

this extraordinary case, and had obtained the consent of the poor man to allow me to do so, but his attendant neglected to inform me of his death at the time, considering, he said, it was impossible, in the state he was, for me or any other individual to remove that part of the spine, and he was, consequently, buried before I was aware of his death.

Chipping Ongar, Essex,
January, 1821.

VII.

Observations on the Tænia Solium ; and on its Removal from the Human Intestinal Canal by Spirits of Turpentine. By ROBERT KNOX, M. D. Member of the Wernerian Natural History Society.

SIR,—Since the publication of the learned and elaborate work of Rudolphi on intestinal and other worms,* the numerous disputed points relative to the origin, growth, and propagation of these, seem to have been tacitly given up by medical men in favour of the opinions of that learned and ingenious author; or the inquiry, perhaps, has, from its abstruseness, been deemed beyond the present bounds of science. To the admirers of natural history it would be superfluous to offer any apology for these brief remarks on one species of intestinal worm; and to the practical medical man, few inquiries can be more interesting, as its aim is to elucidate the origin and treatment of an exceedingly obscure and untractable complaint.

It has happened to me to witness the disease of *tape-worm* on an extensive scale, and even, to a certain extent, to experiment on its nature. The observations I have made seem to throw some additional light on this very obscure subject. Should it appear differently to the readers of your widely circulated Journal, I shall still feel satisfied in having performed my duty to science, by submitting these cases and remarks to the public.

The colony of the Cape of Good Hope is remarkable for the general salubrity of its climate. It enjoys, indeed, almost an immunity from the host of diseases, to which, in other countries, mankind is exposed; to this there are a few exceptions, amongst

* Entozoorum, sive Vermium Intestinalium Historia Naturalis. Auctore C. A. Rudolphi.

which may be reckoned the occasional prevalence of *tape worm*. It was long ago remarked by Dr Sparrman, that the colonists, or more particularly those inhabiting the banks of the great Fish River, "had very little knowledge of one of the most frequent and most troublesome disorders to which they were subject, and that was worms."* He observes, moreover, "that adults, and even elderly persons, seemed more generally troubled with the complaint than children."

This so great frequency of the disease amongst the colonists I have never observed, nor was my attention directed towards this subject previous to October 1819, when *tape worm* became so general amongst the troops as to resemble an epidemic. The greater part of these men had just returned from a short though active campaign of a few weeks; they had been exposed to some rainy weather, and had remained for a short time encamped on the open field; yet these circumstances were productive of no sickness, nor did any ailment occur, excepting the singular prevalence of intestinal worms, and more particularly of *Tania Solium*.

There are a few general observations which it may be useful to mention, previous to entering on the more detailed account of cases and remarks. The disease was not confined to any particular class or rank in society; intestinal worms, of one or other species, attacked as well those enjoying every possible comfort, as those exposed to all privations; they spared neither the young nor old, temperate nor debauched, male nor female.

Of the troops employed on the eastern bank of the great Fish River, the proportion of those who became affected with worms, to those who escaped this troublesome complaint, appeared to me about two to five; the *ratio* of those who remained in the colony differed from the preceding, and probably did not exceed one to four. The *Tania Solium* and other worms, more especially *Ascarides lumbricoides*, appeared, *for the first time*, in most of the individuals attacked; they were almost all, without exception, healthy young men, accustomed to much exercise, constant discipline, and regular habits. The greater number of the individuals affected could not remember ever having passed worms, even from their earliest infancy to the period of their attack in 1819. Intestinal worms were passed at this time by men who had lived several years in the colony, and who had not previously been afflicted with them. In one case the gentleman had been *nine* years in the colony before the attack of the disease.

* Sparrman's Travels, Vol. II. p. 127.

Cases and Observations.

CASE I.—Of a detachment consisting of about 86 men, 38 were found, on inquiry, to be affected with worms; of this number, two had the *Ascarides lumbricoides*, and the remainder *Tænia Solium*. The detachment was composed of young healthy men, previous to the appearance of the worms. Those affected became, generally speaking, emaciated and weak, low-spirited, pale, and unhealthy. They laboured under other symptoms, which will be more particularly described in a future case. The cure of all who chose to adopt the means was easily effected by small doses of the spirits of turpentine, after the failure of purgatives and various other remedies.

