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clinical notes on parasites of man and domestic animals according to the experience gained in medical practice in Brazil

Adolpho Lutz
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I. *Ascaris lumbricoides*

In allowing myself to present some clinical notes on *Ascaris lumbricoides*, I am moved less by the hope of bringing something new than by the desire to confirm earlier observations. It is true that clinical aspects of the disease caused by this worm have been set forth several times in a very thorough manner in the publications of Davaine, Leuckart, Kuechenmeister and others. Nevertheless, these works are by no means accessible to medical practitioners everywhere, and some important points are omitted from most text-books of internal medicine and children's diseases in general use. In clinical teaching also, this subject is not gone into sufficiently, because in hospitals it is by no means so important as in private practice, especially in rural practice. I do not recall ever having my attention called to that most important means of diagnosis, the examination of feces, during my years of clinical study, although I was at three German-speaking universities, two of them in Germany. Even if the last years should have wrought any change in this respect, a return to the matter may not be entirely superfluous.

I shall not go into the frequency of *Ascaris*, as I have discussed this point several times, especially in regard to the conditions prevalent in Brazil. Suffice it to say, frequency varies considerably in different regions but is everywhere related to the conditions of life, work and hygiene. Wherever the eggs of *Ascaris* are allowed to accumulate on the surface of ground used for building, or for living purposes, the persons whose habits bring them into repeated contact with these foci become ill. In this sense, childhood, gardening, agriculture and earth works are predisposing factors. *Ceteris paribus*, the frequency of the parasites is influenced by the measures taken against them. In many places, certain remedies against worms are so popular that they are invariably used as a preliminary to every other medical treatment,

especially in children. This easily results in useless suffering; on the other hand, the desired effects often fail to come about because of deficient knowledge on the subject. In my Brazilian practice, which comprises some 3,500 patients, most of them belonging to the rural population, I have only been consulted about 30 times because *Ascaris* was either suspected or had been found present. In about twice as many cases I found it either as a complication or in stool examinations undertaken in regard to it.

However, this percentage (slightly over 2.5%) lags very much behind the proportion of the total population infected, either temporarily or for a longer period.

The diagnosis of *Ascaris*, like that of most other intestinal worms, can be undertaken in three different ways: from the symptoms, by the passing of entire specimens or of fragments of them and through microscopic examination of the feces, which show the eggs (or in some others species the embryos). I will touch on these methods successively.

Although a considerable number of symptoms are cited for *Ascaris* infection, diagnosis by their means remains very uncertain, because the manifestations mentioned are not only inconstant but mostly not characteristic either. This applies for instance to differences in the pupils, itching in the nose, grinding of teeth, nocturnal frights of children, an unpleasant odor from the mouth, etc.

In my experience, the following signs are somewhat more reliable: habitual distention of the abdomen, increased demand for food and a generally retarded state of nutrition in children, but these only become noticeable when there are large numbers of worms. Swollen bellies are generally due to meteorism and a very large quantity of ascarides are needed to increase the solid contents of the intestine (through them). Retarded nutrition is only seen in protracted and intense infections. Painful, colic-like, sensations are mentioned by some patients and it seems that, on occasion, the movements of the worms are perceived, though not clearly. Although not one of these symptoms occurs exclusively in *Ascaris* infections and even their conjunction is more characteristic for worms in general than for ascarides, in particular, if all the circumstances are weighed, they may permit diagnosis, to a certain degree. Not rarely, marked symptoms are entirely missing despite the presence of many ascarides, but even then it is desirable to make sure and to get rid of the worms.

The passing of isolated ascarides often occurs by the mouth or as well as by the anus. Strictly speaking, it does not permit the conclusion that others have remained in the intestine as the emigrants are often single individuals; all the same it is of some practical value because the elimination of isolated ascarides is also very common in more intense infections. The reasons for emigration will be discussed below.

The only reliable method of ascertaining the presence of ascarides is microscopic examination, but even this presents a few drawbacks. It does not allow for diagnosing the presence of males or of undeveloped females; but as a rule, among a number of ascarides there are some females; in fact, often the majority of the specimens present belong to this sex, and given the rapid development of this species, if a second examination is made a few weeks later, the formerly unripe specimens will then betray themselves.
Stool examination is destined to show the presence of eggs, which in this, as in most other parasitic nematodes, are voided in enormous amounts. For a description of the eggs, I refer my readers to text-books on helminthology or to newer ones of clinical medicine, and for the technique of examination, to the similar rules laid down for ancylostomiasis (Volkmann's *Klinischer Vorträge*, no. 265). The best way to become familiar with helminth eggs (correspondently embryos) consists in comparing them with others taken from the uterus of the mother-worms. In so doing, it must be taken into account that they may be modified during passage through the intestinal tract. In *Ascaris* this does not consist in further development, but merely in the acquisition of a brown color, due to *bilifuchsin*, as opposed to the initial whitish and transparent, mulberry-like outer involucres.

