, and Echinococcus, are capable of being converted, on being transferred into the alimentary canal of a suitable animal, into Tæniæ; that the Tæniæ thus produced from several recognised species of Cysticercus and the Cænurus cerebralis were identical, but that from Echinococcus a different Tænia was developed. Von Siebold holds it as probable that several other Tæniæ, distinguished by helminthologists as of different species, are only varieties of the same, and analogous to Tænia serrata.

After the foregoing results had been obtained and confirmed in farther experiments by Kuchenmeister and Van Beneden, it was extremely interesting to find that the converse kinds of experiments were attended with equal success—that is, that the formation of Cænurus and Cysticercus takes place in animals in consequence of their being fed with the segments of tape-worms containing the ripe ova.

Kuchenmeister, having previously caused the production of the Tænia serrata in a dog by feeding it with the Cænurus cerebralis from a sheep, gave to young lambs some of the ripe joints or proglottides of this Tænia, and by the fifteenth day the usual symptoms of sturdy began to appear in the lambs. Kuchenmeister sent some of the same Tænia to Van Beneden at Louvain, to Eschricht at Copenhagen, and to Leuckart at Giessen, all of whom, in separate experiments, caused lambs in the same manner to take the Tænia joints along with their food, and in all the cases the same result was found to be produced, in the occurrence of the symptoms of sturdy at a period of from fifteen to eighteen days after the Tænia joints were given to them. The same experiment had likewise been performed by Dr. Haubner of Dresden, with the same result.

Several of these experimenters, having examined carefully the lambs so affected, were able to detect the progressive stages of formation of the Cænurus in the cortical substance of the brain, where alone these entozoa seemed to attain the true Cænurus form. There were abundant traces of them in the heart, diaphragm, and other muscles, and also, in some of the experiments, under the skin; but in these situations they appeared to be abortive, while in the brain they gradually increased in size, and, in some instances, the vesicle had attained the size of a hazel-nut. The brain

was, in all instances, marked with inflamed grooves over its surface, indicating, probably, the track of the tænia-embryoes; for at the end of each of these tracks, in the early stages, were found the minute Cænuri.

Another confirmation of the fact of the conversion of the ova of Tænia into cystic entozoa has been afforded by an experiment of Leuckart's, which merits separate mention here. It gives also the complement of the relation between the Cysticercus fasciolaris of the mouse and the Tænia crassicollis of the cat. Having in his possession a family of white mice, which he had employed for various experiments, and in none of which had the Cysticercus of the liver been perceived, he gave to six out of twelve, along with their food and drink, the ova of the Tænia crassicollis, obtained by breaking up the ripe joints or proglottides of this tape-worm from a cat. Four months afterwards he found, on opening these mice, that four of them were affected with the Cysticercus fasciolaris of the liver; and he ascertained that in none of the mice which had not received the tænia-ova was there any production of these entozoa.

The last experiment to which I shall refer may, by many, be looked upon as the most interesting of all, and we owe it again to Dr. Kuchenmeister.* Having the opportunity of repeating on a condemned criminal the experiments which he had previously performed on animals, Dr. K. contrived to give to this man, at seven successive times, between 130 and 12 hours previous to his execution, mingled with various articles of food, a number of Cysticerci from the hog and some from the rabbit. On examination after death, a number of young Tæniæ, in different stages of advancement, were found in the intestine; the greater number of them loose, but a few attached to the mucous membrane. The form of the hooklets, and other circumstances, induced him to regard these tape-worms as the usual T. solium. There were no traces of the Cysticerci last swallowed, and Kuchenmeister was of opinion that those only which were first taken, and which were quite fresh, had been converted into Tæniæ, and that those taken later, being dead, had been digested along with the food.