CASE II.—One of the above mentioned detachment, whose name I think was *Gardiner*, had resorted to a variety of methods in order to rid himself of so troublesome a complaint, but ineffectually. He had restricted himself entirely to a milk diet for about three weeks, with the effect of arresting the growth of the *tænia*, as few or none of the detached joints appeared in his stools during the continuance of this regimen; they reappeared immediately on his returning to the use of animal food. The spirits of turpentine were prescribed for him, in the dose of two drachms morning and evening. He, almost immediately after, voided by stool a portion of a *tænia*, consisting of about 240 distinct joints, each about $\frac{3}{4}$ of an inch in length; the unpleasant harassing symptoms which generally accompany the presence of *tænia* in the human body immediately left him, and did not return.

CASE III.—A middle-aged man (a half-pay officer) had been affected with *tænia* for eight years, during which long period, an incredible quantity of drugs had been prescribed for the complaint, and taken without any permanent advantage. He had been under the care of several medical men, and his constitution was greatly impaired. During these eight years, he had been in the constant habit of passing detached joints of the *Tænia Solium* by stool, in great quantities, and his existence had become, in consequence of this and other complaints, truly miserable. Two drachms of spirits of turpentine in a little water were taken twice a day, for four successive days. He now passed the *tænia* in large connected masses; the symptoms of disease disappeared, and his health returned.

CASE IV.—In this case, (also an officer,) the *tænia* appeared suddenly, whilst the individual enjoyed perfect health. He had never passed any worms previous to the present attack. The symptoms, as in most others, were acute headache, dyspnoea, fetid breath, grinding of the teeth, constant itching of the nostrils, stiffness of the lower jaw, sensation of pain in the temporal muscles, increased flow of saliva, sickness and pain of stomach, pains in the chest and bowels, slight tenesmus, paleness, general debility, emaciation. The complaint was observed to be much aggravated by the use of animal food, and a vegetable diet was found effectual in repressing the growth of the *tænia*, but did not succeed in removing the disease. A powerful

dose of jalap and calomel was prescribed, with the view of expelling, at least, the detached joints of the *tænia*, if not the worm itself. It proved useless in either way, for it neither expelled the worm entire, nor any of its detached joints. The cure was finally effected by the spirits of turpentine.

It would be tedious to enumerate more of the cases which occurred, as they bear to each other so close a resemblance; but there are circumstances regarding the action of the remedy employed, and the exciting cause of the complaint, which merit minute discussion.

It has been generally allowed by medical writers, that there is scarcely any part of medical science more obscure than the origin of intestinal worms. The works of the ancients contain no accurate observations on this interesting point, and the labours of later authors tended only for some time to involve the subject more and more in obscurity and error. Much was to be expected from the exertions of the natural historian, and from the aid of the microscope in the hands of men of science, accustomed to habits of correct observation, and to the impartial investigation of nature. This class of men *has* done much towards elucidating the nature of intestinal worms, or, speaking more generally, of *entozou*, the name by which worms living within other animal bodies are distinguished. But great difficulties remain to be overcome, and the opinions maintained by the most accurate writer on this subject, (Rudolphi,) appear to me quite untenable.

A simple enumeration of the various causes which have been assigned for the production of intestinal and other worms, would convince an impartial reader, that such were inadequate to produce the effect, and were supported by men, who did not give credit to their own doctrines. The extreme difficulty attending such investigations will be made manifest by remarking, that the so justly celebrated Linné entertained notions regarding the origin, habits, and growth of *tænia*, which Pallas and Rudolphi have since proved to be entirely erroneous. It is unnecessary here to discuss the opinions of a host of writers so ably combated and refuted by these authors. It seems preferable rather to inquire into the causes which gave rise to intestinal worms, in so great a number of otherwise healthy individuals,—an inquiry fraught with interest to the medical practitioner; since next to the removing disease when present, the most important subject for investigation is its exciting cause.

