

PART X

DISEASES DUE TO ANIMAL PARASITES

GENERAL DISCUSSION

The human body seems able to adapt itself to the presence of animal parasites, but only rarely to develop any specific toxin in the way of self-protection. This may be due, in part, to the fact that the inflammations set up by animal parasites are rarely profound, but are either very slow and chronic, or are absent altogether. With the human extravagance in regard to making provision, most bodies are able to act as free hotels for many, or for very large animal parasites, without being seriously affected by their presence. On the other hand, there are a few animal parasites which cause very serious, even fatal, symptoms.

In order to facilitate diagnosis, the following list of parasites is prepared:

The Digestive System.

Salivary glands—*Echinococcus* cysts.

Stomach wall—*Pentastomum denticulatum* and *Echinococcus*.

Intestines—Tapeworms, nearly all the nematodes and Rhizopoda. Almost any parasite may be an inhabitant of the intestines at some time.

Liver—*Echinococcus*; *Distomum hepaticum*; Coccidia; *Pentastomum denticulatum*; more rarely—*Cysticercus cellulosus*; *Ascaris lumbricoides*; *Psorosperms*.

Urinary System.

Kidneys and Ureters—*Filaria*; *Distomum hematobium*; *Eustrongylus gigas*; *Ascaris lumbricoides*.

Bladder—*Echinococcus*; *Filaria*; *Distomum*; Ova of *Bilharzia*.

Urethra—*Eustrongylus gigas*; Thread-worms; Larvæ of certain flies.

Respiratory System.

Bronchi—*Echinococcus*; rarely nematode worms.

Lungs—*Echinococcus*; *Cysticercus cellulosus* rarely; *Strongylus longivaginus*; Monas; *Cercomonas*; Coccidia; *Pentastomum denticulatum*; psorosperms; *Distomum pulmonale*.

Pleurae—*Echinococcus* and *Psorosperms*.

Medistinum—*Echinococcus*.

Circulatory System.

Heart—Pericardium, *Cysticercus*, *Echinococcus*, *Trichina*, *Pentastomum denticulatum*.

Myocardium—*Echinococcus* and *Cysticercus*.

Lymphatic vessels—*Echinococcus* and *Filaria*.

Lymphatic glands—*Filaria*, *Trichina*, Trypanosomes, *Echinococcus*, *Cysticercus*, *Pentastomum denticulatum*.

Blood.

Malarial organisms, *Filaria*, Piroplasma, Trypanosomes.

Nervous System.

- Brain—In the pia and arachnoid, *Echinococcus* and *Cysticercus cellulosus*.
- Cord, the spinal dura—as above.
- Retina—rarely the *cysticercus*.
- Vitreous humour of the eye—*Filaria* and *Cysticercus*.

Genital System.

- Prostate—*Echinococcus*.
- Scrotum—*Filaria* and *Echinococcus*.
- Membranes of the testis—*Filaria* and *Echinococcus*.
- Vagina—Larvæ of certain flies; *Oxyuris vermicularis*; *Ascaris lumbricoides*; *Trichomonas vaginalis*.
- Uterus—*Echinococcus*.
- Ovaries—*Echinococcus*.
- Mammary Gland—very rare—*Echinococcus* and *cysticercus*.

Miscellaneous.

- Spleen—*Echinococcus*; *Cysticercus*; *Pentastomum denticulatum*.
- Pituitary body—rarely *Echinococcus*.
- Thyroid—rarely *Echinococcus*.
- Bones—*Echinococcus*; *Cysticercus cellulosus*.
- Joints—*Echinococcus*.
- Nose—Larvæ of certain flies.
- External ear—Larvæ of certain flies; *Ascaris folliculorum*.
- Muscles—*Trichina*.
- Skin—Hook-worm; Medina worm.

CHAPTER LI

PROTOZOAN INFECTIONS

MALARIAL FEVER

Malarial fever is a specific infectious disease caused by the presence in the blood of the plasmodium malarie and presenting clinically the following varieties: (1) periodically recurring paroxysms of intermittent fever; (2) continued fever with well-marked remissions; (3) certain pernicious, rapidly fatal forms; (4) a chronic cachexia with anemia and enlarged spleen.

Etiology. The disease is caused by the plasmodium malarie or hemamebæ. There are three forms exciting disease in man as follows: plasmodium malarie, causing the quartan form; plasmodium vivax, the tertian; and the plasmodium precox or hemebeæ, causing the estivo-autumnal form. The disease is spread by the bites of mosquitoes of the genus Anopheles which must themselves have been infected. Predisposing factors are exposure at night, a country with marshes, humidity, high temperature, absence of winds, and such other factors as favor the breeding of mosquitoes. Lesion of the eighth to the tenth thoracic vertebrae and ribs are constant.

The parasites are found in the red blood cells during paroxysms. The enlargement of the spleen is sometimes very great. In recent cases the organ is soft, in older cases, firm, "ague cake." Congestion of the liver is present. Anemia is usually marked.

Types of Intermittency. Tertian—When one group of tertian parasites is present, the paroxysms recur every third day; when two groups are present, double tertian or quotidian type is present, with chills every day. This is the most common type in the northern and middle states.

Quartan—When one group is present of quartan parasites the paroxysm recurs every fourth day; when two groups, it occurs for two days in succession, the third day none; when three groups are present, daily paroxysms occur.

The paroxysm is said to "anticipate" when it comes a little earlier each succeeding day; and to "postpone" when it comes on a little later.

Intermittent Fever. (Ordinary ague.) The paroxysm is usually preceded by a day or so of premonitory symptoms. The typical attack usually consists of three stages, a cold, hot, and sweating.

Cold Stage—The patient shivers violently, the teeth chatter, the skin is pale and cold, and the papillæ are raised (goose skin or cutis anserina), nails and lips are blue, the face anxious and the features pinched. There are often vomiting, thirst and hyperpnea. The temperature is much lowered externally but raised in the mouth and rectum to 102° to 104° F. The urine is pale, copious, of low specific gravity. This stage lasts from a few minutes to an hour or more. Towards the end the temperature may be 103° to 106° F.

Hot Stage—There is a gradual or sudden onset. The skin is hot, red, and burning, vomiting is increased, the carotids throb forcibly; headache is intense; there may be violent delirium. The temperature is often 106° F. or more, the pulse rapid and full, and epistaxis or diarrhea may occur. This stage lasts from one to many hours. The urine is scanty, of high specific gravity, large quantities of urates and urea, and albuminuria is frequent.

Sweating Stage—The sweating commences at the roots of the hair and soon becomes general and profuse. The pulse is softer, the temperature falls gradually, and the patient is restored to a normal condition. The urine is of high specific gravity, scant in quantity, the urates are more abundant than urea. This stage usually persists from two to four hours and is often followed by refreshing sleep.

Remittent Fever. (Bilious, tropical, marsh, bilious remittent, typho-malarial, or estivo-autumnal fever). This form is associated with the estivo-autumnal parasite, and is especially frequent in the tropics. It may be seen in the late summer and autumn in temperate climates.

The type is either definitely intermittent with irregular intervals between the paroxysms, or there may be continuous fever with well-marked remissions but no intermissions.