To evaluate the extent of the difference, it is best to compare eggs from the stools contained in the terminal portion of the intestine of the host with those from the uterus of the worms. (A rough similarity to *Ascaris* eggs is only found in certain composed grains of starch, for instance beans, which are often found in the feces [in Brazil], and often no longer give the iodine reaction because of chemical changes undergone previously.) Two forms of eggs are found in the stools; those generally described and figured allow one to see the yolk, which is not yet contracted, whereas the prominences of the outer involucres are clearly visible only in profile. The other forms, which may have been used for the drawing given by Schneider (*Monogr. der Nematoden*), do not show the usual picture, as one would expect, given his otherwise excellent illustrations. Such eggs are narrower and more elongated, and the prominences of the outer involucres are more perceptible on the surface turned towards the observer; the inside, however, is indistinct and does not contain a well-formed yolk.

These eggs, which may be found either alone or mingled with the others, are sterile, because either the mother or just the eggs remained unfertilized, or (what seems less likely) because of some pathological process. (In his work on parasites, Leuckart mentions that sometimes whole cultures fail to develop, a fact which he attributes to the virginal character of the females which laid them. He also mentions sterile eggs, in general, but does not explain the striking morphological differences, any more than do the other authors available to me.)

The problem as to whether unfertilized *Ascaris* females do lay eggs would be worth investigating. If this should be so, the passing of sterile eggs would permit the conclusion that an unfertilized female was present. Of course the same thing might occur if a previously fertilized female had exhausted its provision of sperm. In the presence of well-conditioned eggs one would, conversely, be authorized to conclude as to the former or actual presence of ripe males (other eggs which remain sterile probably owe this to unfavorable conditions of the culture).

Experience has taught me that isolated females can also be diagnosed from the elimination of eggs. This is due, on the one hand, to the great fertility of this species, and on the other to the intimate mingling of the intestinal contents with the eggs, so that the latter can be found even in quite small particles of the stool. The size of the eggs, which almost permits recognition by the naked eye, allows low magnifications to be used.
I now turn to the habits of the ascarides and the damages caused by them.¹

In regard to lively movements by the worms in the intestine of the host, I can contribute the following notes.

As a rule the adult ascarid is indolent, and mostly remains immobile, as one can observe in animals just slaughtered or in early post-mortems, even before opening the intestine. (I once made the same observation while laying on an anus praeternaturalis, during which two ascarides could be felt inside a protruding intestinal loop. In such cases the presence of worms is indicative of a rather high, and consequently less appropriate, part of the intestine). On the other hand, several cases of so-called lost worms and direct observation show that ascarides are able to move about energetically. They seem to fix themselves by gaining support at several points on opposite sides of the intestinal wall through serpentine curves, especially where the loops show slight inflexion. In spite of this they are probably often carried along by the movements of the intestine and its contents and their attempts to regain their position may partly explain their activity. A second reason for the movements of the worms lies in the sexual instinct, which they also possess, and for the satisfaction of which wandering, at least by one sex, seems indispensable. If this produces no result – for instance, in isolated adult specimens – the movements may extend beyond the usual limits. This might explain the emigration of isolated, sexually mature specimens, especially males. A third possible reason for emigration might be the pathological condition of the hosts, especially those who have high fever, which might make it uncomfortable for the parasites to remain. Some medications, such as quinine, might also contribute towards this, though they are by no means necessary. It is a fact that the worms may also feel satisfied in the intestinal tract in spite of several weeks of high fever and of violent diarrhea, and I can add further proof of this to those already extant. In a few cases, of young individuals, none of these explanations seem apt. The very youngest phases are, however, remarkably mobile.

The emigration of ascarides into the stomach, from which they are generally ejected by vomiting, seems to be a frequent occurrence; at any rate, I have seen a number of such cases. They generally occurred in sick, mostly in feverish patients. The passing of parasites may also be a consequence and not the reason for vomiting, for instance, when this lasts long enough to empty the small intestine, as in ileum. This also occurs in sea sickness and here undoubtedly it is not the cause but an effect.

An example of the penetration of Ascaris into narrow cavities was seen by me in the liver of a recently slaughtered pig. Two of the larger bile-ducts which open into the porta hepatis were displaced by not quite full-grown ascarides that had penetrated into them; they seemed to have forced themselves in and had certainly not developed there. Both were dead and macerated, one of them more than the other.

There is also an interesting contribution to make regarding the so-called perforations by ascarides. It occurred in a slave who died after being unwell for some time without having had any medical treatment. When I was called in, I found

¹The second article begins next (v.3, n.19, p.585-8, 1888). [E.N.]
him already dead, after painful symptoms. At the request of the master and so as to ascertain the cause of death, I undertook postmortem examination of the still warm corpse. A general perforating peritonitis was present, the opening of which was found at once because of the bubbles of gas. At a certain distance from it (about 6 inches), I found a full-grown, immobile Ascaris free in the peritoneal cavity, between the superficial loops of the intestine, whereas the perforated loop lay deep in the ileocecal region. The site of perforation was located one meter above Bauhin’s valve; it was round and the size of a lentil, corresponding exactly to the thickness of the worm. It occupied one half of a plaque of Peyer, whereas the other half was somewhat infiltrated. The neighboring masses of follicles and lymph-glands showed barely perceptible signs of inflammation; the rest of the intestine was normal and it did not contain any further parasites. It seemed to me doubtless that the actual perforation was caused by the worm; the lack of pathological alterations and the localization at a spot not appropriate for peptic ulcers, the fulminating development of the peritonitis, with abundant exudation, and the finding of the worm at a little distance from it made this likely, the more so as the latter occurred in a part of the intestine generally not inhabited by ascarides, and the corpse was not sufficiently cold to have induced emigration. A previous alteration of the intestinal wall was of course probable, but there was no indication as to its nature.