In the same communication, Kuchenmeister adds that, by his own experiments, and those of Van Beneden and Haubner, it is now proved that the Cysticercus cellulosæ may be produced in great quantity in hogs by feeding these animals with ripe joints of the Tænia solium; but that this does not occur either in the dog or sheep. He mentions also that he has not succeeded in obtaining the Cysticercus cellulosæ by feeding animals with the Tænia serrata vera, nor with the Tænia of the Cysticercus tenuicollis, nor of the Cænurus, nor Echinococcus, while these Tæniæ are all readily obtained by feeding animals with the Cysticercus pisiformis, and C. tenuicollis, and Cænurus cerebralis.

From the whole series of observations and experiments shortly

* I quote from the Union Médicale of 21st April, 1855, p. 193, in which the account is extracted from the Wiener Medizin. Wochensch., No. 1, 1855.

referred to in the previous pages, the general conclusion may be drawn, that, while much probably remains to be done in the details of the subject, a most important advance has, through their means, been made in the explanation of the manner in which entozoa gain access to the seat of their parasitic habitations. It appears by them to have been ascertained—1st, that entozoa are always introduced into animals from without; 2d, that some obtain access to the body of animals from water, or other matters, in which they have previously lived in the free condition, while others are taken along with animal food in which the entozoa have lived parasitically; 3d, that entozoa, when reaching sexual perfection in their parasitic condition, require to be in a situation which communicates with the external air, their most common position being the alimentary canal, and more rarely the pulmonary cavities; 4th, that almost all the entozoa inhabiting close cavities, or encysted, in the bodies of animals, are only imperfect and earlier forms of other entozoa, which may attain maturity in the open cavities of the same or of different animals, or in the free condition; 5th, that entozoa rarely propagate themselves in the same animal in which they have arrived at sexual maturity, but require a different habitation, which they reach by migrations in the various modes before referred to; 6th, that the cystic entozoa are the imperfect states of different Tæniæ; 7th, that full-grown Tæniæ are almost invariably introduced, in their earlier condition, into the bodies of animals along with flesh or other animal food; 8th, that, if the ova of Tæniæ be introduced into the alimentary canal of a suitable animal, their tendency is, by penetrating the tissues, to become encysted, and to assume the form of a cystic entozoon, such as Cysticercus, Cœnurus, or Echinococcus; 9th, that, if these cystic entozoa again are taken by certain animals along with their food, the head part (which corresponds with that of a Tænia) resists digestion, and has a tendency to establish itself and become developed into some form of Tænia in the alimentary canal, by attachment to the mucous membrane, and by the formation of segments.

There can be no doubt whatever, that the occurrence of tape-worm in the human subject, as in animals, is dependent on the introduction into the alimentary canal of the Scolex-larva, accidentally or along with food. The most frequent, though not the only, source of these Scolices in this country and a part of the continent of Europe, is probably the Cysticercus cellulosæ of measly pork, when this is used in a partially cooked or raw state. This accords with general belief, and with what has been ascertained in a number of instances of persons affected with tape-worm, viz., that they had been in the habit of eating raw or imperfectly-cooked meat. In Abyssinia, where this habit prevails to a great extent, the inhabitants are well known to be remarkably subject to tape-worm; indeed, in that country the affection is looked upon as entirely a natural one.

The difference in the prevalence of Tænia solium in this coun-

try and in western Europe, and of the Bothrioecephalus latus in the eastern division of the Continent, is well known; but I am not aware whether any observations have yet been made upon the most probable source of the latter entozoon. In Russia, however, where the Bothriocephalus is the usual tape-worm, it has been found that the long-continued use of an exclusively animal diet, such as is recommended for the cure of some diseases, has been followed by the occurrence of the Tænia solium. In Switzerland, also, in the eastern parts of which the Bothrioecephalus prevails, it has been observed that the hogs are rarely, if ever affected with the Cysticercus; but occasionally pork is introduced from France strongly tainted with this affection, which may account for the occasional occurrence of the Tænia solium, especially in western Switzerland.*

These circumstances seem to point out very clearly the means to be adopted for the prevention of this troublesome complaint. At the same time, it is probable that there may be other accidental means by which these larvæ of the tape-worm may be introduced; and it will be easily understood how this may more particularly happen in the cases of butchers, cooks, or others in the habit of handling affected meat.