The symptoms common to both types are coated tongue, epigastric pain, anorexia, bilious vomiting, constipation or diarrhea, jaundice, a moderate cold stage, which does not recur with each paroxysm, an intense hot stage with intense headache and gastric irritation, and lastly an almost imperceptible sweating stage which may be absent. Either type tends to merge either into an ordinary intermittent attack or into a typhoid state of grave prognosis. As a rule, this fever lasts from seven to fourteen days. Both remittent and the regular intermittent type tend to spontaneous improvement, after several weeks of fever, the symptoms gradually disappearing and the patient thinking himself well. After weeks or months, a relapse occurs, to be followed by another and another, any of which may prove fatal or lead to malarial cachexia. Spontaneous recovery is uncommon.

Pernicious Malarial Fever. (Congestive fever; malignant intermittent fever; malignant remittent fever; congestive chills.) This form is due to the estivo-autumnal parasite and is comparatively rare. Predisposing causes are lesions producing a general lowered resistance and splenic area lesions, exposure to hardships, intemperance, previous attacks of malaria, or other exhausting diseases. The attacks are of sudden onset, of great severity, and of many forms. Hyperpyrexia has temperature of 107° to 110° F. or higher.

The **cerebral** type is due to plugging of the cerebral centers by the plasmodial emboli. Comatose, convulsive, and paralytic forms are described.

In the **algid** form no febrile reaction occurs after the chill; the body surface is intensely cold; the rectal temperature is 104° to 107° F., a cold sweat covers the body; the radial pulse is slow and feeble and often absent; thirst is intense; mind clear, the countenance death-like, and case ends in collapse.

The **algid** type is due to an accumulation of the parasites in the splanchnic vessels, with mild thrombosis in the vessels of the intestinal mucosa. Recovery from one or several attacks may occur, but any attack may be fatal.

Choleraic (Dysenteric, gastro-intestinal type) is characterized by stools containing bile, intense nausea, vomiting, purging, tenesmus, burning sensation in the stomach, frequent weak pulse, intense thirst, cold feet and hands, and face with shrunken features, cramps and marked depression. This lasts from one half to several hours.

Thoracic types are characterized by marked dyspnea, oppressed cough with blood-streaked sputum, frequent weak pulse, cold surface, terror stricken features, and intense pulmonary congestion.

Blackwater Fever. (Hemoglobinuric fever; malarial hemoglobinuria.) Occurs in tropical Africa, rarely in certain parts of India, and is endemic in the southern states. The predisposing causes are prolonged residence in malarial regions; repeated attacks of malaria which have led to anemia and debility; and "prolonged use of quinine."—R. Koch. One attack predisposes to another.

It is an acute hemolysis. The malarial parasites are absent or scanty in the blood during an attack or in the internal organs after death. Red corpuscles are rarely found in the urine, but hemoglobinuria is severe. There is cloudy swelling of the hepatic and renal cells, the skin and conjunctivæ are yellow or brown from jaundice.

It may commence as an ordinary malarial attack. In a few days a severe rigor occurs, the urine becomes very dark or black, is at first copious, later diminished or suppressed; there is yellow discoloration of the skin and sclerotics; bilious vomiting;

sharp pains in the loins and epigastrium; usually bilious diarrhea. The condition may either pass off in a few hours not to recur; there may be recurrences, or there may be no remission at all. Marked anemia and prostration develop and death is frequent. In the malarial region, the slightest chill or over-strain may provoke a recurrence.

Malarial Cachexia. Repeated or prolonged attacks of malarial fever lead to severe cachexia. It may be impossible to find the organism in the blood.

The peculiar characteristic features are: anemia, often intense; sallow, earthy skin; tendency to hemorrhages as epistaxis, purpura and retinal hemorrhages; irregular attacks of fever or of subnormal temperature; enlargement of the spleen and liver. Complications in the order of frequency are: orchitis, neuralgia, headache, paraplegia, enteritis, nephritis, rheumatism, typhoid fever, lobar pneumonia, jaundice and dysentery. The patients finally succumb to general weakness, tuberculosis, gangrene, or amyloid degeneration of the internal organs.

Diagnosis. Malaria is recognized by the symptoms peculiar to the types as given, and by the presence of the parasites in the blood.

Blood in malaria. Red cells are destroyed so the count is decreased after each paroxysm, but the number is almost restored before the next attack. The anemia is progressive. The cells contain granules and the parasite in its various forms. Some forms are free in the plasma. Melanin is the pigment free in the blood stream and in the organs in which the plasmodia collect. Hemoglobinemia may occur. In the estivo-autumnal form, the new cells are pale, varying in size and shape, nucleated reds are common, regeneration is slow. There is extensive necrosis and resulting induration of the bone marrow. The hemoglobin suffers more than the red cells and returns to normal much more slowly.

Leucocyte count is always subnormal, with a slight rise just before a paroxysm and then steadily decreasing until the temperature is lowest, sometimes to 1000 to 2000 cells per cubic millimeter. The differential count shows a relative decrease in the polymorphonuclears, an absolute increase in the large mononuclears, especially pronounced in the apyretic periods and usually absent in the fever period.

The diagnosis is made positive by finding the plasmodium malarie in the blood. Children may only show the enlarged spleen clinically.

Malaria must be distinguished from tuberculosis, pyemia or concealed suppuration, pyelitis, ulcerative endocarditis, and gallstones; the remittent type from typhoid fever; and the pernicious form from yellow fever.

Treatment. The most common lesions are found as lateral deviations between the seventh and twelfth dorsal and the fourth lumbar vertebræ with consequent displacement of the ribs in connection with the dorsal lesions. During the chill give vigorous treatment to the whole spinal column. Deep steady pressure at the eighth dorsal also assists in stopping the chill, or in lessening the next one. Raise the ribs over spleen and liver. Deep steady pressure to the suboccipital nerves reduces the temperature. Sponging is grateful to the patient. "I adjust all the bones of the neck because I wish to relieve the congestion of the cerebellum, medulla, and all the nerves above the diaphragm."—A. T. Still.

Muscular contractions with marked hypersensitiveness appear in the interscapular region just before the onset of the chill. Vigorous treatment relieving this tension, with correction of lesions and increase of spinal flexibility may prevent the entire paroxysm, or greatly diminish its severity.

During the sweating stage, deep steady pressure in the suboccipital fossa, treatment at the upper dorsal and first lumbar are all necessary. If no further symptoms are noted, the patient must be treated upon the third, fifth, seventh, fourteenth and twenty-first days as a prophylactic measure.

In blackwater fever, fluids should be given especially freely to flush the tubules and avert suppression. Special attention must be given to the renal splanchnic area and gentle direct treatment to the abdomen. In very serious cases, normal saline should be given subcutaneously or by rectum to make up the amount of fluid and avert collapse. On no account should the patient sit up owing to the risk of cardiac failure.

"When the patient has the quartan parasite, as soon as the temperature begins to fall I give him from two to six ounces of red meat juice, extracted from rare beefsteak, sometimes as much as five pounds in the first twenty-four hours following the chill. In almost all cases of quartan malaria the blood is built up sufficiently by the time they reach the second cycle to pass without the paroxysm, or chill. By the time for the third cycle, which is the seventh day, I always have built up the patient's resistance so as to enable him to pass by this cycle without any symptoms of malaria whatever. In cases of double or triple I find the same treatment causes about the same results. I do not give any other diet, except dry toast if they eat the beef instead of taking the juice. If they can take the steak I prefer their taking it, but almost all cases prefer the juice. * * * The treatment for the tertian type of malaria is practically the same as the treatment for the quartan.