The riddle did not, however, go unsolved for long. This case and two others, with fever, proved to be the beginning of an epidemic which involved 25 persons (more than half the personnel of the plantation), and which included every degree of illness from initially light or severe cases which suddenly became abortive, to other most severe ones, of several weeks duration. The disease was certainly typhoid fever, as diagnosed in part from the clinical symptoms, in part through a second postmortem. This was performed on a Negro woman, 70 years of age, who lay unconscious for several days with cold extremities and the physical signs of peritonitis. (In this case also, abundant fibrinous exudation and a very extensive typhus affection of the lower end of the ileum were present. The crusts had fallen off everywhere, and the serous membrane, which was as thin as a wafer, provided the ulcerous foundation, to the extent of some half dozen plaques of Peyer. In one place it was also perforated and in others it tore up on simple moving of a piece of the intestine). In two other cases (one of which began ambulatory to become extremely severe later, whereas the other was severe from the first, with 41° [Celsius] for a long while), distinct symptoms of incipient peritonitis supervened, but did not reach fluid exudation; on the contrary, both healed, as did most of the other patients mentioned. Treatment consisted mostly of antipyrin, though in the beginning quinine was also given. The infection was probably due to the water of a brook into which refuse was dumped from another plantation, higher up (where similar cases had occurred earlier); the epidemic occurred in connection with long and violent rains. The planter and his family, who used water from a cleaner and more distant course, remained immune. The slaves, however, often used the dirty water of the brook, for convenience, as it was the nearest to their dwelling.²

²The following paragraph corresponds to the beginning of the third article (v.3, n.20, p.617-20), which Lutz dated February 1888. [E.N.]
The majority of these patients were also infected with ascarides in rather large numbers (which also showed that they had been swallowing water or earth contaminated by fecal matter). Ascaridae were eliminated several times by them per anum or by vomiting. In spite of this, even when there was fever for several weeks, sometimes of over 40° [Celsius], part of these patients still retained many ascarides, which were only eliminated by the use of antihelminthics. This proves, in accordance with earlier observations, that neither high fever nor large doses of quinine can be regarded as certain means of eliminating Ascaris.

Most of the many other symptoms which are ascribed to ascarides in this country can be traced to teething troubles or to other diseases. This applies especially to diarrheas, which occur in persons infected with ascarides but are generally not a consequence of their presence. The same can be said of most convulsions of children, though these may be caused by worms, in as much as I have seen two cases of convulsions in adults due to their presence. It is quite possible that ileum may occur in consequence of displacement of the intestine, torsion of its axis, etc., owing to the presence of numerous ascarides. The clumps that Ascaridae often form in the intestine are not produced, as is often affirmed, after the death of the host; on the contrary, I have often seen extremely massive clumps in pigs just slaughtered. (I can also testify to the presence of infection at such spots).

For this reason I consider it appropriate to examine for parasite-eggs in all cases of disturbances of the lumen of the intestinal tract. The sample needed for this purpose is so small that it can be obtained even in cases of ileus (by washing out the rectum, etc). I consider such an examination indicated also in cases of jaundice.

I now have to report, briefly, on the two cases of worm-cramps in adults. The first occurred in a girl of 16, who until then had never had any hysterical symptoms or sexual disturbances, and was otherwise quite healthy too. The attack consisted of an extremely violent ophisthotonus and was only subdued with difficulty by the use of narcotics. After 78 ascarides had been passed, following an anthelminthic, no further attacks occurred. I would decidedly have classified this convulsion as hysterical (or hystero-epileptic) if it had not been for the lack of any characteristic etiology, so that it was not possible to consider the patient as simply hysterical; on the contrary, the rapid improvement after elimination of the worms demonstrated the cause unequivocally.

In the second case, the patient had already often shown slight signs of hysteria. Once, while infected with intermittent fever, the daily paroxysm took the form of a hysterical attack, so that only the elevation of the temperature pointed to the real nature of the illness, which was quickly cured by the use of quinine. Later, the same patient had similar series of daily hysterical attacks, but without the rise of temperature; microscopic examination showed numerous eggs of Ascaris and improvement began at once after a large number of worms (30 at least) had been eliminated upon taking santonin. In this case, the attacks, though caused by the ascarides, were undoubtedly to be classed as hysterical. The fact that such attacks are not always started by the genitalia is also shown by the first experience with intermittent fever, for which analogies are found in the literature.

