

so persistently noted that I feel the importance of seeking the coexistence of these intestinal parasites in the particularly obstinate, chronic and recurrent forms of malaria in these southern districts as possible influences in the clinical course of such a case.

Another example of the importance of the subject is the recent discovery in Texas and elsewhere of *Tænia nana*, a tapeworm known to be responsible for considerable intestinal disturbance, for the development of pernicious anemia and in various instances of epileptiform phenomena. Such instances of the importance of animal parasites might be indefinitely multiplied; and the importance of this branch of pathology is manifesting itself more and more as time goes on. The field, however, has by no means received the attention its importance deserves; and for one I feel anxious that it shall soon be represented by some adequate reference work in our own language, or some translation of one of the worthy European works annotated from an American standpoint.

DR. H. B. WARD, Lincoln, Neb.—I think Dr. Wynn's date of two years is the record for the banana fibers, though within that time Stiles of Washington, Bierring of Iowa and a number of men in different parts of the country have made the same discovery. One case to which I did not refer in the paper came to me last year in Nebraska, which has the further interest that the physician said it was a remarkable case of tapeworm, as it was found in the alimentary canal and also in the vagina.

One thing I should like to emphasize in closing. It has been mentioned again and again to-day in this and in other sections that there is a sad lack of fecal examinations. Last year a very well educated and a very bright and thoughtful physician in a city not my own permitted a patient to die of pernicious anemia without a single fecal examination.

UNCINARIASIS IN THE SOUTH.

FURTHER OBSERVATIONS.*

CLAUDE A. SMITH, M.D.

Pathologist to Grady Hospital; Demonstrator of Pathology and Bacteriology, Atlanta College of Physicians and Surgeons; Professor of Pathology and Bacteriology, Southern Dental College.

ATLANTA, GA.

Since presenting the paper before this Section at the meeting in Saratoga last year, in which I reported three cases of ankylostomiasis, or uncinariasis, the first case being found postmortem, in December, 1901, and the other two being mild cases found among the negro convicts working in the brickyards near Atlanta, I have found this disease to be exceedingly common from the Carolinas to Texas. I make this statement as a result of examinations of medical students at the Atlanta College of Physicians and Surgeons, at the Southern Dental College, patients sent to Atlanta from the adjoining states and a systematic examination of all the patients in the Grady Hospital for the past year. However, very few cases have appeared at the Grady Hospital for the reason that all the patients in the public wards must be residents of Atlanta, and, as this is a disease of the country and not of the city, we would not, therefore, expect to find many in the hospital. Since the postmortem on the case reported last year, I have made fifty postmortem examinations at the hospital, and among these have had only one case of uncinariasis.

This disease is found in the mountains as well as in the lowlands, but is more common the farther south you go, as the conditions for the production and development of the larvæ are more favorable. The disease is very common in regions where the chances of con-

tamination of the drinking water with surface drainage is very slight.

The disease may occur at any age, but is more commonly found in children. The cases seen by me range from three years to over fifty years of age. It is more common in males than females, and is usually found among the children of the lower classes, but I have seen several cases among the better class. It appears to be more frequent among the whites than the negroes. It is a disease of the country, and the possibility of its presence should be considered in all patients who give a history of having resided in the country or small villages within seven or eight years. It prevails where unsanitary conditions abound.

The eggs of the parasite are passed in the feces of persons affected with the disease, and these feces, being deposited about on the earth, furnish the original source of infection. The life history of the parasite found in the dog and the one found in man is very similar, but I have not been able to infect one from the other.

I have found the eggs in the stools of a dog, and a careful postmortem examination showed only three of the worms in the intestine of the dog. This shows that no matter how small the number of worms may be, it is possible to find the eggs in the feces. Practically, the same thing applies to the parasite found in the human intestine, as one case disclosed only seven worms postmortem. It is possible for one experienced in making these examinations to give a fair idea of the number of worms in the intestine from the number of eggs appearing in the stools. They can be estimated with a greater degree of accuracy in this way than by the symptoms of the patient, as a comparatively small number in one person will produce severer symptoms than a larger number in another person.

