be sacrificed at times to peace of mind. The diet is to be simple and light at first, but as nutritious as possible with returning health: beef-tea palatably made, soups of any kind, milk if it does not increase constipation, scraped raw meat, with a little salt, and gruels, if not distasteful. Plain water, seltzer water, Apollinaris, or any simple carbonated drink, should be proffered at proper intervals, without over-solicitation or any anxiety should everything be refused. With the beginning subsidence of the disease an egg may be dropped into the soup, or sweetbreads, fish, the white meat of fowl may for a few days preface the more solid meats.

Especial attention is to be paid to the bladder. The soft catheter, thoroughly cleansed, warmed above the heat of the body, and greased with pure vaseline, brings this organ, when refractory, under control. Constipation is overcome with calomel, two to ten grains, or castor oil, in preference to an enema, which causes too much disturbance.

The treatment proper is purely symptomatic, and has reference to the two sets of symptoms, general and local. Of these the symptoms produced by the local lesions—pain, opisthotonos, hyperæsthesia—assume prominence in the great majority of cases. For the relief of these symptoms no remedy equals in value opium. Opium is the "sheet-anchor" in the treatment of cerebro-spinal meningitis. It acts solely by its anodyne influence. It protects, by obtunding, the nervous system until the force of the poison is spent. Surprising amounts of the drug may be given in this disease without narcotic effects. Thus Steiner often gave ten grains at a dose in cases of severe convulsions without producing stupor; Chauffard, three to fifteen grains; and Boudin, seven to fifteen grains at first, and later, one to two grains every hour before soporific effects were produced. Stillé was in the habit, he says, of prescribing one grain every hour in very severe, and every two hours in moderately severe cases, without inducing even an approach to narcotism in any case. "Under the influence of the medicine the pain and spasms subsided, the skin grew warmer and the pulse fuller, and the entire condition of the patient more hopeful." When quick effects are to be had, or when the drug is rejected by the stomach, resort will be had, of course, to the hypodermatic use of morphine. Ziemssen gives expression to an experience made by every practitioner with this disease when he says that morphine is, without doubt, "indispensable" in its treatment. But "*medicus systematicus periculosissimus vir*"; that would be indeed a routine physician who would prescribe opium indiscriminately in every case.

The use of the warm bath in cerebro-spinal meningitis was introduced by Aufrecht, of Magdeburg (1894), with the report of a single case cured by daily warm baths. Voroshilsky, of Odessa (1895), employed the warm baths three times a day in sessions of ten minutes at a temperature of 104° F. with good results in two cases. These observations were confirmed by Borling and Kellmeyer, of St. Petersburg, and Steckel, of Vienna, and more recently by Netter, who reports six cases treated with warm baths repeated every three or four hours, with no mortality. This experience leads Netter to declare that the warm bath is "a specific method of treatment of cerebro-spinal meningitis."

Venesection in this disease belongs to history, or is only at most to be practised in relief of intracranial pressure, as in apoplexy, in the most sthenic cases, and in these cases the same results may often be effected by milder means, as by purgatives, calomel, and jalap. But local blood-letting by cups along the spine, or by leeches behind the ears, may often relieve the headache and unrest. Cold in the form of bags of ice to the head or along the spine is of great value when the period of excitability, hyperæsthesia, and jactitation may have given place to the state of sopor and indifference. Radcliffe claims that "the application of cold to the head and spine either by means of ice or a freezing mixture in Esmarch's (or Chapman's) india-rubber bags, has furnished by far the most satisfactory results of all direct treatment."

Vomiting is best relieved by ice, champagne, effervescent drinks, milk and lime water, bismuth, soda, carbolic acid, or creosote. No drug equals in efficacy sips of water excessively hot.

Hiccough is often brought under control by the same means prescribed for vomiting, by the administration of a few drops of the oil of cajeput, or by clysters of sodium bromide. More obstinate cases of either vomiting or singultus call for the subcutaneous use of morphine.

The hypodermatic injection of an aqueous solution of corrosive sublimate along the spinal column has been recommended by Angyan in daily doses of 1. cgm. for adults and .5 cgm. for children, continued until the rigidity disappears. Angyan reports thirty cases treated in this way with twenty-one recoveries.

Kay lauds the virtue of permanganate of potassium in grain-to-the-ounce solution, a tablespoonful every hour, and reports four cases with three recoveries.

It is useless to encumber space in a work of this kind with more than a mention of other remedies lauded in the treatment of this disease. As to quinine, which was recommended by the committee of the American Medical Association, it is now admitted to be of no avail whatever, except in antipyresis, a call which is seldom made in this disease. But in the exceptional cases, in which high fever does occur, quinine in scruple dose, salicylic acid or antipyrin in double the quantity, are more valuable than the cold bath, because of the commotion created by the bath. Blisters, moxa, ferrum candens, are brutal assaults in the height of the disease, but may be justifiable in the treatment of sequelæ. The same remarks apply to the use of electricity. Ergot, iodine, physostigma, mercury, the benzoates, the bromides (which may be substituted for opium in a very mild case), other anodynes, belladonna, with a host of other remedies, have been recommended on theoretical grounds, or praised as specifics by practitioners of the "experience" school, who for the most part remain untrained to eliminate "the personal equation," but none of them stands the test of time.