"The estivo-autumnal type of malaria differs from the quartan and tertian types; first, in that the paroxysms are, as a rule, much more irregular; second, they are much longer in duration; third, the chills are more frequently absent; fourth, the fever is often irregular, intermittent, remittent, or continuous in character. This type very often takes the form of blackwater or hemoglobinuric type with hemorrhagic symptoms, with hemorrhage from nose, gums and bowels. The first thing to do in a case of hemorrhagic malaria is to put an ice bag on the abdomen, which will tend to control the hemorrhage from the kidneys. Give the patient all the red beef juice you can get him to take, provided he has not developed a very sick stomach; if so, give him high saline enemas

and in one half hour give him four ounces red beef juice per rectum. Repeat the feeding per rectum in four hours. As soon as he can retain anything on stomach give him all the juice he can take comfortably. Treat the liver thoroughly—at least three times in the first twenty-four hours. At the end of thirty-six hours the yellow cast will be very much lighter, which is a sure sign that the patient is getting better. Watch the urine closely. The third day there may occur a suppression. If so, give strong stimulation to the renal plexus through the abdomen, and be sure there is a thorough relaxation of the dorsal and lumbar muscles.

"It is an established fact that people in the malarial districts eat very little beef. I find that ninety-nine per cent of the cases of malaria never eat it, or when they on rare occasion do, it has been so overcooked that all the blood-building substances have been destroyed. The beef raw would be better in my opinion; although, the possible chance of getting a tapeworm or animal parasite is so considerable that I would advise that the beef should be heated to 250 degrees F."—E. C. Armstrong.

Prognosis. In the intermittent type the outlook is always favorable with treatment. The remittent type usually ends in recovery with treatment, but death may occur in very severe cases.

Prophylaxis is important. Properly screened windows and doors of all buildings are necessary, especially where malarial patients are ill. Wage a crusade against the larvæ of the Anopheles, by drainage of marshes and stagnant pools, by covering those recently drained and those undrained with a film of kerosene or crude petroleum. In tropical towns, those not native should live in a separate quarter and avoid being out at night. Isolation of the patient from mosquitoes prevents spread of infection and also reinfection of himself.

TROPICAL SPLENOMEGALY

(Kala-azar; dum-dum fever; tropical cachexia; piroplasmosis)

This is a tropical disease occurring chiefly in India, Ceylon, China, and Egypt, caused by the parasite *Leishmania Donovani*, which is conveyed by bedbugs and perhaps fleas, and is found in the spleen, liver, and bone marrow. It is a disease of rats and dogs also, and these perpetuate and transmit it. It is characterized clinically by great enlargement of the spleen and liver, anemia and leucopenia, hemorrhages from mucous surfaces and purpura; irregular fever, transitory edema, later muscular atrophy and great emaciation and cutaneous ulcers. An infantile form occurs in Italy and Greece.

Diagnosis is by hepatic puncture to find the parasite in the fluid.

Treatment. The prevention is of utmost importance. Cleanliness and the destruction of bedbugs and rats, isolation of the sick and their protection from bedbugs, are prophylactic. After the disease appears, treatment must be symptomatic and supporting.

Prognosis. Recovery is not to be expected. The disease may last for months or years, or be fatal within a few weeks.

CUTANEOUS LEISHMANIASIS

(Oriental sore; Biscra button; tropical ulcer; Aleppo, Delhi, or Bagdad boil; natal sore)

This is very common in Oriental countries; it seems to be limited to the countries in which the camel is used. The infection appears to be identical with that of kala azar, but it is less virulent. The possibility that it is the same organism, modified by its transmission through the camel, is of interest. The sores appear only upon exposed portions of the body, beginning as small red macules, which slowly increase in size and discharge pus. A crust forms, drops off, and exposes a granulating ulcer. The crusts keep forming and dropping off, leaving ulcers of increasing size, which after months or years heal, leaving a depressed scar and often great deformity.

One attack confers immunity. The diagnosis is made by the characteristic sore, and by finding the Leishman-Donovan bodies in the granulation tissue. The treatment consists in the surgical dressing of the sores, and such constitutional treatment as may be indicated on examination.

Prophylaxis. Any contact with persons suffering with sores upon them, in the tropics, or among people recently arrived from the tropics, should be surrounded with precautions. The hands must be well gloved, and thoroughly washed often. Travelers in tropical countries are to be careful, since they possess little or no immunity to many of these diseases. The bites of insects are especially to be avoided.

ROCKY MOUNTAIN FEVER

(Rocky Mountain spotted fever; tick fever)

Rocky Mountain fever is an acute infection caused by *piroplasma hominis*, and transmitted by the tick, *Dermacentor reticulatus*, and characterized by chill, fever, pains in the back and bones, and a characteristic eruption.

The disease is limited to the Rocky Mountains between 40° and 47° N., and is most prevalent at 3,000 to 4,000 feet elevation.

The disease confers immunity and this in animals is transmitted to their young. Incubation is from three to ten days.

Diagnosis. The disease begins with a chill, fever, 103° to 105° F., severe pains in the back and limbs, a rash appearing from the second to the seventh day which is macular, dark and becomes hemorrhagic. The skin is often swollen. At the height of the

fever, there may be delirium and stupor. Convalescence begins in the fourth week.

The history of exposure to the danger of tick-bite, with the symptoms, gives the diagnosis. The red blood cells show destruction; the hemoglobin diminishes rapidly, sometimes to fifty per cent.

Treatment. The symptoms must be treated as they arise. Warm continuous baths may control the pain and the delirium. Treatment to control the circulation, especially through the liver and spleen, is indicated. During convalescence the treatment for the secondary anemia, raising the ribs, is important and the diet should be rich in chlorophyll and nitrogenous foods.

Prognosis. Different localities give very different fatalities, totally apart from therapeutic considerations.

Prophylaxis. The destruction of the tick is difficult. The piroplasm is transmitted to the young ticks, and these transmit the disease. Persons who are much in the woods should protect themselves from danger of tick-bite, by thick clothing and shoes. As rapidly as possible, the tick should be completely exterminated.

FLAGELLATA

(Mastigophera)

These are unicellular organisms, microscopic in size. They are nucleated, and may be green, with chlorophyll bodies.

Trichomonas vaginalis is found in the vagina of both pregnant and non-pregnant women, especially if the secretions are acid, but may not cause any particular disturbance. Chronic vaginitis with pruritis was found associated with this organism in two P. C. O. Clinic cases.

Trichomonas intestinalis is associated with chronic diarrhea, especially in the tropics.

Trichomonas pulmonale have been found in the sputum in cases of gangrene of the lung and in pleural exudates.

Lambliia intestinalis inhabits the jejunum and duodenum causing a chronic diarrhea.

TRYPANOSOMIASIS

(Sleeping-sickness)

Trypanosomiasis is a chronic disease of tropical Africa and other countries, clinically marked by fever, wasting, lassitude, enlargement of the glands and a terminal stage of lethargy. The exciting cause is the protozoon, *trypanosoma gambiense*, which is conveyed by the tsetse fly. Natives of West African coast, Congo

basin, Uganda, and the course of the Niger are chiefly attacked, but Europeans are not exempt. The incubation time is unknown.