It now only remains to add a few words on therapeutics. Of the natural remedies, nowadays only Flores Cinae (Semen Contra) and santonin, derived from them, are
still in general use. Both are active when the quality is good but as I must point out, emphatically, one must not be content with the elimination of worms, but must also make sure that none have been retained. This result can only be attained by taking the medicine several days. I want to mention, as great lacking [sic], that the dosing of santonin is by no means sufficiently established. This can easily be confirmed by looking up the subject in books; even those on the treatment of children often mention only two dosages, one for younger and one for older children, and that is most unsound in dealing with such a variable product. Sometimes the magnitude of the dose also provides food for thought. It would be a grateful task to establish a table of dosages, according to the years of life, which would set forth the smallest effective doses and the highest permissible (i.e., not dangerous) ones. In my experience, in adults, doses of 0.1 three times a day may already produce decided santonin side effects. It is of course possible that the difference between slightly toxic and really dangerous doses may be quite marked.

Generally speaking, an effect is obtained by prescribing a dose of 0.1 three times a day, for 3 days, for adults. With this treatment, the ascarides are often eliminated only on the 3rd day, dead and completely macerated, if no strong laxatives are taken. In case of need, the treatment can last longer, as santonin is easy to administer. Thymol also produces positive results, as I found while treating Ancylostoma, but in the present case repetition is sometimes necessary, as ascarides are sometimes more difficult to get rid of than other worms, probably because of their large size. Extractum ilicis maris ether, of good quality, should act in the same way as thymol; camala is also praised, but its quality seems to be variable. There remains to be said that the Ascaris driven out often show signs of life (much more often than other worms). This fact can be put to the test by immersion in water at the temperature of the body. Prolonged or repeated action of the medication seems necessary to kill them.

As to the occurrence of species of Ascaris in domestic animals, as I have had occasion to mention before, I have often found A. lumbricoides in pigs, in Brazil. I have also seen Ascaris mystax in cats and in dogs; but I have never been able to find any proof of their presence in man, though in several places conditions seemed very favorable for human infection by them.

II – Oxyuris vermicularis

Among the parasites of man, Oxyuris vermicularis occupies a special place, in many respects. Its distribution, as well as its diagnosis and treatment, present many peculiarities which are determined by its habitat and its mode of reproduction and of development. Although it is very largely independent of climatic conditions and follows man into all zones, in many places the practitioner seldom meets with it. On the other hand, it is distributed in a much more uniform manner over the different classes of society than the other worms, which often constitute an occupational disease. Though it hardly spells real danger for the host, Oxyuris vermicularis does
cause such bothersome symptoms that the combat against this very persistent affection deserves much greater interest than is generally accorded to it.

To judge by my clinical experiences, I should say that in my former region of work – Limeira, in the province of São Paulo, Brazil – this is a rare parasite, since, out of 3,500 patients, only 7 sought my help because of it; that is hardly more than 2 pro mille of my patients. In stool examinations I found it somewhat more common, but these also do not give an accurate idea of its distribution for reasons to be discussed soon. Only careful postmortems, which unfortunately do not offer sufficient data, could convey an accurate idea of its distribution.

The presence of this worm is generally betrayed by one well-known symptom, the unpleasant itching at the anus, especially inside the sphincter, which is caused by its spontaneous emigration, whereas on the mucous membrane the movements are not perceived and hardly bother, even after it has crossed. Some persons seem rather insensitive to this irritation, which is extraordinarily painful to others. One single little worm is enough to make the patient completely impervious to everything that is not connected with removing it, or satisfying the instinct to scratch.

Although the physician is seldom troubled with complaints on this point, there are several revealing circumstances. It is just the more sensible patients who are the most diffident about revealing their trouble; as they mostly cannot find any explanation for it, they also believe that such an explanation cannot be expected from others.

Unfortunately, only too often they are right, as the basic principle of looking for *Oxyuris* in every pruritus analis, specially in periodic ones, is by no means sufficiently spread among physicians. A large proportion of the cases, and just the most intense and enduring ones, affect persons who are not able to complain, such as infants and the mentally diseased. Consequently, help is sought mostly when, either by chance or by examination, the worms are discovered. As a rule this only occurs when they are very numerous. However, since it is very important to reach a diagnosis, I shall devote a few words to its technique.

Whilst in other species of intestinal worms, microscopic examination of stools is the most reliable method of diagnosis, this is by no means the case for *Oxyuris*, as I feel confident to say after rather large experience with it. Occasionally one does find the curious characteristic eggs, flattened on one side, especially if samples are taken only from the slimy covering or the outer layer of the feces, and preferably from several different places; but even so, positive results do not constitute the rule even in undoubted bearers of *Oxyuris*. This is probably due, in part, to the fact that the eggs are not laid one by one but in large lots separated by long intervals; besides this, the more consistent contents of the large intestine do not permit an equable distribution of the eggs and embryos like that which occurs in parasites of the small intestine.