Lumbar puncture has been recommended in treatment, but is not at the present time believed to be curative, although after the withdrawal of a small amount of fluid there is often marked improvement of the symptoms.

The various symptoms presented in the course of the disease are treated precisely as are the same symptoms in any acute infection, after methods mentioned in detail in this work in the history of diseases in which these symptoms assume especial prominence.

James T. Whittaker.
George E. Malsbary.

CERIUM.—A single salt, only, of cerium is official in the United States Pharmacopœia, namely, *cerous oxalate*, entitled *Cerii Oxalas*, Cerium Oxalate: formula, $Ce_2(C_2O_4)_3$, $9H_2O$. This salt is "a white, granular powder, without odor or taste, and permanent in the air. Insoluble in water, alcohol, ether, or in solutions of potassium or sodium hydrate; soluble in diluted sulphuric or hydrochloric acid" (U. S. P.). In effect cerous oxalate most nearly resembles the insoluble bismuth compounds, being, from its insolubility, devoid of active properties, but yet like many other insoluble metallic powders, having a power to allay local nervous irritability. This influence is utilized to combat reflex nausea and vomiting, especially the vomiting of pregnancy, and also to repress irritative dry coughs. In this latter application, when successful, the present drug has the advantage over the ordinary run of cough medicines of not disordering the stomach, but, on the contrary, of tending to quell any irritation of that organ. The oxalate may be given in doses of from .30 to .65 gm. (gr. v. to x.) several times a day, best taken dry upon the tongue. Such doses may be kept up for a number of days in succession with no other effect than causing, at first, a little dryness of the mouth. For cough, the medicine should be persisted in even if, as

may happen, there be no benefit for the first two or three days; and especially should doses be given on the empty stomach early in the morning and late at night.*

Edward Curtis.

CERVICAL FISTULA. See *Teratology*.

CERVICO-BRACHIAL NEURALGIA. See *Neuralgia*.

CERVICO-OCCIPITAL NEURALGIA. See *Neuralgia*.

CESTODA.†—The branch or Phylum Platyhelminthes, commonly known as the Flat Worms, is characterized by a bilaterally symmetrical body somewhat flattened dorso-ventrally and usually elongate, by the mass of parenchymatous tissue which fills all the spaces of the body, by the absence of any true body cavity, by a protonephridial excretory system, and by the complicated sexual apparatus which with rare exceptions is hermaphroditic, and which produces so called compound eggs. Among the most prominent orders of the branch are the Trematoda or Flukes (*q. v.*) and the Cestoda or Tapeworms to be considered here.

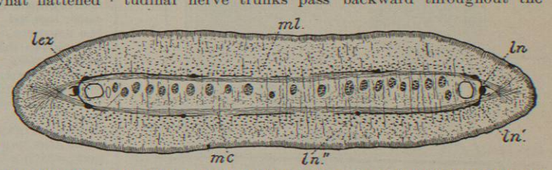


Fig. 1204.—Transection of Proglottis of *Tænia solium*, Somewhat Diagrammatic. *ln*, Main lateral nerve; *ln'*, accessory lateral nerve; *ln''*, ventral longitudinal nerve; *lex*, longitudinal excretory canal; *ml*, longitudinal body muscles; *mc*, transverse body muscles. The section is represented as having cut one of the ring commissures throughout nearly its entire extent. (Original.)

The order Cestoda includes a large number of forms which manifest considerable differences in anatomical detail, but are comparatively uniform in general appearance and structure. The small group of Cestodaria, or Monozoa, which differ from all others in possessing but a single set of reproductive organs, and consequently but a single segment in the body, is included by some investigators in the order under consideration, but by others placed intermediate between the trematodes and the cestodes, forming as it undoubtedly does a group transitional from the one order to the other. The species of Cestodaria are, however, rare and infest the lower animals, so that they will not be discussed here.

In the Cestoda *s. str.* the body is characteristically ribbon-like and divided into "links," segments, or proglottides. In most cases, including all the tapeworms of man, the segmentation is evident externally. At the posterior end of the chain the proglottides are larger and more distinct, and often so loosely attached as to separate from the series under the slightest disturbance. In fact such separation takes place normally as the segments become ripe. Toward the other end of the chain the proglottides grow gradually smaller and less distinct until near the anterior end it is usual to find a short region, the neck, in which no trace of segmentation is visible. The anterior end has the form of a bulbous swelling, known as the head or scolex (Fig. 1203), on which are borne the organs of fixation. The latter are either suckers, hooks, or both, and the suckers may be either elongate grooves or bothridia, cup-shaped hollows or acetabula, or, as in some marine tapeworms, of a folded form which is much more complicated.