A live uncinaria removed from a dog under chloroform was seen by me to discharge 22 eggs in one minute, and while this was taking place there was no appreciable diminution in the quantity of eggs contained in the uterus of the worm. This gives us some idea of the great number of eggs which may be thrown off by one worm.

As a rule, the eggs do not hatch while in the intestines. I have found the larvæ hatched out in only two specimens of feces. Usually, it is necessary for the eggs to become mixed with earth before they will begin to hatch; that is, they seem to need air. The eggs can be hatched without any difficulty if the feces containing the eggs are mixed with sufficient earth or sand to destroy the odor of the feces. They will hatch in from twelve to twenty-four hours, or longer, depending on the temperature and moisture; too much moisture inhibiting their development.

They are destroyed by freezing, as also by drying, but they must be thoroughly dry, the least bit of moisture preserving them. Feces which are perfectly dry on the outside will be found to be moist in the interior and the eggs there still preserving their vitality. In warm weather, if the eggs are kept in moist feces, I have been unable to hatch any of them after two weeks. In hatching, I have observed the larva emerge tail first from the egg.

For the first day or so the larva is rather sluggish, but as the first sheath appears it becomes more energetic and is extremely lively at times. If in water alone it wiggles at a lively rate, but does not make much headway, but if imbedded in earth or sand, where it can obtain a foothold, by a sinuous motion it darts through sand at a lively rate. These periods of activity are of

* Read at the Fifty-fourth Annual Session of the American Medical Association, in the Section on Pathology and Physiology, and approved for publication by the Executive Committee: Drs. L. Hektoen, F. B. Wynn and W. S. Hall.

variable duration. The larva will move quite lively for from a few minutes to half an hour or more, and then it will straighten out and lie perfectly still for a corresponding length of time.

Freezing destroys the larvæ, as will also drying. However, it should be remembered that soil which to the naked eye appears perfectly dry will, on examination with the microscope, be found to contain a small amount of moisture, and such an amount as is sufficient to preserve the vitality of the larvæ. But, if they do become thoroughly dried, if only for a moment, they can not be revived. Knowledge of the conditions under which these larvæ exist are of great value in determining when and how the disease may be contracted. When we remember that it freezes every winter throughout the South down through the northern part of Florida, we can readily see that the disease could not be contracted in the winter; also, as drying destroys the larvæ, their existence is a very precarious one. However, during the warm summer months, when there is a rainy spell, the ideal conditions prevail for the development of the larvæ, and so this is the time at which we would be most likely to encounter them.

The next point which concerns us is, how do they reach the intestinal canal? It was not suspected until the last few years that it could reach the intestines other than through the mouth, and especially as moisture is necessary for the existence of the parasite it was supposed to gain entrance principally through drinking water. However, since Looss has demonstrated that the larvæ may pass through the skin, and Bentley has attributed the *pani-ghao*, or ground itch, to the larvæ, it has opened up new avenues for investigation. At first consideration of this view I was loath to believe that the parasite could gain entrance by passage through the skin, as it appeared to me more probable that it made entrance through drinking water. But after a careful observation and investigation of the habits of the larvæ and of the disease itself as it exists, I was forced to the opinion that in the great majority of cases they gain entrance through the skin of the feet, and that the true ground itch is simply the manifestation of this passage. There is no doubt that some cases may be produced through drinking water, but my observations of the development of the larvæ and the conditions surrounding the disease have led me to believe that this is the exception and not the rule. That infection could take place through dirt on the hands and then taken into the mouth I am also inclined to believe is the exception, even more so than infection through drinking water, for it is likely that the larvæ would become destroyed by drying before they would be taken into the mouth.

