A REVISION OF THE ADULT TAPEWORMS OF HARES AND RABBITS.[1]

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A DISCOVERY by Cooper Curtice in 1887 regarding certain young stages of rabbit tapeworms, observations which I was able to confirm and extend in 1894, immediately brought the leporine cestodes into a very important position, viewed from an economic as well as from a scientific standpoint, for Curtice's observation at first sight seemed to offer a guide to solving the puzzle as to the larval stage of the tapeworms of cattle, sheep, horses, and certain other animals.

Curtice observed in the intestine of rabbits certain young cestodes which bore minute hooks upon the rostellum, and older stages were found which had lost these hooks. He determined the adult cestodes found in these rabbits as *Tænia pectinata* and looked upon the armed forms as the young of this species.

With these observations before us, it looked as if some very radical changes would be made in the near future in the classification of the tapeworms of the larger domesticated animals; it further seemed probable that the young stage of the tapeworms of cattle, sheep, and horses, would eventually be found to be an armed cysticercoid.

In a paper[2] in 1894 I called attention to this bearing of the question and extended Curtice's observations. I found that the suckers[3] as well as the rostellum were armed, and that the head bore a remarkable resemblance to the head of *Davainea*. This complicated the question in so far as to render necessary the consideration of two further possibilities—i. e., were these young cestodes the early stages of avian

[1] At the request of the author, it is here stated that he is not responsible for the insertion of commas between the names and the authorities, and for the absence of capitals at the beginning of specific names derived from personal names. These changes have been made in order to bring his paper into conformity with the usages at present followed in the U. S. National Museum.—EDITOR.

[2] Notes sur les Parasites—31: Une phase précoce des Ténias du Lapin. (Notice préliminaire), Bull. Soc. zool. France, 1894, XIX, pp. 163–165.

[3] Some old sketches of Curtice's show that he also observed the hooks upon the suckers.

cestodes which had accidentally gained access to rabbits, or did there exist in American rabbits an adult cestode belonging to the genus *Davainea*?

The relation of the subject to the tapeworms of cattle, sheep, and horses made it absolutely necessary from an economic standpoint, and the relation of these forms to the adults in rabbits made it desirable from a scientific standpoint, to immediately revise the adult cestodes found in rabbits. This work was accordingly begun, and in 1895 my paper[1] was published announcing the finding of a double-pored cestode with occasional single pores, and the occurrence in American rabbits of a single-pored cestode with a *Davainea*-like uterus.

This paper practically disposed of the young armed cestode of rabbits, for after reading it the natural conclusion of every helminthologist would be that this parasite was probably a *Davainea* and that we were no nearer the solution of the question as to the young form of *Moniezia* than we were before.

The present paper is the result of the revisional study mentioned above. In it I finally dispose of the armed form mentioned in 1894, and at the same time I am obliged to complicate the question as to the larval stage of *Moniezia* still further by presenting an unarmed young cestode in rabbits. I further give an anatomical systematic revision of the adult leporine tapeworms, together with their generic relationship to the cestodes of cattle, sheep, and horses.

I desire to call particular attention to the young unarmed cestode described on p. 201. Had any worker found this parasite in an insect, worm, or snail in a locality where cattle and sheep are infested with *Moniezia expansa*, he would hardly have hesitated to announce the discovery of the intermediate host of this important parasite. The finding in one host of a larval form whose head resembles a certain adult in another host does not, however, scientifically establish the life history of that particular parasite.

I can now prophesy confidently that it will be almost, if not entirely, impossible to distinguish the larval stage of *M. expansa* from that of a dozen or so of other tapeworms, and on account of the great economic importance of this question I caution against any too early and too ungrounded announcement of the source of infection of cattle and sheep by this species. The only work upon this subject which will be worthy of full credence is experimental feeding.

Within recent years it has been customary to associate the larvæ found parasitic in some animals with the adults parasitic in other hosts simply because of a similarity of the heads and hooks. This is particularly the case with the avian tapeworms. I feel it necessary to enter a protest against carrying these generalizations too far, for at present, when so many of the adult avian parasites are so incompletely described

[1] Notes on Parasites—36: A double-pored cestode, with occasional single pores, Centralbl. f. Bakter. u. Parasitenk. I Abt., XVII, 13–14, pp. 457–459.

that they can scarcely be recognized, it can hardly be expected that the larvæ can be determined with certainty. The work by Mrázek, Moniez, Hamann, von Linstow, and others in describing these larval forms has been most valuable; but authors have, I believe, generalized too much upon these observations.[1]

Acknowledgments.—I am indebted to the following gentlemen for furnishing me with specimens for study in preparing this revision:

Prof. Raphael Blanchard, of Paris: A portion of Baird's type of *Tænia goezei;* specimens of *Anoplocephala wimerosa* and *Cittotænia leuckarti.* Dr. Gustav Brandes, of Halle: Original cotypes of Riehm's *Dipylidium pectinatum*, *D. leuckarti*, and *D. latissimum.* Geheimrath Karl Möbius and Dr. A. Collin, of Berlin: Fragment of Rudolphi's *Tænia pectinata.* Prof. Herbert Osborn, of Ames, Iowa: Specimens of *Cittotænia præcoquis.* Prof. M. J. Elrod, of Bloomington, Illinois: Specimens of *Bertia americana.* Mr. J. H. Tallichet, of Austin, Texas: Specimens of *Davainea salmoni* and *Cittotænia variabilis.* Dr. A. K. Fisher, Division of Mammalogy and Ornithology, United States Department of Agriculture: Specimens of *Davainea retractilis.* Mr. Robert A. Mills, of Chuluota, Florida: Specimens of *Cittotænia variabilis imbricata.* Dr. Austin Peters, of Boston, Massachusetts: Specimens of *C. variabilis.*

The other material[2] used belonged to collection of Bureau of Animal Industry (collected by Curtice, Hassall, Stiles); collection of the United States National Museum; collection of Leidy (University of Pennsylvania), and collection of Stiles (United States National Museum).

Although this article treats primarily of leporine cestodes, it has been found necessary to include several forms from other hosts for comparison.

To my assistant, Albert Hassall, I am indebted for the entire technique connected with the specimens used, and also for the preparation of the bibliography, and to Mr. W. S. D. Haines, artist of the Bureau of Animal Industry, Department of Agriculture, for preparing the plates.

Unfortunately much of the material at my disposal was poorly

[1] For a detailed discussion of this subject cf. Stiles: Report upon the Present Knowledge of the Tapeworms of Poultry, Bull. 12, Bureau of Animal Industry, U. S. Department of Agriculture, 1896, pp. 7–73, pls. I–XXI.

[2] Since issuing my preliminary note on this group, I have received the following specimens from the gentlemen mentioned:

Prof. A. Moniez, of Lille: His entire collection of anoplocephaline cestodes, including the type specimen of *Tænia wimerosa* and undetermined specimens of *Cittotænia denticulata* and *C. pectinata.* Geheimrath Rudolf Leuckart, of Leipzig: cotypes of Riehm's *Tænia rhopalocephala* and *T. rhopaliocephala* and one of Meyner's originals of *Tænia (Bertia) mucronata.* Dr. Victor A. Norgaard, of Alice, Texas: Specimens of *Davainea salmoni.* Dr. O. von Linstow, of Göttingen: Specimen of *Cittotænia pectinata.* Dr. von Marenzeller, of Vienna: Several of Riehm's cotypes. Dr. Collin, of Berlin: Rudolphi's cotypes of *Tænia denticulata.*

The manuscript of this article was delayed in order that these specimens could be studied and the results incorporated in the revision.

preserved, so that a number of points I have been obliged to leave for further study. The present study, however, reduces the known leporine forms (*Andrya* and *Bertia* excepted) to a comparatively satisfactory system.

It must be held in mind that every classification proposed for the Cestoda for some years to come is experimental and provisional, for helminthology is not yet so far advanced that we can tell with any degree of certainty what characters or combinations of characters should be looked upon as of family, subfamily, generic, subgeneric, specific, and varietal value, and what characters should be attributed to host-influence.

Date of American species.—"Notes on Parasites—38: Preliminary note to 'A Revision of the Adult Leporine Cestodes,'"[1] established August 28, 1895, as the date of the new specific names used in this paper.

Important notice to helminthologists.—Owing to the fact that Hassall and I have been using material from different helminthological collections, more particularly from the collection of the Bureau of Animal Industry, collection of the United States National Museum, collection of Hassall, collection of Stiles, and collection of Leidy (University of Pennsylvania) bearing parallel current numbers, some confusion has arisen because the same number sometimes appears in all five collections. These five collections were commenced independently, and as their union (temporary or permanent) was not foreseen, this duplication of numbers could not be avoided.

To avoid such confusion in the future as far as possible, the collection of the Bureau of Animal Industry and collection of Stiles will be covered into the United States National Museum, and receive the current numbers of the helminthological collection of the Museum.

The numbers which have been published will not be affected by this change, so far as can now be foreseen. The numbers of a few of the specimens which have been distributed, however, will in all probability be changed. Records of these specimens have been kept in the Zoological Laboratory, Bureau of Animal Industry, and new labels bearing the new numbers will be written and mailed to specialists and museums possessing such specimens as are affected by the renumbering of the collections.

The Leidy collection, as I have stated in another publication, is deposited with me only temporarily and will be eventually returned to the University of Pennsylvania. Duplicates, however, will be kept with the United States National Museum.

Family TÆNIIDÆ.

Diagnosis.—Cestoda with distinctly segmented strobila; head provided with four cup shaped suckers; rostellum well developed, or

[1] Vet. Mag., II, June, 1895, pp. 341-346, issued Aug. 28, 1895.

rudimentary and not always evident (? or entirely absent); genital pores generally lateral; uterus without special pore.

Type genus.—*Tænia*, Linnæus, 1758.

All of the leporine cestodes known at present belong to the family Tæniidæ, in which most authors place indiscriminately all tapeworms provided with four cup-like suckers. Were this family subjected to revision by any set of zoologists except helminthologists, it would undoubtedly soon be raised to superfamily rank at least, and divided into several families, subfamilies, and numerous genera. Most helminthologists, however, are very conservative in proposing genera, even when very prolific in establishing species! A superfamily Tænioideæ will, I believe, soon be established, but this step it will be well to postpone until the cestodes of birds are brought into better order.

ANALYTICAL KEY TO THE GENERA OF ADULT TAPEWORMS FOUND IN LEPUS.[1]

1. Head unarmed; genital pores single or double; ova with pyriform body. ..... *Anoplocephalinæ* 2
   Head armed with numerous hooks on the rostellum and suckers; genital pores single; ova without pyriform body ..... *Davainea* (p. 194.)
2. Genital pores double; single pores a rare exception and then in strobilæ containing double pores ..... *Cittotænia* (p. 170.)
   Genital pores single 3
3. Genital pores unilateral; testicles unilateral or nearly so, in portion of median field opposite pores; uterus transverse with proximal and distal egg pouches; no separate and distinct prostatic gland present ..... *Anoplocephala* (p. 150.)
   Genital pores irregularly alternate; testicles extend across the median field to or beyond the ovary; uterus appears as a network or as a transverse tube with egg pouches 4
4. Separate and distinct prostata wanting; uterus a transverse tube with proximal and distal egg pouches ..... *Bertia* (p. 160.)
   Separate and distinct prostata present; uterus reticulate; genital pores show a marked tendency to unilaterality ..... *Andrya* (p. 154.)

Subfamily ANOPLOCEPHALINÆ, R. Blanchard, 1891.

Diagnosis.—Tæniidæ with unarmed head; genital pores lateral, single or double; segments nearly always broader than long; uterus transverse and tubular, or reticulate; ventral canals always well developed; dorsal canals generally less developed; ova generally with pyriform body; calcareous bodies present or absent.

Type genus.—*Anoplocephala*, E. Blanchard, 1848.

Riehm[2] in 1881 placed the three double-pored rabbit cestodes known to him in the genera *Dipylidium*, R. Leuckart, and *Cittotænia*, Riehm, and the single-pored forms in *Tænia;* in his second[3] paper he placed

[1] See also p. 213.

[2] Zeitschr. ges. Naturw., 3 ser., VI, p. 200.

[3] Studien an Cestoden, Zeit. ges. Naturw., 3 ser., VI, pp. 545-610.

all the double-pored forms in *Dipylidium*. R. Blanchard[1] in 1891 placed the double-pored forms in *Moniezia*, the single-pored forms in *Anoplocephala;* Stiles[2] in 1893 separated the double-pored forms from *Moniezia*, but did not establish any genus for them; Railliet[3] in 1893 created the genus *Ctenotænia* for the double-pored forms and *Andrya* for the single-pored forms.

My studies now lead me to adopt *Cittotænia* for the double-pored leporine cestodes, and to divide the unarmed single-pored forms between the genera *Anoplocephala*, *Andrya*, and *Bertia*.

Genus ANOPLOCEPHALA, E. Blanchard, 1848 (nec Stål 1870).

1848, *Anoplocephala*, E. Blanchard, Ann. des Sci. nat., 3 ser., Zool., X, p. 344. Type by elimination, *Tænia equina perfoliata*, Goeze, 1782.

1871, *Plagiotænia*,[4] Peters, Proc. Zool. Soc. Lond , p. 146. Type, *Tænia gigantea*, Peters, 1856.

1891, "*Plagotænia*, Peters, 1871" (as synonym) in R. Blanchard, Mém. Soc. zool. France, IV, p. 446.

Diagnosis.—Anoplocephalinæ with segments broader than long. One set each of male and female organs in each segment; genital pores unilateral (dextral[5]); testicles in the aporose, ovary in the pore side of the median field. Uterus a transverse tube with proximal and distal pouches. Dorsal canals lie dorsal or lateral of ventral canal. Genital canals cross the longitudinal canals and nerves dorsally. Calcareous bodies (always?) absent from parenchyma. Eggs with well-developed pyriform body. *Hosts:* Perissodactyla, Rodentia.

Type.—*A. perfoliata* (Goeze, 1872), E. Blanchard, 1848.

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[1] Sur les Helminthes des Primates Anthropoides, Mém. Soc. zool. France, IV, pp. 186–196. Notices helminthologiques: 7 —Cestodes du groupe des Anoplocephalinæ R. Blanchard, 1891, Mém. Soc. zool. France, IV, pp. 443–450.

[2] A Revision of the Adult Cestodes of Cattle, Sheep, and Allied Animals, Bull. IV, Bur. An. Ind., U. S. Dept. Agric.

[3] Traité Zool. méd. et agric., I.

[4] Max Braun (1891, Vermes, 36–37 Lieferung, p. 1138) erroneously gives the date of this genus as 1870; R. Blanchard spells the generic name *Plagotænia*. A typographical error in R. Blanchard, 1891, p. 446, gives *Anoplocephala* the date of 1868, while Braun (loc. cit., p. 1133) dates the genus 1847. Errors of this kind naturally creep into every author's writing. In this connection I would call attention to the list of Cestoda given by Braun (loc. cit., pp. 1133–1145). While this list is extremely valuable in tracing the different species, it must not be looked upon as complete; furthermore, care must be exercised in using the dates of species given by Braun. Rudolphi's species of 1810 are erroneously given as 1808; Krabbe's species of 1869 are erroneously given as 1870. A number of other species are also incorrectly dated.

[5] In *A. wimerosa* the pores are evidently dextral, but in the other species I am unable to determine whether they are dextral or sinistral, either from the figures or descriptions given by various workers. In one of my preparations of *A. mamillana* they are certainly sinistral; in another preparation they are apparently dextral. Professor Zschokke has reexamined his preparations of *A. mamillana* at my request and writes me that he finds the pores dextral, which agrees with the topography found upon a preparation by Railliet very recently sent to me.

R. Blanchard in 1891 admitted the following species to this genus:

A. perfoliata[1] (Goeze, 1782).
A. mamillana (Mehlis, 1831).
A. plicata (Zeder, 1800).
A. transversaria (Krabbe, 1879).
A. wimerosa (Moniez, 1880).
A. globiceps[2] (Diesing, 1856).
A. blanchardi, Moniez, 1891.
A. zebræ (Rudolphi, 1810).
A. hyracis (Rudolphi, 1810).
A. gigantea (Peters, 1856).
Tænia rhopalocephala, Riehm, 1881.
T. rhopaliocephala, Riehm, 1881.

Two of these species, *Tænia rhopalocephala* and *T. rhopaliocephala*, I refer with Railliet to the genus *Andrya* (vide, p. 154). Of the other species, *A. wimerosa* is the only one which occurs in rabbits. This form is very closely allied to *A. mamillana* of the horse and *A. transversaria* of the marmot, which are here introduced for comparison. Several of the remaining forms require further study before their generic position can be looked upon as fully established. Setti (1893) refers *Arhynchotænia eritica* Pagenstecher, 1877, and *Tænia ragazzii* Setti, 1891, from *Hyrax* to this genus.

ANOPLOCEPHALA WIMEROSA (Moniez, 1880), R. Blanchard, 1891.

(Plate V, figs. 1–7.)

1880,[3] *Tænia wimerosa*, Moniez, Bull. scientif. du Départ. du Nord, 2 ser., 3 ann., no. 6, Juin, pp. 240–242.
1891, *Anoplocephala wimerosa* (Moniez, 1880), R. Blanchard, Mém. Soc. zool. France, IV, p. 187, p. 449.
1893, *Andrya wimerosa* (Moniez, 1880), Railliet, Traité de Zool. méd. et agric., 1, p. 283.

Moniez, in 1880, described as *T. wimerosa* a cestode which he found in *Lepus cuniculus* at Wimereux. His description reads as follows:

[p. 241.] Le *Tænia Wimerosa* appartient au type du *Tænia expansa*. Observé à l'œil nu ou sous de faibles grossissements, cette espèce qui atteint à peine un centimètre de long sur une largeur de un millimètre et demi, se présente avec un corps épais, formé d'une dizaine d'anneaux seulement. La tête est grosse, les ventouses écartées, il n'y a ni bulbe ni crochets, le cou est nul. Les anneaux s'accusent d'abord par des plis accentués; leur rebord inférieur très saillant est arrondi et orné d'une série de cils élégamment disposés; leur aspect rappelle celui des cils des ventouses dont j'ai parlé ailleurs à propos de la Ligule.

L'appareil génital n'est pas double dans cette espèce comme chez beaucoup d'Inermes et, par une autre particularité, tous les anneaux le portent du même côté. En même temps, l'ouverture génitale débouche au rebord inférieur de l'anneau, bien

[1] The tapeworms of the horse should be subjected to an anatomical revision, and at the same time their specific names should be correctly established. I refrain from attempting to straighten out these names at present, as this can be done satisfactorily only when one has a good line of specimens before him. The tapeworms of horses are unfortunately very poorly represented in the Bureau of Animal Industry collection.

[2] Lühe, 1895 B, pp. 202–205, has recently reexamined Diesing's type material of this species, and has shown it to be an unquestionable *Anoplocephala*.

[3] The citations immediately following the specific names include only those articles which have a direct bearing on the synonymy s. st.; other references are cited in the text by date of publication. (See Bibliography, p. 222.)

que la poche péniale soit située exactement en son milieu; le pénis, qui est très long, décrit donc pour sortir une courbe accentuée. La saillie que ce dernier organe peut faire en dehors est considérable.

Le développement de la poche péniale imprime des modifications particulières à la forme de cet animal. La poche péniale occupe d'abord la plus grande partie de l'anneau; par suite de la rapidité de son développement, qui marche beaucoup plus vite que celui du reste de l'anneau, elle forme, sur le bord, une saillie très forte qui s'efface à mesure que l'anneau grandit. La symétrie se trouve ainsi rétablie, mais le développement des œufs fait bientôt disparaître complètement l'énorme poche péniale.

Les forts grossissements permettent de voir les œufs; dont les caractères sont ceux des œufs des Tænias inermes [p. 242] vrais; leur appareil pyriforme est très développé. Les muscles longitudinaux sont gros et forment une zône continue et peu épaisse. La zône de prolifération est très étendue et sous-jacente aux ventouses.

Blanchard in 1891 found the same form in *Lepus variabilis* and determined it as an *Anoplocephala*.

Railliet in 1893 transferred it to his genus *Andrya*.

Through the kindness of Blanchard, I obtained a number of his specimens upon which the following details are based:

The worms attain 10 mm. in length by 2 mm. in breadth. The head is unarmed, nearly square when viewed *en face*, measuring about 0.78 to 0.88 mm. broad; it sits like a knob on the end of the strobila, from which it is sharply defined. No rostellum was visible. The four suckers are powerful, having a diameter of nearly 0.4 mm. Neck absent segmentation beginning immediately back of the head; as many as 28 segments are present in some individuals. The anterior segments are much broader than long and somewhat asymmetrical; the posterior segments may measure 2.24 mm. broad by 0.8 mm. long; in some cases they become nearly as long as broad. The genital pores are unilateral and dextral.

The reproductive glands are confined to the anterior third of the worm, while the posterior two-thirds are occupied by the uterus. The genital pore becomes almost or quite obliterated upon the atrophy of the glands. The testicles are confined entirely to the aporose side of the segment, as is the case with *Anoplocephala mamillana* and *A. transversaria*.

This parasite is very closely allied to *A. mamillana* of the horse. From the descriptions of former authors and from my own studies, I propose the following as a revised specific diagnosis:

Diagnosis.—*Anoplocephala vimerosa* (Moniez, 1880). R. Blanchard, 1891: Strobila attains 10 mm. in length by 1.5 to 2.25 mm. in breadth, and contains from 10 to 28 segments which are always broader than long; proximal segments often asymmetrical in outline. Distal segments attain about 2.25 mm. broad by 0.8 mm. long, rarely becoming nearly as long as broad. Head unarmed, nearly cuboid, measuring 0.7 to 0.88 mm., and sits like a knob on the end of the strobila; rostellum not observed; suckers 0.4 mm. in diameter, prominent, rounded, opening diagonally forward; posterior lobes absent. Neck absent. Genital pores unilateral, dextral. The sexual glands are confined to the

proximal third of the worm, the uterus occupying the distal two-thirds. Male organs: Testicles about 15 to 30 in a segment, left of the median line; they appear in the first or second segment, and atrophy by the fifteenth; cirrus-pouch dorsal of vagina, attains 0.48 mm. in length, crossing the longitudinal canals dorsally. Female organs: Ovary appears in earliest segments in about the median line, and atrophies earlier than the testicles; receptaculum seminis elongate; uterus ventral, transverse with distal and proximal pouches. Ova 52 μ in diameter, pyriform body 12 μ, horns crossed. Dorsal canal dorsal to lateral of ventral canal. Genital canals pass dorsally of longitudinal canals and nerves.

Hosts.—European Rabbit (*Lepus cuniculus*) by Moniez; Mountain Hare (*L. variabilis*) by R. Blanchard.

Type.—No. 1452, U.S.N.M., belongs to collection of Moniez. Typical specimens in collection of R. Blanchard (Paris);[1] collection of Bureau of Animal Industry;[1] collection of Stiles (U.S.N.M.);[1] Nos. 112, 1353, 1358, 1359, 1360, 1361, U.S.N.M.;[1] collection of Hassall;[1] collection of Leidy (University of Pennsylvania);[1] collection of Harvard University;[1] collection of H. B. Ward.

Geographical distribution.—France: Wimereux (by Moniez); Briançon, by R. Blanchard.

ANOPLOCEPHALA MAMILLANA (Mehlis, 1831), R. Blanchard, 1891.

(Plates V, fig. 8; VI, figs. 1–3.)

1831, *Tænia mamillana*, Mehlis, Gurlt's Lehrbuch d. path. Anat. d. Haussäugethiere, I, p. 380, pl. IX, figs. 7, 11.

1891, *Anoplocephala mamillana* (Mehlis, 1831), R. Blanchard, Mém. Soc. zool. France, IV, p. 187.

Diagnosis.—*Anoplocephala mamillana* (Mehlis, 1831), R. Blanchard, 1891: Strobila attains 6 to 30 mm. in length by 4 to 6 mm. in breadth. Head unarmed, 0.7 to 0.8 mm. broad by 0.5 mm. long; suckers very muscular, elliptical with elongate openings; posterior lobes absent. Neck absent. Thirty-five to fifty-two segments present, the distal 4 to 8 completely filled with ova; sexually active segments 3 to 5 mm. broad by 0.3 to 0.6 mm. long; posterior segments may attain 2 mm. in length. Genital pores unilateral in posterior half of lateral margin. Male organs: Testicles confined to aporose side of segment, appearing in the first segments, and atrophying by the seventeenth to eighteenth segments; they are 60 to 100 in number; cirrus-pouch well developed, may attain 0.8 mm. in length, cirrus spinous. Female organs: Vagina ventral of cirrus-pouch; ovary visible in seventh segment, reaches its highest development in thirteenth to sixteenth and atrophies in twentieth to twenty-second; it is situated slightly to the right of the median line; receptaculum seminis globular; the transverse uterus appears in fifth or sixth segment, develops proximal and distal pouches, and begins to fill about the fifteenth segment; eggs oval, 88 μ by 50 to 60 μ.

[1] Specimens distributed from collection of R. Blanchard.

Dorsal canal dorsal to lateral of ventral canal. Genital canals pass dorsally of longitudinal canals and nerves.

Host.—Horse (*Equus caballus*).

This diagnosis is based in part upon the anatomical discussion of this worm by Zschokke,[1] in 1888.

ANOPLOCEPHALA TRANSVERSARIA (Krabbe, 1879), R. Blanchard, 1891.

(Plate VI, figs. 4–7.)

1879, *Tænia transversaria* KRABBE, Verh. d. K. Ges. d. Frde. d. Natur, Anthropol. und Ethnographie, XXXIV, Moskau, pp. 2–3, figs. 1–6.

1891, *Anoplocephala transversaria* (KRABBE, 1879), R. BLANCHARD, Mém. Soc. zool. France, IV, p. 448.

Diagnosis.—*Anoplocephala transversaria* (Krabbe, 1879), R. Blanchard, 1891: Strobila attains 10 to 16 cm. in length by 6 to 8 mm.[2] in breadth, and is composed of 200 to 300 segments. Head distinct, 0.6 to 0.8 mm. broad by 0.6 mm. long, suckers powerful and prominent; posterior lobes absent; neck absent. Genital pores unilateral at about the middle of the margin. Male organs: 60 to 80 testicles to each segment, confined to the aporose portion of the median field; cirrus-pouch large. Female organs: Vulva ventral of cirrus-pouch; receptaculum seminis elongate; ovary in pore-side portion of median field; uterus transverse, with pouches. Dorsal canal lateral of ventral canal. Genital canals pass the longitudinal canals and nerves dorsally. Ova with well-developed pyriform body.

Host.—*Arctomys*, sp.; in Turkestan by Fedschenko.

Diagnosis is based on Zschokke's anatomical discussion in 1888.[3]

Genus ANDRYA, Railliet, 1893.

1893, *Andrya*, RAILLIET, Traité de Zoologie médicale et agricole, I, p. 283. Type, *Tænia rhopalocephala*, Riehm, 1881.

Provisional diagnosis.—Anoplocephalinæ with segments broader than long, or as long as broad. One set each of male and female organs to each segment; genital pores irregularly alternate with marked tendency to unilaterality; female glands in median field on pore side of median line; uterus appears as a network with peripheral dichotomous branches and afterwards assumes a more saccular form; testicles confined to median field; a distinct round or elongate pedunculated prostatic gland near ventral canal on pore side of median field; genital canals pass dorsally of ventral (and ? dorsal) canal and nerve. Dorsal canal dorsal to dorso—(? lateral) of ventral canal. Calcareous corpuscles develop in distal portion of strobila. Egg with well-developed pyriform body, the horns of which are rather short. *Hosts:* Rodents.

Type.—*Andrya rhopalocephala* (Riehm, 1881), Stiles, 1895.

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[1] Reches. Struc. Anat. et Histl. des Cestodes, Genève, pp. 18–46, figs. 1–14.

[2] There is evidently a typographical error in Zschokke's figures, for he gives the breadth of the mature segments at 0.6 to 0.8 mm., yet states on the same page that the proglottids are 0.5 mm. long, and twelve times as broad as long.

[3] Reches. Struc. Anat. et Histl. des Cestodes, Genève, 1888, pp. 47–63, figs. 15–20.

The genus *Andrya* was proposed by Railliet in the following words:

Il n'est pas douteux, bien que leur étude anatomique soit encore peu avancée, que les anoplocéphalinés des Rongeurs, pourvus de pores génitaux alternes, doivent être séparés génériquement de ceux des Équidés, qui ont les pores génitaux unilatéraux. Nous en faisons donc le genre *Andrya*, d'après le *Tænia rhopalocephala* Riehm, et en l'honneur de Nicolas Andry, le savant médecin du XVII^e^ siècle, qui a contribué l'un des premiers à élucider l'histoire des Téniadés.