Diagnosis. The organism may be in the blood for years without symptoms. This form is marked by recurrent attacks of fever resembling malaria, with glandular enlargement, with intervals of apparent health.

In other cases there is lassitude from the first, with slow gait and speech, headache, and nocturnal fever. The glands are usually enlarged. Irregular edema and dropsy, anemia, fine tremors of the tongue and hands, and wasting lead into the terminal stage. There is gradually deepening coma (sleeping sickness), which may be accompanied by convulsions, paralysis, or bed sores. The duration of the disease varies from a few months to years, and death often occurs from an intercurrent affection.

Several species of trypanosomes have been described. In Brazil children are affected by the *Schizotrypanum cruzi*. It invades the thyroid, causing symptoms of acute myxedema. High fever, enlarged lymph glands, spleen and liver, meningitis or encephalitis, lead either to death or to permanent nervous lesions. Carriers of the disease may suffer slightly or not at all.

The protozoon is more readily found in the glandular tissue than in the blood.

Prophylaxis. The method of combatting the disease is war against the tsetse fly and protection from it.

PSOROSPERMIASIS

This disease in man is due to infection by coccidia oviforme, which is the cause of spotted liver of rabbits. It is rare in man, and is clinically characterized by intermittent fever, diarrhea, nausea, tenderness over the liver and spleen, and drowsiness, and pathologically by caseous foci with rings of congestion in the liver, spleen, and intestines resembling tubercles, but containing the coccidia. Death is inevitable when the disease is recognized.

Cutaneous psorospermiasis (*keratosis follicularis*) may greatly resemble, perhaps even may cause, neoplasms of the skin.

Treatment. Surgical removal of the skin lesions is indicated in favorable cases.

Prophylaxis consists in cleanliness. Especially when rabbits are allowed to run about in a vegetable garden, there is danger in eating raw vegetables or small fruits.

AMEBIC DYSENTERY

Amebic dysentery is an acute or chronic inflammation of the mucous membrane of the large intestine, caused by the ameba

dysenteriae and characterized by fever, tormina, weakness, frequent watery stools containing gelatinous mucous masses, with a special liability to hepatic abscess.

Etiology. The exciting cause is either the *entameba tetragena* or the *entameba histolytica*. It is swallowed in contaminated water and upon uncooked vegetables.

Predisposing causes are lesions of the lumbar region, especially the third, fourth and fifth, which are usually far back on the sacrum, this posterior condition extending as far up as the tenth dorsal. Contractions occur all along the spinal musculature.

Diagnosis. The onset is gradual (a frequent and painless diarrhea following a period of ill-health) or abrupt, marked by the passage of many small, watery stools containing mucus but no blood, and alternating with constipation. The milder cases are attended by weakness and emaciation, and dull expression; pale and sallow skin, pale, flabby, moist, and slightly furred tongue, and insomnia. The temperature does not rise above 100 F., the pulse feeble, ranging from 70 to 90. The abdominal pain is constant, cramp-like, dull aching or burning, mainly in the upper quadrants.

Tenesmus is infrequent, but there is a burning sensation in the rectum and in the anus during and after passage of feces. The tendency to chronicity is great. In the grave form, the face is drawn, cyanosed or flushed, the expression anxious, the mind clear; there is anorexia, intense thirst, and sleeplessness with normal or subnormal temperature, small, rapid pulse, and free sweating. Retracted abdomen and greenish-yellow color of the skin with progressive anemia and emaciation may dominate the intestinal symptoms. Death may occur in a few days or at any time for months from hemorrhage, perforation, sloughing, hepatic abscess, or exhaustion.

The chronic form may follow the acute attack, or it may be chronic from the first. The symptoms resemble the bacillary dysentery but there is more definite tendency to alternating periods of diarrhea and constipation. The tongue is red, glazed and beefy. The appetite is capricious, the digestion is easily disordered. In the United States the patients retain their nutrition remarkably well in contrast to the marked emaciation of those in the tropics. Diarrhea may be the only symptom and characterized by great variation in character and frequency. Exacerbations may begin suddenly and subside in the same manner, lasting from two to ten days. The intermissions continue from one day to three weeks, during which feces are soft but contain mucus. This periodicity is most marked in cases with hepatic abscess. True relapses are common.

The complications include hepatic abscess and other abscesses with rupture usually into the lung. This is indicated by dry, hacking cough, sudden expectoration of diffluent, tenacious, alkaline,

frothy sputum with odor like "anchovy-sauce." This contains the amebæ with blood, bile constituents, and sometimes degenerated liver cells. Conjunctivitis or vaginitis may be due to direct infection by soiled fingers.

Diagnosis depends upon finding the ameba in the stools or pus by the microscopic examination preferably on a warm stage.

In the chronic form the urine is often albuminous and may contain casts. In the gangrenous form, there may be retention. Amebæ are not present unless the bladder becomes infected. There is varying anemia. Mild leucocytosis is the rule; sometimes eosinophilia is present. At first the stools are small, consisting of mucus, with more or less bright blood and small fecal masses, four to twenty or more each day. As ulceration advances, they become more copious and watery, feces and blood diminished, and containing gelatinous grayish masses about one to three centimeters in diameter. When sloughing occurs, shreddy masses of necrotic tissue are found.

Treatment. The first work in treatment is to adjust the lumbar vertebræ, especially the second and third. Other lesions are corrected as found.

There is nothing yet known which kills the amebæ with no harm to the patient. The only thing is to keep the intestinal tract clean, and to get rid of the amebæ with the feces. The fact of the frequent stools does not prove that retention is not occurring. Frequent washing of the colon helps to clear away retained masses, if these can be felt on palpation, or if the dysentery is not relieved, by the ordinary measures. The "drop method" may be employed if the usual enemas are irritating or unsuccessful.

Diet. In chronic cases, cellulose may be freely employed, if it does not precipitate a more acute attack. Probably there is nothing which is more completely and thoroughly cleansing to the entire intestinal tract than a full cellulose diet, with plenty of water drinking. Pineapple, apples, celery, lettuce, onions, raw cabbage, carrots, all should be eaten in abundance, and the amounts of proteid, carbohydrate and fatty foods kept to a rather low measure of the metabolic requirements of the body. The food must be liquid during an acute attack.

For the conjunctivitis or vaginitis, which may result from accidental contamination, frequent washing with any bland and non-irritating liquid is the best thing. The inflammation which may result from the infection is best treated by the usual osteopathic methods of treating simple inflammation of those membranes. Hepatic abscess, or the rare abscesses in other parts of the body, require surgical evacuation.

Prognosis. The majority of cases recover from the acute attacks. The chronic form may persist for years.

Prophylaxis. Especially since more frequent communication with tropical countries it is necessary to be sure of the purity and cleanliness of water and food supply. Cases in southern California have been caused by the ameba upon salad vegetables irrigated with contaminated water. Disinfect all stools and urine of patients.

MYIASIA

The larvæ of flies and other dipterous insects occasionally gain entrance into the human body, either with food or by direct invasion of the orifices or ulcers upon the skin. The screw-worm *compsomyia macellaria* is the most common in the United States. The larvæ of *dermatobia noxialis*, *lucilia serricata* and *lucilia cæsar* are occasionally found responsible for myiasia.