The instances in which the human body is affected with the Cysticercus, or other cystic entozoa, though not very rare, are by no means so frequent as those of tape-worm; but they are much more serious in their effects, more obscure in their origin, and in the meantime, therefore, more difficult to prevent. Scarcely any attention has yet been given to the source from which the various cystic entozoa infesting the human body may have derived their origin; but the observations already referred to make it extremely probable, that the explanation of their introduction is to be sought for in the same causes which have been shown to operate in the lower animals. Thus it appears to have been demonstrated that the Cœnurus of the sheep proceeds from the ova or first embryoes of Tænia, and it is most probable that these are obtained from the dog. The only mode, therefore, of removing this affection from a flock in which it may have become prevalent, and in which it is well known sometimes to cause very great losses, must be the careful separation of the dog from the sheep for a certain time; for such time, indeed, as that the dog shall find no more Cœnuri in the offal, &c., of the sheep, in eating which it receives the larvæ of its Tænia, and that the dog being free from this Tænia, shall not furnish the ova or embryos, which being taken accidentally with the pasture or water by the sheep, establish themselves in them as encysted Cœnuri.

* See in the June number of the *Edin. Monthly Jour. of Med.* for the present year, the notice of a case, in which it appeared that the abstinence from the practice of eating raw meat during some time, effected a cure of inveterate tape-worm, with which a person had been for long affected. A gentleman of my acquaintance, who has long been affected with a very large and inveterate tape-worm, informs me, that formerly he was in the habit of taking animal food very imperfectly cooked.

V. Siebold states the important fact, that those floeks whieh are entirely without dogs, and are stall-fed, are never affected with the sturdy.

A remarkable example of the prevalence of eystic entozoa in the human subject is mentioned by Von Siebold, as having reeently been described by Dr. Schleisner, in his "Medical Topography of Ieeland," published in 1851. It appears that the people of that country have been for some time suffering, to a great extent, under a very remarkable hydatid disease. The hydatids affeet the liver, peritoneum, and subeutaneous texture. Esehrieht writes to Von Siebold, that this disease has extended itself to sueh an alarming degree, about a sixth of the whole population of Iceland being affected with it, that it is attraeting eonsiderable attention at Copenhagen. It produees a long-protracted illness, and terminates with a painful death; and means of cure have not yet been discovered. Von Siebold eonsiders it as extremely probable that this disease, eonsisting in the development of a eystic entozoon, depends on the introduction of the ova of a Tænia into the body; and that this arises from the immense quantity of dogs kept in Ieeland for the purpose of herding sheep and eattle. Should the further elueidation of this faet lead to the adoption of sueeessful measures for the prevention of the disease, it will be a satisfactory instance of the assistance which may be furnished to rational pathology and the practice of medicine from physiological researehes, whieh might at first sight have appeared to some to be very remote from such an applieation.

Before concluding, I would call the attention of medical practitioners, more direetly than heretofore, to the investigation of the habits and circumstances of patients who may be under their care for various verminous affeetions. There is another department of the subject upon which I have been unable to toueh, whieh is also greatly deserving of increased attention, I mean the collection of observations by those who may be favourably situated, as to the nature of the entozoa which affect different races and nations of mankind, together with the eireumstances and modes of life, whieh may seem to have an influence in determining the nature of the entozoa in different countries. As a single example of what may be expected from well-conducted observations of this kind, I may here mention, that at Von Siebold's suggestion, Dr. Bilharz, being in charge of making dissections of the dead bodies in the hospital of Cairo, has already, within the short spaee of two years, diseovered five entozoa with whieh the Egyptians and other native Afrieans are affeeted, and some of them very frequently and to a great extent, which are different from those whieh have long been known as the eommon entozoa of the European races.