Besides the type-species, Railliet placed here *Tænia rhopaliocephala*, Riehm (= *Anoplocephala cuniculi*, R. Blanchard), and *T. wimerosa*, Moniez. The latter species I return to the genus *Anoplocephala* (p. 151). In my preliminary note in 1895 I placed an American form (*Andrya americana*) in Railliet's genus, but since examining Meyner's specimens of *Bertia mucronata* I am inclined to transfer *A. americana* to the genus *Bertia*, see p. 165. Regarding the validity of the genus *Andrya*, see p. 164. Of Riehm's original material I have obtained the following specimens:

Cotypes of Riehm's Tænia rhopalocephala and *Tænia rhopaliocephala.*

U. S. N. M. number.	Label.		Received from—	Redetermined as—
	Parasite.	Host.		
1377	Tænia rhopalocephala.	Lepus timidus....	Vienna Museum..	Andrya cuniculi.
1378	.....do.....	Lepus cuniculus..	.....do.....	Do.?
1379	.....do.....	Lepus timidus....	.....do.....	Andrya rhopalocephala.
1484	Tænia rhopaliocephala	.....do.....	Leuckart.....	Do.
1485	Tænia rhopalocephala.	.....do.....	.....do.....	Do.?

All of these specimens were evidently originally determined by Riehm, who, however, trusted too much to the external form of the segments, for a careful comparison of the worms with Riehm's figures and description shows that some of the specimens were misdetermined.

Riehm states that his *T. rhopalocephala* was found only in *Lepus timidus*, while *T. rhopaliocephala* (=*Andrya cuniculi*) was confined to *Lepus cuniculus*. Whether the discrepancies between his labels and this statement are due to an error in host determination or an error in writing the labels of the specimens is a point which, of course, can not now be settled. For the present I adopt his statements and assume an error in the labels. If both host determination and labels are correct, then *Andrya cuniculi* must also occur in *Lepus timidus*. This point must be settled by new collection of material.

None of the specimens are in very good condition, on which account I am unable to enter into a detailed study of the organs. My observations, however, lead me to accept both species as well founded, and my results agree in general with those obtained by Riehm.

ANDRYA RHOPALOCEPHALA (Riehm, 1881), Stiles, 1895.

(Plates VII, figs. 1–7; VIII, 1–3.)

? 1800, *Alyselminthus pectinatus* (GOEZE, 1782), ZEDER, Erster Nachtrag z. Naturg. der Eingeweidewürmer, Leipzig, p. 246–249.

? 1803, *Halysis pectinata* (GOEZE, 1782), ZEDER, Anleitung z. Naturg. der Eingeweidewürmer, p. 332.

1881, *Tænia rhopalocephala*, Riehm, Zeitschr. f. d. ges. Naturwiss., 3 ser., VI, p. 200; 551–562, pl. v, figs. 1, 7–10, 18, vi, 1.

1891, *Anoplocephala rhopalocephala* (Riehm, 1881), R. Blanchard, Mém. Soc. zool. France, IV, p. 448.

1893, *Andrya pectinata* ([Goeze, 1782] Zeder, 1800), Railliet, Traité de Zool. méd. et agric., I, p. 283.

1895, *Andyra rhopalocephala* (Riehm, 1881), Stiles, Vet. Mag., II, pp. 343, 344.

I can find no evidence that Goeze (1782) had any single-pored forms before him when he described his *Tænia pectinata*. Zeder[1] in 1800 redescribed what he supposed was Goeze's species, but states that the pores were single. Riehm[2] in 1881 considered Zeder's species identical with the one now under consideration, and authors have followed him in this opinion. Zeder's description appears to me, however, altogether too fragmentary to accept this view as proven; at the same time it is impossible to definitely disprove Riehm's conclusion. Riehm[3] in 1881 was the first to recognize *Tænia rhopalocephala* as a distinct form; his revised diagnosis[4] reads as follows:

Kopf hakenlos, gross und keulenförmig, mit stark vorspringenden, mächtigen Saugnäpfen, scharf abgesetzt gegen den Halstheil. Geschlechtsöffnungen einfach im unteren Viertheil des Proglottidenrandes gelegen, meist durchgängig auf derselben Seite. Glieder trapezförmig, etwa eben so breit als lang. Länge im ausgestreckten Zustande 60—80 cm., Breite der reifsten Glieder wenig über 5 mm. Wohnthier: *Lepus timidus*.

Blanchard[5] in 1891 transferred Riehm's species to the genus *Anoplocephala*, while Railliet[6] in 1893 took it as type of the genus *Andrya*. Railliet reverted to Zeder's specific name, but I now adopt *rhopalocephala* on the ground that Zeder's *pectinata* was not proposed as a name for a new species, but Zeder was under the impression that he was redescribing Goeze's form. *Andrya rhopalocephala* has not yet been recorded for this country. The following statements are based upon Riehm's specimen (No. 1484, U.S.N.M.), mentioned on p. 155.

The anlage of the genital canals and female glands appears earlier than the testicles. In the lateral third of the segment on the pore side the undifferentiated anlage of the canals may be distinguished in the distal portion of the segment, and at its median end it becomes widened to form the anlage of the female glands. The anlage of the canals gradually thickens while the portion destined to form the female glands becomes more or less distinctly separated from it. At a time when this apparent separation takes place, small, quite indistinct, points of chromatophile material appear in the aporose portion of the median field and form the anlagen of the testicles. The segment now

[1] Erster Nachtrag zur Natur. der Eingew., Leipzig, pp. 246–249.

[2] Stud. an Cestoden, Zeit. ges. Nat., 3 ser., VI, pp. 545–546, pl. v–vi.

[3] [Untersuchungen an den Bandwürmern der Hasen und Kaninchen], Zeitschr. ges. Naturw., 3 ser., VI, p. 200.

[4] Studien an Cestoden, Zeitschr. ges. Naturw., 3 ser., VI, p. 551.

[5] Mém. Soc. zool. France, IV, p. 448.

[6] Traité de Zool. méd. et agric., I, p. 283.

measures about 0.9 mm. broad by 0.35 mm. long. The anlage of the canals next becomes differentiated into the anlagen of the male and the female ducts, and the anlage of the female glands divides into the anlagen of the separate glands. The testicles are now distinct; the segments measure 1 mm. broad by 0.64 mm. long. The ovarial tubes then become distinct, the receptaculum seminis appears and increases in size, and the elongated prostata and the cirrus pouch develop. The developed cirrus pouch measures about 0.32 mm. long by 0.16 mm. broad. In the meantime the testicles have encroached upon the pore side of the segment anterior to the ovary. The next change in the segments is brought about by the development of the uterus, which gradually hides the testicles from view. As my material is very poorly preserved, and hence does not stain altogether satisfactorily, the description of the various stages of the uterus must be left for some one who can obtain fresh specimens. Plate VII, fig. 7, represents a segment measuring 2.08 mm. broad. The cirrus pouch with the enclosed inverted cirrus is the only portion of the male organs which is now visible. The female glands have also disappeared, but the receptaculum seminis is still present. The uterus fills the entire median field of the segment and appears as a reticulate structure, with dichotomous branches on the periphery. As the ova develop, the boundaries between the different branches of the network become more and more indistinct and the uterus assumes the form of a simple sac (Plate VIII, fig. 1), in which no divisions, or at most extremely fragmentary and rudimentary divisions, are visible. The cirrus pouch and the receptaculum seminis are still present.

Whether this uterus is primarily an actual network, or whether it is originally a simple tube with numerous proximal and distal branches which secondarily anastomose and then gradually disappear to form a common simple sac, can not be stated at present with certainty, but with the data now at hand, I incline decidedly to the latter view.

The ova measure 52 to 60 μ; the pyriform body measures 12 μ broad by 28 μ long (horns included).

In the younger segments no calcareous corpuscles are visible. When the ova in the uterus become more distinct and the partitions in the uterus become less distinct, a few calcareous corpuscles appear in the cortical portion of the segments. As the shells of the ova develop, the calcareous corpuscles become numerous.

From Riehm's anatomical description and from my own study, I propose the following as a revised specific diagnosis:

Diagnosis.—*Andrya rhopalocephala* (Riehm, 1881), Stiles, 1895: Strobila attains 60 to 80 cm. in length by 5 mm. in breadth. Head unarmed, about 1 mm. in diameter, nearly quadrate in apex view. Neck about 1 mm. long. Segments 500 to 600 in number; active segments slightly broader than long; segments gradually increase in length so that posterior segments are as long as broad; they may attain 5 to 5.5 mm. in breadth. Genital pores single, near posterior corner of the segment,

for the greater part unilateral. Genital organs appear in about the one-hundredth segment. Male organs: Testicles dorsal, comparatively few in number, 75 to 80 μ in diameter, and more numerous in the aporose than in the pore side of the segment; cirrus pouch 0.32 to 0.34 mm. long by 0.16 mm. broad; cirrus short, generally lies in two spirals within the pouch; prostata elongate. Female organs: Vagina slightly distal of cirrus pouch, swells to a large receptaculum seminis median and dorsal of ventral canal; ovary, shell-gland, and vitellogene gland distal in pore half of median field; uterus ventral, appears as an apparent network with dichotomous peripheral branches, and finally forms a sac with indistinct partitions or without partitions. Ova 52 to 60 μ; pyriform body 12 μ broad by 28 μ long. Calcareous bodies appear in segments containing ova, and become numerous in segments in which the egg shells are distinct.

Host.—European Hare (*Lepus timidus*) by Riehm in Saxony.

Cotypes.—Nos. 1379, 1484, 1485, U.S.N.M.; collection of Leuckart; Vienna Museum.

ANDRYA CUNICULI (R. Blanchard, 1891), Railliet, 1893.

Plates VIII, figs. 4–8; IX, fig. 1.

1881, *Tænia rhopaliocephala* [nec *rhopalocephala*] Riehm, Zeitschr. f. d. ges. Naturwiss., 3 ser., VI, pp. 562–565, pls. v, fig. 2, vi, fig. 3.

1891, *Anoplocephala cuniculi*, R. Blanchard, Mém. Soc. zool. France, IV, p. 447.

1893, *Andrya cuniculi* (R. Blanchard, 1891), Railliet, Traité d. Zool. méd. et agric., I, p. 283.

Riehm described this form in 1881 under the following diagnosis:

Kopf hakenlos, klein, aber gegen den sehr dünnen Halstheil stark keulenförmig abgesetzt, wenn letztere nicht zu stark contrahiert ist. Geschlechtsöffnungen einfach, im dritten Viertheil des Proglottidenrandes gelegen; Glieder trapezförmig, etwa eben so lang wie breit. Länge im ausgestreckten Zustande bis 100 cm., Breite der reifsten Glieder bis zu 8 mm. Wohnthier: *Lepus cuniculus*.

Blanchard in 1891 changed the name to *cuniculi* on grounds of articles 54 to 55 of the International Code, and placed the worm in the genus *Anoplocephala*. Railliet in 1893 placed the form in the genus *Andrya*.

I have not yet found this species in the United States, but have been fortunate enough, through the kindness of Geheimrath Leuckart and Dr. von Marenzeller, to obtain some of Riehm's original stock.

One of the specimens, which was mounted whole, shows the following details: The anterior end is very narrow (0.4 mm.) and segmentation is scarcely visible, so that only the head and a portion of the neck have been lost. Segmentation is noticed 0.64 mm. from the anterior extremity, while 2 mm. from the end the segments are perfectly distinct, measuring 0.8 mm. broad by 0.24 mm. long. The anlagen of the female organs are indistinctly visible at about this point; they lie close to the pore side of the segment, but owing to the poor condition of the material they can not be analyzed. Testicles could not be distinguished in

these segments, but they appear about twenty segments later, soon becoming numerous and distinct and occupy the entire median field except the portion taken up by the female organs. Plate VIII, fig. 6, represents four segments about 15 mm. from the anterior end. About forty testicles are present. The anlage of the female glands is near the median line in the pore side of the median field; it is roundish and not very prominent. The genital canals are not very distinct, but may be traced to the lateral margin. Plate VIII, fig. 7, represents three segments about 30 mm. from the anterior end. The testicles have increased in number and size; the ovary and vitellarium are distinct, but the shell-gland is scarcely visible; the genital canals have become well differentiated, and the pore has developed. The greater majority of the genital pores are on one side of the strobila, and are situated in the distal half of the margin. In the specimen under discussion they range about as follows:

15.	16.	119.	44.	7.	5.	9.
4.	4.	6.	6.	2.	2.	18. etc.

About 50 mm. from the anterior extremity the structure of the segment becomes complicated by the development of the uterus. My preparation does not permit a study of its gradual development, but this organ appears to be much more complicated than one would expect from Riehm's description. At first no distinct limits can be made out, and one sees only numerous ova scattered through the segment. As the testicles atrophy, however, and the uterus comes more distinctly into view, the latter is apparently composed of a network of anastomosing tubes, much like the uteri found in *Moniezia*, and totally different from the transverse uterus found in *Cittotænia*, *Bertia*, and *Anoplocephala*. As in the case of the anastomosed testicles of *Fasciola*, it is here often impossible to distinguish whether we are dealing with anastomosing tubules or branched tubules which lie close together.

My limited material will not warrant a more minute study of the uterus of this form. See also General Remarks, p. 203.

The cirrus pouch is seen to best advantage in segments in which the uterus has begun to develop. It is pyriform and measures 0.4 mm. long by 0.144 mm. broad. It is highly muscular, especially in its proximal portion, and its middle portion contains a prominent dilatation representing a vesicula seminalis. Median to the pouch is found a roundish body, which evidently corresponds to the "prostata" described by Riehm.

The vagina and large elongate receptaculum seminis lie distally of the pouch and vas deferens, as Riehm has already described.

The ova measure 48 to 60 μ in diameter; the pyriform body measures 20 μ broad by 32 to 44 μ long.

The following is proposed as a revised specific diagnosis:

Diagnosis.—Andrya cuneuli (R. Blanchard, 1891), Railliet, 1893: Strobila attains 100 cm. in length by 8 mm. in breadth. Head

unarmed, about 0.5 mm. in diameter; rostellum not observed; neck filiform. Segments 500 to 800 in number, quadrate, broader than long; gravid segments may attain 8 mm. in breadth. Genital pores in about the middle of the margin or in distal half of the margin, irregularly alternate, but for the greater part unilateral. Male organs: Testicles scattered through the entire breadth of the median field; cirrus pouch 0.4 to 0.48 mm. long by 0.14 to 0.16 mm. broad, quite muscular, and contains a distinct vesicula seminalis; prostata round. Female organs: Vagina distal of cirrus swelling to an elongate receptaculum seminis ventral of vas deferens; ovary near median line in pore side of median field; uterus forms a network in median field, but as the ova develop the boundaries of the meshes become quite indistinct. Ova 48 to 60 μ in diameter; pyriform body 20 μ broad by 32 to 44 μ long. Calcareous bodies become numerous in distal segments.

Host.—European wild rabbit (*Lepus cuniculus*) in Saxony by Riehm; ? European hare (*Lepus timidus*), see p. 155.

Cotypes.—Nos. 1377, 1378, U.S.N.M.; collection of Leuckart; Vienna Museum.

Genus BERTIA, R. Blanchard, 1891.

1891, *Bertia*, R. Blanchard, Mém. Soc. zool. France, IV, pp. 186–196. Type, *Bertia studeri*, R. Blanchard.

Provisional diagnosis.—Anoplocephalinae, with segments broader than long. Genital pores regularly or irregularly alternate. Uterus (in all cases?) a transverse tube with proximal and distal egg pouches: genital canals pass dorsally of dorsal and ventral canal and lateral nerve trunk, but in the two cases at least ventrally of dorsal longitudinal nerve; distinct prostatic gland wanting. Dorsal canal dorsal to dorsolateral of ventral canal. Egg with well-developed pyriform body. Calcareous corpuscles present or absent. *Hosts:* Primates and rodents.

Type.—*B. studeri*, R. Blanchard, 1891.

Two years prior to the publication of the genus *Andrya* by Railliet, R. Blanchard, in 1891, proposed the genus *Bertia* for anoplocephaline cestodes with alternate genital pores, taking *B. studeri* from *Anthropopithecus troglodytes* as type of the genus; as second species of the genus he described *B. satyri*.

Unfortunately, on account of paucity of material, Blanchard was unable to give the anatomy of the type species, so that the generic diagnosis was based chiefly upon external characters. His original diagnosis reads as follows:

Caput crassum, subsphaericum, rostro aculeisque carens, acetabulis ellipticis, in dua paria valde distantia dispositis. Collum breve, propre tam largum quam caput. Corpus e permultis annulis brevissimis latisque, imbricatis, constans. Pori genitales marginales, tenuissimi, ab uno annulo ad alterum plus minus regulariter alternantes. In annulo permaturo, ova in plures fasciculos regulares, transverse dispositus, collecta. Oncosphaera pyriforme apparatu circumdata. Involutio ignota.

From Blanchard's descriptions of the species the following may be taken as provisional specific diagnoses.

BERTIA STUDERI, R. Blanchard, 1891.

(Plate IX., figs. 2–3.)

1891, *Bertia studeri*, R. BLANCHARD, Mém. Soc. zool. France, IV, pp. 187–190, figs. 1–4.
1894, *Taenia studeri* (R. BLANCHARD, 1891), BRAUN, Vermes, Bronn's Klassen und Ordnungen, etc., IV, 36–37, p. 1143.

Diagnosis.—*Bertia studeri*, R. Blanchard, 1891: Strobila attains 130 mm. in length, 15 mm. in breadth, 2.5 mm. in thickness; contains about 400 segments. Head subspherical, 0.65 mm. broad by 0.61 mm. long; suckers oblong, 0.34 to 0.345 mm. long by 0.27 to 0.28 mm. broad, two arranged on dorsal surface, two on ventral surface. Neck very short (0.3 mm.); about as broad as head. Segments always much broader than long; maximum breadth 15 mm. at 45 mm. from head, maximum length about 0.35 mm. Genital pores very small, lateral, alternating very regularly. Male organs: ? Female organs: Glands? Uterus in fully developed stage composed of 30–35 polyhedral packages, 0.5 to 0.9 mm. by 0.1 to 0.8 mm., arranged in transverse row, occupying entire breadth and thickness of segments. Ova 53 to 60 μ, pyriform body 14 to 16 μ broad, 23 to 30 μ long, horns generally straight, oncosphere 10 to 12 μ. Cortical layer of strobila supplied with numerous calcareous corpuscles 15 to 20 μ by 11 to 17 μ.

Host.—Chimpanzee (*Anthropopithecus troglodytes* (Linnæus) [*Troglodytes niger*]), by Studer.

Type.—Type and one paratype in Zoological Museum at Berne, Switzerland. Fragments in collection of R. Blanchard.

BERTIA SATYRI, R. Blanchard, 1891.

1891, *Bertia satyri*, R. BLANCHARD, Mém. Soc. zool., France, IV, pp. 190–192.
1894, *Tænia satyri* (R. BLANCHARD, 1891), BRAUN, Vermes, Bronn's Klassen und Ordnungen, etc., IV, 36–37, p. 1143.

Diagnosis.—*Bertia satyri*, R. Blanchard, 1891: Strobila attains 245 mm. or more in length by 10 mm. in breadth by 2 mm. in thickness, and contains about 350 segments. Head and neck unknown. Segments always much broader than long, attaining a maximum length of 0.75 mm. Genital pores very small, lateral, irregularly alternate. Calcareous corpuscles numerous, attaining 30 by 20 μ. Dorsal canal lateral of ventral canal. Cirrus-pouch claviform, large and elongated. Uterus resembles somewhat that of *B. studeri*. Ovum 35 to 38 μ by 30 to 32 μ, pyriform body 12 to 17 μ by 19 to 25 μ, oncosphere 13 μ.

Host.—Oran-Utan (*Simia satyrus*, Linnæus).

Type.—Leyden Museum.

From these descriptions it is impossible to come to any satisfactory conclusion as to whether the genera *Andrya* and *Bertia* should be kept separate or united. The form of the segments must surely be rejected as a generic character, and the fact that the pores of *Bertia* show a tendency to appear regularly alternate while those of *Andrya* show

a remarkable tendency to unilaterality can not, unassociated with other characters, be looked upon as establishing the genera as distinct.

In the preliminary note to this revision, I described two American parasites as provisional members of the genus *Andrya*, reserving opinion as to the validity of the genus and calling attention to some important differences in the American and German leporine single-pored forms. Since the publication of my note,[1] I have received a copy of a recent paper by Meyner describing two new species of cestodes, probably allied to the two forms of *Bertia* described by Blanchard, and through the kindness of Geheimrath Leuckart I have obtained one of the cotypes of Meyner's *Tænia* (*Bertia*) *mucronata*. It will be necessary to consider these forms briefly in connection with the leporine parasites.

Meyner evidently accepts *Bertia* only as a subgenus of *Tænia;* as *Bertia* has, however, absolutely no generic relations with *Tænia*, I now change his specific combinations from *Tænia* (*Bertia*) *mucronata* and *T.* (*B.*) *conferta* to *Bertia mucronata* and *B. conferta*.

Meyner discusses the anatomy of these two forms in detail, and from his account the following descriptions may be taken as specific diagnoses:

BERTIA MUCRONATA (Meyner, 1895), Stiles, 1896.

(Plate IX, figs. 4–5.)

1895, *Tænia* (*Bertia*) *mucronata*, MEYNER, Zeitschr. f. Naturw., LXVIII, (5 ser., VI), pp. 1–86, pl. 1, figs. 1–7.

Diagnosis.—Bertia mucronata (Meyner, 1895), Stiles, 1896: Strobila dagger-shaped, attains 140 mm. or more long by 8 to 10 mm. broad, serrate, imbricate, whitish yellow. Head, 0.34 to 0.714 mm. broad, apex nearly square, rostellum wanting; suckers oval 0.255 mm. broad, 0.2 mm. deep. Neck short, not sharply separated from head. Genital pores irregularly alternate. Male organs: Testicles appear in one hundred and twentieth segment, numerous, 75 to 100 μ in diameter, crowded together in [antero-]dorsal portion of median field. Vas deferens dorso-anterior of vagina; cirrus-pouch not mentioned. Female organs: Glands in pore side of median field; vagina long; receptaculum seminis globular; uterus single, transverse, at first a simple tube appearing in about one hundred and thirtieth segment; eggs enter it in three hundred and fiftieth segment and blind pouches are formed. Ova 36 μ, with three membranes; pyriform body 15 to 16 μ broad; oncosphere 13 to 14.4 μ. Three longitudinal nerves each side of segment, of which middle nerve is the largest. Dorsal canal dorsal of ventral canal. Genital canals pass dorsally of longitudinal canals and longitudinal ventral and main nerves, but ventrally of dorsal nerve. Calcareous bodies 4.9 to 18.4 μ, more numerous in cortical layer; about 150 visible in transverse section of scolex, 10 to 12 visible 10 mm. from anterior extremity, 400 to 500 in transverse section of distal segments.

[1] Notes on Parasites—38: Preliminary note to "A Revision of the Adult Leporine Cestodes," Vet. Mag., 1895, II, p. 341–346.

Host.—Black Howler (*Alouatta caraya* (Humboldt) [*Mycetus niger*]) in Paraguay, collected by Nemmeister.

Types.—In collection of Leuckart; one cotype No. 1483, U.S.N.M.

In the cotype of this species at my disposal the uterus is not developed. The worm presents an entirely different appearance from *Andrya*. The muscular cirrus pouch seems to be almost wanting, so far as I can distinguish, the end of the male canal appearing simply as a widened portion of the vas deferens with very weak muscles and much less prominent than the vagina. The prostatic gland, so characteristic for *Andrya rhopalocephala* and *A. cuniculi*, is entirely wanting. Plate IX, figs. 4–5, give the general topographical anatomy of the segment.

I do not believe that the division of the ovary into two wings as described by Meyner can be maintained, for in the cotype this division is extremely irregular. In some cases the ovary is not divided; in other segments it is divided into two, three, or four wings. I further find the dorsal canals dorsal to dorso-lateral of the longitudinal canals.

BERTIA CONFERTA (Meyner, 1895), Stiles, 1896.

(Plate IX, fig. 6.)

1895, *Tænia* (*Bertia*) *conferta*, MEYNER, Zeitschr. f. Naturw., LXVIII (5 ser., VI), pp. 86–103, pl. 1, figs. 8–13.

Diagnosis.—*Bertia conferta* (Meyner, 1895), Stiles, 1896: Strobila attains 84 mm. or more in length by 6.5 mm. in breadth; serrate. Head roundish, 0.68 mm.; rostellum wanting; suckers oval. Neck about 2 mm. long, at first about as broad as the head, from which it is not sharply separated. Segments always much broader than long; sexual segments measure 5.1 mm. broad by 0.27 mm. long by 1.02 mm. thick. Genital pores irregularly alternate. Male organs: Testicles numerous in dorsal portion of median field (in figure, of transverse section confined to aporose two-thirds of median field at plane of genital pore), vas deferens dorso-anterior of vagina, its lateral portion quite wide; cirrus-pouch? Female organs: Glands in middle of pore side of segment; receptaculum seminis oval; vagina with widened ciliated lateral portion. Uterus single, transverse, at first tubular, later with blind sacs. Ova begin to enter uterus 35 mm. from head in about the one hundred and thirtieth segment. Three lateral longitudinal nerves as in *B. mucronata*. Dorsal canal dorsal of ventral canal. Genital canals pass dorsally of longitudinal canals. Calcareous bodies numerous, may attain 19 μ; 20 to 25 visible on transverse section of sexual segments, 600 to 800 on transverse section of distal segments.

Host.—Bonnet Monkey (*Macacus sinicus* (Linnæus) [*Macacus radiatus*]).

Type.—In collection of Leuckart.

While looking upon Meyner's paper as an interesting and important contribution to the knowledge of the worms of this group, I do

not feel justified in utilizing his work as basis for more than a provisional generic diagnosis for *Bertia* until the type species of the genus (*B. studeri*) can be studied more in detail. Nor do I consider the data at hand sufficient to justify a worker in suppressing Railliet's genus *Andrya* in favor of the earlier genus *Bertia*. From the very limited material and data at hand, I am inclined to believe that *Anoplocephala*, *Bertia*, and *Andrya* will all eventually be recognized as good genera, established upon well-recognized anatomical characters, but for the present, although *Anoplocephala* unquestionably stands, *Bertia* and *Andrya* can be accepted only as provisional genera, and as convenient means of classification. The final acceptance of the genera can follow only after examination of a larger series of specimens representing, if possible, more species[1] than are at present included under *Andrya* and *Bertia*.

To utilize the generic terms *Andrya* and *Bertia* provisionally is certainly better than to place the forms in the same genus with *Tænia solium*.

BERTIA PLASTICA (Sluiter, 1896), Stiles, 1896.

1896, *Tænia plastica*, Sluiter, Centralbl. f. Bakteriol., Parasitenk. u. Infektionskr., I Abt., XIX, No. 24, pp. 941-946, figs. 1-6. June 30, 1896.

During the proof reading of this revision an article has appeared by C. Ph. Sluiter, describing a new species of tapeworm (*Tænia plastica*) from *Galeopithecus volans*. Sluiter is inclined to consider this new parasite as very closely related to *Anoplocephala plicata*, *A. mamillana*, and *A. perfoliata*, all of which he retains as members of the genus *Tænia*.

Unfortunately, several important points in the topographical anatomy have been omitted by the author, but his description and figures show that *Tænia plastica* is much more closely related to Meyner's *Tænia* (*Bertia*) *mucronata* than it is to the tapeworms of horses, on which account I transfer it to the genus *Bertia*. From Sluiter's description and figures, the following specific diagnosis is written:

Diagnosis.—*Bertia plastica* (Sluiter, 1896), Stiles, 1896: Strobila more

[1] Gottheil (1887) described two other cestodes, which may have some bearing upon the question, with the following diagnoses:

(*Tænia*) No. 1. Length 20 cm., breadth at largest segment 3.5 mm. Head globular, four suckers, no rostellum, and no hooks. Neck extremely fine and filamentous—2.5 cm. long. Proglottides slowly increase in size, greatest breadth being only attained 15 cm. from head. Sexual orifices at the sides. Segments oblong, 3.5 mm. by 0.75 mm. From Macaque monkey (*Macacus cynomolgus* (Schreber)).

(*Tænia*) No. 2. Length of largest specimen, 15 cm. Breadth at largest segment, 8 mm. Head large and clubbed, four suckers, no rostellum or hooks; neck short and thick; proglottides rapidly increase in size after the first inch and attain their full diameter from head, 7.5 cm. mature proglottides. They overlap each other at their posterior angles. Segments mature measure 8 by 4.5 mm.

From Macaque monkey (*Macacus cynomologus* (Schreber)) and Weeping Capuchin (*Cebus capucinus* (Linnæus)).

From the descriptions and figures it is very possible that these two forms are anoplocephaline cestodes, but Gottheil gives no characters which will aid in definitely determining the question at hand.

or less lanceolate, attaining 24 to 220 mm. in length by 6 to 11 mm. in breadth, and containing 80 to 400 segments. Head about 1 mm. broad by 1 mm. long; suckers round. Neck absent. Proximal segments increase rapidly in breadth; middle segments the broadest; distal segments decrease gradually to 5 mm. in breadth, with more or less crenate and imbricate posterior edge, and measure 0.5 to 0.76 mm. long. Genital pores irregularly alternate in about the middle of the lateral margin; genital cloaca and organs developed in fortieth segment; eggs in uterus in fiftieth segment. Male organs: Cirrus large; cirrus-pouch muscular; testicles occupy chiefly the anterior portion of the segments extending the entire breadth of the median field. Female organs: Vagina distal to cirrus-pouch; receptaculum seminis elongate; vagina and receptaculum together extend about one-third across the segment; ovary very broad, extending nearly or quite to the aporose submedian line; shell-gland and vitollegene gland about in the porose submedian line; uterus tubular, transverse with proximal and distal pouches. Eggs 25 μ in diameter. Topography of nerves and canals?