The best authors have remarked, that, for the production of intestinal worms, a certain predisposition of the body is necessary, which foreign writers call a "*diathesis verminosa*," and

sometimes a "*dispositio verminosa corporis*." This they describe as originating in scanty, unwholesome vegetable diet, and hence the frequency of intestinal worms amongst the poor; but they also assert, that debility, from whatever cause arising, may give origin to the same complaints. In confirmation of these opinions, they remark, that the inhabitants of low marshy countries, as Holland, are more subject than others to intestinal worms. All preceding theories having been disproved by minute microscopical inquiry, naturalists have admitted the preceding statements, and explained the generation of worms in the human body, by a process totally dissimilar to what is known to take place in the production of all other animals, and somewhat resembling the growth of mushrooms, from a *compost* employed for that express purpose. Nor do the careful expressions of Rudolphi diminish the difficulty, or explain away the absurdities attending the admission of such an *hypothesis*. "Organic particles," he observes, "are required for the production of *entozoa*, in the same manner as we find the classes of animals called *infusoria*, and *phytozoa*, and some *fungi*, are produced." In parts, he further observes, which have been organized, (*partibus organicis*,) as well animal as vegetable, and which have been macerated in water for some time, innumerable animalcules called *infusoria* are known to arise, and to be produced by a process not unlike putrefaction.

It is with diffidence that I offer, in opposition to the opinions of such accurate observers of nature, the following objections: Debility presents itself to the medical practitioner daily in a hundred forms, without being accompanied by intestinal or other worms. On the contrary, these appear in the strongest constitutions, particularly exemplified by the cases detailed at the commencement of these remarks. The individuals alluded to were, with few exceptions, young, healthy, active men. The climate of the Cape is remarkably dry, forming, as it were, the counterpart of Holland, and Hasselquist* says of Egypt, that the inhabitants are much afflicted with *tape-worm*, a practitioner in Cairo assuring him, that two-thirds of the inhabitants of that city were afflicted with them. Moisture, therefore, can have little effect in the production of *tænia*. Neither can a vegetable diet be blamed for its production, since many months had elapsed during which vegetables, bread excepted, formed no part of the diet of any of the individuals alluded to in the preceding cases.

* Hasselquist's *Voyages and Travels*, p. 386.

As *tænia* and other worms are occasionally found in fish, some writers have asserted that they are thus transferred to the human frame. The observations of naturalists have shown, that the *tænia* observed in fish and man differ essentially; and in addition, it may be remarked, that of the hundreds whom I have known to be affected with *tænia*, none had tasted fish for the period of at least six months previous to the appearance of the worms, and many not for years. It remains, therefore, to be explained, how so many young, healthy, active men, became suddenly affected with *tænia*, for assuredly no theory hitherto offered on the subject of intestinal worms throws any light on their origin in the present instance. From the disturbance worms generally create in the human frame, we should be inclined to adopt the conclusion, very different from that of preceding writers, and forming almost an exact counterpart, viz. "That intestinal worms are not natural to man." This opinion is confirmed by the constant efforts nature makes to throw off the disease,—efforts more or less obvious in different individuals, but perhaps existing in all. The *Filaria medinensis* has been classed with the *entozoa*, though several writers allow that it naturally exists in the wells and rivers of warm countries.

Intestinal worms are introduced into the human frame mixed with the food or drink, and, finding in the intestines an apt place for their existence, they there live and thrive; but they do not arise from a weak and injured digestion, and a consequent combination of matter capable of converting itself into intestinal worms.* Were we satisfied with such explanations, the origin of man, and all other animals, would be readily accounted for, from "a peculiar arrangement and combination of organic molecules placed under peculiar circumstances;" the story of the serpent *Python* would be no longer a fable.

Perhaps the strongest objection hitherto offered to the opinion, that *entozoa* are not generated within the bodies of man and other animals, but are transferred to them through the medium of the *ingesta*, arises from the fact, well ascertained, that intestinal and other worms have no where been found excepting within the *viscera* of other animals. But to this it may be observed, that the repeated errors committed by microscopical observers have brought this mode of observing natural phenomena into a certain degree of disrepute. The indefinite nature of the theory supported by late writers, that *entozoa* are generated

* "Dissimilatio vermes gignit.