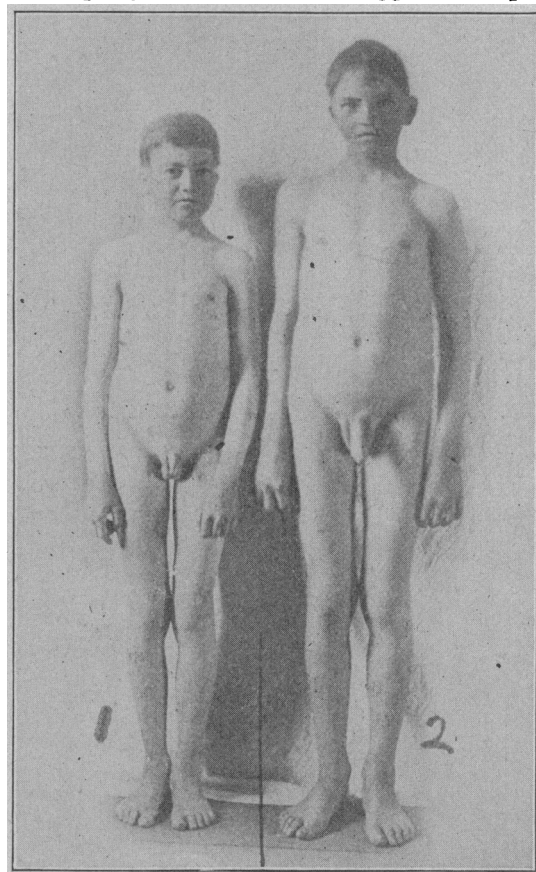
Ground itch is the most common disease in the South, and the majority of cases are never carried to the physician, but are treated with home remedies. It appears in the summer and always as a result of going barefoot in wet weather. In many sections in the South it is thought to be the result of being poisoned by the dew, but it is always contracted at the time when the ground is damp, which is the condition most favorable to the development of the larvæ of the uncinaria. In some districts they take great pains to try to keep the children indoors during rainy weather, and especially when it rains several days, so as to prevent them from having this ground itch. One patient told me that he was fond of wading in ditches after a rain, and he was sure that the foam which collected along the sides of the ditches

contained the "poison," as he always had an attack from wading in that foam.

The first symptom of ground itch is an itching between the toes, which begins after going barefoot in the mud. It may appear at one place between two toes, or it may appear between all of the toes, and also under them, and in some cases may extend up some distance on the foot. This itching increases and the skin becomes very red, and finally small vesicles are formed. The itching continues and these vesicles are usually ruptured, leaving a raw weeping surface. The itching is generally excruciating, and the condition may last two, three, four or more weeks.

The following is some of the evidence in favor of the ground itch being the method of entrance into the human body of the larvæ:

Every person who has had true ground itch within seven or eight years will have the eggs of the parasite



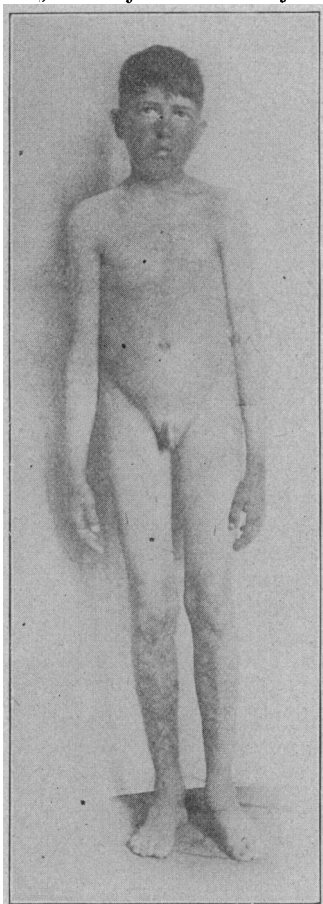
Case 1.—17 years of age. Case 2.—15 years of age.

These two are brothers. Examination of stools showed a great number of eggs of uncinaria in stools of No. 1, and comparatively few in stools of No. 2. This illustrates the lack of development in the extreme type of uncinariasis. No. 1 is two years older than No. 2, yet presented the appearance of a boy of 12 years, with no development of sexual organs. No. 1 is unable to do any work, while No. 2 is apparently as vigorous as other boys.

in their stools. This time limit is not positive as yet, but the evidence points strongly to a limit of about seven years.