Host: Flying Lemur (*Galeopithecus volans*), collected by Hubrecht in In India.

Type: ? Deposited in Amsterdam. Technique of type?

BERTIA AMERICANA (Stiles, 1895), Stiles, 1896.

(Plate X, figs. 1-10.)

1855, ? *Tænia laticephala*, LEIDY, Proc. Acad. Nat. Sci. Phila., VII (1854–1855), December, 1855, p. 443.

1895, *Andrya americana*, STILES, Vet. Mag., Phila., II, June, p. 344. Aug. 28, 1895.

Leidy has given a short description of a tapeworm (*Tænia laticephala*) from the Canada Porcupine which agrees in some characters with the form I described (*Andrya americana*) from the yellow-haired Porcupine. I am unable to find Leidy's types, but it seems to me very questionable whether the two parasites are identical. Leidy's description, which in a measure recalls the genus *Davainea*, reads as follows:

TÆNIA LATICEPHALA, Leidy. Head large; acetabula opposite, very prominent, large, hemispherical; month slightly prominent, unarmed. Neck short. Anterior segments of the body short, oblong squnre; posteriorly square. Generative apertures marginal, alternate. Protruding penes, elongate conical. Length of one specimen 9 inches, greatest breadth $\frac{2}{3}$ of a line. Breadth of head $\frac{1}{2}$ a line; of neck $\frac{1}{4}$ a line.

Hab. The small intestine of *Hystrix dorsata*.

B. americana was described in the preliminary note to the present revision as an *Andrya*, but a comparison of Meyner's excellent anatomical description of *B. mucronata*, and of his cotype, with the form under discussion shows that the American species is more closely related to *B. mucronata* than to *A. rhopalocephala;* on this account *A. americana* is transferred in the present paper to the genus *Bertia*.

Several specimens of tapeworms were sent to the collection of the

Bureau of Animal Industry by Professor Elrod, of Bloomington, Illinois, with the following label: "From Mesenteries of Canada Porcupine. Snake River,[1] near Nat. Park. Aug., 1894, M. J. Elrod."

The following specific description will easily allow the recognition of the form:

Diagnosis.—Bertia americana (Stiles, 1895), Stiles, 1896: Strobila attains 33 mm. in length by 6 mm. in breadth and contains about 90 segments, the oldest of which are 0.8 mm. long. In some specimens the posterior segments become much narrower, longer, and thicker than the middle segments. Head, unarmed, measures 0.6 mm. broad by 0.38 mm. long by 0.32 mm. thick, and is nearly rectangular in apex view. The neck is absent, and the head is frequently retracted into the body, as in *Drepanidotænia lanceolata*. Suckers round, 0.176 mm. in diameter, open anteriorly. Genital anlagen visible in the earliest segments. Genital pores alternate in posterior half of margin. Male organs: Testicles form a continuous band in the distal portion of the median field, extending on both sides to the longitudinal canals; about seventy testicles to a segment; vas deferens runs in the proximal portion of the segment; cirrus-pouch lies dorsal of the vagina, is very muscular, 0.48 mm. long by 0.144 mm. broad and extends to the ventral canal; it contains a vesicula seminalis (0.19 mm. long) in its proximal portion, and the rather short, retracted, spinous cirrus in its distal portion. Female organs: The anlagen of the glands are seen immediately back of the head in or near the median line ventral of the testicles; at first the glands are but little differentiated, but on their pore side a globular receptaculum seminis rapidly develops and becomes filled with spermatozoa; the glands develop rapidly, coming to lie right and left of the median line, the ovary becoming quite broad. The development of the uterus could not be followed in detail, but eventually it occupies the entire median field and becomes filled with ova 40 μ in diameter; bulb of pyriform body 16 to 18 μ. Excretory and nervous systems:[2] Dorsal canals lie lateral of ventral canals and possess a thin lining. Genital canals cross the longitudinal canals and nerves dorsally. Calcareous corpuscles absent.

Hosts.—Yellow-haired Porcupine (*Erethizon epixanthus*), by Elrod; Canada Porcupine (*E. dorsatus*), by A. K. Fisher.[3]

[1] The Canada Porcupine (*Erethizon dorsatus*) does not extend so far west; the host must have been the yellow-haired Porcupine (*E. epixanthus*).

[2] The excretory system of this form will repay a careful study; in several anterior segments (transverse sections) I found the dorsal canals connected with the transverse canals, see pl. x, fig. 8.

[3] Since finishing this paper I have found some specimens in the Bureau of Animal Industry collection (No. 1502) which agree with Elrod's specimens, and bear the label, "*E. dorsatus*." These specimens were collected by Dr. A. K. Fisher at Lake George, New York. Fisher states that nearly every porcupine he has examined harbors this worm.

Cobbold, in 1862, examined some parasites from the same host-species and determined them as "*Tænia pectinata*," with pores "all on one side."

Types.—Bureau of Animal Industry Cestode Series No. 1349 designated as type, and deposited with sections of paratypes (Nos. 1350–1352) in United States National Museum. Paratypes distributed as follows: *America:* Collection of Bureau of Animal Industry; collection of Stiles (U.S.N.M.); collection of Hassall; collection of M. J. Elrod (Bloomington, Illinois). *Europe:* Berlin Museum; Vienna Museum; collection of Blanchard; British (South Kensington) Museum (London).

Geographical distribution.—North America (Wyoming, by Elrod, and Lake George, New York, by Fisher).

BERTIA AMERICANA LEPORIS (Stiles, 1895), Stiles, 1896.

(Plate X, figs. 11–15.)

1895, *Andrya americana leporis*, STILES, Vet. Mag., II, June, p. 344. Aug. 28, 1895.

Of this form I have but five specimens, all in exceedingly poor condition and unfit for any histological observations or detailed anatomical study. Enough can be seen on the preparations, however, to give a diagnosis which distinctly separates the parasites from all the other forms found in rabbits.

The specimens were collected by Cooper Curtice; when they came into my possession there was nothing upon the label to give any clue to their origin, other than that Curtice collected them from *Lepus*.

The specimens (Bureau of Animal Industry, Cestode Series Nos. 1170–1172, 1175–1176), all mounted, measure 23 to 47 mm. long, the widest segments attaining 5 to 6.5 mm. in breadth. Due allowance must here be made for the contraction of the specimens and the fact that they were subjected to pressure in mounting.

The head is present on all specimens, and varies in measurement, as shown in the following table:

Measurements of heads of Bertia americana leporis.

No. (U. S. N. M.).	Breadth.	Length.
	mm.	*mm.*
1170	0.640	0.504
1171	.656	.448
1172	.656	(?)
1175	.688	(?)
1176	.640	.672

The form of the head can not be taken as a character of value, as it varies according to contraction. Plate X, figs. 12–13, show the heads of Nos. 1170 and 1176, U.S.N.M. Rostellum could not be distinguished. The four suckers are powerful, and open diagonally forward; they are unarmed in the specimens at hand; their diameter varies between 0.22 and 0.24 mm., the muscular wall measuring about 64 μ thick. There is no neck present, the segments being perfectly distinct immediately back of the head.

The number of segments in the different specimens varies from about

60 to 95, but in no case was the strobila complete, as all of them had evidently shed proglottids. In some cases the head was retracted into the anterior segments, as is described for *Drepanidotænia lanceolata*. In only one specimen (Plate X, fig. 13) was it extended. The first segment could not be satisfactorily measured; the second segment (No. 1176, U.S.N.M.) measured 0.448 mm. broad (slightly narrower than the head) by 64 μ long, and showed no trace of genital organs. The cirrus was distinctly visible in one specimen in the sixth segment, but no positive statement can be made for the earlier proglottids. In some of the other specimens the cirrus did not appear until several segments later—in the eleventh in one case. The poor condition of the material must, however, be taken into consideration in this connection.

Several segments after the appearance of the cirrus, a roundish body about 16 μ in diameter appears in each proglottid, alternating a very short distance to the right and left of the median line. This body, which develops first from the eighth to the fourteenth segment, evidently represents the receptaculum seminis. In each succeeding segment it is slightly farther from the median line than in the segment immediately preceding, so that we may conclude that the median line of the cestrode strobila is the seat of very active growth, a conclusion supported by observations on other species also, more particularly on the early genital anlagen of *Thysanosoma giardi*.[1] The testicles soon appear and extend in an irregular line across the median field of the segment, for the greater part distally of the female anlagen; their number could not be ascertained exactly because of the poor condition of the material, but, as nearly as could be estimated from various portions of segments which were in better condition, there are about 50 testicles to each proglottid.

The genital pores are alternate and situated in about the middle of the lateral margin; the genital cloaca is generally quite deep. The cirrus and cirrus pouch are quite characteristic and allow an immediate determination of the form. The cirrus pouch assumes various shapes and proportions according to its contraction, but in general may be described as pyriform; it measures about 0.4 mm. long by 0.16 mm. broad; its proximal portion (0.192 to 0.224 mm.) is extremely muscular, being provided with an inner circular layer and an outer longitudinal layer, the two together, in some cases, measuring 16 μ thick. The cirrus extrudes from the pouch in the majority of the segments; when retracted, it appears spinous (wrinkles of the cuticle?) but extruded it is evidently smooth; the largest cirrus observed was 0.24 mm. long by 32 μ thick. The continuation of the cirrus canal in the proximal portion of the pouch is swollen into a vesicula seminalis and from the proximal extremity of the pouch the rather prominent vas deferens extends, somewhat sinuously, through the anterior portion of the pore side of the segment to

[1] A Revision of the adult cestodes of Cattle, Sheep, and allied animals; Bull. 4 Bureau of Animal Industry, p. 63, pl. XII, fig. 3.

the vicinity of the female anlage—farther than this it could not be traced. The female organs gradually undergo a change, but this process can not be described in detail because of lack of proper material. All that it is at present safe to say is that a dark body of cells arises in the vicinity of the receptaculum seminis and develops into the female glands very similar to those found in the *Bertia* of the porcupine; the uterus gradually extends over the segment suppressing the genital glands.

Eggs globular with three membranes, but pyriform body not visible; outer membrane 40 to 42 μ in diameter; middle membrane could not be studied; inner membrane immediately surrounding the oncosphere 21 μ in diameter; hooks of oncosphere 9 μ long. Numerous small calcareous corpuscles present in the parenchyma.

This worm has an entirely different appearance from the one found in the porcupine and it is possible that it will eventually be raised to specific rank. My material, however, does not warrant such a step at present.

The following is proposed as a diagnosis of the variety:

Diagnosis.—*Bertia americana leporis* (Stiles, 1895), Stiles, 1896: Strobila 23 to 47 mm. long by 5 to 6.5 mm. broad, possessing from 60 to 95 segments. Head about 0.6 mm. broad by 0.4 to 0.6 mm. long, unarmed; suckers large, about 0.2 mm. in diameter, unarmed. Neck absent, stobilization beginning immediately back of the head. Genital pores alternate, situated in about the middle of the lateral margin. Genital organs develop very early, the male organs being visible sometimes as early as the sixth segment. Cirrus large and (?) smooth. Cirrus pouch about 0.4 mm. long by 0.16 mm. broad; its proximal portion is very muscular and contains a vesicula seminalis. Vas deferens, large and prominent, extends from the region of the female glands to the cirrus pouch in the proximal portion of the segment; testicles for the greater part in the distal portion of the segment, about 50 in number, arranged in an irregular row across the median field. Female glands first appear in the eighth to fourteenth segment alternately right and left of the median line; uterus spreads from female glands and occupies entire median field; ova globular with three thin membranes; pyriform body apparently not present; outer membrane 40 to 42 μ in diameter; middle membrane?; inner membrane 21 μ in diameter; hooks of oncosphere 9 μ long. Calcareous corpuscles present.

Host.—*Lepus*, sp. ?, by Curtice, development unknown.

Types.—Description based upon five specimens, of which Bureau of Animal Industry Cestode Series No. 1171 is designated as *Type* and deposited in the United States National Museum; paratypes Nos. 1170, 1172, 1175, 1176 U.S.N.M.

Original material poorly preserved, alcohol (?) method, stained with hæmatoxylin.

Geographical distribution.—United States of North America (State?) by Curtice.

Genus CITTOTÆNIA, Riehm, 1881.

1881, *Cittotænia*, Riehm, Zeitschr. f. d. ges. Naturwiss., 3 ser., VI, p. 200. Type, *Cittotænia latissima* Riehm, 1881 = *Tænia denticulata* Rudolphi, 1804.

1881, "*Dipylidium*, Leuckart," 1863, p. p. of Riehm, Zeitschr. f. d. ges. Naturwiss., 3 ser., VI., p. 200; p. 565. Type, *Tænia canina* Linnæus, 1758.

1891, *Moniezia* p. p., R. Blanchard, Mém. Soc. zool. France, IV, p. 187; p. 444. Type, *Tænia expansa* Rudolphi, 1810.

1893, *Ctenotænia*, Railliet, Traité Zool. méd. et agric., I, p. 278. Type, *Tænia marmotæ*, Frölich, 1802.

Diagnosis.—*Cittotænia*, Riehm, 1881: Anoplocephalinæ with segments broader than long and longer than thick; end segments in some cases showing a tendency to become longer and narrower. Two full sets of genital glands and two lateral genital pores to each segment; generally one, in some cases two, simple transverse tubular uteri in each segment; uterus generally possesses simple proximal and distal diverticula. The vagina is ventral of the cirrus pouch on both sides of the segment. Dorsal canal varies somewhat in position, but shows a constant tendency to lie between the ventral canal and nerve, especially at the plane of the genital pores. Genital canals cross the longitudinal canals and nerves dorsally. Interproglottidal glands absent. Calcareous bodies not yet recorded. Eggs with well-developed pyriform body, the horns of which are long, generally filamentous, crossing each other.

Hosts.—Rodents.

Type.—*Cittotænia latissima*, Riehm, 1881, = *Cittotænia denticulata* (Rudolphi, 1804), Stiles & Hassall, 1896.

Riehm proposed the genus *Cittotænia* in 1881, with *C. latissima* as type and only species; his description reads as follows:

4. *Cittotænia latissima.* Die Gattung ist errichtet mit Rücksicht auf die merkwürdige Ausbildung des Excretionsorganes, welches nicht leiterartig, sondern mit je 3–5 vielfach anastomosirenden und in einander übergehenden Hauptseitenstämmen und zahlreichen, das ganze Thier netz-förmig durchsetzenden Nebenästen, rankenartig die Tänie durchzieht. C. latissima hat doppelte Geschlechtsorgane, welche auf den zizzenartig vorspringenden Hinterecken der Glieder nach aussen münden. Der Kopf breiter als bei den vorigen erscheint vorn abgestutzt, hakenlos. Länge der Strobila bis 2½ Fuss, Breite der letzten Proglothiden bis über ¾ Zoll. Wohnthier: Kaninchen.

In the same paper Riehm placed two other double-pored anoplocephaline cestodes in Leuckart's genus *Dipylidium*, i. e., *D. pectinatum* and *D. leuckarti*, and later in the same year[1] he rejected his newly established genus *Cittotænia*, uniting it with *Dipylidium*.

In 1891 Blanchard[2] united in the genus *Moniezia* the double-pored anoplocephaline cestodes of rodents with those of ruminants. In 1893

[1] Studien an Cestoden. Zeitschr. f. d. ges. Naturwiss., 3 ser., VI, 1881, pp. 565, 580.

[2] Mém. Soc. zool. France, IV, 1891, p. 187.

Stiles[1] excluded the known parasites of rodents from the genus *Moniezia*, while Railliet proposed for the double-pored leporine forms the genus *Ctenotænia* with *Tænia marmotæ* as type.

At first thought this genus does not appeal to helminthologists, who have not paid special attention to the Anoplocephalinæ, as being well founded, but an anatomical study of the various forms does, I believe, fully justify the separation of the double-pored cestodes of rodents from the double-pored forms found in ruminants. The generic term *Cittotænia* having priority must of course be accepted in preference to *Ctenotænia*.

The characters of the three genera of double-pored anoplocephaline forms, according to my present interpretation, are as follows:

Diagnosis.—Moniezia, R. Blanchard, 1891: Anoplocephalinæ with segments generally broader than long and longer than thick; end segments showing a tendency to become longer and narrower. Two full sets of genital organs, with two (very complex) reticulate uteri and two lateral pores in each segment. On the right side the vagina is ventral, cirrus dorsal; on the left side vagina dorsal, cirrus ventral. Dorsal canal lies dorso-median of ventral canal. Genital canals cross the longitudinal canals and nerves dorsally. Interproglottidal glands generally present. Calcareous corpuscles absent from parenchyma. Eggs with well developed pyriform body, the horns of which generally (always ?) end in a disk.

Hosts.—Ruminants.

Type.—Moniezia expansa (Rudolphi, 1810), R. Blanchard, 1891.

For diagnosis of *Cittotænia*, see above, p. 170.

Diagnosis.—Thysanosoma, Diesing, 1835: Anoplocephalinæ with segments generally broader than long and longer than thick; end segments show a tendency to become longer and narrower. Two sets or one set of genital glands and two lateral genital pores, or one lateral genital pore to each segment; one transverse undulating uterus with ascon-spore or cornucopia-like egg-pouches. Genital canals cross the ventral canal and nerve dorsally, the dorsal canal ventrally. Interproglottidal glands absent. Calcareous bodies absent from the parenchyma. Horns of pyriform body absent.

Hosts.—Ruminants.

Type.—Thysanosoma actinioides, Diesing, 1835.

From this analysis of characters it will be seen that *Cittotænia* forms an excellent intermediate genus between *Moniezia* and *Thysanosoma*.

The genus may be divided into two groups: *Marmotæ* or *Denticulata Group* and *Pectinata Group*, the division being based upon the form of the cirrus pouch. In the first group this organ is pyriform, distinct and very muscular; in the second group it is more elongated, resembling the nozzle to a hose, and is less distinct.

[1] Centralbl. f. Bakteriol. u. Parasitenk., XIII, 1893, p. 457; also, Bull. 4, Bureau Animal Industry, 1893, p. 54.

MARMOTÆ OR DENTICULATA GROUP.

CITTOTÆNIA MARMOTÆ (Frölich, 1802) Stiles & Hassall, 1896.

(Plate XI, figs. 1–8; Plate XII, figs. 1–2.)

1802, *Tænia marmotæ*, Frölich, Der Naturforscher, XXIX, p. 77–79, pl. II, fig. 17–20.
1891, *Moniezia marmotæ* (Frölich, 1802), R. Blanchard, Mém. Soc. zool. France, IV, p. 187; pp. 444, 461–467, figs. 31–35.
1893, *Ctenotænia marmotæ* (Frölich, 1802), Railliet, Traité d. Zool. méd. et agric., I, p. 278.
1896, *Cittotænia marmotæ* (Frölich, 1802) Stiles & Hassall, Veterinary Magazine, III, p. 407.

Gœze[1] in 1782 examined a worm which Blumenbach had collected from the Marmot: this parasite, which was probably *Cittotænia marmotæ*, Gœze considered identical with his *Tænia pectinata*.

Frölich[2] in 1802 found a cestode in the intestine of the Marmot (*Arctomys marmota*) and described it under the name *Tænia marmotæ*, as follows:

[p. 77.] 43: *Taenia Marmotae* oblonga lanceolata antice attenuata utrimque serrata, articulis brevissimis, medio utrimque poro pilifero notatis, capite mutico. Tab. II, f. 17–20.

MURMELTHIER-BANDWURM.

Die Länge dieser Würmer ist sehr veränderlich. Die grössten Individuen hatten 6–7 Zoll in der Länge, ungefähr 11‴ in der Breite am Hintertheile, und beinahe 1‴ in der Dicke. Ihre Gestalt ist überhaupt lanzettförmig, in die Länge gezogen, am Vordertheile allmälig, aber sehr beträchtlich, verschmälert, so dass das Vorderende am Grunde des Halses kaum etwas über 1‴ breit ist. Aeltere Würmer, die durch Geburten schon mehrere Glieder abgesetzt haben, sind am Hinterende am breitesten, abgestutzt, oder halbmondförmig ausgerandet; jüngere Würmer, die noch nicht geboliren haben, werden am Hinterende etwas schmächtiger, und das letzte Glied ist abgerundet.

Der Kopf ist verhältnissmässig sehr klein, rundlich, rüssellos, unbewaffnet, hellweiss, mit vier deutlichen Saugblasen, die gepaart über einanderstehen; [p. 78] an der Spitze ein undeutliches Knötchen, statt des Rüssels.

Der Hals ist zusammengedrückt rundlich, sehr schmächtig, etwas länger als der Kopf, gliederlos, abwärts breiter, und unvermerkt in den Vorderkörper übergehend.

Das Vorderende des Körpers scheint da, wo es an den Hals grenzet, fast gliederlos, wird von da abwärts sanft und unvermerkt breiter, und die Glieder, die vorwärts nur durch Querstreifen angezeigt waren, entwickeln sich da deutlicher.

Die Glieder des Körpers sind ganz sichtbar ineinander geschoben, wenigstens 20 mal breiter als lang, gleichbreit, dicklich, perlenweiss, zu beiden Seiten in einen scharfen, hervorragenden Zahn auslaufend, in der Mitte der Oberfläche eine eingedrückte Längslinie. Jedes Glied hat in der Mitte des Seitenrandes ein dunkleres, hervorragendes, wulstiges, in der Mitte durchbohrtes Knötchen, aus welchem ein haarfeiner, geradegestreckter, schneeweisser, über 1‴ langer Borsten hervorragt. Diese Seitenborsten sind nicht immer sichtbar, sondern sehr oft in den Rand der Glieder zurückgezogen, wo sie denn an jeder Seite des Gliedes eine hellere Querlinie bilden. Die hintern Glieder nehmen an Breite und Länge etwas zu.

[1] Versuch einer Naturg. der Eingeweidewürmer thierischer Körper, Blankenburg, p. 363, footnote.

[2] Beiträge zur Nat. der Eingeweidew., Der Naturforscher, XXIX, 1802, Halle, p. 77.

Wohnort: In den dünnen Gedärmen des Murmelthiers (*Arctomys marmota* Schreb.).

Anm. Ich traf diese schöne Wurmart in dem genannten Thiere, das in den allganischen Alpen einheimisch ist, und von dem ich ein paar Stücke am 28 Julius 1797 zu untersuchen Gelegenheit bekam, in ausserordentlicher Menge an. In den Gedärmen eines ältern Murmelthiers fand ich ganze Nester von diesen Würmern, so dass ihre Zahl, im Ganzen genommen, über 50 Stücke betragen haben muss. Es lagen ihrer manchmal 5–7 beysammen, und dehnten den Darmkanal, indem sie in Knaulen übereinander lagen, ungemein aus.

Ich sah Stücke von diesen Würmern, deren hintere Glieder in der Mitte durchlöchert waren; andere Individuen hatten sich am Hintertheile durch die Schlinge geschoben.

Man sieht von selbst, dass die gegenwärtige Art mit dem lanzetförmigen Bandwurme[1] ungemein viele Aehnlichkeit habe, da auch dieser an den Rändern der Glieder kurze Seitenborsten zu haben pflegt; demungeachtet kann ich mich bey genauer Vergleichung nicht überzeugen, dass beide Würmer einerley Art seyn. Auch die *Tænia pectinata*[2] ist mit dieser Art nahe verwandt.

Rudolphi[3] in 1814 and 1819, Diesing[4] in 1850, and Baird[5] in 1853, mention Frölich's parasite under *Tænia pectinata*, accepting *Tænia marmotæ* as synonym. R. Blanchard[6] in 1891 was evidently the second zoologist to find this species; he found 214 worms in four marmots at Briançon, in September, 1887. The specimens attained 112 mm. in length by 5 to 13 mm. in breadth. Head measured 0.55 to 0.63 mm. long by 0.80 to 0.84 mm. broad; suckers globular, 120 μ in diameter; neck absent; segments varied from 56 μ to 0.75 mm. in length; genital pores double and opposite, in posterior half of lateral margin. Blanchard described a subcuticular excretory system, with two lateral longitudinal canals, connected by a transverse canal with the canals of the opposite side. Ova measured 48 to 60 μ; bulb of pyriform body, 23 μ.

Stiles[7] in 1893 found that the dorsal canal lies between the ventral canal and nerve, and that the genital canals run dorsally of the longitudinal canals and nerves. He was unable to find Blanchard's accessory excretory system. Later he[8] figured the genital organs.

Railliet[9] in 1893 took this species as type of his new genus *Ctenotænia*.

From writings of Frölich and Blanchard and from my own studies I propose the following as revised specific diagnosis:

Diagnosis.—Cittotænia marmotæ (Frölich, 1802), Stiles & Hassall, 1896: Strobila attains 112 mm. (perhaps more) in length by 5 to 13 mm. in breadth. Head, 0.8 mm. broad by 0.5 to 0.6 mm. long; hooks absent;

[1] Goeze, Eingeweidew., p. 377, pl. XXIX, fig. 3–12.

[2] Ebendas, p. 363, pl. XXVII, fig. 7–12.

[3] Erster Nachtrag, etc., Ges. Naturf. Freunde Berlin, etc., VI, 1814, p. 108; Entozoorum Synopsis, 1819, p. 488.

[4] Systema helminthum, I, p. 498.

[5] Cat. Specs. Entozoa or Intestinal Worms, Coll. Brit. Mus., p. 78.

[6] Mém. Soc. zool. France, IV, pp. 444, 461–466, figs. 31–35.

[7] Cent. f. Bakt. u. Paras., XIII, pp. 449–450, fig. 9.

[8] Stiles & Hassall, 1893, Bull. 4, Bureau of Animal Industry, p. 71, pl. VII, figs. 6–7.

[9] Traité de Zool. méd. et agric., I, p. 278.

rostellum not visible. Neck absent, segmentation beginning immediately back of the head, the proglottids rapidly becoming distinct; segments vary in length from 56 μ to 0.75 mm., and are always much broader than long, measuring in some cases 13 mm. broad; the posterior flap projects but a short distance over the anterior border of the next following segment. Genital pores double and opposite in posterior half of lateral margin. Genital cloaca quite deep. Anlagen of genital canals and female glands visible in the first segments, testicles appear a little later. Male organs: Testicles appear about the thirtieth segment, between 100 and 150 in number to a proglottid, scattered through the median field between the ovaries; cirrus-pouch, 0.5 mm. long by 0.17 mm. broad, very muscular, with vesicula seminalis in proximal portion and coiled smooth penis in distal portion. Female organs: Female glands nearly 1 mm. from the lateral border of the segment, some distance from the longitudinal canals; ovarian tubules appear about the thirty-fifth segment, reach their highest development from the forty-seventh to fifty-seventh segments and then rapidly atrophy, disappearing almost entirely by the sixtieth segment; vagina ventral of the cirrus-pouch on both sides of the segment; uterus single, transverse, proximal to testicles, and possesses proximal and distal blind pouches, similar to those of *Cittotænia pectinata*. Ova, 48 to 60 μ; bulb of pyriform body, 23 μ. Excretory system: Dorsal canal between ventral canal and nerve. Longitudinal nerves rather close to lateral margin, near distal end of cirrus-pouch. Genital canals cross the longitudinal canals and nerve dorsally.

Host.—Marmot (*Arctomys marmota*) by Frölich and Blanchard.

Types.—Original type (?). Typical specimens with R. Blanchard (Paris), collection Bureau of Animal Industry (No. 1370, B.A.I.), and collection of Stiles (U.S.N.M.).

Geographical distribution.—(?) Frölich; France (Briançon), by Blanchard.

CITTOTÆNIA DENTICULATA (Rudolphi, 1804), Stiles & Hassall, 1896.

(Plate XII, figs. 3–8; Plate XIII, figs. 1–3.)

1804, *Tænia denticulata*, Rudolphi, Bemerkungen a. d. Gebiete d. Naturg., etc., p. 81.

1828, *Alyselminthus denticulatus* (Rudolphi, 1802), de Blainville, Dict. d. Sci. nat., LVII, p. 607.

1853, *Tænia goezei*, Baird, Cat. Entozoa Coll. British Museum, p. 78.

1881, *Cittotænia latissima*, Reihm, Zeitschr. f. d. ges. Naturw., 3 ser., VI, p. 200.

1881, *Dipylidium latissimum* (Riehm, 1881). Riehm, Zeitschr. f. d. ges. Naturwiss., 3 ser., VI, pp. 583–590. pl. v, figs. 5, 15, 17; vi, fig. 2.

1887, *Tænia latissima* (Riehm, 1881), Neumann, Traité des maladies parasitaires non-microbiennes, p. 426.

1891, *Moniezia denticula* [*ta*] (Rudolphi, 1804), R. Blanchard, Mém. Soc. zool. France, IV, p. 187.