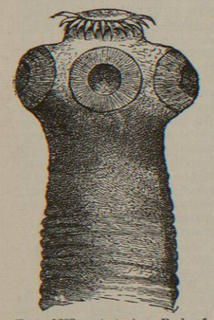


Fig. 1203.—Anterior End of *Tænia solium*, Showing Scolex, Suckers, Rostellum with Hooks, and Neck. × 45.

At the apex of the head is found in the Tæniadæ a muscular organ, the rostellum which bears the hooks, usually in one or more annular rows. In form and degree of development the rostellum is a very variable organ; at the one extreme in *Tænia saginata* it is reduced to a small muscular sucking apparatus, often spoken of as the apical or fifth sucker of that species, while in other forms it is powerfully developed and capable of extension or retraction into a pocket at the apex of the scolex. It is a valuable feature in the distinction of various species.

In the head one finds the central nervous system in the form of a bilateral ganglionic mass with one or two ring-like commissures from which nerves are given off directly to the suckers and rostellum, and from which the longitudinal nerve trunks pass backward throughout the length of the chain. Three of these trunks, the main lateral nerve (Fig. 1204, *ln*) and two minor (*ln'*) are grouped together on each side of the proglottis, while the two dorsal and the two ventral longitudinal nerves (*ln''*) are located nearer the median line. The various longitudinal trunks are connected by commissures which at stated intervals pass around the proglottis; they also give off branches by which the various organs are innervated.

Near the lateral nerve trunks are located the main longitudinal canals (*lex*) of the excretory system which originate in an irregular network in the head and from which are given off numerous branches often in the form of a network of fine vessels in each proglottis. In many forms a prominent transverse canal near the posterior margin of each proglottis joins the longitudinal canals (*cf.* Fig. 1205, *C*). Terminating the finer canals of this system are found the characteristic flame cells which are peculiar to this type of excretory system.

A cross section of a proglottis (Fig. 1204) shows the various layers of which it is composed. Externally the cuticula, a resistant, elastic membrane, covers the body and is reflected a short distance inward at the various external orifices. The older view, by virtue of which an epithelium is wanting in cestodes and the outer layer represents a basement membrane, has been definitely set aside by the recent investigations of Blochmann; the cuticula is really the product of the subcuticular cells, though they are apparently separated from it by a considerable interval. Immediately beneath it occurs a delicate double layer of dermal muscles, having externally circular, and internally longitudinal fibres, the myoblasts of which lie deeper in the body. Between these fibres the bases of the subcuticular cells extend from the cuticula to the deeper lying bodies of the cells; the remaining space of the body between the various organs is filled with parenchymatous tissue. Within the parenchyma occur usually large numbers of calcareous bodies, highly refractive spherical or oval masses of small size, the function of which is yet uncertain. They are, however, characteristic features of cestode structure.

The cross section is divided by the parenchyme or body musculature into two regions, an external cortical layer and the median area or medullary region. In the latter are found most of the reproductive organs, although in the Bothriocephalidæ the vitellaria lie in the cortical layer. The body muscles are of three sets, longitudinal, transverse, and dorso-ventral or sagittal. The longitudinal

* Report to New York Therapeutical Society; the Medical Record, June 12th, 1880.

†A general discussion of parasitism and its effects will be found under the heading *Parasites*.

muscles (Fig. 1204, *ml*) form the outer layer of the muscular mass broken only at the sexual pore, and though variable in amount are always numerous. The transverse muscles (*mc*), often called circular, constitute a plate just within the longitudinal fibres; at the side these fibres intersect and spread through the longitudinal muscles like

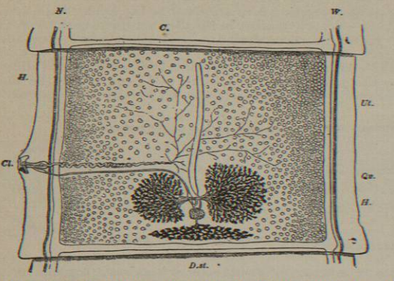


FIG. 1205.—Sexually Mature Proglottis of *Tænia saginata*. *C*, Transverse commissure of excretory canals; *Cl*, genital cloaca; *D.st.*, vitellarium; *H*, testicular follicles; *N*, lateral nerve trunk; *Ov*, ovary; *Ut*, uterus; *W*, longitudinal excretory canal. ×10.

the rays of a fan. The sagittal fibres extend singly or in small bundles from dorsal to ventral surfaces directly through the proglottid; they are scattered and not so numerous as the other systems of fibres.

Absolutely no trace of an alimentary tract has yet been discovered in the cestodes. Imbibition is the only known method of taking food, and the adult tapeworms are accordingly limited to those organs, alimentary canal and serous cavities, in which the parasite is bathed in a nutrient fluid.