The destructive powers of these larvæ are surprising. They may invade the brain by way of the nasal passages and cribriform plate or the eye-ball from the conjunctiva, or the muscles, cartilages and bones from skin lesions.

The only efficient treatment is surgical removal of the infested tissues. If this is impossible recovery may occur as the result of the death of the parasite, but in most cases death of the patient is speedy and inevitable.

CHAPTER LII

NEMATODES

Nematode (threadlike) worms are round and usually very small. They include a number which produce diseases of varying severity, in the human race as well as among animals. They include the following worms:

Strongyloides intestinalis. (*Rhabdonema strongyloides*; *Anguillula intestinalis et stercoralis*.)

Filaria sanguinis hominis. (*F. Bancrofti*.)

Dranunculus or *filaria medinensis*. (Guinea worm; Medina worm.)

Trichocephalus dispar. (*Trichinis trichinora*; Common whip-worm.)

Trichina spiralis. (Flesh-worm; *Pseudalius trichina*.)

Ankylostoma duodenale.

Necator or *Uncinaria americana*.

Ascaris lumbricoides.

Oxyuris vermicularis. (*Ascaris vermicularis*.)

Ascaris alata. (*Mystax*.)

Nematodes rarely found as causes of disease in man in this country include the following:

Strongyloides intestinalis (*Anguillula stercoralis*) occurs chiefly in Asia, and is not known to be pathogenic to its human host.

Eustrongylus gigas is a very large round worm, about a meter long, which is very common in dogs and other carnivora, but is a rare parasite of man. It attacks the kidney, causing hematuria. The ova may be found in the urine.

Trichocephalus dispar or common whip-worm is common in Syria and Egypt, being an inhabitant chiefly of the cecum, appendix, and the large intestine, and rarely causing symptoms. It is about an inch long, the anterior half being thin and thread-like, and the posterior part much thicker.

Ascaris mystax (*Alata*) is two to three inches long, infests cats and dogs, rarely man.

Filaria sanguinis hominis infects the blood.

DRACONTIASIS

(Guinea worm disease; dranunculosis; medina worm disease)

This disease is due to infection by the persarum, or *dranunculus mediensis*. The worm passes one part of its existence in the cyclops, a crustacean. The disease is characterized clinically (about

a year after the ingestion of the polluted water) by the appearance of a small blister usually just above the ankle, the event ushered in with fever, sometimes urticarial rashes. The blister ruptures and through the small ulcer is seen the female worm's head with the coils felt like a bundle of cords beneath the skin. By playing a stream of water over the ulcer, the embryos are discharged and the worm leaves her host.

The patient is unable to walk but there are no other symptoms than the local irritation unless pyogenic infection occurs. There may be more than one extruding at a time. The male worm has not been found.

Treatment. The native treatment is unique but effective.

As the worm begins to leave she is wrapped about a small piece of smooth wood to prevent retraction, and day by day the patient winds a little more of the worm on the wood, being careful not to tear her, doing this until she is finally extracted.

Prophylaxis. In order to avoid this infection, it is necessary to avoid drinking water, or bathing in water, which might be the home of cyclops in tropical countries.

OXYURIS VERMICULARIS OR THREAD-WORMS

The male is one-eighth inch long with a curved tail; the female is about one-fourth inch, thin and thread-like with a tapering tail. They gain entrance to the body by water or upon salad vegetables, and inhabit the large intestine, especially the rectum and descending colon, and are often found around the anus.

Diagnosis. The patient is usually a child who is extremely restless and irritable; the sleep is disturbed; there is loss of appetite; there may be anemia of a more or less marked degree; vesical and rectal tenesmus and priapism may be present. Itching and erythema around the anus and perineum is very annoying, and if the worms reach the penis in boys, or the vagina in girls, may cause masturbation. This symptom is worse when worms come down and especially at night when warm in bed.

The pruritis leads to scratching, and thus the ova may become lodged around the finger nails. No unusual carelessness then is necessary to permit infection of the food, and thus the infection of others, or a second infection of the patient. The feces contain the ova in large numbers.

Treatment. Merely the repeated washing of the rectum with warm soapy water, or an emulsion of oil and soap, will usually clean the body of the worms. For more speedy relief, quassia decoction—about an ounce to a pint of water—may be injected into the rectum and left for a short time. This procedure may be repeated

once a week or so, until no further evidence of the worms can be found.

Usually spinal rigidity and lesions involving the lumbar vertebræ are found; the correction of these conditions promotes recovery from the malnutrition and nervous irritability due to the presence of the worms.

Prophylaxis. The carelessness associated with defecation, especially in children and in uncleanly adults, permits the spread of these organisms. The use of raw vegetables irrigated with sewage or grown in fields enriched with excrement is dangerous.

ASCARIS LUMBRICOIDES

(Common round worm)

The male is four to six inches long; the female is ten to sixteen inches, they resemble the ordinary earth-worm in appearance. They inhabit the small intestine but exhibit a marked tendency to wander to other parts.

Diagnosis. In children, who are usually affected, they produce many reflex symptoms as restlessness, irritability, twitchings, picking at the nose, grinding the teeth, foul breath, and often convulsions. Gastro-intestinal catarrh without any other cause is often present. Eosinophilia is present, and in some cases there is a marked anemia.

The stools show the adult worm, the ova, and sometimes both.

Treatment. Thorough treatment to the liver, correction of all spinal defects, and careful direct abdominal treatment is essential to provide a good blood stream freely circulating and good digestive juices which will make the intestines a poor place for the parasites.

Cleanliness must be insisted upon; correction of the whole hygiene and the diet is necessary for a complete recovery.

It is sometimes necessary to kill the parasites quickly. For this five drops of oil of wormwood, on a lump of sugar, taken after a fast of at least twenty-four hours, is usually efficient. Santonin is used, but sometimes produces symptoms of poisoning. No drug taken to kill the worms is apt to be effective unless the intestinal tract has first been pretty thoroughly emptied of its contents. Constant and thorough cleanliness is the important thing to prevent recurrence.

FILARIASIS

This is a disease of the tropics due to the presence of one of several filaria in the blood. These include filaria sanguinis hominis, both nocturna and diurna, and the less common filaria perstans, filaria demarquai and filaria Phillipinensis. The adult

forms, which live only in the lymphatic nodes, were called *filaria Bancrofti* and *filaria loa*. The latter is the cause of the Calabar swellings; its embryonic form is called *filaria s. h. diurna*.

Filaria s. h. nocturnis is the most common form; the embryos appear in the blood only at night. The embryos, sometimes the adult worms, may block the lymphatic vessels, even the thoracic duct. The mosquito, *Culex fatigans*, is the intermediate host.

The filarial embryos, after entering the mosquito's body, cast their sheaths and bore through the intestine of the insect, enter the body cavity, find their way to the head and there enter the proboscis. Hence they leave the insect when it bites a warm blooded animal or man. The filaria may live for years in the human body without causing symptoms. In other cases, they cause pain in the back, abdomen, or perineum, chiefly from lymphatic obstruction, and lead to various enlargements.

The filaria are found also in the glands, membranes of the testes, pelvis of the kidney, ureter, and bladder, and in the vitreous humor.