1891, *Moniezia latissima* (Riehm, 1881), R. Blanchard, Mém. Soc. zool. France, IV, pp. 187, 451.

1891, *Moniezia goezei* (Baird, 1853), R. Blanchard, Mém. Soc. zool. France, IV, pp. 444, 452–457, figs. 21–25.

1893, *Ctenotænia goezei* (Baird, 1853), Railliet, Traité d. Zool. méd. et agric., I, p. 278.
1896, *Ctenotænia denticulata* (Rudolphi, 1804), Stiles & Hassall, Vet. Mag., III, p. 6–9, and Centralbl. f. Bakt., Parasitenk. u. Infektionskrankh., Erste Abt., XIX, 70–72.
1896, *Cittotænia denticulata* (Rudolphi, 1804), Stiles & Hassall, Vet. Mag., III, p. 407.

This species has had a most curious history, which should be a demonstration to every helminthologist not yet convinced that in determining a cestode the microscope—not the yardstick—is his most important instrument, and that internal topographical anatomy—not conditions of contraction of the external form—furnishes the important characters for classification.

At present we may be said to have two extreme parties in helminthological work; one party apparently considers minute histological details as all-important, and looks down upon the systematic work, especially that class of systematic work which studies into the bibliographic history of the species and demands a consistent application of the international rules of nomenclature; a second party appears to conceive the highest helminthology as consisting of determining and describing species chiefly upon external form, looking upon histological and anatomical details as "of interest to those who are interested in such matters," but of no importance to science. The history of *C. denticulata* should, however, convince everyone that there is a middle ground upon which we should all unite, namely: First, careful determination and description of worms upon internal topographical anatomy; secondly, a thorough study of the history (both life history and bibliographic history) of each species; thirdly, histological details, and fourthly, a consistent application of such rules of nomenclature as will render all of our work international: International Rules.

Rudolphi[1] in 1804 originally described *Tænia denticulata* as follows:

Unter den Eingeweidewürmer [*i. e.*, in the Hanover collection] war ein Stück, das mich sehr interessirte, nämlich ein Bandwurm, der in Havemanns Gegenwart einem Kalbe abgegangen war; er war aber ohne Kopf.*

*Ich habe diese Würmer im Museum zu Alfort wieder gefunden, und auch einige Exemplare geschenkt bekommen. In seinem itzt ganz vergriffenen Werke über die Würmer hat Chabert ihn mit allen übrigen Bandwürmern, unter dem Namen Tenia rubnaé [rubané] zusammengeworfen; im Museum hingegen war der Bandwurm aus Darm und Magen der Kuh ohne Noth in zwey Arten getheilt. Es ist eine wirklich neue, noch nirgends beschriebene Art, die ich *Tænia denticulata* nenne, und an einem andern Ort ausführlich beschreiben werde. Der Wurm ist 5 bis 16 Linien lang, die vordern Glieder sind 2 bis 5 Linien, die hintern beynahe einen Zoll breit; der kleine viereckige Kopf unbewaffnet, mit vier in Kreuz stehenden Saugmündungen; kein Hals, alle Glieder kurz, mit Oeffnungen an beyden Seiten, aus denen mehrentheils ein kleiner spitzer Körper hervorsteht, wodurch der Wurm wie gezahnt erscheint. Ich selbst habe ihn nie beym Rindvieh gefunden.

Later,[2] in 1805, he adds:

14. *Tænia denticulata* mihi. T. rubanés et lancéolés dans les intestins d'une vache.

[1] Bemerkungen aus dem Gebiete der Naturgeschichte, Medizin und Thierarzneykunde auf einer Reise durch einen Theil von Deutschland, Holland und Frankreich, I, Berlin, p. 81.

[2] Bemerkungen, etc., II, p. 39.

Im Katalog steht: Deux espèces de Ténias rendues par la vache. Auf einem andern Glase steht: Ténias rubanés dans la caillette d'une vache. Ich muss aber alles für einerley halten, und habe schon von dem Wurm eine kurze Beschreibung gegeben wie ich von dem Kabinet der Thierarzneyschule in Hannover sprach.

Still later Rudolphi[1] in 1810 continues the parasite under the same name and discusses it more in detail. His entire remarks are quoted here, as they are important, being based upon the original material.[2]

[P. 79.] TAENIA DENTICULATA, R. Taenia: *capite tetragono, collo nullo, articulis brevissimis foraminibus marginalibus oppositis, lemniscis dentiformibus.*

[P. 80.] Camper's a Beschäft. Berl. N. Fr., 4, p. 139.

Gmelin, Syst. Nat., p. 3074, n. 55, Taenia ovina *β.* bovis.

Carlisle Transact. Soc. Linn. 11, tab. 25, fig. 15, 16. Taenia ovina, bovis.

Rudolphi hedoepor, Vol. I, p. 81; Vol. II, p. 39. Taenia denticulata.

Hab. in *Bove.* Camperus a bove; Havemannus, Scholae Vet. Hannov. Director meritissimus, a vitulo (solitariam, capite destitutam); Chabertus a vacca copiose, dejectam observaverunt, hic etiam in vaccae ventriculo quarto reperit. Specimina mea ex Museo Scholae Veterinariae Altorfensis ditissimo.

Descr. Vermes quindecim ad sedecim pollices longi, antice duas ad quinque lineas, postice fere pollicem lati; coloris albidi, vel grisei.

Caput exiguum, tetragonum, latiusculum, *osculis* quatuor, anticis, subcontiguis, subglobosis, horum apertura exigua, orbiculari. *Collum* nullum. *Articuli* aliquot capiti proximi angusti, mox vero latiores, tandem latissimi et subaequales fiunt, ita tamen, ut in uno alterove specimine media vermis pars paullo angustiores et simul longiores objiciat; omnes ceteroquin brevissimi, ut longitudo latissimorum vix lineam, plurimorum ne dimidiam quidem excedat. Margines articulorum postici crenati sive undulati superficiem insequentium qua partem tegunt; laterales (anterioribus nonnullis, rarius mediis quibusdam articulis exceptis) obtusiusculi [p. 81], foramine utrinque medio, opposito, insignes, e quo denticulus acutus, leviter reflexus et durinsculus (lemniscus) exscritur. Substantia mollis, plus minus crassiuscula, ut crassities interdum lineam adaequet. *Ova* in substantia media cumulata, ovariis regularibus mihi non visis.

Obs. 1. Carlisle in figuris citatis canales articulorum laterales longitudinem versus decurrentes et ovaria in racemum brevissimum et latissimum digesta, habet; haec omnia ne in tenuioribus quidem speciminibus vidi, vel sectione detegere potui. Denticuli validi horumque foramina ab eodem minus bene sistuntur.

Obs. 2. Chabertus in opere Bibl. n. 199.[3] indicato Taeniam hanc cum reliquorum mammalium Taeniis, sub nomine Ténia rubané, perperam conjunxit, in Musei Alfortensis autem catalogo duas in species (Ténia rubané et Ténia lancéolé) praeter ullam necessitatem divisit, nam specimina minora quam reliqua ad formam lanceolatam magis accedere nil refert.

Obs. 3. A specie praecedente notis in obs. 2. ad eandem indicatis abunde differt quibus autem Taenia caprae n. 84. dicta distinguenda sit, hujus capite non viso determinare non ausim; pars antica tamen quam in denticulata tenuior, licet quam in praecedente latior, videtur.

That the citations from Camper, Carlisle, and Gmelin must be rejected from the bibliography of this species follows from the data given on page 177.

[1] Entozoorum sive vermium intestinalium. Historia naturalis, II, pt. 2, p. 39.

[2] The original description of 1804 is evidently based upon the Alfort material and not upon the specimen seen at Hanover. Chabert's specimens must therefore be taken as types.

[3] Traité des maladies vermineuses dans les animaux. Paris, 1782; second edition, 1787; German translation, Göttingen, 1789.

Gurlt[1] in 1831 obtained Rudolphi's specimens and gave two figures of the worm. Creplin[2] in 1842 also studied the originals and gave quite a fair description of them (for details see Stiles[3]).

Since Creplin's time numerous authors have mentioned *T. denticulata* as a parasite of cattle and sheep, and quite a number of specimens have been determined as belonging to this species (for details see Stiles[4]). In 1891 Blanchard[5] placed this species in his genus *Moniezia*. Later,[6] in 1893, I studied several end segments of Rudolphi's originals, compared them with several specimens determined as *T. denticulata* by various helminthologists, and called attention to the disagreement in the statements of different authors as well as to the fact that none of their specimens agreed with Rudolphi's original type. The few statements I made upon the originals were extremely meagre and guarded, showing that "we know practically nothing of the microscopic anatomy of *M. denticulata*."

Upon examining originals of Baird's *Tænia goezei* and Riehm's *Dipylidium latissimum*, Hassall and Stiles were surprised to find the great resemblance the cirrus bore to the cirrus in the few segments of Rudolphi's material deposited in the United States National Museum. Through the kindness of Geheimrath Möbius and Dr. A. Collin we obtained further material of Rudolphi's originals and were able to prove[7] that *Tænia denticulata* contained two distinct species of cestode, i. e., one agreeing with Riehm's *D. latissimum* and *T. goezei*, the other with *Ctenotænia pectinata* (Goeze, 1782 partim, Riehm, 1881), Railliet, 1893. We then expressed the opinion that an error had occurred in the original label of Rudolphi's specimens, and that they were in reality leporine rather than bovine cestodes.

Baird's description[8] of *T. goezei*, in 1853, reads as follows:

19. *Tænia Goezii*, Baird. Head wanting. Articulations of body very short, numerous. The inferior margin straight. Genital orifices opposite, situated on or near the lower edge of each joint, the lemniscus being projected out in form of an elevated papilla, which curves downward. Greatest breadth of body 6 lines. length of articulations abont ½ a line.

This species differs from *expansa* and *denticulata* in having the posterior border or edge of each joint smooth and rounded, instead of being crenulate or undulated, and having the genital orifices situated on the lower edge of the joint instead of in the middle.

Hab. (?)

From old collection.

[1] Lehrbuch der pathologischen Anatomie der Haussäugethiere, p. 381, pl. x, figs. 3–4.

[2] Endozoologische Beiträge, Weigmann's Arch. Naturg., I, pp. 315–327.

[3] Revision of adult Cestodes of cattle, sheep, and allied animals, Bull. 4, Bur. An. Ind., U. S. Dept. Agric., 1893, p. 44.

[4] Loc. cit., 1893, pp. 44–46.

[5] Mém. Soc. zool. France, IV, 1891, p. 187.

[6] Loc. cit., 1893, pp. 42–47.

[7] Vet. Mag., III, 1896, p. 6–9.

[8] Cat. Specs. Ent. or Intestinal Worms, Coll. Brit. Mus., Lond., p. 78.

Riehm[1] in 1881 studied the tapeworms of rabbits and hares, and in a preliminary account of his work described this same form as *Cittotania latissima*, new genus, new species. Later[2] he placed this species in the genus *Dipylidium* with the following specific diagnosis:

Kopf hakenlos über ¾ mm. breit, mit stark vorspringenden Saugnäpfen und dadurch gegen die lanzettförmig sich verbreiternde Gliederkette deutlich abgesetzt. Geschlechtsöffnungen beiderseits, in den zitzenartig vorspringenden Hinterecken der Glieder, welche den Rändern, besonders der contrahierten Thiere ein gefranztes Ansehen verleihen. Glieder stets viel kürzer als breit und namentlich nach den Seiten hin ungemein dick. Länge im gestreckten Zustande bis 80 cm., Breite der reifsten Glieder 15 mm. und darüber Wohnthier: *Lepus cuniculus*.

Of anatomical details he gives the following, which appear to me to be of importance:

Segments may attain 3 to 3.5 mm. in thickness; the strobila is generally found in the lower portion of the small intestines and is of a grayish to a reddish gray in color, something like *Bothriocephalus latus*. Black pigment on the suckers and genital pores. Suckers prominent; neck short. Genital anlagen appear very early. Male organs: Testicles very numerous, 0.115 mm. in diameter, scattered throughout dorsal portion of median field; cirrus pouch large, provided with three layers of muscles, two circular and one longitudinal layer, cirrus is generally protruded. Female organs: Vagina opens close to cirrus, and is quite thin; median to the longitudinal canals it swells into a receptaculum seminis; female glands essentially the same as in *Dipylidium pectinatum*, but situated very close to the longitudinal canals. The uterus is described "not as a simple tube, widened here and there, and running transversely through the segment, but it is broken up into two or three such tubes, which unite here and there, and thus cut the parenchyma up into islands. This structure is seen, however, only in segments without eggs. Through the pressure of the developing ova these tubes widen so that the islands of parenchyma are suppressed and the uterus then appears as a single tube." In some segments an extra (third) set of female glands was observed right or left of the median line. Excretory system very highly developed; in the younger segments it is composed of a network of canals, with one lateral canal which is especially large; transverse canal with numerous anastomoses present; as the genital organs develop, the canals of the median field become more or less suppressed, but three or four lateral canals persist each side and the transverse canals at the posterior margin become larger, so that the excretory system now bears more of a resemblance to that of *Dipylidium pectinatum;* the second canal system (dorsal canal) resembles that of *Dipylidium leuckarti*. (Abstract.)

Neumann[3] in 1888, places this worm in the genus *Tænia*.

Blanchard[4] in 1891 examined Baird's specimens and recognized them as identical with *D. latissimum*, Riehm. He also examined fresh specimens, which he describes in some detail.

Strobila measures 40 to 50 cm. long and contains about 210 segments; head, 0.8 mm. broad by 0.63 long. Neck absent, segments may attain 4 mm. in length by 15 in breadth. Genital pore appears about the seventy-eighth segment; in the older segmnets it is more distal than in the younger segments; egg is spherical 52 to 60 μ; bulb of pyriform body 16 to 21 μ, horns long and curved. (Abstract.)

[1] [Untersuchungen an den Bandwürmern der Hasen und Kaninchen. Zeitschr. ges. Naturw. 3 ser., VI, 1881, p. 200.

[2] Studien an Cestoden, Zeitschr. ges. Naturw., 3 ser., VI, 1881, pp. 583–590.

[3] Traité des maladies parasitaires, p. 126, Paris, 1888.

[4] Mém. Soc. zool. France, IV, 1891, pp. 444, 451, 452–457, figs. 21–25.

Railliet[1] in 1893 places Riehm's species in his genus *Ctenotænia*.

From the work of former authors and from my own observations upon the original material of *T. denticulata*, *T. goezei*, and *Cittotænia latissima*, I propose the following as a revised specific diagnosis:

Diagnosis.—*Cittotænia denticulata* (Rudolphi, 1804), Stiles and Hassall, 1896: Strobila attains 40 to 50 cm., even 80 cm. in length by 15 mm. in breadth by 3.5 mm. in thickness, is grayish to grayish red in color, and is made up of 200 or more segments. Head unarmed, 0.8 mm. broad by 0.63 mm. long, suckers large and prominent; rostellum not observed. Neck absent. Genital pores double, prominent, opposite in posterior half of margin, near corner of the segment. Male organs: Testicles 0.115 mm. in diameter, very numerous, scattered through the dorsal portion of the median field; cirrus-pouch large and prominent, 1.12 mm. long by 0.32 mm. broad. Female organs: Vagina runs ventrally and distally of cirrus-pouch on both sides of segment; female glands very similar to those of *Cittotænia pectinata*, situated close to longitudinal canals; uterus very complex. Eggs 52 to 60 μ in diameter; bulb of pyriform body 16 to 24 μ. Excretory system: Very complex, numerous, thin-walled longitudinal canals (probably all belonging to the ventral system); dorsal canals with thick wall. Genital canals cross the longitudinal canals and nerves dorsally.

Host.—Common European wild rabbit (*Lepus cuniculus*).

Types.—Rudolphi's type in Berlin Museum; fragments in the collection of Stiles, Nos. 17, 1492, U.S.N.M. Baird's type in South Kensington Museum (London); fragments in collection of Blanchard. Riehm's cotypes in collection of Leuckart; Vienna Museum; No. 1328, U.S.N.M. Several typical specimens in collection of Moniez.

Geographical distribution.—Europe: France (Chabert, R. Blanchard, Moniez); Saxony (Riehm).

CITTOTÆNIA CTENOIDES (Railliet, 1890), Stiles, 1896.

(Plate XIV, figs. 1–8.)

1881, *Dipylidium leuckarti*, Riehm, Zeitschr. f. d. ges. Naturw., 3 ser., VI, p. 200; pp. 566–577, pls. v, figs. 3, 11–13, 16; vi, figs. 5–6.

1888, *Tænia leuckarti* (Riehm, 1881), Neumann, Traité des maladies parasitaires, etc., p. 426 [nec *Tænia leuckarti*, Krabbe, 1869, Bidrag, p. 335].

1890, *T. ctenoides*, Railliet, Rev. d. Sci. nat. appliq. Bull. Soc. nat. d'Acclimat. de France, p. 346.

1891, *Moniezia leuckarti* (Riehm, 1881), R. Blanchard, Mém. Soc. zool., France, IV, p. 187; pp. 144, 450–451.

1893, *Ctenotænia leuckarti* (Riehm, 1881), Railliet, Traité de Zool. méd. et agric., I, p. 278.

1896, *Cittotænia leuckarti* (Riehm, 1881), Stiles & Hassall, Veterinary Magazine, III, p. 407.

For the history of this species prior to Riehm, 1881, see the historical review of *C. pectinata*, p. 184.

[1] Traité Zool. méd. et agric., I, p. 278.

Riehm[1] in 1881 was the first to clearly define this form, which he named *Dipylidium leuckarti*, with the following specific diagnosis:

Kopf hakenlos, sehr klein, etwa 0.5 mm. breit, mit 4 flachaufliegenden Saugnäpfen, nicht abgesetzt gegen den Hals, welcher mit lanzettförmiger Verbreiterung in die Gliederkette übergeht. Geschlechtsöffnungen beiderseits im hinteren Viertheil des Proglottisrandes. Glieder trapezförmig, auch im gestrecktesten Zustande noch breit, für gewöhnlich aber etwa 3–6 mal breiter als lang. Länge im gestreckten Zustande bis 80 cm., Breite der reifsten Glieder bis 1 cm. Die Strobila häufig durch Längsfalten der Haut wie gestreift. Wohnthier: *Lepus cuniculus*.

In the anatomical discussion, and in his figures, Riehm brings out the following points:

The head measures 0.5 mm. broad by about 0.166 mm. thick; neck moderately long, its distal end nearly twice as broad as its proximal end; 500 to 750 proglottids present in the strobila; posterior edge of segments extends prominently over the next following segment, so that the side of strobila appears serrate. Male organs: Testicles 50 to 60 μ in diameter, arranged in two groups in each segment, one on each side of the median field near the ovary; cirrus pouch small, saccular, contains a small vesicula seminalis and the retracted and coiled penis. Female organs: The female anlagen appear as early as the twenty-fifth segment; female glands quite close to ventral canal; uterus same as in *C. pectinata*. Excretory system: Circular canal said to be absent from the head; a median canal forms a dorsal and a ventral loop between the suckers; each loop branches, one forming the two ventral canals, the other the two dorsal canals; the ventral canals are connected by the transverse canals in each segment, but in the posterior segments a network of canals supplants the ordinary transverse canals; a second canal system—evidently the dorsal canals—is described as possessing a thick muscular layer. It is figured as lying between the ventral canal and nerve. Ova, 67 to 70 μ in diameter. Of more than 150 wild rabbits, only 10 to 12 were not infested with this parasite. (Abstract.)

Neumann[2] in 1888 placed the worm in the genus *Tænia*; later[3] he reverted to *Dipylidium* and recorded a worm from the domesticated rabbit which he considered identical with this form. Railliet in 1890 found this worm in France and proposed the name *Tænia ctenoides* in place of *T. leuckarti* (Riehm, 1881), Neumann, 1888 [nec Krabbe, 1869].

R. Blanchard[4] in 1891 placed this species in the genus *Moniezia*, translating Riehm's diagnosis.

Railliet in 1893 transferred the species to his genus *Ctenotænia*.

I have examined one of Riehm's originals, and, through the kindness of R. Blanchard, I have received several tapeworms under the label "*Tænia pectinata*, Lapin domestique, 10, 8, 89. G. Marchal. Hucqueliers près Montrei—[?] sur mer." These worms agree with Riehm's specimens of *Dipylidium leuckarti*. One of Moniez's specimens labeled "Açores" is also a *D. leuckarti*. Upon the material at my disposal and Riehm's anatomical discussion I base the following revised specific diagnosis:

[1] Stud. an Cestoden. Zeitschr. ges. Naturw., 3 ser., VI, p. 200; pp. 566–575.

[2] Traité des maladies parasitaires. Paris, 1888, p. 426.

[3] Traité des maladies parasitaires, Paris, 2d ed., 1892, p. 461. Parasites and Parasitic Diseases of Domesticated Animals, London, 1892, p. 473.

[4] Mém. Soc. zool. France, IV, p. 187; pp. 150–151.

Diagnosis.—*Cittotænia ctenoides* (Railliet, 1890), Stiles, 1896. Strobila serrate may attain 80 cm. in length by 10 mm. in breadth; composed of 500 to 750 segments, which are always at least 3 to 5 times broader than long. Head unarmed, about 0.44 to 0.5 mm. broad by 0.16 mm. thick; no rostellum visible. Suckers 0.176 mm. in diameter. Neck short and broad, or absent, segmentation beginning immediately back of the head. Genital pores double, situated in posterior half of margin. Male organs: Testicles arranged in two groups in lateral portion of median field; about 60 to 80 testicles to each group, 50 to 60 μ in diameter. Cirrus pouch small, 0.16 mm. long by 0.128 mm. broad; it does not reach the longitudinal nerve; contains the coiled and inverted cirrus and a small vesicula seminalis. Female organs: Ovary, vitellogene, and shell glands agree in general with the same organs in *C. pectinata*, but are situated much closer to the longitudinal canals; uterus agrees with that of *C. pectinata*, but appears to be rather more simple. Dorsal canal lies between ventral canal and nerve or dorsal of ventral canal. Vas deferens, vagina, and uterus extend from median field into lateral field dorsally of the longitudinal canals and nerves. Ova, 64 μ in diameter; bulb of pyriform body, 20 μ.

Hosts.—European wild rabbit (*Lepus cuniculus*), by Riehm; tame rabbit (*L. cuniculus domesticus*), by Neumann, Railliet, and Marchal.

Types.—Cotype, No. 1327, U.S.N.M. (from collection of Riehm). Typical specimens: No. 114, U.S.N.M. (from collection of Blanchard); Nos. 1449.4 and 1457, U.S.N.M. (from collection of Moniez); collection of Blanchard; collection of Moniez.

Geographical distribution.—Europe: Saxony, by Riehm; France, by Neumann, Railliet, Marchal, Moniez. The Azores (collection of Moniez).

CITTOTÆNIA PRÆCOQUIS (Stiles, 1895), Stiles & Hassall, 1896.

(Plate XV, figs. 1–6.)

1895, *Ctenotænia præcoquus* [typographical error for *præcoquis*], Stiles, Veterinary Magazine, II, June, p. 345. Aug. 28, 1895.

1896, *Cittotænia præcoquis* (Stiles, 1895), Stiles & Hassall, Veterinary Magazine, III, p. 407.

Prof. Herbert Osborne, of Ames, Iowa, collected two specimens of tapeworms from the Pocket-Gopher (*Geomys bursarius*), which he presented to the Bureau of Animal Industry. The species is rather a difficult one to interpret, especially upon press preparations, and the limited amount of material does not allow a minute anatomical analysis by means of sections, but sufficient characters can be given to enable one to easily recognize the form.

The specimens measure about 40 mm. long and contain about 150 segments; the greatest breadth, about 5.5 mm., is reached about 10 mm. from the distal extremity; the distal 10 mm. becomes narrower. Head not very distinct from the strobila, 0.43 mm. broad by 0.32 mm. long. No rostellum visible; no hooks present; sucker 0.16 mm. long by 0.128 mm. broad.

Neck very short and broad. Segmentation visible 0.56 mm. from anterior extremity of the head. The proglottids rapidly become distinct, and in the specimens at hand the posterior border of each segment overlaps the anterior border of the next following segment for about one-third of its length in the anterior segments to one-sixth of its length in the posterior segments. The genital anlagen become visible almost immediately after the segmentation. The genital pores are double and opposite in about the middle of the lateral margin. Male organs: The testicles are numerous and are scattered over the entire dorsal portion of the median field, but do not quite reach the lateral canals; in the middle portion of the median field they extend farther ventral than in the lateral portion. The cirrus pouch lies dorsal and slightly posterior to the vagina on both sides of the segment; it is 0.24 mm. long by 96 μ broad (proximal end); it is relatively muscular; the lateral portion is narrow, but the proximal portion is swollen to contain a globular vesicula seminalis; the vas deferens coils and curves from here median and cephalad, the convexity of the curve being distal. Female organs: The female glands lie in the median field, about halfway between the median line and lateral canals; they were not analyzed in detail; details of the development of the uterus must also be left to some one who can obtain further material; the vagina lies ventral and slightly proximal to the cirrus-pouch on both sides of the segment; it is narrow, 19 mm. long, and extends to a point slightly dorso-median of the ventral canal, where it swells into an enormous receptaculum seminis which occupies the ventro-lateral portion of the median field, and in some sections measures 0.72 mm. long by 0.19 mm. broad; median of this organ and ventral of the testicles are situated the female glands; there is apparently a common uterus to both ovaries; it is situated ventrally of the testicles at the height of the genital pores, but proximally and distally of this plane it extends farther dorsad; sections on other planes than that of the pore show that dorso-ventral trabeculæ of the body stroma divide the uterus into numerous pouches, although sections at the pores generally show a more or less continuous transverse stem; the ova are unusually small, measuring 32 to 36 μ in diameter; the bulb of the pyriform body varies between 8 μ and 12 μ; the horns are relatively long and crossed. Excretory and nervous systems: At the height of the genital pores the dorsal canal lies between the ventral canal and nerve; in other planes it may lie dorsal of the ventral canal. The genital canals pass dorsally while the uterus passes ventrally of the longitudinal canals and nerves.

As specific name, I proposed *præcoquis* (misprinted as *præcoquus* in the original description), referring to the unusually early development of the genital organs. The following is proposed as a specific diagnosis:

Diagnosis.—Cittotænia præcoquis (Stiles, 1895), Stiles & Hassall, 1896. Strobila attains about 40 mm. in length by 5.5 mm. in breadth by 0.72 mm. in thickness; the posterior 10 mm. is slightly narrowed.

Head unarmed, not very distinct from strobila, 0.43 mm. broad by 0.32 mm. long; rostellum not observed; suckers 0.16 mm. long by 0.128 mm. broad. Neck short and broad. Segmentation begins about 0.56 mm. from the anterior extremity of head. About 150 proglottids present, very distinct; the posterior flap overlaps the anterior one-third to one-sixth of the next following segment. Genital pores double and opposite, not prominent, in about the middle of the lateral margin. Male organs: Testicles numerous, confined to dorsal portion of median field; cirrus pouch dorsal of vagina on both sides of segment, 0.24 mm. long, muscular, containing globular receptaculum seminis (about 90 μ diameter) in its proximal portion; it extends to or slightly beyond the ventral canal. Female organs: Female glands about halfway between median line and ventral canal; vagina narrow, extends across ventral canal, then dilates into a large receptaculum seminis; uterus probably single, possessing blind proximal and distal pouches. Ova, 32 to 36 μ in diameter; bulb of pyriform body, 8 to 12 μ; horns long and crossed. Excretory system: Dorsal canal between ventral canal and nerve at height of the genital canals; genital canals cross dorsally, but uterus crosses ventrally, of the longitudinal canals and nerves.

Hosts.—Pocket Gopher ([1]*Geomys bursarius* (Shaw, 1800)), collected by Herbert Osborne at Ames, Iowa.

Types.—Bureau of Animal Industry cestode series No. 1079 designated as type and deposited in the United States National Museum; paratype (1372, part in sections) deposited with type. Technique of types: Corrosive sublimate, alcohol, acid carmine.

PECTINATA GROUP.

The European form *Cittotænia pectinata* forms, with certain American parasites, a very compact group, but it is difficult to know what rank should be given to this division. Generic rank would be too high, specific rank too low. I propose to include these cestodes in the *Pectinata* group, which I base upon the peculiar cirrus pouch.

Three species come within this group at present:

1. Type species *C. pectinata*, as defined below, p. 188, its chief characters being the length of the cirrus pouch, the quadrangular arrangement of the testicles, and their extension beyond the ovaries to the lateral canals.

[1]Synonymy after Merriam: 1800, *Mus bursarius*, Shaw; 1815, ? *M. ludovicianus*, Ordway; 1817, *Diplostoma fusca*, Rafinesque; 1817, *Geomys cinerea*, Rafinesque (*Mus bursarius* renamed); 1820, *Saccophorus bursarius*, Kuhl; 1821, *Mus saccatus*, Mitchill; 1823, *Pseudostoma bursarius*, Say; (1822) 1825, *Ascomys canadensis*, Lichtenfell; 1859, *Geomys? bursarius*, Richardson; 1852, *Geomys canadensis*, LeConte; 1852, *G. oregonensis*, LeConte.