The principal reason, however, is to be found in the fact that often – I believe I may say as a rule – the eggs are laid only outside the human intestine because the female filled with eggs finishes her emigration before voiding them.

If such emigrated specimens are put under the microscope, and perhaps because of the cold, one can see that the eggs are being voided in a stream and soon form an easily perceptible white spot beside the collapsed body of the mother.
When, as often happens, the patient is instructed by the physician to look for worms in his stools, the results easily become negative. Leaving aside the fact that many patients do not have the eyesight or the visual training needed for observation, the finding of isolated worms is not an easy task, even when one is willing, especially in voluminous and not very consistent stools. Altogether, the elimination of *Oxyuris* in bowel movements is rather accidental, whereas active emigration is the rule.

The following procedure is the only symptomatically effective and appropriate one, and thus to be recommended. The patient is told that, as soon as the itching starts, he must take an enema of quite cold water, as little as possible, to be introduced without pressure and to be released at once. The cold water paralyzes the worms immediately and they are easily found in the sparse and hardly clouded liquid. The itching will cease instantaneously, a relief that cannot be obtained as quickly nor as thoroughly by mechanical means. If this procedure should fail the first time, this will not happen again after a second or a third trial. The relief afforded will not only favor re-examination but is diagnostically valuable.

For purposes of differential diagnosis, be it remarked that the finding of a local infection, eczema, or hemorrhoids does not excuse examination for *Oxyuris*, as they may be an accidental complication or sequel. In affections of this kind, *pruritus nervosus* will not start or stop so suddenly, nor be so much tied to certain hours, as in the crossing of the worms, whose movements are also perceived rather clearly. In recent cases at least, itching is decidedly the consequence of their mechanical activity.

In children and irresponsible individuals the proper moment for examination will generally be indicated by unequivocal gestures, and the necessary steps will then have to be taken by those in charge of them.4

Parasitism by *Oxyuris* often is just a short episode, which is fortunate for the patients, who seldom owe their cure to medical efforts. In other cases it is a very lasting and obstinate ailment. *Ceteris paribus*, diagnosis will be highly influenced by the intensity of the first infection, since, according to general views, prolonged infection can only be maintained by repeated importation.

The conditions needed for this are found most easily in self-infection, which cannot be entirely precluded even in the cleanest persons. The main cause is the itching, which is too imperious to be withstood, even if only unconsciously, by a sort of reflex. It is evident that this cannot be prevented any more than bacterial invasion by bathing and ablutions. Several helminthologists have found to their cost that working on this worm may lead to transmission; as contact with the worms is generally avoided, such infection perhaps occurs while washing or cleaning slides and cover glasses. Be it said, however, that, in accordance with our present information on the subject, it would be necessary to import several eggs, as a single one could not ensure sexual reproduction. Consequently, cases in which the infection lasts year in year out, inevitably call attention. Such cases may be due, in part, to the environment and to faulty conditions of hygiene; but, as the

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4 The part of the article that was published in v.3, n.23, p.713-6, 1888 begins in the following paragraph. [E.N.]
requirements for development of *Oxyuris* do not permit prolonged immersion of the eggs in water, these factors should not play so big a part as in the case of other parasites. There is another possibility which has not been discussed hitherto. Although Leuckart’s findings make it unlikely that a new generation should grow up by the side of the older one, without previous immigration, one cannot deny that the clinical circumstances do suggest constant multiplication in the digestive tract. Perhaps an intermediate position can be reached.

One need only suppose that one, among the often very numerous, pregnant females should, on occasion, take the opposite way and finally reach the stomach and ensure abundant issue. This possibility can hardly be excluded *in limine*.

The span of life of the individual *Oxyuris* must necessarily be short, for reasons which cannot be gone into here. If self-infection can be avoided for a time, the infection may easily die out. All means of preventing itching therefore also help to halt the illness; otherwise, only misunderstanding of real conditions are conducive of attempts to influence the parasites by local applications at the anus, which can only arise from an entirely erroneous conception of the habits of the worm. Another therapeutic illusion consists in believing that the elimination of the worms through cathartics ensures success. In any case, proof would be needed that a large number of parasites had been expelled before accepting the usefulness of this procedure. Besides, one must not aim at decreasing their numbers but at total eradication of the worms, and this will only be achieved if they are either killed or at last paralyzed. This is by no means easy with substances taken internally and has probably only seldom been successful.

In the treatment using enemas, a correct understanding of the aims is often also missing. An endless assortment of substances have been praised as effective but no proof has been forthcoming. One is often content to point to a certain number of immobile specimens, without stating either the temperature at which the substance was introduced, or seeking to find out if the worms are really dead and not numbed by the cold. As mentioned above, *Oxyuris* can certainly be driven out by cold water, provided they come into sufficient contact with it. Any substance dissolved in this water will have the same effect. We must, however, refrain from using it if the substance is too toxic to be allowed to fill the whole of the large intestine for a while, which would be the only method by which the substance could act on the parasites, should it really be deleterious to them. It would be a useful piece of work to ascertain experimentally which anthelminthic substances are really effective.