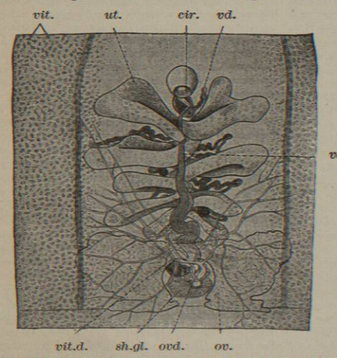


FIG. 1206.—Central Portion of the Sexually Mature Proglottis of *Dibothriocephalus latus* from the Ventral Surface. *cir*, Cirrus sac; *ov.*, ovary; *ovd.*, oviduct; *sh.gl.*, shell gland; *ut.*, loop of uterus; *vag.*, vagina; *vd.*, coil of dorsal vas deferens; *vit.*, vitellaria; *vit.d.*, yolk duct. The numerous follicular testes lie beneath, *i.e.*, dorsal to the vitellaria shown here. (After Sommer and Landois.)

The organs of the reproductive system are grouped so that each proglottis contains a complete set, and even when the body is not segmented externally, examination of the internal structure shows them to be repeated. Each proglottis contains all the organs of both sexes (Fig. 1209) and appears in this respect a complete hermaphroditic individual. The organs first make their appearance in the anterior proglottides as indistinct cords of cells which gradually assume the character of the sexually mature condition. In general the male organs reach maturity a little in advance of the female, and copulation with an older proglottis of the same or of a different chain may hence be inferred. The male system consist of numerous small testes, the vasa efferentia of which unite near the centre of the segment to a common vas deferens, and the latter, which is commonly provided with an enlargement, the vesicula seminalis, and which terminates in a copulatory organ, the cirrus, opens with the vagina into a genital cloaca (*cl*) at the common genital pore, located either at the margin or on the surface of the segment. The female organs may be said to take their origin from the genital pore with the vagina which leads inward, furnished at some point with an enlargement, the receptaculum seminis, in which the supply of sperm is stored up. The ovary, either single or paired, empties by an oviduct which joins the vagina near the shell gland and which often has near its origin a muscular organ, the oocapt, by which the eggs are taken from the ovary and forced onward to the vagina. The vitellarium is a single, large racemose gland (*D.st.*, Fig. 1205), or a multitude of small follicles (*vit.*, Fig. 1206) in which are produced the masses of yolk material to be included in the eggs. Vitelline duct and oviduct join the continuation of the vaginal canal in the shell gland, and to this portion of the duct the name ootype has been given. Here the ovum coming from the ovary is fertilized by the spermatazoon from the seminal receptacle, is surrounded by a mass of yolk material from the vitellarium, and the whole encased in a capsule formed by the secretion of the shell gland, which rapidly hardens into a thick chitinous shell. The completed eggs are then forced onward into the uterus. Since they consist not only of a fertilized ovum but also of a mass of disintegrated yolk cells, the name compound egg has been applied to them. Such eggs occur only in the flat worms.

FIG. 1207.—Ripe Proglottis of *Tænia saginata* with branched uterus. ×2. (After Braun.)

The uterus may possess a special external opening or may be without such. In the latter case it is small at first, but with the accumulation of eggs it becomes irregularly enlarged by the formation of lateral outpocketings so as to occupy with its branches almost the entire space of the proglottis (Fig. 1207). In the course of this transformation other organs gradually disappear until the ripe segment is little more than a muscular sac which encloses the branching uterus crowded with eggs. The manner of branching is characteristic of the species, as is also the way in which ripe proglottides are detached either singly or in groups, and both features together with other details in the structure of the reproductive system are discussed in connection with the individual species.

FIG. 1208.—Egg of *Tænia solium*. ×380. (After Leuckart.)

The eggs of the cestodes are oval and provided with a thin shell which is often supplied with a lid. Within this occurs in many eggs (Fig. 1208) a thicker second shell, so-called, of a structure characteristic for the family in which it occurs. In reality this inner structure is not a shell but an embryonic membrane, and takes its origin during the early growth of the germ cell, which occurs in most cases while the egg is still retained in the uterus of the adult cestode. When the uterine egg is examined soon after its formation, the shell is seen to contain a single germ cell surrounded by a number of yolk cells which, in some cases, have lost their cellular identity and constitute merely a mass of granular yolk substance.