You can form a fair estimate of the number of eggs that you will find in the stools by taking a careful history of the severity and extent of the number of attacks of ground itch. For example, if a patient gives a history of having had a number of attacks of ground itch which involved all of the toes and possibly a portion of the feet, you will find a great number of eggs in the stools of that patient. In the last postmortem in which I found the uncinaria in the intestines, I saw the patient

just two days before her death, and in getting her history learned that she had had an attack of ground itch about four or five years previously, but she informed me that she did not have it very bad, as it existed only in one place between two toes. A careful search at the postmortem examination disclosed only seven of the worms. I have seen only two cases of the disease which did not give a history of having had ground itch within seven years. They were two dental students who lived at the same place in Florida, and they were both sure that they had not had ground itch for fourteen or fifteen years. However, their drinking water was obtained from wells only three or four feet deep and which overflowed every time it rained. These were probably infected through drinking water, but in both cases the infection was very slight, as it required careful search to find the eggs in the stools, as they were so very few in number.



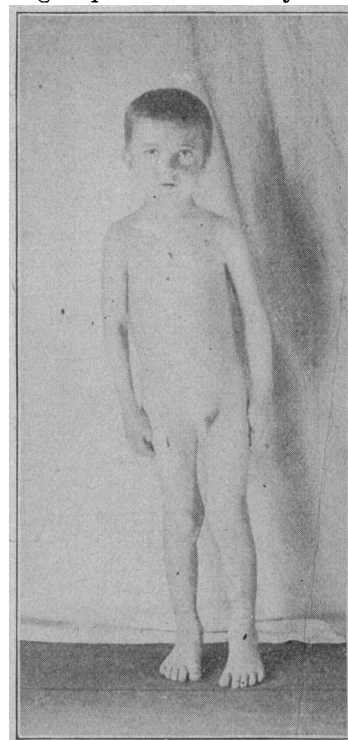
Case 3.—White; male; age 17. Skin resembles yellow parchment; mucous membranes blanched; appetite poor; sleeps fairly well; has severe griping of bowels at times; badly constipated. Red corpuscles, 1,672,000; hemoglobin, 22 per cent. Notice lack of development of sexual organs. Has had "ground-itch" so many times that can not recall any year that he did not have it. Stools contain eggs of uncinaria in great numbers. Barely able to get about, and unable to do any work.

Many of the cases of the disease were suspected and located only on finding a history of having had ground itch within seven years. One was a medical student from the mountains of South Carolina, who presented a picture of perfect health, with a ruddy complexion, and who did not suspect that he had uncinariasis until he overheard a conversation about the relation of ground itch to the disease. He then came to me and told me that he had had a severe attack of ground itch about five or six years before, and on examination of his stools I found numerous eggs of the uncinaria. Examination of his blood showed: red corpuscles, 4,120,-

000, and hemoglobin, 95 per cent. After two doses of thymol of one gram each, eighteen uncinaria were found in his stools and no eggs were found a week later. It usually requires several attacks of ground itch, extending over a period of several summers, for sufficient numbers of the larvæ to get into the system to produce the extreme type of the disease.

A careful examination was made of all the members of a family of eight who had lived under the same conditions, drinking the same water, etc., and this showed that those who had been keeping the feet protected for over eight years by wearing shoes, and who had not had ground itch during that time, did not have the eggs in their stools, while all who had had ground itch within that time had the eggs in quantities in direct proportion to the number and severity of the attacks of ground itch.