The disturbances produced by this nematode are as follows: chyluria (milky urine), sometimes slightly tinged with blood, is due to the rupture of obstructed lymphatic vessels into the urinary tract. The condition is usually intermittent. The patient may be inconvenienced only by the passage of the blood clots from the bladder and the uneasy sensation in the lumbar region. The urine is albuminous, contains fat granules and filariae, and coagulates upon standing.

Lymph-scrotum is the condition found when the scrotal tissues are greatly thickened, the lymphatic vessels are prominent and may rupture, allowing the chyle to flow over the surface. Inflammatory complications are common.

Lymph vulva is analogous, in the female.

Elephantiasis (arabum) is, at least in some cases, due to this filaria.

Treatment. Methylene blue, which is practically harmless to the human body, is said to be destructive to the filaria. Surgery may be employed for the deformities. No treatment is of much value, except such as may be found necessary to promote the general health of the patient.

Prophylaxis. With the present increase in communication with tropical countries, a guard must be maintained against these infectious agents. Mosquitoes must be eliminated; while the specific mosquito may not live with us, yet it is never safe to depend upon future occurrences so far as biological laws are concerned. Drinking water must be known to be pure, or be boiled, especially in tropical countries. The presence of the worms in the urine suggests suitable disposition of this source of contagion.

TRICHINIASIS

(Trichinosis)

This is a disease chiefly affecting the muscles, due to infection by the *trichina spirilis*. The adult worms live in the intestines; the larvæ become encysted in the muscles. The diagnosis rests upon the symptoms, and upon finding the dead adult worm in the feces, or the embryos in a bit of muscle, excised for the purpose.

The pig is the most frequent intermediate host, though the rabbit, sheep, dog, rat, mouse, and other animals may harbor the worm. The pig may eat the flesh or excreta of the rat or another animal; the larval worms become fully developed in the stomach and intestine of the pig, produce hundreds of thousands of ova, and then the adult worm dies, the ova hatch, and the larvæ burrow out into the body, following the connective tissues, until they reach muscle. They become encysted, and their development ceases for a long time. If the pig is killed, the flesh eaten without being thoroughly cooked, the same story may be repeated in the body of a human host. The end of the story varies, for the human body is rarely eaten by others, and human excreta is usually not eaten by animals.

No definite symptoms are manifested unless a large number of the parasites are eaten, when after a few hours or days, there are symptoms of gastro-intestinal irritation with vomiting, diarrhea, and intense sweating, sometimes varying skin eruptions, and abdominal pain. Toward the end of the second week, great soreness and stiffness develops in the muscles; remittent fever appears; and a peculiar edema begins in the face and spreads to the skin over the affected muscles. Infection of the respiratory muscles may cause intense dyspnea. In long continued cases, the patient becomes emaciated and exhausted; the typhoid state may supervene; and death ensue. In mild cases, the symptoms subside in about two weeks. The disease sometimes appears in epidemics. The trichinæ may be found encysted in the esophagus, pericardium, and lymphatic glands.

The blood shows marked eosinophilia—perhaps above 30 per cent of the total leucocyte count. The affected muscles are tense, with a peculiar rubbery feeling on palpation. Adult worms, sometimes dead, may be found in the stools. A piece of an affected muscle may be excised for examination, when the larvæ will be found coiled up within the muscle fibers.

Treatment. When contaminated food is known to have been eaten, prompt emptying of the digestive tract is urgent. Vomiting may be compelled, if the food has been eaten just previously; urgent purgation, even with drugs, if not more than a few days have intervened since the food was taken. Treatment to facilitate the flow of bile into the intestines is indicated in order to destroy and digest the embryos before they have time to leave the intestinal tract.

After the embryos are once encysted in the muscles, they cannot be dislodged by ordinary means. Hot baths, massage, and local manipulation will aid in securing relief. If the life of the patient can be maintained until the larvæ are encysted, the prognosis is good, and further symptoms are not to be expected. If early diarrhea is present, the prognosis is much more favorable, as by it the embryos are removed from the system.

UNCINARIASIS

(European hookworm disease; miner's anemia; tunnel anemia (or cachexia); brickmaker's chlorosis; Egyptian chlorosis; ankylostomiasis; hookworm disease)

This disease results from infection by the hookworm, either the European type, *ankylostoma duodenale*, or the American form, *Necator americanus*. The parasite is voided in feces, and, under proper sanitary conditions, dies. When feces are left unprotected, as is the case among the negroes and the poorer whites of the South, the worms with the dirt may be spread around over the ground, and become unrecognizable. Barefooted persons walking in this unclean place are apt to have abrasions upon the soles of the feet, and the worms enter the skin. Negroes harbor and transmit the disease, but suffer few or no symptoms. The skin becomes inflamed, and this is called "ground itch" or "dew itch." The worms are carried by the blood to the heart and lungs, are carried to the pharynx and then swallowed; pass through the stomach and attach themselves to the walls of the duodenum and the jejunum. The worm may be taken with food, or by the habits of the "dirt-eaters." Occasionally water containing the parasite is used in washing, when the worm gains entrance into the body through abrasions of the skin, or by way of the hair follicles or sweat glands. The worms not only feed upon the blood, but their presence is associated with a toxin, either from their own metabolism or from the intestinal bacteria, which enter the system by way of the wounds made by the worm. The coagulability of the blood is markedly decreased, and this adds to the anemia.

Diagnosis. A considerable number of parasites must be present to cause any symptoms. At the stage of incubation there may be gastro-intestinal irritation and perhaps fever. In an advanced condition, anemia is the most characteristic feature; lack-lustre eyes, dull heavy expression, skin of a dirty muddy hue or waxy white is present. Children are stunted in growth of mind and body. As the disease advances, the liver and spleen enlarge somewhat, there is effusion into the abdomen, and flatulent distention producing a pot-bellied appearance. Palpitation, shortness of breath, cardiac bruits due to severe anemia, and edema of the feet are not uncommon.

The blood shows severe secondary anemia, rarely the picture of pernicious anemia; erythrocytes may be less than one million, but are usually about half the normal count; hemoglobin may be one-tenth to one-half the normal amount. Leucocytosis is not common; eosinophilia is marked. The coagulation time is much increased.

The feces contain the ova, sometimes the adult worms. In doubtful cases, small masses of the feces may be incubated for one or two days, when the worms hatch and are easily recognized.

Treatment. The removal of the worms with the least possible harm to the body is indicated. Thymol is a poison which is not absorbed into the body, when carefully given, and which is very toxic to the parasite. The dose varies from eight grains for a child under five years of age, to forty-five for an adult. Thymol is soluble in fats and in alcohol, so that for a day before thymol is given, and for from one to four days after, no fats or alcohol should be taken. The best way to avoid poisoning by thymol is to give the patient charcoal, then no fat or alcohol is permitted until the treatment is completed. When the stools become black, the thymol is given, on an empty stomach. A purgative is given a few hours later. Enemas should be used very freely, in order to facilitate the removal of the injured or poisoned worms. Another dose of charcoal is given, and when the stools again become black, the patient may return to his ordinary diet. The denial of fats to the person so thoroughly accustomed to bacon three times a day is a factor met with difficulty, in dealing with patients of the ordinary class with the disease.