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As to medicines taken internally, Bremser has already complained that anthelminthics loose their efficacy during the long journey to their destiny. Very soluble substances, easy to absorb, hold out no prospects; nor does medical literature present useful data on the successful treatment of *Oxyuris* by anthelminthics. The success ascribed to santonin is probably illusory and perhaps really due to the spontaneous emigration which often occurs when the worms present are very numerous. However, although *Oxyuris* remains a stepchild of internal treatment, we can make use of some of the experience gained in regard to *Trichocephalus*. This species shares its habitat with *Oxyuris* though it does not go so far down the intestine; consequently, we may assume that the same treatment may be applicable to both. Now two anthelminthics have proved efficacious against *Trichocephalus*.
Extractum Filicis maris aethercum and thymol. They are the most multi-sided antihelminthics and those that extend their effects further down the digestive tract, so much so that their characteristic odor is noticeable even in the stools. This means that absorption is slow. As to the manner of use, I again refer to my earlier findings (Volkmann’s Klin. Vortr., 265, p. 2481 and following pages). The basic principles established by me for the treatment of ancylostomiasis, tapeworms and trichinosis also apply here. Both substances also promise good results in clysmata.

From these explanations, the treatment I consider most useful becomes practically evident. The necessary substances may be taken per os or by enema; where there is no special obstacle it is better to combine both methods if one wants to act quickly and effectively. Simple irrigation with cold water, either with Hegar’s funnel or by douche, will produce results if the temperature of water is kept low and its quantity measured out generously. The masses of fecal matter which prevent filling the large intestine should be removed previously by a purgative, or by a warm douche, taken before the cold one, which should be retained very briefly. The latter is to be taken once a day, shortly before the usual hour of emigration of the *Oxyuris*; it will prevent the itching and thus reduce the danger of self-infection to a minimum. Food should be chosen so as to leave as little residue as possible. Even if in this treatment *Oxyuris* occupying the highest points of the intestine are not reached, their number will be considerably diminished and spontaneous dying out will soon bring about complete healing.5

I unexpectedly discovered that thymol taken internally is effective against *Oxyuris* by finding dead females of this worm in ancylostomiasis patients. Unfortunately, I cannot specify whether all the specimens had been driven out and whether this result is certain, but I believe that thymol, taken two or three times at weekly intervals, should lead to a complete cure, which would manifest itself by the ceasing of itching. In general, I recommend that thymol cures be undertaken after preparation of the intestine, and that if itching recurs, cold-water enemas be taken for a few more days. The patients I treated like this made no more complaints later, but I cannot cite this as absolute proof because they were all out-patients.

In any case, it is advisable to treat *Oxyuris* infection at the beginning, and for this reason the other members of the family should be observed. In my practice, I found that in infections of infants, the mother was invariably infected as well. Sleeping in the same bed favors infection, though nowadays, of course, no one would suggest that the parasites penetrate spontaneously into the anus. Emigration from the rectum to the genitalia seems rather frequent in female patients, as I have observed several times. This possibility must not be overlooked in cases of leucorrhoea, specially in infants.

Severe general symptoms, such as have been recorded by a few observers, I have never encountered personally. They seem to occur only in very intense infections. As a curiosity I will mention that I once found a male *Oxyuris* in copula with a female that was emigrating. He was wound across the body of the female, but separated from her spontaneously during observation under the microscope.

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5 The section published in v.3, n.24, p.745-8, 1888 begins in the following paragraph. [E.N.]
Rhabdonema strongyloides Leuckart and longum Grassi

In an earlier communication,\(^6\) I explained that the so-called Anguillula stercoralis is frequently found in examinations of stools, and that a bisexual, free-living generation can be raised from it. Already then, I expressed my doubts as to the correlation of this common and very numerous parasite with the regionally delimited Cochinchina diarrhea, which is unknown in Brazil. I have not had any reason for changing my point of view since.

As the proliferation of individual Anguillula stercoralis is rather moderate, only a very prolonged and painstaking examination of the feces permits excluding the presence of isolated specimens.

The species I observed in the pig (which is probably identical to Rh. longum Grassi) I have found once more since then, in São Paulo (Jan. 1888), in quite a young suckling; 20 specimens were present.

The culture of the free generation from the feces did not succeed, mostly because the reduced number of eggs made observation very difficult in the voluminous feces.

Docchius ankylostoma and allied species

I have little to add to my former communication on this subject.\(^7\) The cure with thymol has proved itself again, also in the hands of others. I want to mention a peculiar aspect of it; the curved teeth of the mouth-capsule are generally, if not regularly, missing in the eliminated specimens; perhaps they remain in the mucous membrane when the worm is expelled.

To the life history, I may also add that by the swallowing of several full-grown larvae, part of them invested by the sheath-like old cuticle, I managed to raise a few Ancylostomae in an experimental subject free from them until then.