C. Hart Merriam, 1895. Monographic Revision of the Pocket Gophers, Family Geomyidæ (exclusive of the species of *Thomomys*), p. 120. North American Fauna, No. 8, Division of Ornithology and Mammalogy, United States Department of Agriculture.

2. The second species, *C. perplexa*, is directly intermediate between the first and third, but I am unable to find connecting links between it and the other forms. The cirrus pouch is about two thirds as large as that of *C. pectinata* and somewhat more distinct than that of *C. variabilis*; the testicles are arranged in two triangles and extend laterally beyond the ovaries to the lateral canals. In general configuration of the body it resembles *C. pectinata* very closely, but is much shorter.

3. *C. variabilis* represents the last form of the series, presenting a cirrus pouch slightly smaller than that of *C. perplexa* and testicles in a quadrangle which is confined entirely to the space between the ovaries. It occurs in three different forms as follows:

(*a*) *C. variabilis* found in *Lepus sylvaticus* with characters described below, p. 192, measuring up to 10 mm. broad, the segments always much broader than long.

(*b*) *C. variabilis angusta* differs from *C. variabilis* only in point of size; it measures only 2 mm. broad and the segments are about three times as broad as long. This form I have never found with ova, and it may be a case of arrested development. Those authors who take external form as a specific character would be obliged to give this parasite specific rank, but I am unable to admit this view. This variety is found in *Lepus sylvaticus*.

(*c*) *C. variabilis imbricata* is the third variety, and is one due probably entirely to host influence. It is found in *Lepus palustris* in Florida. The differences between this form and the type are but very slight; the posterior margins are more scalloped, the segments more imbricate, and the cirrus pouch slightly more distinct.

CITTOTÆNIA PECTINATA (Goeze, 1782 partim, Riehm, 1881), Stiles & Hassall, 1896.

(Plate XVI, figs. 1–2; Plate XVII, figs. 1–2.)

?1781, *Tænia acutissima*, Pallas, Neue nord. Beyträge, I, pp. 75–81, pl. III, fig. 25.

1782, *T. pectinata*, Goeze, Versuch einer Naturgeschichte d. Eingeweidew., pp. 363–368, pl. XXVII, figs. 7–13.

?1800, *Alyselminthus pectinatus* (Goeze, 1782), Zeder, Erster Nachtrag zur Naturg. d. Eingeweidewürmer, pp. 246–249.

?1803, *Halysis pectinata* (Goeze, 1782), Zeder, Anleitung zur Naturg. d. Eingeweidewürmer, p. 332.

1810, *Tænia leporina*[1] Rudolphi (in synonymy), Ent. Hist. Nat., II, Pt. 2, p. 82.

1881, *Dipylidium pectinatum* (Goeze, 1782 partim), Riehm, Zeitschr. f. d. ges. Naturwiss., 3 ser., VI, p. 200; pp. 575–583, pl. V, figs. 4, 14; VI, figs 1, 7.

1891, *Moniezia pectinata* (Goeze, 1782 partim, Riehm, 1881), R. Blanchard, Mém. Soc. zool. France, IV, pp. 187, 445, 450–452, 457–460, figs. 26–30.

1893, *Ctenotænia pectinata* (Goeze, 1782 partim, Riehm, 1881), Railliet, Traité de Zool. méd. et agric., I, pp. 278–279.

1896, *Cittotænia pectinata* (Goeze, 1782 partim, Riehm, 1881), Stiles & Hassall, Veterinary Magazine, III, p. 107.

[1] Blanchard (1891A, p. 457) has already shown that Limbourg (1766) did not use "*Tænia leporina*" as a specific name; the name therefore dates from Rudolphi, 1810.

Marigues[1] in 1778 mentions and figures tapeworms found in the body cavity of rabbits; but it is impossible to determine what species he had before him.

Pallas in 1781 found no tapeworms in the many hares he examined. He received some worms taken by Graf von Bork from hares and described them as *Tænia acutissima*. The worm is evidently a double-pored leporine form, and on that account probably a *Cittotænia*; but from the description given by Pallas it is impossible to definitely decide which of the three leporine double-pored forms he had before him. On this account I do not consider myself justified in reinstating the specific name *acutissima*.

Pallas evidently thought that *Drepanidotænia lanceolata* of geese was identical with the leporine form, and he also placed *Schistocephalus* from the body cavity of *Gasterosteus* side by side with the parasite of hares, although his text clearly shows that he thought further investigation might result in separating *Schistocephalus* as a distinct species.

Goeze in 1782 states that *Tænia pectinata* is found in hares and wild rabbits, but he never found it in tame rabbits; he mentions its similarity to a parasite (*Drepanidotænia lanceolata*) of geese, to one (*Schistocephalus solidus*) of the Stickle-back (*Gasterosteus*) and to the broad tapeworm (*Moniezia expansa*) of sheep, but does not consider it specifically identical with any of these forms. Goeze found the species nearly always present in 1-year-old hares and in wild rabbits, often 20 to 30 in an individual host. "The margins of each segment were rather bluntly rounded, and on this rounding, by means of the hand lens a very small opening was visible, out of which eggs could be pressed, and out of which, when the live worms were placed in hot water, through the sudden contraction of the canals, they were pressed in small threads." The first part of this quotation, "the margins, etc." ("Die Seitenrände jedes Gliedes kulpichtrund, und auf dieser Ruendung") is the only portion of Goeze's article which can be interpreted as referring to double pores. His figures do not show pores, but Figure 7 *makes the impression upon a worker of being a* double-pored cestode. The head is described as very small; segmentation begins almost immediately back of the head; the segments increase in size very rapidly; four suckers on head, but no hooks; of thirteen specimens the longest measured about 6 inches; it possessed 204 segments.

Zeder in 1800 placed Goeze's specific name in the genus *Alyselminthus*, and gave a discussion of the parasite which he supposed was identical with Goeze's form. He states, however, that he found only a single pore to each segment. While it seems possible that Zeder's form is identical with *Andrya rhopalocephala*, as assumed by several authors, the point can not be definitely settled, as Zeder's description

[1] Observations sur des vers Ténia trouvés dans le ventre de quelques lapins sauvages; Observations sur la physique, etc. (Rozier), XII, Paris, pp. 229–231, pl. II, fig. 3.

is too indefinite to allow a specific or even generic determination. In 1803 he transferred the species to *Halysis*.

Rudolphi[1] in 1810, as Riehm remarks, certainly had more than Goeze's species in mind when he wrote his diagnosis: a portion of his description applies very well to *C. denticulata*, and a portion to *C. ctenoides*. He includes Zeder's single-pored form in *T. pectinata*. The fragment of Rudolphi's (1810) specimen of *T. pectinata* which I examined is so poorly preserved that no statements can be made on it, but, as Stiles and Hassall in 1896 have shown, part of Rudolphi's original material of *T. denticulata* belongs to this species.

Bremser[2] in 1824 gives two figures of *T. pectinata*, in regard to which Riehm remarks that Figure 5 is an unquestionable *D. leuckarti*, while Figure 6 (head) is similar to *D. latissimum* (= *C. denticulata*).

Diesing's[3] description of 1850 can be made to apply to several different forms; he includes all the literature given for *T. pectinata*.

Our chief knowledge of *C. pectinata* we owe to Riehm in 1881, who studied its anatomy in detail. Riehm divided the heterogeneous mass of tapeworms, which earlier authors had included under the term *T. pectinata*, into five species, which he named *T. rhopalocephala* and *T. rhopaliocephala* (single-pored forms), and *Dipylidium pectinatum*, *D. leuckarti*, and *D. latissimum* (double-pored forms). This is the first time, therefore, that *T. pectinata* was described in detail, so that this species stands to-day upon Riehm's division, he having designated the particular parasite which should bear Goeze's specific name.

Riehm[4] diagnoses his form as follows:

Kopf hakenlos, ausserordentlich klein, kaum ¼ mm. breit, gegen die lanzettförmig sich verbreiternde Strobila nicht abgesetzt. Geschlechtsöffnungen beiderseits, fast in der Mitte des Proglottidenrandes. Glieder kurz, trapezförmig, auch im gestrecktesten Zustande mindestens 4 mal breiter als lang. Länge des ausgestreckten Wurmes nicht über 40 cm, meist geringer. Breite der reifsten Proglottiden bis 8 mm. Die Strobila ist oft durch Längsfalten gestreift. Wohnthier: *Lepus timidus*.

This diagnosis is hardly detailed enough to meet the requirements of the present day, but in the anatomical description Riehm gives data which supply what is lacking in the passage just quoted. Many of the points he mentions can hardly be looked upon as specific characters, but should, I believe, be attributed to influences of technique, individual variation, and possibly the specific influences of environment, namely, the host—a subject to which the helminthology of the future must certainly give its most serious and careful consideration. The characters which appeal to me most in Riehm's description may be briefly summarized as follows:

Male organs: The testicles form a continuous band across the median field in the distal portion of the segment, and in Plate VI, fig. 4, they extend laterally close to the

[1] Entozoorum sive Verminm intestinalium Historia naturalis, II, Pt. 2, Amstelædami, pp. 82–84.

[2] Icones Helminthum, pl. XIV, figs. 5–6.

[3] Systema Helminthum, I, 1850, p. 498.

[4] Loc. cit., p. 575.

longitudinal canals; the cirrus pouch is deserving of special notice. In the majority of the known Tæniidæ the cirrus pouch is pyriform and rarely extends median of the ventral canal, but in *C. pectinata* it is a long narrow structure reminding one of the nozzle of a hose; Riehm gives its average length as more than 1 mm., and on Plate VI, fig. 4, shows that it is more than twice as long as the distance between the genital pore and the longitudinal canal. This extreme length of the pouch is a character of great importance. Female organs: The vagina, according to Riehm, is about as large as the cirrus pouch. At a point corresponding to the proximal end of the cirrus pouch it becomes suddenly very thin, and leads to a second swelling, the receptaculum seminis. The female glands correspond in all essential characters to those of the genus *Moniezia*, except that the ovary is described as composed of two quite distinct halves. Their position, some distance from the longitudinal canals, is striking. The uterus is said to be similar to that of *C. ctenoides*, namely "a common uterus for both sides, which extends the entire breadth of the segmen, and is constricted only in the middle, so that in the gravid segments the lateral portion appears swollen by the ova in comparison with the rather thin median portion. Its volume is also considerably increased laterally [namely, laterally to the uterus, longitudinal in reference to the worm] by apparently unbranched tubes which extend anteriorly and posteriorly. As a matter of fact, however, these tubes resolve themselves as the optical sections of a corresponding number of circular widenings of the uterus." Excretory system: The dorsal canals become obliterated some distance from the head. The transverse canals are connected with one another, not only by the ventral canals, but also by numerous smaller longitudinal canals. Topographically, Riehm figures the genital canals as dorsal of the nerve and longitudinal (ventral) canal. The parasite is said to occur only in the fall and first half of the winter, and only in hares. It was especially common around the Röblinger See, but rare on the higher plateaux of Saxony.

Blanchard[1] in 1891 states that he found this species in several hares of unknown origin. He has never found it in hares in the central part of France or around Paris, but found four specimens at Briançon in *Lepus variabilis*, killed at a height of 1,500 meters. His description, based upon these specimens, may be summarized as follows:

The largest specimen was 18 cm. long; maximum breadth, 7 to 10 mm.; head 315 to 340 μ broad; neck, 285 to 325 μ broad; in contracted specimens the neck may measure 1 mm. broad at the first segment; suckers elliptical, 142 μ long by 135 μ broad; opening, 80 μ long by 53 μ broad; mature segments, 7 to 10 mm. broad by 1.1 to 2 mm. long; penis smooth, 40 to 45 μ in diameter, extrudes 175 to 200 μ from pore; eggs generally polygonal from reciprocal pressure, but become elliptical or subspherical when pressure is removed; 80 to 90 μ by about 75 μ; outer membrane 1 to 2 μ thick; diameter of bulb of pyriform body 25 to 30 μ; length 40 to 50 μ; horns terminate in a long filament; hooks of oncosphere 8 μ.

Railliet[2] in 1893 places this species in his genus *Ctenotænia*.

Through the kindness of Dr. Brandes, I have obtained one of Riehm's original specimens of *Dipylidium pectinatum* for comparison with the American forms, and Blanchard has placed his forms from *L. variabilis* at my disposal. In my private collection I find several specimens of tapeworms from *Lepus timidus* which I collected in Leipzig in 1890, and which agree perfectly with Riehm's form. With this material at hand, together with one specimen from von Linstow and several from Moniez,

[1] Mém. Soc. zool. France, IV, pp. 445, 452, 457–460, figs. 26–30.
[2] Traité Zool. méd. et agric., I, pp. 278–279.

I can add a few points of importance to Riehm's diagnosis and lay greater stress upon other points which I think should be brought out more emphatically.

The anlagen of the female glands and genital canals appear in the earliest segments, while the testicles begin about 7 mm. back of the head. Male organs: The testicles are confined entirely to that portion of the segment which lies distally of the uterus, and they extend on both sides laterally of the ovaries to the longitudinal canals; this latter character is one of considerable importance when we compare the American and the European forms. Riehm has already directed attention to the long hoselike cirrus pouch and vagina, but I venture to call particular notice to their size and form.

Female organs: The excessive development which the female glands may attain is worthy of note: Riehm's statement that each ovary was divided into two halves I was unable to confirm. A peculiar feature of the female glands is that they develop suddenly and atrophy suddenly. In Riehm's cotype, for instance, the tubes of the ovary become visible 8 mm. from the anterior end (head lost); they then develop rapidly to a maximum and suddenly disappear, so that 22 mm. from the point where the ovarian tubes appear (or about 30 mm. from the anterior extremity) the ovary can no longer be seen; the testicles persist very much longer. The first trace of the uterus is seen about 12 mm. from the anterior end of specimen (about 14 mm. from anterior end of individual, if we allow 2 mm. for the lost head and first segments): the uterus passes on the ventral side of the ovary, and in all segments which I have examined there is a single uterine anlage extending across the segment.

The genital canals and uterus run dorsally of the nerve and ventral canal as Riehm figures them, and on transverse sections the cirrus is shown to lie dorsally of the vagina on both sides of the segment. The nerve is very close to the lateral margin.

Riehm gives no measurements for the ova; Blanchard (1891, p. 460) states that the ova measure 80 to 90 μ by 75 μ, and that the bulb of the pyriform body measures 25 to 30 μ in diameter. The measurements in Riehm's specimen are somewhat smaller, the ova varying from 72 to 84 μ, the bulb of the pyriform body 14 to 16 μ. My own specimens agree with Riehm's, but many of the ova do not exceed 56 μ in diameter.

The following is proposed as a revised specific diagnosis:

Diagnosis.—Cittotænia pectinata (Goeze, 1782, partim, Riehm, 1881), Stiles & Hassall, 1896. Strobila may attain 400 mm. in length and 8 mm. in breadth, anterior portion usually lanceolate. Head small, about 0.25 mm. or less in diameter, and about 0.125 mm. thick; rostellum and hooks not observed; suckers small. Neck very short, segmentation beginning almost immediately back of the head; the proglottids rapidly become distinct and are always much broader than long, the length being about one-seventh of the breadth; gravid posterior segments measure

about 10 mm. broad by 1.5 mm. long. The anlagen of the genital organs appear very early; the female anlagen are found near the longitudinal canals immediately back of the head; testicles appear about 6 mm. back of the head; genital pores double, in posterior half of margin. Male organs: The testicles are about 0.64 mm. in diameter; they are numerous, about 150 in number, confined to distal half of segment, posterior to uterus, and extend across the entire median field passing the ovary on each side to the longitudinal canals; cirrus pouch unusually large, attaining 1 mm. in length, extending some distance median of the longitudinal canals. Female organs: Ovary, shell gland, and vitellogene gland situated some distance median of the ventral canal, about 1 mm. or more from the lateral margin; a common transverse uterus to both ovaries; it passes the ovary ventrally, is generally larger in its lateral portions than in its median portion, and increases its volume by proximal and distal branches. Excretory system: Dorsal canal not observed; ventral canal median of nerve; transverse canals connected by secondary longitudinal canals. Longitudinal nerves close to lateral margin. Cirrus pouch, vagina, and uterus pass from median field into lateral field dorsally of nerve and longitudinal canals. Cirrus pouch dorsal of vagina on both sides of the segment. Ova globular 56 to 84 μ in diameter; bulb of pyriform body 14 to 16 μ; horns long, curved.

Hosts.—Common European hare (*Lepus timidus*) by Goeze, Riehm, von Linstow, and Stiles; Mountain hare (*L. variabilis*) by R. Blanchard. Development unknown.

Types.—Original types?. Cotypes of Riehm in the collection of Leuckart; No. 1411, U.S.N.M. Typical specimens in collection of Blanchard; collection of Moniez; collection of Stiles (Nos. 116, 1234, 1238, U.S.N.M.).

Geographical distribution.—Europe: Germany (Saxony by Riehm and Stiles; ? by Goeze); France (Briançon by R. Blanchard; ? Lille by Moniez).

CITTOTÆNIA PERPLEXA (Stiles, 1895), Stiles & Hassall, 1896.

(Plate XVIII, figs. 1–3.)

1895, *Ctenotænia perplexa*, STILES, Veterinary Magazine, II, June, p. 345. Aug. 28, 1896.
1896, *Cittotænia perplexa* (STILES, 1895), STILES & HASSALL, Veterinary Magazine, III, p. 407.

The specific name *perplexa* was proposed because it was so difficult to decide what to do with the form under discussion. Some half a dozen specimens were collected by Hassall from *Lepus sylvaticus* in Bowie, Maryland. They are all contracted and measure up to 57 mm. long by 10 mm. broad.

The parasite resembles *C. pectinata* in general form in the early appearance of the genital anlagen and in the fact that the testicles extend beyond the ovaries to the lateral canals. It differs from *C. pectinata* radically in the size of its cirrus pouch and vagina, and in the

fact that the testicles are almost absent from the median portion of the field, being arranged in two triangles.

C. perplexa agrees with *C. variabilis* in the general size of cirrus pouch. It differs from *C. variabilis* in the earlier appearance of the genital anlagen in the position and arrangement of the testicles. The following is proposed as specific diagnosis:

Diagnosis.—Cittotænia perplexa (Stiles, 1895), Stiles & Hassall, 1896. Strobila attains 57 mm. long by 10 mm. broad. Head unarmed, small, about 0.32 mm. broad, not distinctly separated from body; rostellum not observed; suckers 0.112 mm. in diameter. Neck extremely short, segmentation beginning almost immediately back of the head. Genital pores double, and opposite, in about the middle of the margin. Anlagen of female glands and canals visible within 0.64 mm. of the anterior extremity of the head. Male organs: Cirrus pouch similar to that of *C. variabilis*, but smaller, about 0.288 to 0.32 mm. long, extending to or slightly beyond the lateral nerves; testicles arranged in two groups in each segment, one triangle being around each ovary and extending laterally to the longitudinal canals. Female organs: Agree essentially with those of *C. variabilis*, as does the general topography; uterus single or double.

Host.—Cottontail Rabbit (*Lepus sylvaticus*) by Hassall in Bowie, Maryland.

Types.—Bureau of Animal industry, Cestode series, No. 1126, designated as type, and deposited in the United States National Museum. Paratypes in Bureau of Animal Industry; Nos. 1110, 1131, 1137–1139, U.S.N.M.; collection of Stiles; collection of Hassall. Other typical specimens will not be distributed until more material is obtained.

CITTOTÆNIA VARIABILIS (Stiles, 1895), Stiles & Hassall, 1896.

(Plate XIX, figs. 1–14; Plate XX, figs. 1–5.)

1892, "*Tænia pectinata*, GOEZE," 1782, ex parte of CURTICE, Journ. Comp. Med. Vet. Arch., XIII, pp. 232–233.

1895, *Ctenotænia variabilis*, STILES, Veterinary Magazine, II, June, p. 345. Aug. 28, 1896.

1896, *Cittotænia variabilis* (STILES, 1895), STILES & HASSALL, Veterinary Magazine, III, p. 407.

As stated in the introduction, helminthology is not so far advanced that it is possible for us to determine what limits should be given to genera, subgenera, species, and subspecies, and for some time to come all classification into groups must be looked upon as experimental, the ideas of every author being subject to change from day to day as new facts in the comparative anatomy of cestodes are published or observed. The American form which I now describe as *Cittotænia variabilis* is one of the parasites which can equally well be considered as a distinct species, or as a subspecies, possibly peculiar to given hosts. It is so perfectly distinct from the European *C. pectinata* that no specialist could fail to recognize the differences when he has the two forms side by side for comparison. Yet it is so closely allied to the European

C. pectinata that the question forces itself upon us whether these differences can not be considered as subspecific, possibly due to some extent to a difference of conditions found in different hosts and in different countries. I frankly admit that during an examination of a large series of specimens I have changed my mind a dozen times in regard to this particular species. I am now of the decided opinion, however, that this form should be given specific rank.

The specimens upon which this description is based were collected at Bowie, Maryland, by Hassall from the cottontail (*Lepus sylvaticus*). The strobila attains 100 to 180 mm. in length and 10 mm. in breadth.

The head is very small, measuring 0.32 to 0.56 mm. broad; it may or may not be sharply defined from the neck; no rostellum or hooks visible; the suckers are small, measuring 0.12 to 0.28 mm. long by 0.112 to 0.24 mm. broad; the opening of the sucker is directed diagonally forward. The neck is very short or absent, segmentation beginning very early and the proglottids rapidly becoming distinct. The anterior portion varies greatly in shape, according to contraction. The genital anlagen appear rather early; at about 5 to 10 mm. from the head two roundish bodies appear in each segment, one on each side of the median field near the longitudinal canals; these anlagen soon change in form to the pistol-shaped anlagen described for *Moniezia;* at about 25 mm. from the head the first testicles are visible. The genital pores are double and opposite, and situated in about the middle third of the margin.

Segments 125 mm. from the head measure 0.56 mm. long by 6.5 mm. broad by 0.48 mm. thick. Male organs: The testicles number about 65 to 90; they are confined to the dorsal half of the segment distally of the transverse uterus, and do not extend laterally of the ovaries. The cirrus pouch lies dorsally of the vagina on both sides of the segment; it is long, narrow, and quite indistinct, coloring in carmine much more lightly than the vagina. Female organs: The vagina runs ventrally of the cirrus; it is long and narrow. From the margin of the segment for a distance of about 0.48 mm. it is surrounded by a deeply coloring layer of cells, and then it is reduced to a thin narrow canal which later swells into the receptaculum seminis. The ovary, shell gland, and vitellogene gland resemble those of *Moniezia* and *C. pectinata* and lie 1.28 mm. from the lateral margin. The uterus may be double or single; in some segments a single uterine anlage extends across the entire segment, running through the ventral portion of the ovary, and passing to the lateral fields dorsally of the longitudinal canals and nerves; in the majority of segments there are two distinct uterine anlagen, one to each set of female glands. The ventral canal runs about midway between the ovary and the lateral margin; the dorsal canal lies dorsomedian of the ventral canal and is bound by a heavy cuticular lining. The longitudinal nerve lies laterally of the ventral canal, and ventrally of the genital ducts, about 0.64 mm. from the lateral margin.

In the older segments the topography described above is preserved,

but gradually the uterus develops to such an extent that it suppresses all the genital glands. The cirrus pouch becomes indistinct, but the vagina can be traced in nearly all segments.

As the uterus increases in size it gives rise to proximal and distal branches, but the latter are far less regular than those of the European *C. pectinata*. In the posterior segments it is generally difficult to distinguish the two uteri. The ova measure 60 to 64 μ in diameter; the bulb of the pyriform body, 12 to 16 μ. This is the species (var. *angusta*) upon which my paper, "A double-pored cestode with occasional single pores" was based, and since writing that note another case of the same variation was noticed. On account of the numerous variations in the position of the genital pores, uterus, etc., noticed in the specimens studied, I proposed to name the worm *Ctenotænia variabilis*.

Larval stage.—The young specimens described on page 201 were collected in the same locality as the species here described, and from the same host; and it seems probable that the unarmed young mentioned on page 201 are the young of either *C. variabilis* or *C. perplexa*.

Diagnosis.—*Cittotænia variabilis* (Stiles, 1895), Stiles & Hassall, 1896. (American representative of *C. pectinata*.) Strobila attains 100 to 180 mm. in length and 10 mm. in breadth. Head small, about 0.3 to 0.6 mm. in breadth; it may or may not be defined from the neck according to contraction. Neck very short, segmentation beginning almost immediately back of the head; segments always much broader than long. Genital anlagen appear very early, about 5 to 10 mm. from the head. Genital pores double, in about the middle third of the lateral margin. Male organs: Testicles about 60 to 100 in each segment, confined between the ovaries to the dorsal portion of the distal half of the median field; cirrus pouch about 0.4 mm. long, narrow and very indistinct, lying dorsally of the vagina on both sides of the segment. Female organs: Ovary, shell gland, and vitellogene gland resemble the corresponding organs of *Moniezia;* they lie median of longitudinal canals, about 1.3 mm. from the lateral margin; the vagina is rather distinct, lies ventrally of the cirrus pouch, and for about 0.5 mm. from the pore it is surrounded by deeply staining cells; uterus may be double or single (in the same specimen) and may produce proximal and distal branches; ova 60 to 64 μ in diameter; bulb of pyriform body 12 to 16 μ. Longitudinal nerve about 0.6 mm. from the lateral margin; ventral canal large with thin lining; dorsal canal much smaller than ventral canal, dorso-median of ventral canal, with thick lining; transverse canals connect ventral canals [no injections made for secondary longitudinal canals]. Genital ducts and uterus pass from median to lateral field on the dorsal side of the longitudinal canals and nerves.

Host.—Cottontail Rabbit (*Lepus sylvaticus*), by Hassall; Marsh Hare (*L. palustris*), by Mills.

Types.—Bureau of Animal Industry, Cestode series No. 117 designated as type and deposited in the United States National Museum. Paratypes distributed as follows: Collection of Bureau of Animal

Industry; collection of Leidy (University of Pennsylvania); collection of Harvard Museum of Comparative Zoology; collection of Ward; collection of Stiles; collection of Hassall. Europe: Berlin Museum; collection of Leuckart; collection of Max Braun; Halle Zoological Institute; Vienna Museum; collection of Stossich; collection of Parona; collection of Monticelli; collection of Zschokke; collection of R. Blanchard; collection of Railliet; collection of Neumann; collection of Moniez; British (South Kensington) Museum. Asia: Imperial University of Japan, Tokyo. Technique of types: Corrosive sublimate, acetic acid, acid carmine.

Unarmed young stages deposited in collection of Bureau of Animal Industry; collection of U.S.N.M.; collection of Stiles; collection of Hassall; collection of Berlin Museum; collection of Leuckart; collection of R. Blanchard.

Geographical distribution.—Maryland (by Hassall), Florida (by Mills), Long Island (by Peters), ? Puget Sound (collection of Leidy).

Varieties.—To classify the forms at my disposal, I am compelled to recognize three varieties:

(*a*) *C. variabilis.* B. A. I. Cestode series No. 117, type of the species is designated as type of this variety. The posterior flaps of the segments are nearly straight; genital pore in about the middle of the lateral margin. Habitat: *Lepus sylvaticus.*

(*b*) *C. variabilis angusta.* B. A. I. Cestode series No. 1119, designated as type and deposited in the United States National Museum. This variety is only about 2 mm. broad, the posterior flap is straight and does not overlap prominently, the genital pore is generally in the posterior half of the lateral margin. Pores occasionally single.

(*c*) *C. variabilis imbricata.* No. 1246, U.S.N.M., borrowed by B. A. I.; B. A. I. Cestode series No. 1246, designated as type and returned to United States National Museum. At first sight it seems almost like splitting hairs to create a variety for these specimens the technique of which was different from that of *C. variabilis.* The worms were collected by Robert Mills, an enthusiastic collector at Chulnota, Florida, and kindly presented to the United States National Museum. They were placed in 95 per cent alcohol, accordingly they are somewhat contracted. The posterior border of the segments is lobed, a character which is quite constant, and overlaps the next following segment about one-third of its length so that the segments have a general campulate appearance.

Subfamily DIPYLIDIINÆ, Railliet, 1896.

1850, Section *Rhynchotænia,*[1] DIESING, Systema Helminthum, I, p. 497.
1858, Subf. *Malacolepidota* (Soft-shell Tapeworms), WEINLAND, Human Cestoides, p. 52.
1863, *Cystoidea,* R. Leuckart, Die menschlichen Parasiten, I, p. 389.
1864, Subg. *Rhynchotænia,*[1] DIESING, Sitzber. Akad. Wiss. Wien, XLIX, 1, p. 365.

[1] *Rhynchotænia,* Diesing, 1850, a "section" of *Tænia,* may be interpreted as a subgenus; by the law of priority, however, it falls as a synonym of *Fimbriaria,* Frölich, 1802, taking of course the same species as type, i. e., *Tænia malleus,* Goeze, 1782. In order to meet objection to this ruling, should objection arise, I here definitely propose *Tænia malleus,* Goeze, as type of the subgenus.