The embryo originates from the egg cell alone while the yolk cells during its early growth. From the development of the egg serve as nutriment division of the egg cell, which undergoes total cleavage, there arises a spherical embryo surrounded by one or more embryonic membranes. From the latter may originate an inner shell, as is the case in Tæniadæ (Fig. 1208), or a ciliated mantle, as in Bothriocephalidæ (Fig. 1209). The spherical embryo (Fig. 1210), which is known as the onchosphere, is uniformly characterized by the presence of three pairs of hooks of variable shape and by great mobility, and in this condition is ready for introduction into the secondary host. This may be the result of a direct migration, as when the ciliated bothriocephalid embryo, swimming about in the water, is swallowed by a suitable host; or it may be of passive character, as when the tænioid egg containing an embryo enveloped in its membranes arrives by chance in the alimentary canal of the larval host; in the latter case, at least, it is necessary that the eggs should be introduced into the stomach and be subjected to the action of the gastric juice to disintegrate the shell and membrane. Were this not so it is clear that the harboring of the adult in the intestine would be, in those cases in which the larva parasitizes in the same animal, a source of extensive secondary infection. In such cases it is well known, as for instance in *Tænia solium* of man, that any reversal of the ordinary peristaltic action of the canal, which brings loose proglottides into the stomach and subjects them to gastric digestion, will result in the release of the six-hooked onchospheres, and in the infection of the host with the larvæ. Once that the membranes are broken down and the onchospheres set free they bore their way actively, by virtue of the hooks, through the wall, probably in most cases of the proximal portion of the intestine, and are believed to be distributed further by virtue of the portal circulation; at least the liver and the connective tissue adjacent to it are the chief seats of the larvæ. Having come to rest at such a point the embryo throws off its hooks and forms on its surface a thick cuticular layer beneath which are differentiated the muscle fibres, while about each embryo is formed a cyst by the activity of the host. The centre of the sphere is filled at first with a loose parenchymatous tissue in which soon appear irregular spaces that later fuse to form a large central cavity. Thus has been reached the first form of the larval stage known as the bladder worm or cysticercus (Fig. 1211). A growth of two to four weeks is sufficient in most cases to bring the cysticercus to the diameter of a millimeter, when the second stage in the development is entered upon by the appearance of a meniscoid proliferation of cells at some point on the bladder; into this projection there penetrates from the exterior a hollow cylindrical ingrowth of the cuticula (Fig. 1211) forming the starting-point of the scolex of the adult worm. As the growth becomes larger the ingrowth presents the form of a flask (Fig. 1212, *A*); it is still covered through-

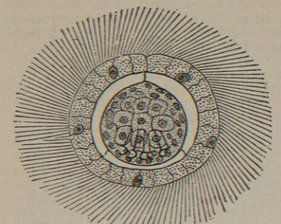


FIG. 1209.—Free Swimming Onchosphere of *Dibothriocephalus latus* in ciliated mantle. × 500. (After Schauinsland.)

FIG. 1210.—Free Onchosphere, Magnified.

FIG. 1211.—Young Cysticercus of *Tænia saginata* with beginning of Scolex Ingrowth, Seen in Optical Section. Magnified. (After Leuckart.)

out by a cuticular layer, and at the base of the flask there arise in reverse the structures which characterize the head of the tapeworm: at the centre the rostellum with its crown of hooks, and on the sides the suckers having, when fully developed, the characteristic form and size (Fig. 1212, *B*) of the adult.

Under proper conditions the head begins to be everted, starting from the base and continuing until, with the

A. B.

FIG. 1212.—Formation of Scolex in Reverse on Cysticercus of *Tænia serrata*. A, Early stage; B, fully developed scolex. Magnified. (After Leuckart.)

neck, it ultimately projects above the surface of the bladder (Fig. 1213). This process may at times take place while the bladder worm is still retained within its host. In other instances the consumption of the flesh in which the cysticercus is enclosed and the digestion of the surrounding tissue form the stimulus for the evagination of the scolex. It is interesting to note that under the influence of the alimentary secretions of the definite host the bladder of the cysticercus is entirely digested, its remnant appearing as a ragged fringe (Fig. 1214, A), at the base of the fully extended scolex and neck. Having attached itself the scolex enters upon a period of rapid increase in length, which is soon accompanied by the appearance of the first proglottides (Fig. 1214, B). The scolex system of excretory canals originates early (Fig. 1208) even before the suckers and rostellum have appeared, and persist unchanged in the scolex of the fully developed adult.

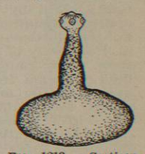
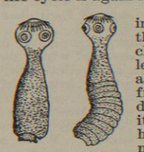


FIG. 1213.—Cysticercus of *Tænia serrata* with Everted Scolex. (After Leuckart.)

In the formation of the proglottides it may be noted that the terminal proglottis is the oldest, and that new segments are continually formed in the vicinity of the neck. The sexual organs appear early as strings or masses of embryonic cells in the midst of the parenchyma. Formation of proglottides and growth proceed so rapidly that the tapeworm has matured and set free the posterior joints in a brief period. These reach the exterior with the fæcal matter, often manifesting great independence and power in movement. They contain masses of eggs stored up in the uterus with which the beginning of the life cycle is again reached.



A. B.

FIG. 1214.—Young *Tænia serrata*. A, Immediately after digestion of bladder by new host; B, with a few proglottides. (After Leuckart.)