The statement made by some authors that these larvae continue to develop outside the body seems to be erroneous.\(^8\) It may derive from the fact that in ordinary drinking water are found other free-living nematodes able to develop there. By thinning out cultures with such water, I succeeded several times in raising many specimens of a species of Diplogaster. They were characterized by unusual resistance to the processes of putrefaction, and were able to attain sexual maturity even in a rather fluid medium. However, they take such a long time to develop to the point of becoming noticeable that they could only be misleading in older cultures.

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\(^6\) "Über eine Rhabdonemaart des Schweines, so wie über den Befund der Rhabdonema strongyloides (Anguillula intestinalis und stercoralis) beim Menschen in Brasilien," published in Centralblatt für Klinische Medicin, June 6, 1885, v.6, n.23, p.385-90. [E.N.]

\(^7\) "Über Ankylostoma duodenale und Ankylostomiasis", in Richard von Volkmann, Sammlung Klinischer Vorträge in Verbindung mit deutschen Kliniker, n.255-6 (Innere Medicin no. 88), p.2295-350; and n.265 (Innere Medicin no. 92), p.2467-506. [E.N.]

\(^8\) This is likewise the opinion of Leuckart (Neue Beobachtungen über Nematoden, Leipzig, 1887, p.18, Anot.). [A.N.]
Of the Dochmius of domestic animals, I have seen only one species, in dogs, which seems to be identical to the one described by Ercolani. It is characterized by three strong hooked teeth to each side, and is a very fit subject for studying the anatomy of the very well developed mouth-capsule. It was first found by Dr. Havelburg in Santos, and is undoubtedly hematophagous. According to a written communication from Grassi (received about two years ago), it is very common in Italy. At the time he considered it identical to *D. trigonocephalus* and stated, quite correctly, that it sucks blood. Unfortunately, I do not have all the literature on the subject, but it seems certain to me that the *D. trigonocephalus* of the older authors was a quite different species. The *Dochmius* of dogs are not clearly defined even in the more recent treatises. Thus Johne (Birch-Hirschfeld, *Lehrbuch der pathologischen Anatomie* 2.ed.) indicates three species (*D. trigonocephalus*, *stenoccephalus* and *duodenale*). I consider the inclusion of the human species a mistake. It may arise from confusion with Ercolani’s *Strongylus* (correctly *Dochmius*) *caninus*, though a practiced eye should be able to see the differences at first glance.

Of the allied Nematodes, *Sclerostomum pinguicula* (*Stephanurus dentatus*) is extraordinarily frequent in pigs, and is certainly not devoid of pathological importance. In the stomach of the same host I once found a smaller species of *Strongylus* with well developed bursa.

As something rather unusual, I would like to mention that three times I found sexually mature male and female specimens of a species of *Strongylus* distinguished by its unusual habitat in Brazilian squirrels (*Sciurus aestuans*). The worms were located in cyst-like hollows of an abdominal organ which could only have been the pancreas. In correlation with them, nematode eggs were also found in the intestine; they were exactly like those of the sexually mature females and could only have got there through the *ductus pancreaticus*. The extreme fragility of these worms made it impossible to preserve them and thus prevented me from studying their marked morphological peculiarities.

**Trichocephalus dispar**

I have often found *Trichocephalus dispar* in man and in pigs; in the domestic cat, there seems to occur a different and considerably smaller species. Human *Trichocephalus* were very wide-spread in my field of work, being found in approximately a third of the stool examinations. Although it seems to occur more often and to be more abundant in hosts of *Ascaris lumbricoides*, *Dochmius ankylostoma* and *Rhabdonema strongyloides*, it was not seldom found alone, and sometimes quite unexpectedly. It is remarkable that in spite of its dissemination, there were always only a few specimens present. The largest number found was nine (six females and three males). Stool examinations often indicated the presence of only one or two females. A few observations seem to suggest that unfertilized females may also lay eggs. (In pigs this worm was found often, but always only a few specimens.)

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9 What follows is the final excerpt published in *Centralblatt für Bakterologie und Parasitenkunde* (v.3, n.25, p.777-81, 1888). [E.N.]
Consequently I have not had the occasion to take steps against *Trichocephalus* but will recount my experiences with it for those who may have to. *Trichocephalus* is generally considered a difficult parasite to get rid of and has only very seldom been found in stools during treatment against tapeworms. Only of late, since the introduction of thymol, have circumstances changed somewhat, so that the elimination of *Tricocephalus* has been reported more often. I myself possess twenty specimens that were passed by five different patients during treatment for *Ascaris* and *Ancylostoma*, but they can only be a part of those I have caused to be expelled, since other patients, treated in the same way, ceased passing *Trichocephalus* eggs; this allowed me to deduce that the mother-organisms were no longer present. Until now, however, thymol seems to be the best remedy against this species and even superior to the best fern extract; it sometimes leaves one in the lurch, if it is only given once, so much as that *Trichocephalus* remains the most difficult worm to eject. Perhaps further studies on the way of treating with thymol (for instance, avoiding the use of purgatives) may alter this in the future. Of the other known antihelminthics, only fern root and the substances derived from it seem to have the same effect on *Trichocephalus*.