1884, Subg. *Microtænia*,[1] SEDGWICK, in CLAUS & SEDGWICK, Elementary Text-book of Zoology, I, p. 336.
1886, *Cystoidei*, R. LEUCKART, Die Parasiten des Menschen, 2d ed., I, p. 825.
1886, Group *Cystoidotæniæ*, RAILLIET, Éléments de Zool. méd. et agric., p. 253.
1896, *Dipylidiinæ*, RAILLIET, Recueil de Méd. vét., 8 ser., III, 5, p. 159.—STILES, Bull. 12, Bureau of Animal Industry, U. S. Dept. Agric., 1896, p. 28.

Diagnosis.—Tæniidæ with rostellum which is generally armed; genital pores lateral (marginal), single or double; eggs with thin transparent shells, frequently arranged in egg sacs, in some cases scattered through the segments; larval stage a cysticercoid; adults in birds and mammals.

Type.—*Dipylidium*, R. Leuckart, 1863.

Genus DAVAINEA, R. Blanchard & A. Railliet, 1891.

1891, *Davainea*, R. BLANCHARD & RAILLIET, Mém. Soc. zool. France, IV, p. 428. Type, *Tænia proglottina*, Davaine, 1860.
?1893, *Chapmania*, MONTICELLI, Naturalista Siciliano, XII (7–8–9), pp. 16–19. Type, *Tænia argentina*, Zschokke, 1888.

Diagnosis.—Dipylidiinæ of small or medium size. Head surmounted by a rostellum or hollowed by a depression, but armed in either case with a double row of numerous small hooks of special form (prong and dorsal root short, ventral root very long, giving to the hooks the form of a hammer). Suckers bordered with several rows of small hooks which may be instable or persistent. Genital pores unilateral or irregularly alternate; in the former case the ova are generally arranged in egg capsules; in some species the ovary develops into uterus; eggs may also be isolated, scattered through the parenchyma.

Type.—*Davainea proglottina* (Davaine, 1860), R. Blanchard, 1893.

Habitat.—Adults in intestine of birds and mammals; cysticercoids, generally in arthropods and mollusks.

This genus is found chiefly in birds, but two species have been recorded in mammals, besides the two species here given for *Lepus*. The diagnoses of the two other forms, which are introduced for comparison, read as follows:

DAVAINEA MADAGASCARIENSIS (Davaine, 1870), R. Blanchard, 1891.

1870, *Tænia madagascariensis*, DAVAINE, Mém. Soc. Biol. Paris, 5 ser., I (1869), 1870, pp. 233–240, pl. I
1891, *Davainea madagascariensis* (DAVAINE, 1870), R. BLANCHARD, Mém. Soc. zool. France, IV, pp. 429, 438.

Diagnosis.—*Davainea madagascariensis* (Davaine, 1870), R. Blanchard, 1891. Strobila attains 250 to 300 mm. in length, and is formed of 500 to 600 trapezoidal segments which are broader than long. Head

[1]The subgenus *Microtænia* of the genus *Tænia* contains the species *Tænia cucumerina*, *T. elliptica*, *T. nana*, and *T. flavo-punctata*, and is thus antedated by the genera *Dipylidium*, Leuckart, 1863, *Diplacanthus*, Weinland, 1858 (nec L. Agassiz), and *Hymenolepis*, Weinland, 1858, but the type has never been proposed. In order to definitely dispose of the genus I propose *Tænia cucumerina* (= *Tænia canina*) as type, thus making *Microtænia* a synonym of *Dipylidium*.

provided with rather a large rostellum armed with a double crown of about 90 hooks 18 μ long. Suckers round and quite large; hooks on suckers not observed. Genital pores unilateral. A single egg in each egg sac.

Host.—Man (*Homo sapiens*). Found in Mayotte, Mauritius, and Bangkok.

DAVAINEA CONTORTA, Zschokke, 1895.

(Plate XXII, fig. 2.)

1895, *Davainea contorta*, ZSCHOKKE, Centralbl. f. Bakter. u. Parasitenk., Pt. I, XVII (18-19), pp. 634-645, figs. 1-4. 21 May.

Diagnosis.—*Davainea contorta*, Zschokke, 1895. Strobila attains 40 to 80 mm. in length by 0.75 mm. in breadth, and contains 400 to 800 segments, all of which are broader than long; margin of strobila serrate. Scolex small, prismatic; rostellum large, armed with (? a single row of) numerous minute hooklets; suckers large, armed with 8 to 10 rows of minute hooklets. Genital organs differentiate in fortieth to sixtieth segment. Genital pores unilateral, in middle of lateral margin. Male organs: Cirrus pouch one-fourth to one-third as long as the segment is broad; testicles two, large, in dorsal portion of median field on aporose side of median line. Female organs: Ovary bilobed; gravid segments filled with large egg capsules, each with a single egg possessing two shells.

Host.—Common Indian Pangolin (*Manis pentadactyla*). Type with Zschokke.

DAVAINEA RETRACTILIS, Stiles, 1895.

(Plate XXI, figs. 1-6; Plate XXII, fig. 1.)

1895, *Davainea retractilis*, STILES, Veterinary Magazine, II, June, p. 343. Aug. 28, 1895.

Of this species, I have seven strobilæ, collected March 10, 1891, in Nevada, by Dr. Fisher, of the Division of Mammalogy and Ornithology, United States Department of Agriculture. The original label reads: "Biological Explorations, U. S. Dept. Agr., Death Valley Expedition, Ash Meadows, Nevada, Mch. 10, 1891. A. K. Fisher. Nye Co. Tapeworms from Cottontail, No. 362." A reference to the specimen in the Division of Mammalogy and Ornithology shows that the host is *Lepus arizonæ*.

Measurements of Davainea retractilis.

B. A. I. Cestode series (No.).	Length.	Breadth.	Condition.
	mm.	*mm.*	
1168	35	3	Fragment.
1187	65	3	With head.
1188	98	3	Fragment.
1189	80	2.75	With head; type.
1190	68	2.75	Do.
1191	74	2.5	Fragment.
1192	105	3	With head.

All of the specimens are so contracted that a study of the general anatomy in detail is out of the question; enough can be given, however, to clearly define the species from other members of this genus. Taking the type specimen as basis for description, I find the following characters:

The head measures 0.480 mm. broad by 0.32 mm. long. The rostellum measures 80 μ in its tranverse and 48 μ in its longitudinal diameter; its equator is provided with a crown—on other preparations shown to be double—of minute hooklets 12 μ long. It is impossible to count the hooks, but there are about as many present as in *D. salmoni*—i. e., about 90 to 120. The suckers are oblong and measure 0.2 to 0.224 mm. by 0.14 to 0.16 mm.; they are armed with numerous hooklets arranged in rows. An estimate of their number is even more difficult than in the case of *Davainea salmoni* (see p. 198). There are about 75 diagonal rows of roots; from 5 to 20 roots have been counted in different rows. Five hundred to seven hundred hooks would probably not be a high estimate for each sucker. The suckers appear at first sight with low powers, to open at right angles to the longitudinal surface of the worm, but a careful study shows that the entire muscular bulb, together with its numerous hooks, is retracted into a sac-like structure which opens directly forward—namely, at right angles to a transverse section; in other words, the entire sucker is inverted in the parenchyma of the head; the direction of the opening of this invagination varies slightly in different specimens. A circular canal 9 μ in diameter surrounds the rostellum; a longitudinal canal runs in the dorsal and another in the ventral median line, which in all probability are connected with the circular canal, although this could not be absolutely demonstrated.

The contraction was such that the neck and the commencement of strobilization could not be judged satisfactorily, although the neck is apparently short, segmentation beginning near the head. As nearly as could be estimated, the strobila contains about 950 segments; in this estimate about 300 segments are allowed for the first 10 mm. of the worm. In the anterior portion, the four longitudinal canals are very distinct and laterally the longitudinal nerve is indistinctly visible; the larger (evidently ventral) canal is lateral of the smaller (dorsal) canal. About 1.12 mm. from the head a small deeply-staining line of cells develops in the median line of the segments, running parallel to the anterior margin; this gradually increases in length as the segments are followed distally; this is interpreted as the anlage of the genital canals and probably also of the female glands. Very shortly after its appearance two groups of testicles are noticed, one group each side of the median line. The cirrus pouch and vagina appear in the lateral field, all of the genital pores being unilateral in the anterior half of the segment. The pouch is small, measuring 0.12 mm. long by 60 μ broad; no clearly defined vesicula seminalis could be seen, but the coils made by the retracted cirrus appear to occupy the entire pouch; the vagina is

immediately distal of the pouch. The changes in the genital system must be left for some one to study who can preserve fresh material for this purpose. Gradually the entire median field becomes filled with eggs; while several eggs are contained in each capsule in *D. salmoni*, the arrangement in *D. retractilis*, so far as could be judged from the poor material, agrees more closely with that described for *D. contorta* and *D. madagascariensis*, each capsule containing but one egg. The ova are about 80 μ in diameter and possess two (?) surrounding membranes.

The segments are all broader than long, variations being found between 0.56 mm. broad by 4 μ long (anterior segments) and 3 mm. broad by 0.24 mm. long. The distal segments are slightly narrower, but there is not the sudden and distinct change seen in *D. salmoni*. As specific name I have proposed *Davainea retractilis*, referring to the retracted condition of the suckers found upon all the heads examined.

The material at hand does not warrant further description, but from the data given the following diagnosis is proposed:

Diagnosis.—*Davainea retractilis*, Stiles, 1895. Strobila 105 mm. or more long by 3 mm. broad, with about 1,000 segments, all of which are much broader than long; segments vary from 0.56 mm. broad by 4 μ long (anterior segments) to 3 mm. broad by 0.24 mm. long (gravid segments). Head measures 0.37 to 0.68 mm. broad by 0.36 to 0.43 mm. long. Retractile rostellum 80 μ by 48 μ, armed with a double row of minute hooklets 12 μ long, about 40 to 60 hooks in each row. Suckers measure 0.2 by 0.14 mm., and may be completely retracted into the head; they are armed with numerous hooklets arranged in rows; the roots arrange themselves regularly in rows, about 75 diagonal rows coming to each sucker, and 5 to 20 roots in each row; about 500 to 700 hooks are estimated for each sucker. Neck is short or absent, strobilization beginning almost immediately back of the head. Longitudinal canals at first very distinct, ventral canal lateral of dorsal canal. Genital anlage appears about 1 mm. from the head, and is at first median; testicles arranged in two groups, one each side of the median line. Genital pores unilateral, cirrus pouch small, 0.12 mm. long by 60 μ broad; vagina immediately distal to pouch. Eggs 80 μ in diameter, inner shell 40 μ; a single egg in each egg capsule.

Host.—One of the cottontail rabbits (*Lepus arizonæ*) by A. K. Fisher; development not known.

Types.—Diagnosis based upon four strobilæ with heads, and several fragments; Bureau of Animal Industry Cestode series No. 1189 is designated as *type* and deposited in the United States National Museum. Paratypes distributed as follows: Collection of Bureau of Animal Industry; Berlin Museum; Vienna Museum; collection of R. Blanchard. Fragments to British Museum; collection of Parona (Genoa); Tokyo University; collection of Zschokke (Bâle). All poorly preserved; technique, alchohol and hæmatoxylin or acid carmine.

Geographical distribution.—Nevada, by A. K. Fisher.

DAVAINEA SALMONI, Stiles, 1895.

(Plate XXII, figs. 3–4; Plate XXIII, figs. 1–9; Plate XXIV, figs. 1–2; Plate XXV, figs. 1–11.)

1887, "*Tænia pectinata*," Goeze, 1782, of Curtice ex parte, Science [N. Y.], March 23.
1895, *Davainea salmoni*, Stiles, Veterinary Magazine, II, June, p. 343. Aug. 28, 1895.

The length of type specimen, mounted (Bureau of Animal Industry Cestode series No. 1196), is 86 mm.; the broadest segments attain 3 mm. in width. Total number of segments about 450 (the exact number could not be ascertained because of contraction at certain points), of which about 230 belong to the first third of the worm. Head 0.736 mm. broad by 0.496 long. Retracted rostellum 0.144 mm. in diameter, provided with a double crown of minute hooks, of characteristic *Davainea* form, 20 μ long, about 60 hooks in each row. The suckers are large and prominent and armed with rows of closely set hooks, the number of which it is utterly impossible to count; they may be estimated at about 750; the size of these hooks varies, the prong of the longest reaching 10 μ. The neck is thin (0.480 mm. broad) and short, segmentation beginning about 0.8 mm. back of the head. The segments vary extremely according to contraction, most of them being broad and short, but others being infundibuliform and nearly as long as broad. Within the proximal third of the strobila variations may be found between segments 0.512 mm. broad by 32 μ long and 0.7 mm. broad by 0.528 mm. long.

The anlage of the genital organs first appears in about the one hundred and seventieth segment, as a darkly staining body, one end of which is in the median line, the other pointed toward the pore side of the segment. As the segments are followed distally this body assumes the characteristic pistol shape found in the genital anlagen of so many tapeworms (*Moniezia*, etc.); the muzzle of the barrel rapidly reaching the lateral margin at the genital pore; the barrel divides into two parallel canals, the vas deferens proximally, the vagina distally, while the handle of the pistol grows distally in the median line to form the female glands in approximately the middle of the segment. The genital pores are irregularly alternate, and vary in position from the middle to near the anterior edge of the margin. The testicles appear at about the two hundred and thirtieth segment, and occupy almost the entire median field. The condition of the material does not warrant a description of the changes the female anlage undergoes, further than to state that the glandular portion divides into two (or probably three) bodies. The anterior body will by analogy represent the ovary, the distal body the vitellogene gland; the third (very indistinct) body would probably represent the shell gland. Canals could be seen between these glands, but could not be analyzed. The development of the uterus could not be followed, but after about the three hundred and fortieth segment groups of eggs gradually appear, suppressing

all of the genital glands. The cirrus pouch and vagina could not be studied in detail; the former is very small and muscular, and measures 0.14 mm. long by 44 μ broad. Excretory and nervous systems could not be analyzed.

These are all the details which can be given for the type specimen, but from some of the other material the following could be observed:

The vagina is distal of the cirrus pouch. The muscular layer of the cirrus pouch measures up to 20 μ thick. The cirrus when retracted forms several coils in the pouch, but no vesicula seminalis could be distinguished; in fact there is no room for one within the pouch when the cirrus is retracted. The egg capsules fill the entire median field of the segment, and occasionally extend into the lateral fields; there are about 160 visible upon one face of a segment; they are globular in form, but assume various shapes by reciprocal pressure; they measure 0.112 to 0.128 mm. in diameter and contain 3 to 15 ova; the ova measure 20 to 24 μ in diameter.

The posterior 10 to 20 segments decrease in breadth and increase in length very rapidly, in some cases measuring 1.8 mm. broad by 1.4 mm. long.

In some specimens the pores show a remarkable tendency to unilaterality; in fact, in two specimens which Dr. Norgaard has collected since this article was written all of the pores are on the same side of the worm. The position of the genital pore is evidently a very uncertain character in the genus *Davainea*.

Further details are not warranted by the material at hand.

As a name for this parasite, I proposed *Davainea salmoni*, dedicating the species to my friend and chief, Dr. Daniel E. Salmon, Chief of the Bureau of Animal Industry, United States Department of Agriculture, to whose broad policy of administration I am indebted for the opportunities of carrying on my work in helminthology.

The larval stage.—In December, 1887, Cooper Curtice examined a rabbit (*Lepus sylvaticus*) in which he found a number of tapeworms in various stages of development. He made an extremely important observation on the younger specimens, which, unfortunately, he never published.

In Science,[1] however, the following notice concerning Curtice's observation is found:

EARLY STAGES IN THE LIFE OF TÆNIA PECTINATA.

Thousands of sheep and lambs perish every winter on the ranches west of the Missouri River. They are not apparently afflicted with any disease. They are weak and lean in the fall, and simply seem to be unable to withstand the severity of the blizzards. The Bureau of Animal Industry of the Agricultural Department has been engaged in an investigation to ascertain, if possible, the cause of the weakness of the animals that perish, and Mr. Cooper Curtice visited the West in the prosecution of this work. An examination of the viscera of slaughtered sheep and lambs, fat

[1] March 23, 1888.

and healthy ones, as well as those that were weak and lean, disclosed the fact that they were almost without exception infected with tapeworms, which were found in the duodenum and gall duct. In the latter they were frequently so numerous as to close it up, and cause a suspension of its functions.

For the purpose of continuing his studies Mr. Curtice brought from the West a number of lambs, which were killed at intervals and their viscera examined, and this material having been exhausted, and it being inconvenient and expensive to obtain more, he turned his attention during the past winter to a study of the early stages in the life of the *Tænia pectinata* (common unarmed tapeworms of the rabbit). In studying these Mr. Curtice thinks he has made some interesting discoveries, which he presented to the Biological Society of Washington at a recent meeting.

The variety examined is found abundantly in nearly all rabbits in this locality. The life-history of the armed tapeworms of man and dogs has long been written, but that of the unarmed species inhabiting our domestic animals, especially cattle and sheep, is as yet comparatively unknown. As far as has been ascertained, the life-history of the *Tænia pectinata* is embraced in two stages. The first covers the development of the ova into the embryo, which is ready to leave the parent *Tænia*; the other covers the period of growth from the youngest forms yet found in rabbits to the adult stage. The life of the *Tænia* from the time they leave the first rabbit as an embryo until they are found as young *Tænia* in the second rabbit infected has as yet been unascertained. Among the theories that have been advanced is one that they pass this stage upon the ground, are eaten by insects, snails, or crustaceans, and that these are then eaten by the rabbits. This, however, is only a theory, as none have ever been found in snails, insects, or crustaceans.

It was Mr. Curtice's good fortune to find a rabbit which had recently been infected with these peculiar parasites, none of which were over 3 centimeters in length, many of them being less than 5 millimeters long. There were more *Tænia* in that rabbit than any he had ever seen before—about 85. Among the smaller *Tænia* were several specimens that showed the stages of development from nonsegmented, armed forms, to segmented, unarmed forms. Mr. Curtice showed to the society specimens illustrating the different stages.

The youngest forms detected were not the smallest, but measured about one-half a centimeter in length. They contained, in addition to the four suckers, a cup-shaped cavity in the place of the rostellum. Around the border of this cup-shaped cavity were situated 85 or 90 hooks. The older specimens show a similar cavity with no hooks. Still older ones show no cavity at all. All of these were in the nonsegmented stages, but other forms, some of them smaller, were without signs of hooks, and had already begun segmentation.

Mr. Curtice compared these stages with similar stages in *Tænia serata* [*serrata*], and said that the youngest stage of the *Tænia pectinata* was probably a cysticercoid stage and not the cysticercal, and that this was indicated by the cup-shaped cavity in the youngest forms of the *Tænia pectinata*.

In discussing the classification founded on the presence or absence of hooks, he declared it to be incorrect, since the discovery described above shows that the unarmed species in adult stages are armed in earlier stages.

The speaker exhibited some elegant drawings made by Dr. George Marx, illustrating the embryo as it leaves the parent *Tænia*. This embryo is six-hooked and surrounded by a curious pyriform envelope, to which there is a double prolongation, surmounted by a cap of the same substance. This cap has a shredded border, and is believed to be the remnants of a mass which, in an earlier stage, completely surrounded the embryo. This peculiar envelope has been previously noticed in Italy by Perroncito [Perroncito] and in France by Raillet [Railliet]. This stage is similar to that found in *Tænia expansa*, the unarmed tapeworm in sheep.

This article was copied in the Texas Live Stock Journal,[1] but, owing

[1]April 14, 1888.

to the inaccessibility of the publications and the lack of details, Curtice's observation has not received much attention from helminthologists.

The only authors—so far as I can find—who have taken cognizance of it are Neumann,[1] in 1892, and Railliet,[2] in 1893, and Braun. Railliet writes as follows:

Subfamily *Anoplocephalinæ*. * * * The life history is still unknown. However, C. Curtice has made an interesting observation on *Lepus sylvaticus*, which will possibly place experimenters in a position to determine the development. He found in the intestine a large number of small *Taniadæ* which were still very young, but in different stages of development. Some of them 5 mm. long, nonsegmented, possessed between the suckers a dome-shaped depression, bordered with 85 to 90 hooks; others, still older, had lost their hooks, while some did not even show the corresponding depression; finally, some of them were segmented, but all of these were unarmed. One is thus led to suppose that the larval stage of the *Anoplocephalinæ* is represented by an armed cysticercoid and that the hooks disappear during the development. (Free translation.)

Curtice's observation I confirmed and extended in 1894.[3] Since publishing this note, Hassall has found the same young stages in several rabbits (*L. sylvaticus*) in Maryland, and with this material the former description can be amplified. Of the young forms collected some were studied fresh, others mounted.

Unarmed forms.—Nine of the mounted specimens showed no trace of any rostellum or hooks, but on the other hand some of them exhibited traces of segmentation. The details of measurements, etc., are as follows:

1. 0.544 mm. long; head, 0.24 mm. broad by 0.208 mm. long; constriction back of suckers 0.128 mm. broad; suckers, 0.112 mm. in diameter.

2. 0.848 mm. long; head, 0.256 mm. broad by 0.192 mm. long; constriction back of head, 0.12 mm. broad.

3. 0.304 mm. long; head, 0.208 mm. by 0.208 mm.

4. 7 mm. long; head, 0.448 mm. broad by 0.32 mm. long; suckers, 0.196 mm. diameter; constriction back of head, 0.368 mm. broad. The transverse lines of the segmentation become indistinctly visible almost immediately back of the head, but no genital anlagen are seen in any portion of the specimen.

5. 0.816 mm. long; head, 0.256 mm. broad by 0.24 mm. long; signs of segmentation.

6. 0.64 mm. long; head, 0.224 mm. broad by 0.176 mm. long; suckers, 0.112 mm. in diameter; segmentation begins 0.224 mm. back of the head.

7. 0.816 mm. long; head, 0.24 mm. broad by 0.192 mm. long; segmentation perceptible, 0.4 mm. back of head.

8. 0.64 mm. long; head, 0.24 mm. broad by 0.176 mm. long; segmentation, 0.224 mm. back of head; suckers, 0.144 mm. in diameter.

9. 0.656 mm. long; head, 0.24 mm. broad by 0.16 mm. long; suckers, 0.112 mm. in diameter; segmentation begins 0.288 mm. back of head.

Armed forms.—Twenty-seven mounted specimens in which rostellum and hooks were present varied in measurements as follows: Length,

[1] Traité des maladies parasitaires, 2d ed., p. 461.

[2] Traité de Zool. méd. et agric., I, p. 268.

[3] Notes sur les Parasites—31: Une phase précoce du ténias du Lapin, Bull. Soc. zool. France, XIX, pp. 163–165.

0.560 to 1.800 mm.: head, 0.352 to 0.512 mm. long by 0.320 to 0.480 mm. broad; rostellum, 0.176 to 0.240 mm. long by 0.112 to 0.160 mm. broad; number of hooks on rostellum, 100 to 122; on some fresh specimens as few as 90 hooks were counted; size of hooks on rostellum, 18 to 24 μ long.

As in the case of the unarmed heads mentioned above, there was a general though not absolute agreement between the size of the scolex and the length of the parasite, and there is no question in my mind that the head of a tapeworm is subject to increase in size after entering its final host; numerous observations upon young specimens of tapeworms from sheep support this view.

In none of these armed specimens was there the slightest trace of segmentation. In many cases the armature was not complete either upon the suckers[1] or upon the rostellum, but in all cases some hooks were found, and the rostellum was always visible.

Taking all these observations into consideration, I am forced to the conclusion that the unarmed forms and the armed forms represent the young stages of two different species. The unarmed forms I am inclined to bring into connection with *C. variabilis*, p. 192, while the close agreement between the rostellum of this young stage with that of *D. salmoni*, the agreement in the size of its hooks, the agreement in the general arrangement of the hooks on the suckers, the fact of their presence in the same host-species, and finally the fact that one of the adult specimens of *D. salmoni* (No. 1124, U.S.N.M.) was found in the same locality in which these forms were found, all lead me to the conclusion that the young armed stage here described represents the young of *Davainea salmoni*. Experimental demonstration of this view is, however, lacking. In several specimens studied alive, the cysticercoids were surrounded by a membrane (Plate XXV, figs. 4, 8, 10), which, however, became entirely lost upon being subjected to technique.

Armed larval forms distributed as follows.—America: Collections Bureau of Animal Industry; U.S.N.M.; Harvard; Leidy; Hassall; Stiles. Europe: British Museum; R. Blanchard: Railliet; Moniez; Zschokke; Parona; Berlin Museum; Leuckart; von Linstow; Looss; Halle Zoological Institute; F. E. Schulze. Specimens will also be sent to Neumann, Stossich, Monticelli, and Max Braun.

Diagnosis.—Davainea salmoni, Stiles, 1895. Strobila attains 86 mm. or more in length and 3 mm. in breadth, and contains about 450 segments which vary in form from nearly rectangular to infundibuliform according to contraction, most segments being much broader than long, the distal 15 to 20 segments becoming longer and narrower, nearly square, 1.8 by 1.4 mm. Head 0.6 to 0.736 mm. broad by 0.38 to 0.448 mm. long. Rostellum retractile, 0.1 to 0.14 mm. in diameter, armed

[1] The number of hooks given for the suckers (150 to 200 at least) in Notes sur les Parasites—31—is very greatly underestimated. It is utterly impossible to count them, but I should now estimate the number about 750 for each sucker.

with a double row of hooks 20 μ long, about 60 hooks in each row. Suckers comparatively large, 0.25 mm. in diameter, armed with numerous hooks of various sizes, the prongs of the longest attaining 10 μ in length. These hooks are arranged in about 7 to 9 concentric rows containing about 750 (estimated) hooks of various sizes. Neck short and thin, 0.8 mm. long by 0.48 mm. broad. Anlage of the genital organs appears about the one hundred and seventieth segment. Genital pores irregularly alternate situated in the middle to near the proximal portion of the margin, cirrus anterior to vagina; cirrus pouch small, 0.12 to 0.14 mm. long by 44 to 64 μ broad, muscular layer may attain 12 to 20 μ in thickness. Testicles occupy almost the entire median field except the center portion in which the female glands are located. Eggs are arranged in egg capsules, about 160 visible from one surface of the segment and measuring 0.112 to 0.118 mm. in diameter; 3 to 15 ova measuring 20 to 24 μ in diameter in each capsule.

Hosts.—Eastern Jackass Hare (*Lepus melanotis*) by Tallichet and Norgaard; cottontail (*L. sylraticus*) by Curtice, Hassall, and Stiles; intermediate host unknown. Several specimens found in collection of Leidy, but collector's name is not stated on label.

Types.—Description taken from four strobilæ with heads, and several fragments. Bureau of Animal Industry Cestode series No. 1196 designated as type and deposited in the United States National Museum. Paratypes distributed as follows: Collection of Bureau of Animal Industry; Berlin Museum; collection of R. Blanchard. Fragments to South Kensington Museum and Vienna Museum. Technique of type specimen (poorly preserved), alcohol, hæmatoxylin.

Geographical distribution.—United States of North America; Texas (by Tallichet and Norgaard); ? (by Curtice); Maryland (by Hassall and Stiles).

GENERAL REMARKS.

Several interesting problems arise in connection with the adult cestodes described above and allied forms, to which it may be well to draw attention, notwithstanding the fact that the data at hand are not so complete and satisfactory as might be desired.

The uterus: Comparing the uteri of the known forms of the Anoplocephalinæ (exclusive of *Stilesia*), we find at least three distinct types represented in both the single-pored and the double-pored genera.

I. The most simple uterus appears first as a simple transverse tube extending across the median field of the segment, as in *Anoplocephala*. This same type of uterus is evidently found (see Meyner) also in *Bertia mucronata* and *Bertia conferta*. In the double-pored genus *Cittotænia* the anlage is generally single, but in some cases (*C. variabilis*) it may be single or double (divided) in the same strobila.

The increase in the size of this type of uterus takes place by an expansion of the uterus at certain points, giving rise to proximal and distal blind sacs or pouches. These pouches may be very distinct and

well defined, as in *Anoplocephala mamillana*, *A. wimerosa*, *Cittotænia marmotæ*, *C. pectinata;* or they may be less distinct (*C. variabilis*, *C. præcoquis*); or they may be totally absent (*C. variabilis*), in which case the uterine tube appears as an enlarged sac. In some species where they are at first well developed (*Anoplocephala mamillana* and *A. wimerosa*) their boundaries may disappear in the older segments, the uterus appearing as a sac.

The uterus of *C. denticulata* seems to be more complex and requires further study.

II. The genus *Thysanosoma* presents a totally different uterus. The anlage is originally a simple transverse tube as in the cases just mentioned, but the increase in size takes place by two different methods, which gives rise to quite a complicated structure. First, the anlage increases greatly in length, giving rise to numerous folds running longitudinally with the worm; next, this undulate tube forms blind pouches which are surrounded by a heavy layer of connective tissue, giving the pouch a characteristic appearance; the ova are deposited in these pouches and the original tube remains empty. The uterus of *Stilesia globipunctata* bears a certain resemblance to the uterus of *Thysanosoma* in that the egg pouches have a somewhat similar structure.