The normal seat of the tapeworm is in the alimentary canal, and usually in the small intestine, where the worm lies close to the wall with its head more or less embedded in the villi. Occasionally one of the smaller species wanders from this place into the ductus choledochus, and more rarely into the liver itself. This seems to be the normal habit of a few species not found in man. The occurrence of tapeworms in the human stomach or anterior thereto, as reported by various medical observers, is due either to a post-mortem wandering or to regurgitation. On the other hand the reported occurrence of Cestoda in the bladder, and the discharge of proglottides from the

urethra, can be explained, in so far as the cases do not rest on erroneous observations, only on the basis of injury or accidental introduction. Portions of a tapeworm have been at times discharged from abscesses or fistulæ which have probably had at some time a connection with the intestine. Leidy's discovery of a specimen in a cucumber admits, however, of no such natural explanation. Though often torpid when examined after discharge, the tapeworm is undoubtedly, it must be remembered, active in its warm-blooded host. To its contractions are due the serious symptoms which often accompany its presence. Even the discharged proglottides live for several days outside the host under ordinary circumstances and perform migrations and movements of considerable extent. By virtue of this apparent completeness and activity, the separate proglottides are frequently diagnosed as flukes.

The effect of the parasite on its host may be regarded first from the standpoint of loss of nutriment. This has been carefully computed by Leuckart for the largest human tapeworms, and amounts in one year for a single specimen of *Dibothriocephalus latus* to from 500 to 700 gm., and for *Tænia saginata* to from 1,500 to 2,000 gm. Although the presence of a number of individuals may heighten this materially, yet the amount is entirely inadequate to explain the far-reaching effects which are manifested by man as the result of the presence of only a single one of these parasites. The severe symptoms are noticeably of a nervous character. Anæmia is a frequent manifestation, and this displays at times a pernicious tendency which in one case at least has terminated fatally.

Many of the symptoms affecting individuals who harbor tapeworms have been attributed to poisons developed by the parasite within the body of the host. Not only is this evinced by the subsidence of the nervous and epileptic symptoms on the removal of the tapeworms, but the affections of the eyes so frequent in those afflicted may naturally be due to the effects of a poison absorbed from the intestine and circulating in the blood. The fluid extracted from a hydatid cyst has been shown by experiment on man and animals to be toxic. To this quality may doubtless be attributed the severe symptoms or even death consequent upon the rupture of such a cyst or its operative puncture. An extract from *Dibothriocephalus latus* has been shown to exert a globulicidal effect on dogs, and one of *Tænia saginata* has been found to kill tubercle bacilli.

The symptoms of tapeworm disease are by no means well defined and may include almost any possible combination. In experimenting upon himself, however, Stiles noted during the presence of *Tænia saginata* as the most constant symptom one not heretofore recorded. He says: "During the time of infection it would very frequently happen as I walked along the street or across the room that I suddenly felt a peculiar sensation almost exactly similar to the sensation one feels upon the sudden descent of an elevator." Despite the indefiniteness of the clinical aspect of tapeworm infection, any suspicions of such trouble may be definitely tested by a microscopical investigation of the fæces. The presence of adult cestodes will be manifested by an abundance of their characteristic eggs.

The specifics which are most frequently employed in driving out tapeworms are Cortex granati, of which the effective principle is an alkaloid known as "pelletierine," Flores Kouso containing the amorphous kosotoxin, Rhizoma filicis containing the amorphous filicic acid, and kamala with the resinous kamalin (see *Anthelminthics*). In bringing about the evacuation of the parasite some precautions are necessary to insure success. When a patient is passing a tapeworm the parasite sometimes breaks in two owing to the transition from the warm bowels to the cold air or to a cold porcelain vessel. By the use of a vessel containing warm water this sudden change and its consequent evil effects may be avoided. In the next place cestodes are frequently expelled in a knotted mass, and any obstruction in the lower portion of the canal may delay their passage sufficiently to permit the parasite to secure a new hold on the wall. Consequently success may depend upon thoroughly clearing out the canal.

The distribution of each species will be considered under its proper heading; here, however, some general items may be noted concerning the frequence of tapeworms. Stiles gives the following table of:

CASES OF TAPEWORM IN MAN.

Authority.	Total number of cases reported.	Sex of Patients.	
		Male.	Female.
Wawruck	173	56	117
Crisp	247	96	151
Seeger	26	10	16
Monti	240*	111	129
Roger	10*	3	7
Krabbe	367	126	241
Total	1,063	402	661

* Children.

He attributes the evident sex difference merely to the fact that women ordinarily prepare the food, and are hence more exposed to chance infection than men. Statistics of French maritime hospitals give for the period 1886–90 about 1.5 per cent. of cases for tapeworm infection, and records of the United States hospital service during the war contain a total of only .012 per cent. treated for tapeworms. This percentage is under the circumstances naturally abnormally low as compared with conditions in times of peace.