**Taenia**

I have not found tapeworms especially frequent in the province of São Paulo (about 0.5% of the patients) but both *Taenia solium* and *Taenia saginata* undoubtedly occur. It is difficult to gain a clear insight into their respective frequency as they show a peculiar separation by nationalities. Three specimens, from Brazilians of good social standing, living in rather urban conditions, and one other specimen passed by a colleague in the same circumstances undoubtedly belonged to *Taenia saginata*. In these cases, infection was probably due to eating very raw beefsteak. Among Germans, on the other hand, I saw 8 cases of *Taenia solium*, only one of which had been imported from Europe. I saw 6 more cases in children of two German families. The specimens I was able to examine were also *T. solium* and, judging from the similarity of the circumstances, the others probably belonged to this species also. All these cases occurred in families that regularly slaughtered pigs (mostly for sale); sausages were made at these times, which is not a custom among Brazilians. Infection probably always occurred from tasting the raw, chopped meat (a habit which was acknowledged several times, even for the children) and not from the ready sausages which were consumed by Brazilians too. Ham is not an available source of infection in this region. Besides these, I had two more cases of tapeworm in Negroes, a man and a woman, who worked on a plantation, where much pork and hardly any beef was eaten. They were probably also *T. solium*.

Of the other human tapeworms, I have seen no autochthonous cases in Brazil hitherto.

Among domestic animals, I have found *T. elliptica* in dogs and *T. crassicollis* in cats; *Cysticercus fasciolaris* of the latter was found several times in mice and rats.

I have had the opportunity to observe human *Cysticercus* a few times, but they are not common. I recall 3 cases, in two of which extirpation confirmed the diagnosis. Twice the *Cysticercus* was isolated on the anterior or on the lateral surface of the
One of the hosts, a German, also had a *Taenia solium*. The third patient had multiple *Cysticercus* under the skin of the abdomen, two or three on the loins and one between the two leaves of the prepuce; the latter were only found during a second examination several months after the first. The specimen in the prepuce had been extirpated and had left a cyst-like hollow. A fourth patient, who was also Brazilian, had tapeworms earlier. The tumor was the size of an orange pip and located in the subcutaneous cellular tissue and was characterized by unusual hardness. On extirpation, it was found to be composed of a whitish, very much calcified, caseous mass, which showed a small accumulation of black pigment near one of the poles, evidently corresponding to the head of the former *Cysticercus*. (Since confusion with an atheroma was excluded, the whole form and position of the tumor could only have been derived from an *Cysticercus*.) Careful decalcification yielded an elongated bladder, the size and shape of an orange seed, with a structureless content and masses of pigment; the most careful search failed to show any remains of chitinous hooklets. Therefore, it does not seem entirely impossible that the dead and calcified *Cysticercus* should have belonged to the lifecycle of *T. saginata*. This supposition would have been more likely if the bearer had also had such a tapeworm. However, this could no longer be ascertained, though the distribution mentioned above also favors.

I should like to add a few words on the treatment of tapeworms. The medicines which easily lose their efficacy have not produced good results in this country. This applies to the extract of the male fern. Of the better-known remedies, the only one that can often be obtained in good condition is the bark of the root of the pomegranate, and it has proved effective several times in large doses (80-100 grs. for adults). I once saw a *Taenia saginata*, with only half the scolex and two of the suckers, passed after its use. Unfortunately, this substance attacks the digestive organs and, on its account and because of its bad taste, its usefulness is very much impaired.

Therefore, nowadays I mostly apply the same cure with thymol described in regard to Ancylostomiasis. I have been using it for several years and believe that I was the first to apply it to tapeworms, and I only refrained from publishing until now because of the scarcity of the material and the incomplete observations. I can, however, state a few certain facts. The use of my thymol method leads to the elimination, in a very short time, sometimes already after the second capsule, of the strobila of *T. solium*, *T. saginata* and *Botriocephalus latus* (two cases of the latter, each of them with 2 specimens). The tapeworms were always passed with the thin part of the neck present, whereas the scolex was often missing. In these cases, I was unfortunately unable to examine the specimens myself as most of the patients lived far away. In several of them (*T. saginata* and *T. solium*) I obtained reliable information as to the absence of relapses, so that, in those cases, the scolex must either have been eliminated also or have died. In the two cases of *Botriocephalus*, the strobila later started to reconstitute themselves; therefore I believe that it is necessary to go on investigating the conditions required for a radical cure. At any rate, thymol is not only easy to take (according to many patients, it is the most pleasant of the worm cures, except perhaps Pelletierin and Koussin), but can also be repeated without danger and even go on being used for
some time. It has the advantage over the other tapeworm remedies of being a chemically pure substance, which does not decompose, and this is of some practical importance, especially given the variability of the other antihelminthics in hot countries.

Of course if a really good ethereal extract of *Filicis maris* is available, it is better to use that, because if it is taken in doses of 6.0-10.0 in gelatinous capsules, it is not very unpleasant and is unexcelled for sure results.

I have never been able to ascertain the presence of the *Cysticercus* of *T. echinococcus* in man; on the other hand, it seems very frequent in pigs.