Prophylaxis is more important than treatment. The most urgent requirement is the establishment of proper methods for the disposal of feces, and the enforcement of some cleanly habit of defecation. Negroes present the most difficult problem, since they harbor the worm but suffer little or nothing from its presence. The ignorance and squalor that permits promiscuous defecation adds greatly to the difficulty of reëducation. Mines, brickyards, schools, camps, as well as homes, must be provided with latrines, and the disinfection of feces made compulsory. Railroad trains offer remarkable facilities for the spread of such diseases; fortunately for others, the persons who suffer most from hookworm do not travel very much.

Good, strong shoes must be worn in the infested districts, and the feet washed often. Great care must be taken to avoid any contact with the soil, especially in places possibly contaminated. Drinking water must be known to be pure, or else must be boiled. The entire problem is simply one of persistent cleanliness.

CHAPTER LIII

TREMATODES

Trematodes (Hole-borers) are so called because they enter the body itself, where they may cause fatal symptoms. They are rare in man, but many of them are common among sheep and other animals.

The following list includes the more common of the flukes which may invade the human body:

Distomum hepaticum. (Liver fluke; *Fasciola hepaticum*.)

Distomum pulmonale. (*D. westermanii*; fluke-worm of the lung; *Paragonimus westermanii*.)

Distomum lanceolatum. (*Dicrocoelium lanceolatum*.)

Distomum hematobium. (*Bilharzia*; *Hematobia thecosomum*; *Gynæcophorus*; *Schistosmum hematobium*.)

Distomum sinense. (*D. japonicum*; *Schistosma japonicum* or *S. cattoi*; *Apisthorchos sinense*.)

Other trematodes which may be found causing disease, usually of the liver, in man are: *Amphistoma hominis*; *distoma lanceolatum*; *distoma crassum*; *distoma sibiricum*; and *distoma spatulatum*.

These are all obstinate to treatment usually, are fatal, or persist through life, and gain access to the human body through uncleanly habits, or through drinking contaminated water, or eating contaminated food.

Distomum Hepaticum causes "liver rot" in sheep. In man it affects the liver, causing great bulging of the hepatic area, with tense abdominal walls. Emaciation, diarrhea, ascites, and death from weakness ensue. Treatment is useless, except for the relief of some symptoms.

The life history of this fluke illustrates fairly well the development of all flukes:

"Let us start the history with the mature fluke living in the liver of the sheep. Eggs are laid in large numbers in the biliary passages, and these find their way through the various bile channels into the intestine of the sheep. With the general debris of the intestine these eggs are expelled from the body of the sheep. Should they fall upon the dry earth, they soon perish, but if by chance they drop into the water, they soon develop into a free swimming ciliated worm which, after living for a short time in the water, enters the body of a snail. Here they reproduce themselves asexually and ultimately cause the death of the snail. If this occurs on the land, the young worms soon perish, but if the body of the dead snail falls into water, it quickly decomposes and the young worms are set free. After enjoying their freedom for a short time, they enter the body of another snail, where they again asexually reproduce. This second snail is not as a general thing killed, but it crawls up on the stalks of weeds and herbage growing in the water and there glues itself to the stem

of the plant. If by chance, this stem is eaten by a sheep and the snail swallowed, the parasites are set free in the stomach of the sheep after the snail is digested, and quickly passing through the stomach into the upper intestine, they make their way to the liver, there to begin the round of life again.

"It is practically certain that it is not absolutely necessary for the fluke to enter the body of its second host, and that if the second host is not readily at hand, the free swimming worms at length attach themselves to herbage growing in the water, and in this form they may be directly taken into the stomach of the sheep and the life cycle may be completed in this way. It is also quite certain that if they should be inadvertently swallowed by a human drinking the water, the person may thus become infected with these most dangerous parasites. For that reason all water to which sheep have access should be regarded with great suspicion."—C. A. Whiting.

Water cress, growing in streams to which sheep have access, may be sold for food. The danger of eating salad made from this cress is evident.

Distomum pulmonale causes endemic hemoptysis, a common disease of China, Japan, Korea, and Formosa, and occasionally observed in the United States. The embryo is probably ingested in water, finding its way to the lung where it matures, deposits its ova, and develops many cysts communicating with the bronchi.

The symptoms are a chronic cough with bloody expectoration containing the eggs, occasional hemorrhages, and frequently a secondary anemia. The diagnosis is made by finding the ova in the sputum.

Jacksonian epilepsy may result from cerebral invasion.

Treatment. No treatment is reported as useful.

Prognosis. Uncertain but not usually fatal unless from complications.

Prophylaxis. The only precaution is to be sure that the water source is uncontaminated when in those countries where this disease is endemic and in seaports by using boiled water.

DISTOMA HEMATOBIMUM

(Blood fluke; bilharzia hematobia)

Distomum hematobium causes endemic hematuria or distomiasis which is endemic in Egypt, prevails in South Africa, Arabia, Persia, and west coast of India, and imported cases are known in Europe and United States. The male is about one-half inch long, cylindrical, with a canal, the gynecophoric, in which the female is found. The way of entrance is unknown, but is probably by water or on green vegetables. It travels to the portal vein, where the young specimens are found uncoupled.

The males bearing the females creep to various parts of the body, especially the bladder, urethra, and rectum; the eggs are laid in the tissues but wander and escape in the urine. If the parasites are

present in large numbers, they give rise to inflammation and hemorrhages from the affected mucous membrane, causing endemic hematuria, or if the colon be affected, diarrhea.

These parasites may cause no inconvenience. The most frequent symptoms are irritability of the bladder; dull pain in the perineum, hematuria, chronic cystitis, a rather slight anemia, and if the rectum is involved, straining and tenesmus with the passage of blood and mucus. In severe cases, large papillomata and chronic ulcerative processes may be present. There may be a chronic vaginitis. Few symptoms are occasioned by the presence in the portal vein.

The complications are kidney and bladder calculi. Periurethral abscesses and perineal fistulae may occur in chronic cases.

Diagnosis is readily made by finding the ova in the bloody urine, in the blood, or in mucus from the stools.

No treatment has been found useful.

Prognosis. The bilharzia may be present for years without producing serious damage. In slight infections the symptoms may disappear, especially in children.

Prophylaxis. Carefulness in regard to the drinking water and in the use of green uncooked vegetables is essential when there is any likelihood of infection.

Quarantine. A laboratory examination of the stools and urine of cases even slightly suspected when from these countries should be made at the immigration ports before these people are allowed to land.

HEPATIC DISTOMIASIS

This disease occurs extensively in Japan, China, India, and some other tropical countries. Imported cases have been reported in Canada and the United States. It is due to infection by the *Distomum* sense, and it usually affects children, especially several members of the same family.

The symptoms are irregular intermittent diarrhea, which may or may not be bloody; gradually enlarging liver, may be pain; an intermittent jaundice; not much fever; after two or three years, dropsy, anasarca, and ascites develop, and the patient becomes much reduced and progressively anemic. There is sometimes a localized epilepsy. The parasite lives in the intestinal canal.

Diagnosis is made by finding the ova in the feces.

Prognosis. Ultimately fatal. A transient improvement may take place, but recurrence comes and the patient dies after many years of illness.

CHAPTER LIV

TAPEWORMS

These are so called from their flat series of proglottids. These, usually called the body of the worm, are merely hermaphroditic units. The entire body of the tapeworm, properly speaking, is what is commonly called the head.