You may take the history of some of the cases which have at one time been in the extreme stage, and you will find that they had attacks of ground itch year after year, or probably skipping a year now and then, and they would get worse from year to year until they had had attacks covering a period of seven years or more, and



Case 4.—White; male; age 7. Skin yellowish-white; mucous membranes blanched; appetite poor and perverted; bowels constipated; shortness of breath; loud hemic murmur; can not walk over 200 yards at a time; headache and vomiting every morning; stools contain an abundance of eggs of uncinaria. Red corpuscles, 1,208,000; hemoglobin, 10 per cent. Has had "ground-itch" every year since able to walk. Has had whooping cough, but no other sickness.

probably they were old enough by that time to begin wearing shoes in the summer time, and, therefore, those parasites which first gained entrance into the body would have passed through their allotted period of existence and would die out, and by the patient wearing shoes, additional larvæ would fail to get into the body, and as each following year more and more of the uncinaria would die out, the patient will give a history of gradual improvement, and his body will begin to take on a vigorous development. There is no difficulty in finding plenty of these cases which give a history of having once been extremely pale and anemic, but have "outgrown" it.

The disease gradually disappears after they stop going barefoot.

The number of the uncinaria in the intestines varies from a few to several hundred. The number is nearly always in direct proportion to the number and severity of attacks of ground itch. A few of the uncinaria may produce no apparent effect on the patient, but it no doubt renders the patient more susceptible to infection as a result of the interference with the nutrition. Severe infections produce various grades of anemia. The blood counts show all stages; some being so severe as to produce dizziness, hemic murmurs and the weakness which accompanies such conditions. These extreme cases are usually emaciated, but the emaciation may not be apparent at first on account of edema. In the extreme cases the skin is of a yellowish-white parchment color, and over the exposed portions of the body, as the cheeks and hands, it appears to be much thickened. The mucous membrane also presents a yellowish-white blanched appearance, and examination of the blood often shows the red corpuscles as low as 1,100,000, and the hemoglobin down to 10 and 15 per cent. If this severe condition is reached about the time of puberty, the sexual development does not take place, and it is not uncommon to see boys 17 and 18 years of age who are dwarfed and whose genital organs have the same appearance as those of a boy about 10 years of age. Also, you will find girls 18 years of age in whom there has never been any effort at menstruation, and who present no evidence of development into womanhood. We must remember that these are the extreme cases. They are the ones which give a history of numerous and severe attacks of ground itch, usually having it for a number of years, and members of the same family who are living under exactly the same conditions, but who have not had so many, nor such severe, attacks of ground itch will have only a small number of parasites in their intestines, and practically no interference with their development.

It is a most pitiable sight to see these severe cases in bright children who are unable to walk 200 yards without being almost completely exhausted and who have to sit down and rest before they can go further. They are unable to play the games with other children, but must drag out their lives sitting and lying around, watching the other children in their games and yearning for the strength to join in with them. Sometimes they succumb to additional infection of the uncinaria, or to attacks of other diseases.

In their earnest desire to be cured and become strong like other children, they are willing to undergo any treatment which will offer any chance of doing them good, and often you will find that they have made the rounds of all physicians in their district, but to no avail. I recall the case of one poor boy who was barely able to drag himself about, and on being told that there was a chance of something being done for him, he arose early in the morning only to find that the rain was pouring in torrents, but, nothing daunted, he dragged himself all alone three miles through the pouring rain to the physician's office, drenched to the skin and shivering with cold, but willing and anxious to begin at once with any treatment that offered any chance of doing him good. That was only three weeks ago, and since then his improvement has been remarkable, as he is now at work again on the farm.

Every country practitioner in the South has more or less of these cases of anemia in his practice, and sometimes they will improve slightly with prescriptions of iron, arsenic, etc., but with no permanent results.

The poor farmers throughout the country who have a house full of children to support are dependent to a great extent on the assistance of these children to make sufficient for their maintenance, and when the children are affected with this disease and are unable to assist him to any extent, but rather instead are a burden to him to pay their physician's bills and supply medicine—these are the ones who often seek the cotton mill, where most of the children, although dwarfed and stunted and incapable of severe exertion, yet have sufficient strength to sit at a loom and do light work about the mills. While it is deplorable that child labor is not better controlled, and, while I believe in giving the devil his dues, yet we should, at the same time, be just, for no doubt many of the cases of children whose lives are supposed to be blighted in the cotton mills, were blighted before they went there, and the confinement and tedious work is but assisting in the work of destruction already begun.