"Vermes ex dissimilationis processu in corpore animali debilitato obtinente oriri statuit."

within the *viscera* of man by a process our food undergoes when not properly digested, has retarded the advancement of knowledge relative to these animals. It has done worse: it has prevented minute inquiry into the immediate exciting cause of intestinal worms, into the particular article of food which more immediately produces them; and it has spread widely a few vague notions, that unwholesome coarse food, whether animal or vegetable, when introduced into a weakened stomach, will at all times give rise to the disease of worms. It seems of importance, therefore, to reduce the subject to a few determinate points, and, by subjecting the inquiry to a stricter analysis, enable succeeding observers readily to prove or confute the existing theory.

It may, I think, be admitted, that intestinal worms (or the matter capable of producing them) can be introduced into the *viscera* of man and other animals only with the food or drink. That they do not arise from the latter, may be conjectured from the following fact, that individuals using, for a series of years, water drawn from the same sources, have not been afflicted with *tænia* or other worms; nor did these appear until other causes, to which, with more probability, they might be referred, were also present.

The cases of *tænia* detailed in the commencement of this paper, occurred in a body of active healthy young men, subjected to the same discipline and privations, and using, with few or no exceptions, the same sort of food and drink. These circumstances merit peculiarly the notice of the professional reader, as it seldom happens that an experiment (for such it seems to me) can be made so extensively in civil life, where the habits of no two individuals resemble each other,—where the food and exercise of the sick are submitted to no precise rules,—and the dissimilarity in age, constitution, and previous habits of life, renders all general conclusions necessarily incorrect.

In men so situated, we must look to some general exciting cause of disease, the explanations hitherto offered of individual cases being totally inapplicable. The food of these men (for to it we must ultimately refer the disease) consisted chiefly of unwholesome meat, the flesh of overdriven, starved, and unhealthy oxen, reduced often to a mere skeleton, by fatigue, want of food, and exposure to the cold rains, which are observed to sicken and destroy most of the horned cattle and sheep which have not preserved their condition throughout the winter. The use of this sort of food, from peculiar circumstances, was unavoidable. I shall not here dispute the point, whether the *tænia* were transferred, as completely formed animals, from the unwholesome and *diseased* meat, to the stomach and intestines of

man, or are there generated ; it is sufficient to have established the point, that they arise from the use of unwholesome animal food, —from the flesh of animals which have been diseased.

I have avoided, as much as possible, detailing any minute facts regarding the natural history of *tænia*, and other intestinal worms, supposing most practitioners in medicine to be acquainted with the leading *phenomena* of these animals. The following brief remarks I therefore submit to the naturalist, and claim his indulgence for any trifling error which may occur.

Various ridiculous opinions were formerly entertained regarding that variety of *tænia* called *Solium*, most of which have been successfully combated by the ingenious and accurate Rudolphi. It is now known that four individuals of the species *Tænia Solium* have been discharged by the same patient ; hence the obvious impropriety of the name. The theory formerly upheld, regarding the indefinite growth of joints to supply the place of those detached from the body of the *tænia*, and passed by stool, has been rendered exceedingly doubtful. The *Tænia Solium* seems to be regenerated rather by an evolution of joints already existing, or by the production of new joints near that extremity of the worm where naturalists have proved the head to be placed. It is probable, therefore, that Rudolphi may be correct, when he states, that the joints of the *Tænia Solium* do not increase in number, but in length ; or we may assent to the opinion of Pallas, who seems to think that there may be a reproduction of joints towards the head extremity of the animal. *

It is no longer disputed by naturalists, that in the small perfect *Tænia Solium* there are constantly found a distinct head and tail joint, which is not perforated by any vessel or tube ; but as the animal, when suffered to come to maturity, secrete joints in great numbers, which pass off with the *feces*, it is obvious, should the observations of naturalists be correct, that the tail joint must *first* be detached, and unless regenerated at a future period, ought never afterwards to be found in the animal. This difficulty has been slightly touched on by preceding writers. It seems to prove that the longevity of the animal is considerable, and that its original habits must have become altered by residing in the human intestines, for the secretion of the tail joint can hardly be considered as a natural process. A change of localities is observed to exert a certain though limited influence even over man and the class *mammalia* ; but over animals of

* It is a remarkable fact, that no well authenticated case exists of worms being found in the intestines of the *fœtus* or infant at the breast.

obscure vitality, and over the vegetable world, (to which *entozoa* bear close resemblance,) the power of external agents knows no limits. By a change in their place of abode, by the slightest change of climate, or culture, they not unfrequently become so remarkably different from their original or parent stock, as with difficulty to be recognised. Hence it probably happens that the *tænia* has never been detected but in the intestines of man and other animals.