III. A third type of uterus appears to be presented by the genera, *Andrya* and *Moniezia*, and this type will require considerable study before it can be correctly interpreted. From the present status of our knowledge, however, it may be described as a complex system of branching and anastomosing tubes, a single set being present in *Andrya*, a double set in *Moniezia*. In the later stages of the uterus the boundaries of the tubes disappear and the uterus appears as a sac.

A transverse uterine anlage has not yet been recorded for these genera, except in the case of *Moniezia trigonophora*, for which species Stiles and Hassall[1] in 1893 have figured a short transverse canal which represented the earliest uterine stage they observed.

An interesting problem now presents itself, namely: In what relation do these types stand to each other? Have we here three parallel series of originally single-pored cestodes, each series with a particular type of uterus, and have the double pores been acquired independently after the three types of uteri became established? Or, do the single-pored forms represent one branch and the double-pored forms represent another, and have the three different types of uteri been developed independently in each branch?

The former supposition appears to me much the more probable, for in *Thysanosoma giardi* and *Cittotænia variabilis* we find both single and double pored segments.

This case represents one of the most interesting cases of homoplasy which has ever been observed in helminthology and should be

[1] Revision of adult cestodes of cattle, sheep, and allied animals, Bull. 4, Bur. An. Ind., U. S. Dept. Agric., pls. VIII, fig. 5; IX, fig. 3.

studied further when proper material is found. It is, however, by no means the only case of homoplasy brought forward in helminthology. I have[1] elsewhere called attention to the branching of the intestine in two distinct types of flukes, as represented by *Fasciola hepatica* and *Distomum delphini*. The presence of more than two testicles, as in two or more other distinct types of flukes represented by *Pleorchis polyorchis* and *P. mollis* on the one hand and *Distomum cygnoides* or *D. richardi* on the other is, in my opinion, another case of homoplasy. The development of double-pored forms in two distinct families (the Bothriocephalidæ—Blanchard's genus *Krabbea*, and a number of cases in which a few double-pored segments have been found in *Bothriocephalus latus*—and the Tæniidæ forms a fourth case of the same nature.

One of the greatest criticisms upon the present classification of parasites seems to me the fact that systematists have not taken into consideration the principle so well established in paleontology and other branches of zoology, namely, that the same structure may develop independently in several parallel series of animals. The sooner this principle is acknowledged the sooner we shall have a natural classification.

Zone of lateral growth.—A comparison of the older and younger segments of numerous Tæniidæ shows that as the segments grow broader, the median field—namely, the space between the two ventral canals—increases much more rapidly in proportion than the lateral fields—namely, the space between the ventral canals and the lateral margin. This establishes the median field as the greatest zone of lateral growth. No particular narrow zone of the median field can be looked upon as the zone of lateral growth for all cestodes, as is shown by a comparison of a large number of forms. In *Tænia* (type *T. solium*), for instance, the entire median field appears to participate in a more or less uniform lateral growth, for the genital glands retain their relative position, increasing in size in proportion to the increase in size of the segment; the same appears to hold for *Davainea*. In the anoplocephaline forms we find some interesting variations in the zone of growth, as is shown by the relative position of the ovaries to the ventral canals or to the median line. In *Thysanosoma giardi* the ovary bears an almost constant relation to the ventral canal, while the distance between the ovary and the median line constantly increases as the segment grows broader; in this case, therefore, there is but little growth between the ovary and the canal, while the growth in the median side of the ovary is very marked. The same holds true to a lesser degree in *Bertia americana*. In *Moniezia expansa* and *M. planissima* also the relation of the ovaries to the ventral canals remains almost constant, while the chief zone of growth is in the median field between the ovaries.

[1]The anatomy of the large American fluke (*Fasciola magna*) and a comparison with other species of the genus *Fasciola* s. st. vide p. 221, Jour. Comp. Med. Vet. Arch., 1895.

In *Cittotænia marmotæ* (Plate XI, fig. 5), *C. præcoquis*, and *C. pectinata* (Plate XVI), on the other hand, there also is a marked lateral growth between the ovary and the ventral canal while the lateral field remains nearly the same width throughout the entire length of the strobila. In *C. variabilis* (Plates XIX–XX) there is a marked growth in the lateral fields.

Abnormalities in the segments.—Riehm has already recorded segments of *Cittotænia denticulata* with three sets of female glands, and I have recorded segments of *C. variabilis angusta* with a single pore. New cases of both of these variations have been noticed in the preparation of this paper, namely, triple sets of female glands in *C. denticulata* and single pores in *C. variabilis*. I can look upon these cases, however, only as variations, similar to the occasional double pores in *Bothriocephalus latus* and *Thysanosoma giardi*, and can not ascribe to them any particular value from a systematic standpoint.

The value of the genital pores in classification.—Objection has arisen in some quarters to adopting the genital pore as the basis of classification. I both agree and disagree with this objection. It must not be forgotten that when Blanchard used the genital pores as basis for his classification, he naturally used the pore as representative of the genital system; thus, if the pores are single, the entire female system is generally single; if the pores are double, the entire system of female glands is generally double. Viewed from this standpoint (which is the only logical interpretation I can give to Blanchard's classification, proposed in 1891), I must insist upon the great value of the pores in classifying cestodes. At the same time I fully agree—and have stated so more than once before—that the pores unassociated with other characters can not be relied upon as basis for a natural classification of cestodes. Internal topographical anatomy must, in my opinion, form the basis of the natural classification for both Cestoda and Trematoda. The size and form of the segments are characters which we should use with the greatest caution, always making due allowances for technique and contraction; as generic characters I can under no circumstances admit their validity, and must therefore reject Sonsino's recently proposed genus *Panceria* (based essentially upon double-pored segments which are longer than broad) unless other characters are brought forward to place the genus on a firmer footing.

In systematic work in helminthology we must not lose sight of another principle which is well acknowledged in other specialities, namely, that a given character which may be of great importance in classifying the species or genera of one group does not necessarily hold as a taxonomic character in all genera or higher groups of the same order or class. Thus the unilaterality of the pores in *Hymenolepis* and *Anoplocephala* appears, so far as investigations have gone, to be a very important and constant character, while the same character must be used with the utmost precaution in the genus *Davainea*. I have shown

above that the pores of *D. salmoni*, for instance, may be either unilateral or irregularly alternate; the same holds for *D. tetragona*, and apparently also for *Andrya*. The characters to be used in classifying the species of any given genus must be determined separately for every genus by an examination of a large series of specimens from different localities and from different hosts. The unsatisfactory condition in which I have been obliged to leave the genera *Bertia* and *Andrya* is directly attributable to the limited amount of material at my disposal, and the fact that what few, and for the most poorly preserved, specimens I have examined represent only a few localities and a few hosts.

The influence of a host upon its parasites.—Considerable has been written upon the influence of various parasites upon their hosts, but very few authors have ventured to publish upon the influence of the hosts upon the parasites. This is probably due to two reasons: first, to the tendency on the part of many helminthologists to take the host species as a specific character of the parasite, and secondly the fact that the influence exerted by the parasite upon its host is a matter of economic importance, while the influence of the host upon the parasite would be looked upon by most workers as purely of scientific interest. To deny the economic importance of the host influence upon the parasite is, however, to my mind a short-sighted policy, for it must be this very host influence (i. e., environment) which has played an important rôle in the evolution of species, and which must have resulted in differentiating species and varieties, each of which after a time becomes in some cases at least dependent upon a single host. The genera *Demodex*, *Psoroptes*, and *Chorioptes* form excellent examples of the point under consideration; in these genera we find varieties which resemble each other so closely that it is often difficult and even impossible to determine the variety without knowing the host; experiments to breed some of the varieties of these genera upon other than their regular hosts, even though the experiment animal harbors a very closely allied variety of the same species, have been totally negative. This same variation is noticeable among worms. Specimens of *Moniezia expansa* taken from *Ovis aries* are for instance totally different from the specimens of the same species found in *Ovis laticauda;* the strobilæ from this latter host recently studied by Setti, which I have been able to examine through the kindness of my Italian colleague Prof. C. Parona, can not I believe be separated specifically from the European form, yet they certainly represent a distinct variety. Lönnberg has called attention to the variation in the hooks of avian cestodes taken from different hosts. I have also repeatedly noticed a variation in the spicules of the same species of nematode (*Strongylus contortus*, for instance) taken from cattle and sheep. To clearly define the varieties peculiar to certain hosts touches directly upon the question of transmission and infection, and on this account I submit that the study is of great economic as well as scientific importance.

The division of the genus Tænia.—In connection with the citations, p. 162, from Meyner's work, I take this occasion to reply to his remarks regarding the efforts which R. Blanchard, Railliet, Hassall, and I have recently made to bring some order into the genus *Tænia*. Upon page 8 of his thesis he says:

Die Versuche von Blanchard, Stiles und Railliet die Uebersichtlichkeit der Familie der Tæniaden durch Zerlegung in eine Anzahl von Unterfamilien zu erleichtern, sind nicht als besonders glückliche zu bezeichnen, namentlich mit Rücksicht darauf, dass die, von verschiedenen Gesichtspunkten ausgehende, stets nur an einer beschränkten Anzahl von Species vorgenommene Eintheilung nothgedrungen auch zu verschiedenen Resultaten führen musste. Bevor nicht durch eingehende Forschungen wenigstens die typischen Hauptformen als feststehend angesehen werden können, dürften derartige Experimente wohl nicht auf allgemeine Anerkennung zu rechnen haben, bis dahin aber verfehlen sie ganz entschieden ihren eigentlichen Zweck, nämlich Klarheit und Einfachheit in die Systematik zu bringen.

In writing this critique, which is of course welcomed both by my French colleagues Blanchard and Railliet, and by Hassall and myself as showing the view which Dr. Meyner takes of our work, the author has unfortunately overlooked several very important points. First of all, he has overlooked that very important principle so well expressed by Bacon in the words, "Truth emerges sooner from error than from confusion." None of us look upon our efforts to classify these parasites as perfect, free from criticism, and final beyond revision. But errors which we may have committed in these attempts to aid in reducing the chaos which exists in the genus *Tænia* can be corrected very easily. We have the satisfaction of knowing that our work has been adopted by a number of specialists in helminthology and hardly feel called upon to apologize for the attempts we have made, even if not approved of by Veterinarian Meyner.

A second error Dr. Meyner has fallen into is that he has forgotten that every classification must undergo an evolution (with epigenesis!).

He would evidently have us include all four-suckered tapeworms in the heterogeneous and collective genus *Tænia*, "until at least the typical chief-forms can be looked upon as established," although he failed to give an explanation of what he meant by "the typical chief-forms." If he refers to the type species of genera, he has lost sight of the fact that the type species of a genus is designated by any given author, and can not be changed after once being so designated. The type species is, therefore, optional, subject of course to certain principles, in the case of the author who designates it and obligatory in the case of other authors. Possibly Meyner refers to the most highly specialized species in the different groups. If so, however, his advice to wait until we study up such forms and decide which are the most highly specialized is wanting in reason. It is certainly far better to create a new genus for a form when we can not logically unite it with the known genera, than it is to place it with forms with which it does not agree in any important character.

Of course our efforts at classification are experimental—we all admit that; but from the very nature of things all efforts at classification in practically unknown groups are and must be experimental. The classifications must be changed time and again as new facts are discovered. Nor have our experiments (or, as Meyner puts it, "derartige Experimente") counted upon immediate general recognition (allgemeine Anerkennung); it was not with that end in view that we published them. We do not expect to see our proposed classifications adopted by zoologists at large until they have stood the test of other specialists in helminthology. We have not heard as yet, however, of any marked disapproval of the genera proposed from workers who were acquainted with the forms and who were competent to pass judgment on the case. When such authors propose a better classification, they can certainly count on Blanchard, Railliet, Hassall, and myself as four helminthologists who are ready to follow them. At present, however, I maintain that the classification originally proposed by Blanchard and since that time considerably expanded by Railliet, Hassall, and myself is a far more natural and satisfactory classification of the forms treated than any other classification ever proposed for the same forms. I am fully convinced, after a study of several thousand specimens, that the main features of the proposed division will stand, although the details of the system may undergo some changes. Helminthologists, as a class, are ultra-conservative in every line except species-making—and yet as long as the Rudolphi-Diesing school exerts such a powerful influence in wielding the yardstick instead of the microscope, perhaps this generic conservatism should be looked upon as a blessing.

A third error of Meyner's is that he does not understand the views which he has attempted to criticise, or the relative rank of the groups proposed, and he ascribes to authors propositions which they never made. Thus he states (page 6):

> Diese Anoplocephalinen theilt er (R. Blanchard) dann mit Rücksicht auf die Anordnung der Geschlechtsorgane in 3 *Unterfamilien* [!] ein und zwar (1) *Genre* Moniezia * * *; (2) *Genre* Anoplocephala * * *; (3) *Genre* Bertia * * *.

Meyner thus makes the terms *subfamily* and *genus* synonymous—rather a novel idea in systematic zoology; he accredits (page 8) Blanchard and Railliet with a *family* "Anoplocephalen," although he states a few lines before that Railliet accepted "Anoplocephaliné" as a subfamily. Upon the same page he speaks of *Bertia* as a *genus* and *Ctenotænia* and *Andrya* as "*Arten*." It does not seem to me at all strange that our efforts should "fail totally in their object" with a worker who confounds such terms as species, genus, subfamily, and family.

A fourth error into which Meyner has fallen in the passage quoted is the assumption that we have taken only a few species into consideration in making our classifications. True, we have not felt called upon to give a list of all the species of cestodes with which we have acquaintance, either through personal study or through the publications

of our colleagues, but it would be going a little far to assume that we did not have other forms in mind at the time we revised a portion of the species known to us. Consistency being such a virtue, however, if Meyner considers the species mentioned in the former papers by the authors he criticises as representing the sum total of the species known to them, he will probably not object to applying the same criterion to himself. As he has published original work on only two species, however, it might be difficult for him to justify himself in attempting upon the basis of these two species to overthrow the conclusions which have been based upon a study of a much larger number of forms by four different specialists, all of whom agree in the general arrangement and differ with each other only in matters of detail. Meyner's remarks represent an excellent example of what is so common in science to-day, namely, a tendency to jump at conclusions and to generalize in a too dogmatic manner when one is not thoroughly at home on the subject he has under discussion.

The above remarks are, I think, sufficient to show that Meyner's amusing criticisms would better have been submitted to more careful thought before they were published. They can not have much weight with helminthologists, and should not have much weight with zoologists in other specialities.

A number of genera not discussed in this paper have been proposed by authors for various forms in the family Tæniidæ. Some of these genera must be rejected. In regard to some of the others, judgment must be reserved for the present. I hope, however, to publish before long a summary of all the genera proposed. Regarding the newly proposed genera for avian cestodes, see Stiles,[1] 1896.

Exchange of cotypes.—There seems to be a popular impression among workers that it is a perfectly easy matter for a scientist to read a description of a species or genus and judge of the validity of the proposed form without examining specimens. This impression is certainly true in some cases, but must always be taken *cum grano salis.* I do not hesitate to assert that not one-half of the species and genera of parasitic worms ever described can be rightly judged from their descriptions, nor is this always attributable either to the description or to the ability of the worker attempting to pass judgment upon the case. It is rather attributable to the undeniable fact that a person obtains an entirely different impression from a study of the objects from what he obtains from reading a description, be it ever so detailed and complete. Many a species or genus has been accepted or rejected by an author who would have decided differently if he could have examined cotypes of the forms he was discussing.

In view of these facts, which I am confident the specialists in helminthology will admit, I wish to appeal again to helminthologists to

[1] Report upon the present knowledge of the tapeworms of poultry, Bull. 12, Bureau Animal Industry, Washington, D. C.

deposit cotypes with the chief museums of the world. It has been our policy to do this as far as possible, and as soon as the international postal laws[1] are amended so as to allow the acceptance of these specimens in the international mails, the system will be extended.

As a matter of justice, I believe the type specimen belongs in the national museum of the country in which the specimen was collected. The first duplicate (paratype) belongs by right to the Berlin Museum, as that museum now possesses more types of parasitic worms than probably any other collection in the world. I would set forth the claims of the United States National Museum for the second duplicate on the grounds that the European workers all have easy access to the specimens at Berlin, while the frequent sending of a rare and valuable specimen from Europe to this continent is attended with more or less danger of loss. Japan certainly has a claim to the third duplicate.

It is indeed time that helminthologists give the question of the preservation of types their serious consideration. Many of the older collections can not be traced; Davaine's collection is evidently destroyed, and many more private collections will follow it if more attention is not given to this subject.

CONCLUSIONS.

The chief results of this paper may be briefly summarized as follows:

1. The time has come when helminthologists must donate their type specimen of every species to museums where they can be properly cared for and where they may be open to the inspection of other specialists. I maintain that the original type rightfully belongs to the national museum of the country in which the specimen was collected; that the second specimen (first duplicate—first paratype) rightfully belongs to the Berlin Museum; that the United States National Museum has a valid claim for the third specimen (second duplicate), and that Japan has a valid claim for the fourth specimen.

2. In order to insure the preservation of types and cotypes, I invite the specialists in helminthology to unite upon some regular plan for the deposit and exchange of such specimens.

3. Permanent mount in balsam appears to me to be a much better method of preserving a type than to retain it as an alcohol specimen.

4. The known adult leporine cestodes belong to the five genera: *Anoplocephala*, *Andrya*, *Bertia*, *Cittotænia*, and *Davainea*.

5. Of these genera *Anoplocephala*, *Cittotænia*, and *Davainea* are considered as perfectly valid genera; *Andrya* and *Bertia* are left *sub judice*, although it is my impression that they will finally be recognized as valid, as soon as sufficient material can be properly studied.

[1] Owing to the absurd international postal regulation (16. 3. b.) excluding zoological specimens from the international mails, some of the paratypes mentioned as "distributed" in this paper have not yet been sent to the authors named; they will be forwarded as soon as an opportunity presents itself.

6. The microscope must supplant the yardstick and internal anatomy must take the place of external form in judging the validity of cestode and trematode genera and species.

7. The principle of homoplasy must be recognized by helmintholo-gists as well as by other zoologists, and any classification which leaves this important and well-recognized principle out of account can be taken only as a preliminary (although often necessary) study (p. 204).

8. The median field of the Tæniidæ is the seat of the most active lateral growth, and the same rule will probably be found to apply to other families of Cestoda. No particular longitudinal zone of the median field can, however, be named as the zone of most active growth in all Tæniidæ (p. 205).

9. The armed young cestode which I mentioned in Note 31[1] (1895) is not the young of an anoplocephaline tapeworm, as Curtice, Braun, Railliet, Neumann, and I had inferred, but represents the young stage of the single-pored cestode referred to in my paper in 1895.[2] It evidently belongs to *Davainea salmoni*.

10. The double-pored cestode with occasional single pores, described in my paper in 1895,[3] is *Cittotænia variabilis angusta*.

11. I have also found some very young stages of an unarmed cestode in the intestine of the cottontail rabbit, which probably belong to *Cittotænia variabilis*. This young stage corresponds to what we may expect to find as the larval form of *Moniezia expansa* of cattle and sheep, and I doubt whether it will be possible to distinguish it from the young of that species. This renders the question of the origin of the tape-worms of cattle and sheep more complicated than it was formerly supposed to be, and demands the strictest experimental proof on the part of any author who suspects that he has solved the mystery of the life history of the cestodes of cattle and sheep.

12. The head of a cestode increases in size after the parasite reaches its final host, as is shown by a comparison of the younger specimens.

13. None of the adult leporine tapeworms thus far described in Europe have as yet been found in America. The American forms which have been published as "*Tænia pectinata*" must be distributed over several species typical to this continent.

14. The following table includes all of the genera at present recognized in the subfamilies Tæniinæ, Mesocestoidinæ, Anoplocephalinæ, and Dipylidiinæ of the family Tæniidæ. A number of other genera have been proposed, but some of them must fall as synonyms, while judgment upon others must be reserved. Several of the genera in this key

[1] Notes sur les Parasites—31: Une phase précoce du Ténias du Lapin. Bull. Soc. zool. France, XIX, 1895, pp. 163–165.

[2] Notes on Parasites—36: A double-pored cestode with occasional single pores. Centralbl. f. Bakteriol. u. Parasitenk., 1. Abt., XVII, 1895, pp. 457–459.

[3] Loc. cit.

are accepted only provisionally,[1] while *Fimbriaria* is used at present only as a matter of convenience.

Key to the genera of the subfamilies Tæniinæ, Mesocestoidinæ, Anoplocephalinæ, and Dipylidiinæ of the cestode family Tæniidæ, including all the species of adult tapeworms found in hares and rabbits.

Tæniidæ.

[Tapeworms of hares and rabbits in roman.]

1. Head with four cup-shaped suckers; rostellum present, but not always evident; uterus without any special pore; genital pores generally marginal 2
   Head generally absent; genital pores marginal. Host: Birds 34
2. *Genital pores ventro-median* (Mesocestoidinæ) ..... *Mesocestoides.*[2]
   Genital pores marginal 3
3. Head never provided with hooks; uterus transverse or reticulate; egg generally with pyriform body; larval stage not known; adults in herbivorous and frugivorous mammals ..... *Anoplocephalinæ* (p. 149), 5
   Head nearly always provided with hooks (*T. saginata* an exception; see also *Hymenolepis*) 4
4. *Egg with thin outer shell and thick brown inner shell; uterus median and longitudinal with lateral branches; larval stage a cysticercus, cœnurus,* or *echinococcus, generally in herbivora; adults in carnivora* ..... (*Tæniinæ*) *Tænia.*[3]

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[1] For *Andrya* and *Bertia*, see pp. 154, 160 of this paper. For the newly proposed genera *Amabilia, Choanotænia, Cotugnia, Dicranotænia, Drepanidotænia* in the subfamily Dipylidiinæ, see my Report upon the Present Knowledge of the Tapeworms of Poultry, Bull. 12, Bureau of Animal Industry, 1896.

[2] 1863, *Mesocestoides*, VAILLANT, L'Institut. No. 1524. Type, *Mesocestoides ambiguus*, Vaillant, 1863.

1885, *Ptychophysa*, HAMANN, Zeitschr. f. wiss. Zool., XLII, p. 740. Type, *Tænia lineata*, Goeze, 1782.

[3] 1758, *Tænia*, LINNÆUS, Systema naturæ, 10 ed., p. 646, 819. Type by elimination *Tænia solium*, Linnæus, 1758.

1800, *Alyselminthus*, ZEDER, Erster Nachtrag zur Naturg. d. Eingeweidewürmer, p. 221. *Tænia*, Linnæus, renamed, hence type *Tænia solium*, Linnæus, 1758.

1803, *Halysis*, ZEDER, Anleitung zur Naturg. d. Eingeweidewürmer, p. 298. *Alyselminthus*, Zeder, renamed, hence type *Tænia solium*, Linnæus, 1758.

1850, *Arhynchotænia*, DIESING, Systema helminthum, I, p. 497. Subgenus containing type of genus, hence type *Tænia solium*, Linnæus, 1758.

1858, *Acanthotrias*, WEINLAND, Human Cestoides, p. 51. Type, *Cysticercus acanthotrias*, Weinland, 1858 = *Cysticercus cellulosæ*, Rudolphi = larva of *Tænia solium*.

1858, *Taniarhynchus*, WEINLAND, Human Cestoides, p. 46. Type, *Tænia mediocanellata*, Küchenmeister, 1852 = *Tænia saginata*, Goeze, 1782.

1858, *Echinococcifer*, WEINLAND, Human Cestoides, p. 52. Type, *Tænia echinococcus*, Siebold, 1853.

1863, *Cystotænia*, LEUCKART, Die menschlichen Parasiten, I, p. 223. As subgenus including type of genus, hence type *Tænia solium*, Linnæus, 1758.

To this list of synonyms must be added the subgenera *Cysticercus, Cœnurus,* and *Echinococcus*. They take the date and authority of the author who first used them in a subgeneric sense and not the date and authority of the author who first proposed them, since according to the International Code, section 48, b, the generic and specific names of larval cestodes (*Cysticercus, Cœnurus, Echinococcus, Finna, Hydatigena, Hydatis,* etc.) are not entitled to the law of priority.

The genus *Tænia* is frequently divided into three subgenera: *Cysticercus* (= *Cystotænia*), *Cœnurus,* and *Echinococcus*. *Tænia* must be substituted for the first subgenus (type *T. solium*) and *Echinococcifer* must probably be substituted for the third subgenus.

Egg with thin transparent shells; frequently in egg capsules; in some cases scattered through the segments; head nearly always armed with hooklets on rostellum; larval stage a cysticercoid; adults in birds and mammals.

Dipylidiinæ (p. 193), 27

Anoplocephalinæ.[1]

5. Ova with well developed pyriform body; genital canals pass dorsally of longitudinal canals and main nerve trunk (not yet satisfactorily demonstrated for *Andrya*) 6

Ova without pyriform body; genital canals pass dorsally of ventral canal and nerve, but ventrally of dorsal canal (not yet demonstrated for Stilesia centripunctata). 10

6. Uterus a transverse tube, generally continuous, in some of the double-pored forms divided (double), one tube for each ovary, and generally provided with proximal and distal pouches; dorsal canal lies dorsal to dorso-lateral of ventral canals; pedunculated prostatic gland absent 7

Uterus more like a network in its early stages; afterwards the boundaries of the meshes nearly or quite disappear and the uterus (or uteri) appears like a sac.. 9

[1] The genera of *Anoplocephalinæ* may also be determined by the following key, which although simpler than the one given above, is much more artificial:

Anoplocephalinæ.

A. Genital pores single ..... B

Genital pores double ..... F

B. Genital pores unilateral or irregularly alternate with decided tendency to unilaterality C

Genital pores regularly alternate or nearly so; pedunculate prostatic glands absent ..... D

C. Pores unilateral; testicles unilateral or nearly so in median field opposite pores; uterus transverse with proximal and distal pouches; pedunculate prostatic gland absent ..... *Anoplocephala*, 11

Pores irregularly alternate with decided tendency to unilaterality; uterus forms a network in its younger stage, later the meshes become nearly or quite obliterated; testicles extend across the median field to or beyond the ovary; distinct pedunculated round or elongate prostatic gland present... *Andrya*, 26

D. Egg without pyriform body ..... E.

Egg with well-developed pyriform body; uterus transverse with thin-walled proximal and distal pouches; genital canals pass dorsally of dorsal and ventral canals and main longitudinal nerve trunk ..... *Bertia*. 14

E. *Uterus single and transverse, without pouches, or double, a cornucopia-like egg pouch being present near each ventral canal, the median transverse connecting canal not visible; genital canals pass dorsally of nerve and ventral canal, but ventrally of dorsal canal (not shown for* S. centripunctata) ..... *Stilesia.*

Uterus transverse but undulate, with thick-walled ascospore or cornucopia-like egg pouches; genital canals pass dorsally of nerve and ventral canal, but ventrally of dorsal canal ..... *Thysanosoma.*

F. *Egg without pyriform body; uterus transverse and undulate, with thick-walled ascospore or cornucopia-like egg pouches; genital canals pass dorsally of ventral canals and nerves, but ventrally of dorsal canal* ..... *Thysanosoma.*

Egg with well-developed pyriform body; genital canals dorsally of ventral and dorsal canals and nerves ..... G

G. Uterus a transverse tube, single or double, with thin-walled egg pouches; dorsal canal dorsal to dorso-lateral of ventral canal; vagina ventral of cirrus pouch on both sides of the segment ..... *Cittotænia*, 19

Uterus reticulate, double; dorsal canal dorsal to dorso-median of ventral canal; vagina ventral of right cirrus pouch, dorsal of left cirrus pouch ..... *Moniezia.*

7. Genital pores single 8
Genital pores double; vagina ventral of cirrus pouch on both sides of the segment ..... *Cittotænia* (p. 170), 19
8. Pores unilateral; testicles unilateral, or nearly so, in median field.
Anoplocephala (p. 150), 11
Pores regularly or irregularly alternate; testicles extend across the median field (not shown as yet for *B. studeri* and *B. satyri*) ..... *Bertia* (p. 160), 14
9. Genital pores irregularly alternate with marked tendency to unilaterality; pedunculated round or elongate prostatic gland near ventral canal on pore side of segment; dorsal canal lies dorsal to dorso (? lateral) of ventral canal.
Andrya (p. 154), 26
Genital pores double; pedunculated prostatic gland absent; vagina ventral of right cirrus and dorsal of left cirrus ..... *Moniezia.*[1]
10. *Uterus single, transverse, but undulate, with asconspore or cornucopia-like egg pouches; genital pores single or double; testicles form a band in median field or are divided into two lateral groups, one in each lateral field* ..... *Thysanosoma.*[2]
Uterus single and transverse, or double, being represented by a cornucopia-like pouch on each side of the segment; genital pores irregularly alternate; testicles in two lateral groups and absent from median line ..... *Stilesia.*[3]

Anoplocephala.