We read our statistics of the destruction wrought by the dreaded tuberculosis and pneumonia, etc., but we have here a disease which is literally sapping the life-blood of the South. But, unlike tuberculosis and pneumonia, etc., we have for this terrible disease an easy means of diagnosis, and a cure which is simple and certain. All that is necessary is for the physicians throughout the country to become familiar with the diagnosis and treatment.

Before treatment is instituted, a positive diagnosis can only be made by the examination of the stools for the eggs, and one experienced in examining these stools with the microscope can get a better idea of the number of parasites in the intestines than from the symptoms of the patient.

The treatment is very simple, but to be thoroughly effective certain precautions should be observed. Two doses of thymol finely powdered of one or two grams each are to be given about two hours apart. The first dose should be preceded several hours by a dose of some purgative, and followed by the same. One very important point is that no food must be taken into the stomach from the time of the first dose of the purgative until after the second is taken. The plan is as follows: A large dose of salts is given at night and the next morning at 8 o'clock two grams of *finely powdered* thymol is given, and two hours later a second dose of two grams, and two hours after this a large dose of salts is given. I lay stress on having the thymol finely powdered and no food being taken into the stomach between the administration of the purgatives. In some instances this treatment is not thoroughly effective, and a microscopic examination of the stools should always be made about a week later, and if eggs are still present, the treatment should be repeated.

In the postmortem examinations of the human intestines containing the uncinaria, I have noticed that the parasite is not so firmly attached to the intestinal mucous membrane, and also that it does not seem to lacerate the mucous membrane, or leave the white central spot with the hemorrhagic area surrounding it, as described of the old world parasite, and also of the parasite in the dog. We can readily understand this when we bear in mind the structure of the oral cavity of the uncinaria, as given by Dr. Stiles, showing that it does not have the little hooklets which are found in the old world parasite and the dog in this country, and, therefore, does not become so firmly attached or so severely lacerate the mucous membrane.

The prophylaxis of this disease is very simple. It is not necessary to boil the water for drinking purposes,

unless the water has been contaminated by surface drainage after a rain. If every person will wear shoes which thoroughly protect the feet in rainy weather or in damp places, there is very little chance of infection.

To determine whether the parasite which infects the dog in my section would exist in the human body, I administered successive doses of the larvæ of this parasite to a negro boy 19 years of age (of course, with his consent), beginning the first dose July 11, 1902, when the larvæ were four days old, and continuing about every two weeks until October 14, using larvæ from the original culture made July 7. The patient disappeared October 14, but examinations of stools two days before that were negative.

In making these investigations, I was much indebted to Dr. S. H. Green of Bolton, Ga., and Dr. C. D. Redding of Warthen, Ga.; also to Drs. J. A. Randall, W. E. Persons, C. D. Jeffries, O. T. White and W. A. Selman, of the resident staff of Grady Hospital.

DISCUSSION.

DR. H. B. WARD, Lincoln, Neb.—Dr. Smith has gone further than any other investigator with reference to the life history. It is of the utmost importance that the method of introduction into the body should be known, as well as the interval between the various stages of development. Dr. Smith has investigated the relation between ankylostomiasis and ground itch so thoroughly as to leave little doubt as to their probable connection. I think the probability is very strong indeed. One of the latest investigators records the fact recently in one of the German journals that he has succeeded in infecting the skin with the larvæ. The larvæ were placed on a member which was about to be amputated. When the skin was sectioned after the amputation the larvæ were found to be penetrating the skin along the line of the hair follicles, and they could be made out in the sections. Some had gone in as far as the subdermal tissue. I think that is the first instance where the entrance of the larvæ has been thoroughly established.

Another point deserves brief mention. The experiments of Looss on dogs shows conclusively to my mind that the infection can not be contracted through drinking water. Where the dogs were fed on infected water the larvæ passed through the canal, except a few which bored into the wall of the esophagus and went down into the tissue, where he got the three stages of development. Those which traversed the canal did not attain the adult condition, but those which got into the tissues attained at least the later larval stage.