The occurrence of various species in different regions may be adjudged from the following table. Such figures exist only for a very few localities:

Authority.	Country.	Dates of records.	Total number of cases.	Tænia saginata.	Tænia solium.	Diboth. latus.	Dipyl. cuninum.	Hymen. diminuta.	Indet.
Parona	Milan	1899	150	121	11	4	..	..	14
Parona	Italy	1868–99	513	397	71	26	..	..	19
Krabbe	Denmark	1869	100	37	53	9	1	..	..
Krabbe	Denmark	1869–87	200	153	24	16	8	..	..
Krabbe	Denmark	1887–95	100	89	....	5	6	..	..
Stiles	U. S. A.	1897	....	Many	Rare	3	..	1	..

Cestodes have been known from the earliest times, and both tapeworms and bladder worms are distinctly recognized in the oldest medical works which have come down to us. One of the hermetic books of the Egyptians, that on medicaments now known as the Papyros Ebers, and dated about 1550 B.C., gives in hieratic writing extensive sections on these parasites and their treatment, which are taken in part from the writings of earlier physicians. The proscription placed by Moses on the use of certain flesh has its undoubted ground in the abundant presence in such animals of bladder worms. Hippocrates notes the presence of echinococcus bladders in man and an operative method for removing them. He also speaks of the evacuation of fragments like pumpkin seeds as diagnostic of the tapeworm. Both he and Aristotle speak of the bladder worm of the pig as well known, and advise the detection of its presence by examining the lower surface of the pig's tongue where the cysticerci appear as swellings. This method is followed even to-day. Aristotle showed also that the tapeworm in contrast with the free round worms of the intestine was attached to the wall of the canal. Pliny adds to the accounts of his predecessors which he quotes only fabulous reports of the length of tapeworms (up to three hundred feet!) and erroneous observations on their presence in cold springs. Galen mentions bladder worms from the abdomen of slaughtered animals and notes the tendency of the liver to "produce" these forms in its surrounding fascia.

It was 1600 A.D., however, before even two species were differentiated among human tapeworms, and 1700

A.D. before the tapeworm head was recognized. About this time cestodes from other hosts began to be studied and the animal nature of the bladder worms, which had previously been regarded as tumors or concretions, was successfully maintained. Even then authors noted the resemblance of certain cestodes and cysticerci, and in 1782 Goeze united the two groups, but this procedure was not accepted by later authors for more than half a century.

The origin of these parasites was universally attributed to spontaneous generation, the tapeworm being said to originate from the inner wall of the canal, from surplus food of a thick character like milk or cheese, or from febrile mucous secretions, while the cysticerci were generally regarded as tumors (hydatids). This belief lasted long, even after the discovery of the eggs in many species. Linnæus was responsible for propagating another serious error, that the cestodes were free living as well as parasitic; and this was not finally refuted until the end of the eighteenth century. It was Zeder who in 1800 first divided the parasitic worms into five classes to which Rudolphi in 1804 gave the Greek names, Nematoidea, Acanthocephala, Trematoda, Cestoidea, Cystica, which they still bear. Of the last two, the tapeworms and bladder worms, Küchenmeister was able to prove about the middle of the century by feeding experiments that the latter were only developmental stages of the former, thus incorporating both in the group of cestodes. Among these those forms with only a single segment may be distinguished as the Cestodaria from the Cestoda *s. str.*, in which group are included the large majority of the tapeworms, and all of the forms reported from man. The latter may be arranged according to the following scheme which adopts the system proposed by Braun. The groups omitted here contain no forms recorded as human parasites. Annotation is made of the stage in which each species is a human parasite and of those forms thus far recorded in this country:

Order Cyclophyllidea.
Family Tæniadæ.
Tænia saginata. Adult in man. U. S. A.
" africana. " " "
" solium. " " U. S. A.
" confusa. " " U. S. A.
" serrata. Larva in man (?)
" marginata. " " (?) U. S. A.
" echinococcus. " " U. S. A.
Davainea madagascariensis. Adult in man.
Hymenolepis nana. " " U. S. A.
" diminuta. " " U. S. A. (?)
Dipylidium caninum. " "
Order Pseudophyllidea.
Family Bothriocephalidæ.
Dibothriocephalus latus. Adult in man. U. S. A. (?)
" cordatus. " "
Dibothrium Mansoni. Larva in man.
Diplogonoporus grandis. Adult

KEY TO ADULT TAPEWORMS OF MAN.

Scolex with four circular suckers; proglottides with marginal genital pore and without uterine orifice.
Cyclophyllidea—Tæniadæ. (A.)
Scolex with two longitudinal sucking grooves; proglottides with superficial genital pore and with special uterine orifice.
Pseudophyllidea—Bothriocephalidæ. (B.)