Intestinal worms infest graminivorous quadrupeds, and particularly the horse. They appear generally during winter, and quit him as soon as he is permitted to regain his flesh and strength on the spring pastures.* The presence of worms in the intestinal canal of man may be suspected when a few of the symptoms already enumerated are present; nor ought the practitioner to doubt the correctness of his diagnostic, on finding that a few doses of a purgative medicine do not bring off worms by stool. The *Tænia Solium* will betray its presence in the intestines by the separation and discharge of distinct joints. When other varieties of *tenia* are suspected, the patient ought to have recourse to *anthelmintics*. The *dyspnœa* occasioned by the *Tænia Solium* is a remarkable symptom, and may in some cases lead to an early detection of the complaint; but the superabundant secretion of *saliva* is connected with many disorders of the frame, and cannot be deemed a test either of the presence of worms, or of the recent use of mercury, but rather as a symptom of general bad health.

A variety of drugs and *methods* have been recommended for the expulsion of *tæniæ* and other *entozoa* from the intestines of man; these may be reduced to three heads.

1st, Mechanical remedies, as *pulvis stanni*; large doses of *aloes* taken in the form of pill, (which have been known to expel *tæniæ* from the intestines,) probably act in the same way. This method sometimes succeeds, but is exceedingly uncertain.

2dly, Drastic purgative medicines which occasionally are found successful in expelling the *tænia*, but whose operation is attended with disagreeable symptoms, and not unfrequently irreparable injury to the constitution. Milder purgatives are often exhibited, preceded by *bitters* and *aromatics*.

3dly, *Anthelmintics* or drugs which destroy intestinal worms, by being inimical to their vitality. Of these the most efficacious is *spirits of turpentine*, given either alone, or compounded with

* When young sweet grass cannot be obtained, the worms are generally expelled by a dose or two of melted fat, taken from the tail of the Cape sheep.

empyreumatic animal oil, as in the celebrated preparation of Chabert. I have generally found, that from one or two drachms of ol. terebinth. given in a little water, morning and evening, for three successive days, were sufficient to destroy the *Tænia Solium*,) even in the most obstinate cases,) and cause it to leave the intestines without the aid of any purgative medicine. The practice, however, of exhibiting a little castor oil about noon of each day, is unobjectionable, and may be useful, as the turpentine never purges the patients. The narcotic effects produced by turpentine on *tæniæ* and other worms may be judged of by the fact, (ascertained by several experiments,) that when one drachm only has been taken, and the patient has declined continuing its use, an immediate stop is put to the secretion of separate joints by the *tænia*; the vigour of the worm is destroyed; it sickens, and in proportion to its unhealthy state, does the patient regain his health and strength. Should the turpentine not be repeated, the worm recovers slowly, and after the lapse of an uncertain period, (two or three weeks,) the usual secretion of joints recommences. A large dose of spirits of turpentine, (from four to eight drachms,) produced in many patients unpleasant symptoms, such as intense headache, vertigo, and a confusion of ideas, amounting to temporary delirium. Neither wine nor spirits should be drank during the use of turpentine, lest strangury be produced. Food ought to be avoided on the mornings of using the medicine, nor should any be taken in the evening. The turpentine has been found most rapid in its effects, when taken about 8 or 9 A. M.

Oil of turpentine has been used with success in cases of *tænia* on the Continent, and more particularly in Germany, for at least fifty years. To it the celebrated preparation of Chabert owes its remarkable efficacy. *Ascarides vermiculares* are easily expelled by the same drug; and it is probable that no intestinal worm will remain in the intestines, if the system be kept under the influence of oil of turpentine for a few days.

Many alarming symptoms have been known to arise from the presence of worms in the intestinal canal, particularly nervous disorders, as epilepsy and convulsions. It is not improbable that *chorea* may often depend on the presence of worms in the intestines, and its removal by the continued use of purgative medicines would seem to confirm this conjecture. I have seen a high degree of nervousness existing in many patients affected with worms, and have found that this nervous state disappeared with the removal of the exciting cause.

March 16, 1821.