I presume Dr. Smith has already thought of it, but it would seem to me that in the region where ground itch prevails he might succeed in some postmortem in getting a portion of the tissue from one who had been recently infected with ground itch, and sections made from this would throw light on the subject.

DR. CLAUDE A. SMITH, Atlanta, Ga.—I recognize the fact that the results so far are somewhat incomplete, and that we have not been able yet to obtain positive proof as to the transmission of the disease. Experiments are being still carried on, from which we hope to obtain more satisfactory results. Until then it can not be stated positively that the infection does get into the system through the feet, but from the evidence of cases I have seen I feel positive that this is so.

As to the question of postmortem of subjects who have had ground itch, it must be remembered that these cases are nearly all in the country, and you know how difficult it is to get permission to hold a postmortem in the country, especially in the case of children. They even object sometimes to examination of the stools.

I hope in the near future to be able to present the proof of the transmission of the disease.

To Remove Plaster-of-Paris Bandages.—Acetic acid brushed in a line over the bandage will render it soft, and in a few minutes it may be cut with an ordinary knife.—*Applied Med.*

OCCURRENCE OF THE STRONGYLOIDES INTESTINALIS IN THE UNITED STATES.

MARSHALL LANGTON PRICE, M.D.

BALTIMORE.

(Concluded from page 655.)

RHABDITIFORM EMBRYOS.

As the parasite occurs in the stools as the rhabditiform embryo, and probably never in any form (excepting rarely after a purge, when the passage of the parthenogenetic mother worm has been reported by one or two observers), it follows that the thorough understanding of this form is most essential to diagnosis; and I have, therefore, described it below at some length.

In a properly prepared specimen the embryo appears as a clear, almost hyaline, nematode, completely transparent and possessed of a very active motility, swimming among the granular detritus, and pushing aside the smaller obstacles in its path, and turning aside to pass the larger ones, when its progress is arrested by an obstacle of considerable size. The consistency of the nematode seems scarcely to exceed that of protoplasm, the parasite quivering like jelly with every movement, or when the microscopic stage was jarred or shaken. It appears to possess a considerable degree of irritability, and when aggregated masses of bacteria would lodge against its side, motions of the tail would be produced toward the offending object.

The structure appears granular. The parasite, on examination, is seen to consist of two portions, an outer clear portion or envelope, and an inner granular zone. The outer portion, forming about one-tenth of the transverse diameter of the parasite, is clear and homogeneous, with the exception of a few fine granules. The inner portion is markedly granular and is well organized.

With the death of the parasite the clear homogeneous structure is lost, the granules become larger and coarser and invade the outer envelope. Finally the whole parasite becomes uniformly granular and shrunken, its transparency is largely lost, and all distinction between the envelope and inner granular zone disappears. The parasite appears to undergo a rapidly granular degeneration as soon as dead.

The length of the nematode varies. The average is probably about 0.3 mm., the breadth 0.04 mm. The head is blunt and slightly conical in shape, and contains the anterior portion of the digestive canal. The body gradually enlarges from the head to its middle part, and then gradually diminishes in size to the thick and somewhat pointed tail. The head is largely occupied by the triangular or fusiform darker area of cells surrounding the digestive canal which passes from the cephalic extremity backward. This darker area becomes constricted as soon as the neck is reached, and after running for a variable distance in a uniform size, again expands into an ovoid or spherical area; leaving this, the canal again passes toward the caudal extremity. A slight fusiform dilatation occurs at about the middle of the body, the canal then passes on in its normal size until it reaches the base of the tail, where a saccular dilatation appears. This appearance, which has not been previously described, can be demonstrated in the majority of specimens by careful examination, and no specimen in which the parasites were numerous failed to show one or more in which this structure was evident. The intestine, much diminished in caliber, turns abruptly after leaving this inferior dilatation and passes to the side of the animal, where it terminates in a slight mammilliform projection. Just below the middle of the body, the in-