(A.) Large forms; uterus in ripe proglottides with median longitudinal trunk and numerous lateral branches; eggs with thin outer and thick inner shell (embryophore). (*a.*)

(*a.*) Head unarmed with small apical fifth sucker.
Ripe proglottis 12 to 19 mm. long by 5 to 7 mm. wide; uterus with 20 to 30 slender lateral branches. *Tænia saginata.*
Ripe proglottis 7 mm. long by 12 to 15 mm. broad; uterus with 15 to 24 simple radiating branches. *Tænia africana.*

(*aa.*) Head armed with circlet of hooks.
Ripe proglottides 10 to 12 mm. long by 5 mm. wide; uterus with 7 to 10 thick branches; ovary on pore side divided by vagina. *Tænia solium.*

(*aaa.*) Head unknown.
Ripe proglottides 27 to 35 mm. long by 3.5 to 5 mm. wide; uterus with 14 to 18 heavy irregular forked branches. *Tænia confusa.*

(AA.) Small forms; eggs with thin transparent shells, in ripe proglottides grouped in capsules or irregularly distributed. (*b.*)

(*b.*) Genital pores unilateral.
Ripe proglottides broadly elliptical, 2 mm. long by 1.4 mm. wide. *Davainea madagascariensis.*
Ripe proglottides trapezoidal, 0.14 to 0.30 mm. long by 0.4 to 0.9 mm. wide. *Hymenolepis nana.*
Ripe proglottides trapezoidal, 0.75 mm. long by 2.5 mm. wide. *Hymenolepis diminuta.*
(*bb.*) Genital pores on both margins of each proglottis; genital organs also double.
Ripe proglottides elliptical. *Dipylidium caninum.*

(B.) Genital organs single in each proglottis.
Head elongated oval; length of worm 2 to 7 meters.
Ripe proglottides 2 to 4 mm. long by 10 to 12 mm. wide. *Dibothriocephalus latus.*
Head short, cordiform; length of worm hardly over 1 meter.
Ripe proglottides approximately 5 to 6 mm. square. *Dibothriocephalus cordatus.*

(BB.) Genital organs double in each proglottis.
Head not known; length about 10 meters.
Ripe proglottides 0.5 to 0.8 mm. long, 10 to 15 mm. wide. *Diplogonoporus grandis.*

In all cases reference should be made to the fuller descriptions given for each species in the text, and thus the results obtained by use of the brief criteria contained in the key controlled. Especial attention should be paid to those species which are as yet incompletely known; the writer will be glad to assist in the identification of any such.

FIG. 1215.—Anterior End of *Tænia saginata*, Somewhat Contracted. × 8. (After Leuckart.)

The Cyclophyllidea possess a scolex with four circular suckers, often with an apical rostellum on which hooks are found when present. Segmentation is pronounced and the ripe proglottides do not separate until fully developed. There is no uterine aperture and the common sexual pore is located on the margin of the proglottides. The eggs are thin shelled and without a cover. The adults lie in the alimentary canal of the higher vertebrates. The order contains but a single family, the Tæniadæ.

For the genus *Taenia* the following characteristics are diagnostic. Large species with ripe proglottides much longer than broad. Uterus with median trunk and subsequently formed lateral branches during the development of which the remaining sexual organs disappear save cirrus and vagina. Larva, a cysticercus, cœnurus, or echinococcus, found in herbivorous mammals and also in man; adult in man and the carnivorous mammals.

TÆNIA SAGINATA Goeze.—T. inermis Brera, T. dentata Nicholai, T. lata Pruner, T. mediocanellata Küchenmeister, T. tropica Moq.-Tand.*

Length 4 to 8 meters or even to 74 meters (Bérenger-Féraud). Head (Fig. 1215) somewhat four-sided, 1.5 to 2 mm. in diameter, without rostellum and circle of hooks but with a sucker-like depression in its place which is often pigmented. Neck long, narrower than head. Proglottides number more than 1,000 and increase gradually in length until the ripe segments of characteristic pumpkin-seed appearance measure 16 to 20 mm. long by 4 to 7 mm. broad. Genital pores irregularly alternating, marginal, and posterior to the centre of the proglottis. Uterus in ripe proglottis with median stem and twenty to thirty-five slender lateral branches, themselves often branched. Egg shell delicate with one or two polar filaments (Fig. 1216), embryophore ovoid 35 to 40 μ by 20 to 30 μ in diameter. Adult exclusively in small intestine of man; larva (*Cysticercus bovis*) in the muscles and viscera of cattle.

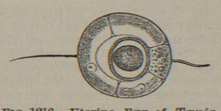


FIG. 1216.—Uterine Egg of *Tænia saginata* Showing Shell with Polar Filaments and in the Centre Onchosphere within the Embryophore. × 375. (After Leuckart.)

Structure.—The arrangement of the reproductive organs in a sexually mature proglottis (Fig. 1205) is best

* Only the synonyms most frequently met are given under each species.