All tapeworms require two hosts for their development. In the carnivorous host the worm secures itself to the intestinal wall and lives upon the food of its host. The proglottids are formed and are lost in the feces. These are voided and male and female elements of the proglottid unite, either during the passage through the intestine or shortly after being set free. The proglottids of some species have the power of wandering a little way. Under favorable circumstances some herbivorous animal eats the vegetation upon which the proglottids have been deposited and the eggs are carried to the stomach of that animal. The eggs hatch, and the larvæ wander out of the digestive tract, into the muscles or other tissues of the new host. Here they encyst themselves, forming what is called a "bladder worm." There may be some muscular pain and fever during this invasion of the herbivorous host. In the course of time, this host is killed, or dies and is eaten by some carnivorous animal. The bladder worms, reaching the stomach of the new host, are set free by the digestion of the cyst, and go on their further development. They attach themselves to the wall of the carnivorous host, form proglottids, and follow in the steps of their ancestors.

In the human being, the worm is usually brought into the body with poorly cooked meat. The use of contaminated water, or the uncleanly habits of children who are allowed to have animal pets, may permit the eggs to be carried into the body, and the bladder worm type may thus be found in the human body. Vegetables which have been fertilized with excrement, or irrigated with sewage, may also be a source of danger. When the human being acts as the herbivorous host, the later development of the bladder worm is prevented, since the human body rarely serves as food for carnivorous animals.

Tapeworms are avoided by cooking all meat very thoroughly. Larvæ are avoided by cooking vegetables whose origin is not known to be wholesome.

The most common of the human tapeworms are:

Bothriocephalus latus. (*Tenia lata*; Broad tapeworm;
Dibothriocephalus latus; *Tenia grisea*.)

Tenia nana. (*Hymenolepis nana*.)

Tenia flavopunctata. (*Hymenolepis diminuta* or *flavopunctata*.)

Tenia lanceolata.

Tenia solium. (*T. vulgaris*; *T. cucurbitina*; Pork tapeworm.)

Tenia saginata or *medio-canellata*. (Beef tapeworm.)

Tenia ecchinoccus. (Bladder-worms; Hydatid *ecchinoccus*; *Cysticercus*.)

Tenia elliptica. (*T. cucumerina*; *Dipylidium caninum*.)

Diplogonoporus grandis and *sparganum mansonii* are found in the Philippines, and may invade this country later. *Tenia confusa* (Ward) has, so far, been found only in Nebraska.

Bothriocephalus latus is the largest tapeworm known, being sixteen to thirty feet long by one inch wide, with 3,000 to 4,000 segments. The head is small, oval or club-shaped, with a longitudinal groove on each side. It has no proboscis suckers nor hooklets. Each segment is bi-sexual. The intermediate host is some fish, as pike or turbot. It is found in Switzerland, northeastern Europe, and Japan, and among the Finns in the United States.

The general symptoms of *Bothriocephali* and *Teniasis* are: reflex disturbances as itching of the nose and anus, colicky pains, attacks of diarrhea, voracious appetite, mental trouble as melancholia, convulsions and occasionally reflex vomiting, loss of flesh, vertigo, grinding the teeth at night, and gastro-intestinal irritation.

The anemia due to this invasion is particularly severe. It shows a blood picture which is often not to be distinguished from that of pernicious anemia.

Tenia flavopunctata is about a foot long, and the eggs are larger than those of the nana. The head is small, clubbed and unarmed. The larvæ develop in the Lepidoptera.

Tenia lanceolata is 31 to 130 mm. long. The head is globular, very small, the rostellum is cylindrical with a crown of eight hooks. The ova have three envelopes.

Tenia solium, or pork tapeworm, is more common in Europe. It is six to twelve feet long, with 200 to 400 proglottids. The head has a projecting rostellum, upon the summit of which are 30 to 40 hooklets and four lateral suckers. The uterus has about twelve horizontal ramifications to a segment. The larvæ are the simplex scolex, which form the measles of pork (*cysticercus cellulosæ*). The intermediate host is the pig.

Tenia nana is from two to three centimeters long by one-half millimeter broad with about two hundred segments. The head has four round suckers at the base of the rostellum which can be inverted. The intermediate host is unknown. It is especially common in children.

Tenia elliptica is five to eight inches long and one-fourth inch broad. The worm spends its larval stage in the bodies of dog-fleas and the adult stage in the intestines of the dog. Children playing with infected dogs can very readily become infected with the mature worm, or they may swallow the fleas.

Tenia saginata, or beef tapeworm, is the most common in this country. It is fifteen to twenty feet long, with a small head surmounted by four powerful sucking cups, but no rostellum or hooklets. The uterus is finely branched. The adult worm, strobile, lives in man and the embryo or scolex lives in cattle. The larvæ are *cysticercus bovis*.

Treatment. The different kinds are differently susceptible to substances poisonous to them, but often not poisonous to the host. The drugs usually used to kill them include santonin, extract of male fern, thymol, etc. A physical agent is found in flaxseed and pumpkin seed, which mechanically loosens the head and permits its elimination.

In any case, a day or a few days of fasting is required in order to remove the protecting food material from the worm, and to cause its weakening. Free flushing of the colon is useful, in order to encourage intestinal activity. Free drinking of water serves the same purpose, and also it keeps up the strength of the patient. The feces must be watched, in order to be sure that the worm is thoroughly removed.

A full cellulose diet, with fasting every other day, plenty of water and plentiful washings of the colon, sometimes lead to the evacuation of the worm, with no other anthelmintic.

Persons afflicted with tapeworm should thoroughly sterilize the stools and the clothing, carefully avoiding contamination of themselves or others.

HYDATID DISEASE

Tenia echinococcus is the smallest of human tapeworms. It is less than half an inch long, and has four segments, of which the last is mature. In this worm, the man acts as the vegetarian host; the dog, rarely other domestic animals, acts as carnivorous host. The ova, embryos, or proglottids are voided in the excrement of the dog, and are dried and blown by dust, or the fecal masses are handled by man, or in some other way the microscopic organisms reach the food of man, and are swallowed. The young larvæ undergo further development, push their way through the walls of the alimentary tract, and become encysted in other organs of the body. These cysts grow to considerable size; and the parasites multiply, producing daughter cysts; the ultimate lobulated cyst forms a hard tumor, filled with a fluid which contains the scolices and hooklets of the parasite. After multiplication beyond the nutri-

tive possibilities, the parasites may die, the cyst become thickened, the fluid dries, and ultimately only a hard, usually harmless tumor is left. The wall of the cyst may rupture, in which case serious symptoms are to be expected. Infection with pyogenic bacteria may cause abscess formation.

Diagnosis is made from finding hooks or scolices in the aspirated fluid.

The liver is far more often affected; the lungs and kidneys less often, and the brain and other organs only very rarely.

The only treatment is the surgical removal of the cyst, when this is accessible.

Prophylaxis. The disease is easily avoided. Dogs ought not to be permitted to live except under supervision. Those who care for dogs should keep them away from human food, and should be cleanly in their habits. Every bit of fecal material should be considered potentially dangerous. Dogs may be protected from infection by feeding them only meat that is known to be free from infection, and, for the most part, meat that has been well cooked. Dogs are too dangerous to be allowed to play with small children; if larger children are permitted to play with them, the most eternal vigilance must be observed in regard to cleanliness and health.