11. *Head with posterior lobes; body may attain 8 to 25 mm. long by 3 to 15 mm. wide; head 2 to 3 mm. broad. Host: Horse* (Equus caballus) ..... *A. perfoliata.*
Head without posterior lobes 12
12. *Head 4 to 6 mm. broad; strobila 9 to 80 cm. long by 5 to 20 mm. broad. Host: Horse* (Equus caballus) *and Mule* (Equus asinus × caballus) ..... *A. plicata.*[4]
Head less than 1 mm. broad 13
13. Strobila 10 mm. long by 1.5 to 2.25 mm. broad; contains 10 to 28 segments; distal segments may become nearly as long as broad; genital glands confined to proximal third of worm; testicles 15 to 30 in each segment; cirrus pouch 0.48 mm. long. Host: European rabbit (*Lepus cuniculus*) and Mountain hare (*L. variabilis*) ..... *A. wimerosa.*
Strobila attains 6 to 30 mm. long by 4 to 6 mm. broad; 35 to 53 segments present, the distal 4 to 8 completely filled with ova; testicles 60 to 100 in each segment; cirrus pouch attains 0.8 mm. in length. Host: Horse (Equus caballus).
A. mamillana (p. 153).
Strobila 10 to 16 cm. long by 6 to 8 mm. broad; 60 to 80 testicles present. Host: Arctomys, *sp* ..... *A. transversaria* (p. 154).

[1] 1891, *Moniezia*, R. BLANCHARD, Mém. Soc. zool. France, IV, p. 187. Type, *Tænia expansa*, Rudolphi, 1810.

For the species of this genus see Stiles & Hassall, 1893, A Revision of the Adult Cestodes of Cattle, Sheep, and Allied Animals, Bull. 4, Bureau of Animal Industry, U. S. Dept. Agriculture.

[2] 1835, *Thysanosoma*, DIESING, Med. Jahrb. d. öst. Staat. n. Folge, VII, pp. 105–111, pl. III. Type, *Thysanosoma actinioides*, Diesing, 1835.

For the species of this genus see Stiles in Stiles & Hassall, 1893, Bull. 4, Bureau of Animal Industry.

[3] 1893, *Stilesia*, RAILLIET, Traité de Zool. méd. et agric., I, pp. 277–278. Type, *Tænia globipunctata*, Rivolta, 1874.

For the species of this genus see Stiles in Stiles & Hassall, 1893, Bull. 4, Bureau of Animal Industry.

[4] Doubtful whether this specific term should stand, as it is antedated by *equina*, 1781, and *magna*, 1789.

Bertia.

14. Hosts: Rodents;[1] cirrus pouch distinctly muscular, prominent, with vesicula seminalis; receptaculum seminis round and prominent; pores very regularly alternate; calcareous corpuscles present or absent 15

Hosts: Primates and lemurs;[1] cirrus pouch?; calcareous corpuscles present 16

15. *Genital pores in posterior half of lateral margin; cirrus pouch about 0.5 mm. long; posterior segments show a tendency to become narrow and thick; strobila attains 33 mm. in length by 6 mm. in breadth, and contains about 90 segments, calcareous corpuscles not observed. Host: Yellow-haired porcupine* (Erethizon epixanthus) *and Canada porcupine* (E. dorsatus), *North America* ..... *B. americana* (p. 165)

Genital pores in about the middle of the lateral margin; cirrus pouch about 0.1 mm. long; posterior segments do not become narrow; strobila attains 23 to 17 mm. in length by 5 to 6.5 mm. in breadth, and contains 60 to 95 segments; calcareous corpuscles present. Host: Rabbit (*Lepus*, sp. ?), North America.

B. americana leporis (p. 167).

16. *Cirrus pouch not so prominent as vagina, and with but weak musculature; receptaculum seminis round to elongate and not very prominent; pores irregularly alternate; ovary confined to pore side of median field; uterus transverse with proximal and distal pouches* 17

Cirrus pouch very muscular; receptaculum seminis elongate; pores irregularly alternate; ovary extends to aporose portion of median field; uterus transverse with proximal and distal pouches; strobila 24 to 220 mm. long by 5 to 11 mm. broad, and contains 80 to 400 segments. Host: Flying lemur (Galeopithecus volans), India.

B. plastica (p. 161).

Cirrus pouch? vesicula seminalis?; uterus composed of 30 to 35 polyhedral packages. 18

17. *Strobila attains 140 mm. or more in length by 8 to 10 mm. in breadth. Host: Black howler* (Alouatta caraya), *Paraguay* ..... *B. macronata* (p. 162).

Strobila attains 84 mm. or more in length by 6.5 mm in breadth. Host: Bonnet monkey (Macacus sinicus), *India* ..... *B. conferta* (p. 163).

18. *Strobila attains 130 mm. in length by 15 mm. in breadth by 2.5 mm. in thickness; genital pore alternates very regularly; ova 53 to 60 μ. Host: Chimpanzee* (Anthropopithecus troglodytes) ..... *B. studeri* (p. 161).

Strobila attains 245 mm. or more in length by 10 mm. in breadth by 2 mm. in thickness; pores irregularly alternate; cirrus pouch clariform; ova 35 to 38 μ by 30 to 32 μ. Host: Oran-utan (Simia satyrus) ..... *B. satyri* (p. 161).

Cittotænia.

19. Cirrus pouch muscular, generally pyriform, with distinct outline, and swollen proximally by the vesicula seminalis ..... Marmotæ-Group, 20

Cirrus pouch tubular, resembling the nozzle of a hose, of equal or nearly equal diameter throughout its entire length, and not swollen proximally by any prominent vesicula seminalis ..... Pectinata-Group, 23

20. Testicles arranged in a band extending across the median field 21

Testicles comparatively few in number, absent from median line, arranged in two triangular groups, one corresponding to each ovary; cirrus pouch small, 0.16 mm. long, scarcely reaching the longitudinal nerve; pores in distal part of lateral margin; female glands near ventral canal; dorsal canal dorsal or dorso-lateral of ventral canal; strobila attains 80 cm. in length by 10 mm. in breadth. Host: Common wild and tame rabbits (*Lepus cuniculus* and *L. cuniculus domesticus*), Europe ..... *C. ctenoides* (p. 179).

21. Testicles not confined to space between the ovaries 22

Testicles confined to distal portion of segment between ovaries; cirrus pouch about 0.5 mm. long by 0.17 mm. broad, crosses the canals; female glands some distance from

[1] Characters satisfactory for an analytical key are still lacking.

lateral canals; transverse uterus single with proximal and distal pouches; dorsal canal between ventral canal and nerve; strobila may attain 112 mm. long by 5 to 13 mm. broad. Host: Marmot (Arctomys marmota), *Europe. C. marmotæ* (p. 172).

22. Cirrus pouch very large and prominent, may attain 1.12 mm. long by 0.32 mm. broad; pores at or near distal corner of lateral margin; female glands not far removed from dorsal canal; several accessory ventral canals; strobila may attain 80 cm. long by 15 mm. broad. Host: Wild rabbit (*Lepus cuniculus*), Europe ..... *C. denticulata* (p. 174).

Cirrus pouch small, 0.24 mm. long; female glands considerably removed from dorsal canal; dorsal canal lateral or dorso-lateral of ventral canal; receptaculum seminis very large; segments imbricate; strobila attains 40 mm. long by 5.5 mm. broad. Host: Prairie gopher (Geomys bursarius), *North America.. C. præcoquis* (p. 181).

23. Cirrus pouch about 1 mm. long, extends some distance median of longitudinal canals; testicles arranged in a band in distal portion of median field, extending beyond ovaries from canal to canal; ovary some distance from longitudinal canals; uterus single, with well-developed proximal and distal pouches; strobila attains 40 cm. in length by 8 to 10 mm. in breadth. Hosts: Common hare (*Lepus timidus*) and mountain hare (*L. variabilis*) Europe.

C. pectinata (p. 184).

Cirrus pouch not over 0.5 mm. long, extends scarcely median of lateral canals; uterus single or double in the same strobila. Hosts: *Lepus*, North America. 24

24. Testicles in two groups, one for each ovary, extending laterally of ovaries but absent from median field; strobila attains 57 mm. or more in length by 10 mm. in breadth. Host: Cottontail rabbit (*L. sylvaticus*) ..... *C. perplexa* (p. 189).

Testicles in a band confined to distal portion of median field between the ovaries; strobila attains 100 to 180 mm. in length by 10 mm. in breadth. Host: Cottontail rabbit (*L. sylvaticus*) and marsh hare (*L. palustris*).

C. variabilis (p. 190), 25.

25. Strobila nearly always more than 3 mm. broad; posterior flap of segments nearly straight; segments slightly imbricate; genital pore in about the middle of the lateral margin. Host: Cottontail rabbit (*L. sylvaticus*).

C. variabilis (p. 192).

Strobila nearly always more than 3 mm. broad; posterior flap of segments lobed; segments imbricate; genital pores generally in distal half of lateral margin. Host: Marsh hare (*L. palustris*)..... *C. variabilis imbricata* (p. 193).

Strobila rarely over 2 mm. broad; posterior flap straight; segments not imbricate; genital pores generally in distal portion of lateral margin, generally double, occasionally single. Host: Cottontail rabbit (*L. sylvaticus*).

C. variabilis angusta (p. 193).

Andrya (*European*).

26. Genital pores near posterior corner of segment; prostatic gland elongate; head about 1 mm. in diameter; testicles comparatively few in number, confined chiefly to aporose side of median field; cirrus pouch 0.32 to 0.34 mm. long; strobila attains 60 to 80 cm. in length by 5 mm. in breadth. Host: Common hare (*Lepus timidus*). Europe..... *A. rhopalocephala* (p. 155).

Genital pores in about the middle, or in the distal half of the lateral margin; prostatic gland round; head about 0.5 mm. in diameter; testicles about 50 in number, scattered through entire median field; cirrus pouch 0.4 to 0.48 mm. long; strobila attains 100 cm. in length by 8 mm. in breadth. Host: Wild rabbit (*Lepus cuniculus*), Europe..... *A. cuniculi* (p. 158).

Dipylidiinæ.

27. *Suckers unarmed* 28

Suckers armed with minute hooklets (with four exceptions known only in birds) 33

28. *Genital pores double*..... 29

Genital pores single, irregularly alternate or unilateral..... 31

29. *Two submedian ovaries in each segment* 30
One median ovary in each segment ..... *Amabilia.*[1]

30. *Several rows of hooks upon rostellum* ..... *Dipylidium.*[2]
A single row of hooks upon rostellum ..... *Cotugnia.*[3]

31. *Dorsal root of hooks much longer than ventral root or prong; ventral root very short; hooks 8 to 12 (rarely to 26) in number; known only in birds* ..... *Drepanidotænia.*[4]
Dorsal root of hooks about the same length as ventral root and prong 32

32. *Dorsal root shorter than prong or ventral root; hooks generally less than 20 in number (range from 10 to 26); genital pores unilateral or irregularly alternate; known only in birds* ..... *Dieranotænia.*[5]
Dorsal root longer than prong or ventral root; if rostellum is armed, there are 24 to 30 hooks present; genital pores unilateral (on left of segments); three testicles normally present in each segment; retractile rostellum armed with minute hooklets or rudimentary and unarmed; eggs with three envelopes; parasitic in man, chiroptera, insectivora, rodents, and insectivorous birds; larval stage in insects or myriapoda. *Hymenolepis.*[6]

33. Hooks on suckers arranged in circular rows on border; hooks on rostellum resemble a hammer in form and are arranged in a double row; with four exceptions known only in birds ..... *Davainea* (p. 194), 35.

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[1]1893, *Amabilia*, DIAMARE, Boll. Soc. Nat. Napoli, 1. ser., VII (1–2), p. 13. August 28, 1893. Type, *Tænia lamelligera*, Owen, 1835.

? 1896, *Diploposthe*, JACOBI, Zool. Anzeiger, XIX, No. 505, June 15, 1896, pp. 268–269. Type, *Tænia laevis*, Diesing.

See Stiles, 1896, Bull. 12, Bureau of Animal Industry, p. 31. From the diagnosis given by Jacobi I fail to see how *Diploposthe* differs from *Amabilia*.

[2]1863, *Dipylidium*, R. LEUCKART, Die menschlichen Parasiten, I, p. 400. Type, *Tænia elliptica*, Batsch, 1786 = *Tænia canina*, Linnæus, 1758.

1858, "*Alyselminthus*, ZEDER, 1800 pp.," of Weinland with *Tænia cucumerina*, Bloch, 1782 = *Tænia canina*, Linnæus, 1758, as type.

1884, *Microtænia*, SEDGWICK, as subgenus in CLAUS & SEDGWICK, Elementary Text-book of Zoology, I, p. 336. Type, *Tænia cucumerina*, Bloch, 1782 = *Tænia canina*, Linnæus, 1758.

For species and bibliography see Diamari's monograph (1893) Il Genere *Dipylidium*, Lkt., Atti R. Accad. Scienze fisiche e matematiche, 2 ser., VI, No. 7, 31 pp., pls. I–III.

[3]1873, *Cotugnia*, DIAMARI, Boll. Soc. Nat. Napoli, 1. ser., VII (1–2), p. 11. August 28, 1893. Type, *Tænia digonopora*, Pasquale, 1890.

See Stiles, 1896, Bull. 12, Bureau of Animal Industry, p. 29.

[4]1892, *Drepanidotænia*, RAILLIET, Bull. Soc. zool. France. XVII, p. 116. Type, *Tænia lanceolata*, Bloch, 1782.

? 1896, *Choanotænia*, RAILLIET, Rec. méd. vét., 8 ser., III (5), March 15, 1896, p. 159. Type, *Tænia infundibuliformis*, Goeze, 1782.

For species and bibliography of this genus see Stiles, 1896, Bull. 12, Bureau of Animal Industry, pp. 36–45, 60–61.

[5]1892, *Dieranotænia*, RAILLIET, Bull. Soc. zool. France, XVII, p. 116. Type, *Tænia coronula*, Dujardin, 1845.

For species and bibliography of this genus see Stiles, 1896, Bull. 12, Bureau of Animal Industry, pp. 32–36.

[6]1858, *Hymenolepis*, WEINLAND, Human Cestoides, p. 49, 52. Type, *Tænia flavopunctata*, Weinland, 1858 = *Tænia diminuta*, Rudolphi, 1819.

1858, *Lepidotrias*, WEINLAND, as subgenus of *Hymenolepis*, Human Cestoides, p. 52. Type, *Tænia murina*, Dujardin, 1845, proposed by Weinland, but this subgenus includes the type of the genus.

For species and bibliography of the genus see R. Blanchard, 1891, Hist. zool. et méd. des Téniadés du genre *Hymenolepis*, Weinland. Paris. 112 pp., 22 figs.

Hooks on suckers arranged in several transverse rows; hooks of infundibulum very small (4 μ) arranged in a single row; known only in birds ..... *Ophryocotyle.*[1]

Hooks on suckers arranged in one median set and two lateral sets; hooks on rostellum provided with long dorsal root and arranged in a single row; known only in birds. *Echinocotyle.*[2]

Subfamily ?

34. *Anterior extremity of strobila expanded in form of a hammer* ..... *Fimbriaria.*[3]
Anterior segments become calciform and function as pseudoscolex ..... *Idiogenes.*[4]

Davainea.

35. *Found in birds; see Stiles, 1896,* [5] p. 45.
Found in mammals 36
36. Genital pores unilateral; a single egg in each egg capsule 37
Genital pores generally alternate; strobila attains 85 mm. or more in length by 3 mm. in breadth; suckers not invaginated; eggs grouped 3 to 15 in each egg capsule. Host: Eastern Jackass hare (*Lepus melanotis*) and Cottontail rabbit (*L. sylvaticus*) ..... *D. salmoni* (p. 198).
37. Suckers (always?) invaginated; strobila attains 105 mm. long by 3 mm. broad. Host: Arizona cottontail (*L. arizonæ*) ..... *D. retractilis* (p. 195).
Suckers not invaginated 38
38. *Rostellum armed with double row of about 90 hooks, 18 μ long; strobila attains 250 to 300 mm. long, composed of 500 to 600 segments. Host: Man* (Homo sapiens). *D. madagascariensis* (p. 191).
Rostellum large, armed with (?) a single row of numerous minute hooklets; suckers armed with 8 to 10 rows of hooks. Host: Common Indian Pangolin (Manis pentadactyla) ..... *D. contorta* (p. 195).

COMPENDIUM OF THE PARASITES ARRANGED ACCORDING TO THEIR HOSTS.

In the following list are given the hosts of the parasites discussed in this paper, so far as they are known to me. I have personally examined the species starred (*) for the hosts under which they are given. For the name of the collector in each case see text. The numbers given with the names of the hosts are those of von Linstow's Compendium and Nachtrag. The geographical distribution refers to the host. One

[1] 1870, *Ophryocotyle*, Friis, Videnskab. Meddel. fra den Naturhist. Foren. Kjobenhavn [aar 1869], 1870, pp. 121–124, pl. I. Type, *Ophryocotyle proteus*, Friis, 1870.

R. Blanchard gives the date as 1869, Braun gives it 1870. Original not at my disposal. For species see Stiles, 1896, Bull. 12, Bureau of Animal Industry, p. 56.

[2] 1891, *Echinocotyle*, R. Blanchard, Bull. Soc. zool. France, IV, p. 423. Type, *E. rosseteri*, R. Blanchard, 1891.

[3] 1802, *Fimbriaria*, Frölich, Der Naturforscher, XXIX, pp. 13–14. Type, *Tænia malleus*, Goeze, 1782.

1850, *Rhynchotænia*, Diesing (as section or subgenus of *Tænia*), Systema Helminthum, I, p. 521. Type, *Tænia malleus*, Goeze, 1782.

1892, *Epision*, Linton, Proc. U. S. Nat. Mus., XV, p. 100. Type, *Epision plicatus*, Linton, 1892.

[4] 1868, *Idiogenes*, Krabbe, Videns. Meddel. fra d. Naturhist. Foren. Kjobenhavn (for Aaret 1867), 1868, pp. 122–126. Type, *Idiogenes otidis*, Krabbe, 1868.

[5] Stiles, 1896, Report upon the Present Knowledge of the Tapeworms of Poultry, Bull. 12, Bureau of Animal Industry, U. S. Department of Agriculture.

or two parasites not discussed in this paper are included in the compendium for reasons obvious in each case.

I have elsewhere (1896) made a plea for the adoption of a modern system of nomenclature for the hosts, and have endeavored to introduce here the correct names for most of the hosts cited. In the main, Flower and Lydekker's Mammals Living and Extinct (1891) has been followed; in the few cases that I have departed from the names given in that work I have done so upon the advice of Dr. T. S. Palmer. In order to prevent confusion by this change in host names, I have added the names used by von Linstow in his compendium or by other authors in their writings, cross-referencing the synonyms to the proper name. It is impossible to give a monographic list of the genus *Lepus* and to establish the correct names of all the forms until that genus is revised by a specialist in mammalogy.

ALOUATTA CARAYA (Humboldt, 1811). Black Howler.
(*Stentor caraya*, Humboldt; 20. *Mycetes niger;* 31. *Cebus caraya*, Fischer).
(Southern Brazil, Paraguay, Bolivia.)
* *Bertia mucronata.*
Tænia megastoma.

ANTHROPOPITHECUS TROGLODYTES (Linnæus, 1758). Chimpanzee.
(2a. *Simia troglodytes; Troglodytes niger* Geoff.)
(Western and Central Equatorial Africa.)
Bertia studeri.

92. ARCTOMYS MARMOTA (Linnæus, 1758). Alpine Marmot.
(Mountains of southern Europe—Alps, Pyrenees, and Carpathians.)
* *Cittotænia marmotæ.*

92*b*. ARCTOMYS, sp.?
(Turkestan.)
Anoplocephala transversaria.

31. CEBUS CARAYA, Fischer vide ALOUATTA CARAYA.

30. CEBUS CAPUCINUS (Linnæus, 1758). Weeping Capuchin.
(Paraguay to United States of Colombia.)
"Tænia No. 2, Gottheil," p. 164.

248. EQUUS CABALLUS (Linnæus, 1758). Horse.
* *Anoplocephala mamillana.*
Anoplocephala perfoliata.
Anoplocephala plicata.
Anoplocephala plicata pediculata.
Anoplocephala plicata strangulata.

124. ERETHIZON DORSATUS (Linnæus, 1758). Canada Porcupine.
(Boreal region of eastern North America.)
* *Bertia americana.*
Tænia laticephala, Leidy.
? "*Tænia pectinata*" with unilateral pores=?, recorded by Cobbold, 1862.

ERETHIZON EPIXANTHUS, Brant. Yellow-haired Porcupine.
(Mountains of Western United States.)
* *Bertia americana.*

GALEOPITHECUS VOLANS (Linnæus, 1758). Flying Lemur, Common Colugo or Cobego.
(Sumatra, Borneo, Java, Malay Peninsula, Tenasserim, and Siam.)
Bertia plastica.

GEOMYS BURSARIUS (Shaw, 1800). Prairie Gopher.
(Upper Mississippi Valley, southward to southern Illinois, Missouri, and eastern Kansas.)
* *Cittotænia præcoquis.*

1. HOMO SAPIENS, Linnæus, 1758. Man.
Bothriocephalus cordatus.
**Bothriocephalus latus.*
Davainea madagascariensis
Dipylidium caninum.
Hymenolepis diminuta.
Hymenolepis murina.
Krabbea grandis.
**Tænia confusa.*
**Tænia saginata.*
**Tænia solium.*

12. INUUS CYNOMOLGUS vide MACACUS CYNOMOLGUS.

LEPUS AMERICANUS, Erxleben, 1777. Northern Hare.
(Wooded districts, New England to Minnesota, and south to Virginia, along the Alleghanies.)
? "*Tænia pectinata*," reported by Curtice,[1] 1892, p. 232.

LEPUS ARIZONÆ, Allen, 1877. Arizona Cottontail.
(Arizona, southern Nevada, and desert region of southern California.)
**Davainea retractilis.*

137. LEPUS CUNICULUS. Common European Wild Rabbit.
Andrya cuniculi. See p. 155.
**Anoplocephala wimerosa.*
**Cittotænia ctenoides.*
**Cittotænia denticulata.*

137*a*. LEPUS CUNICULUS DOMESTICUS. Common Domesticated Rabbit.
**Cittotænia ctenoides.*
? "*Tænia pectinata*,"[1] reported by Curtice, 1892, p. 232.

LEPUS MELANOTIS, Mearns, 1890. Eastern Jackass Hare.
(Plains from Texas to Nebraska, west to Rocky Mountains.)
**Davainea salmoni.*

LEPUS PALUSTRIS, Bachman, 1837. Marsh Hare.
(Marshy lowlands of South Atlantic States, from North Carolina southward.)
**Cittotænia variabilis imbricata.*

138. LEPUS SYLVATICUS, Bachman, 1837. Cottontail.
(Eastern United States.)
**Cittotænia perplexa.*
**Cittotænia variabilis.*
**Cittotænia variabilis angusta.*
**Davainea salmoni.*

LEPUS TEXIANUS, Waterhouse, 1848. Black-Tailed Jack-Rabbit.
(Great Basin.)
"An undescribed *Tænia*,"[2] reported by Curtice, 1892, p. 233.

140. LEPUS TIMIDUS, Linnæus, 1758. Common European Hare.
(All parts of Europe except the north of Russia, the Scandinavian peninsula, and Ireland.)
? *Andrya cuniculi.* See p. 155.
**Andrya rhopalocephala.*
**Cittotænia pectinata.*

139. LEPUS VARIABILIS, Pallas, 1778. Mountain Hare.
(Northern Eurasia.)
**Anoplocephala wimerosa.*
**Cittotænia pectinata.*

[1] I am unable to trace this specimen, but most of Curtice's *T. pectinata* is *C. variabilis.*
[2] Impossible to tell definitely what species Curtice referred to, but possibly the parasite is *Davainea salmoni* and the host *L. melanotis.*

LEPUS, SP. ?
(Some North American species.)
Bertia americana leporis.

?LEPUS SP.? (?WASHINGTONI, S. F. Baird, 1855). Western Varying Hare.
(Puget Sound.)
Cittotænia (?) variabilis.

MACACUS CYNOMOLGUS (Linnæus, 1758). Crab-eating Macaque.
(12. *Inuus cynomolgus.*)
(Malay Peninsula and Philippine Archipelago.)
"*Tænia* No. 1, Gottheil." See p. 151.
"*Tænia* No. 2, Gottheil." See p. 161.

MACACUS SINICUS (Linnæus, 1771). Bonnet Monkey.
(Southern India.)
Bertia conferta.

MANIS PENTADACTYLA. Common Indian Pangolin.
(India and Ceylon.)
Davainea contorta.

20. MYCETES NIGER, vide ALOUATTA CARAYA.

3. PITHECUS SATYRUS, vide SIMIA SATYRUS.

SIMIA SATYRUS, Linnæus, 1758. Orang or Oran-Utan.
(3. *Pithecus satyrus.*)
(Sumatra and Borneo.)
Bertia satyri.

2*a*. SIMIA TROGLODYTES, vide ANTHROPOPITHECUS TROGLODYTES.

TROGLODYTES NIGER, vide ANTHROPOPITHECUS TROGLODYTES.

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EXPLANATION OF PLATES.

Plate V.

Anoplocephala wimerosa and *Anoplocephala mamillana.*

Figs. 1–7. *Anoplocephala wimerosa*, from the European Mountain Hare (*Lepus variabilis*). Drawn from specimens taken by R. Blanchard at Briançon, France.

1. Dorsal view of adult worm, No. 1363, U.S.N.M. Enlarged about 15 times. Zeiss, 4–a* 10.
2. Ventral view of head and proximal segments. Alcohol specimen. Enlarged about 15 times. Zeiss, 4–a* 10.
3. Lateral view of head and proximal segments. Alcohol specimen. Enlarged about 15 times. Zeiss, 4–a* 10.
4. Apex view of head. Alcohol specimen. Enlarged about 15 times. Zeiss, 4–a* 10.
5. Isolated segments showing testicles, cirrus, and female organs. Zeiss, 4–16.
6. Older segments with beginning uterus. Zeiss, 4–16.
7. Egg containing oncosphere surrounded by pyriform body. Zeiss, 4–4.
8. *Anoplocephala mamillana*, from the horse (*Equus caballus*). Combined from Nos. 1368–1369, U.S.N.M., taken by Hassall in London, England. Enlarged about 15 times. Zeiss, 4–a* 10.

Drawn by Haines.

Plate VI.

Anoplocephala mamillana and *Anoplocephala transversaria.*

Figs. 1–3. *Anoplocephala mamillana*, from the Horse (*Equus caballus*).

1. Male organs: *cl. g.*, genital cloaca; *ci.*, cirrus; *p. g.*, genital papilla; *p. d. c.*, cirrus-pouch; *v. s.*, vesicula seminalis; *c. d.*, vas deferens; *t.*, testicles; *c. e.*, vas efferens. After Zschokke, 1889, Pl. I, fig. 10.
2. Female organs: *cl. g.*, genital cloaca; *p. g.*, genital papilla; *o. f.*, vulva; *va.*, vagina; *rec. s.*, receptaculum seminis; *c. sem.*, seminal canal; *g. c. x.*, collecting canal for half of the ovary; *g. d.*, common oviduct; *v. dt.*, vitello-duct; *gl. v.*, vitellogene gland; *gl. g.*, ovary; *gl. c.*, shell-gland; *or. d.*, ovidnet; *ut.*, uterus. After Zschokke, 1889, Pl. I, fig. 11.
3. Egg with three shells. After Zschokke, 1889, Pl. I, fig. 14.

4–7. *Anoplocephala transversaria* from *Arctomys* sp.

4. Male organs: Letters same as for fig. 1. After Zschokke, 1889, Pl. I, fig. 17.
5. Female organs: Letters same as for fig. 2. After Zschokke, 1889, Pl. I, fig. 19.
6. Head and proximal segments. After Zschokke, 1889, Pl. I, fig. 15.
7. Egg with three shells. After Zschokke, 1889, Pl. I, fig. 20.

Drawn by Haines.

Plate VII.

Andrya rhopalocephala.

Figs. 1–7. *Andrya rhopalocephala*, from the European Hare (*Lepus timidus*).

1. Strobila with head, natural size. No. 1379, U.S.N.M.
2. Three views of head, enlarged about 15 times. No. 1379, U.S.N.M.

FIG. 3. Two views of head, enlarged. After Riehm, 1881, Pl. V, fig. 1a-b.

4. A young segment showing testicles in the aporose portion of median field; the cirrus-pouch and vagina are becoming differentiated, and the anlage of the female glands is distinct; the anlage of the receptaculum connects the anlage of the female glands with the vagina. No. 1484, U.S.N.M.

5. An older segment; the testicles are larger; cirrus-pouch, vas deferens, and the elongate prostatic gland are distinct; the ovary, vitellogene gland, and receptaculum seminis are well developed; the latter is connected with the genital pore by the vagina. No. 1484, U.S.N.M.

6. A still older segment; of the male organs, the cirrus-pouch and a portion of the vas deferens are still visible; of the female organs, the glands have entirely disappeared, the receptaculum seminis and vagina are still preserved, while the developing uterus has assumed the form of a network. No. 1484, U.S.N.M.

7. A somewhat older segment, in which the cirrus-pouch and the receptaculum seminis are still visible; the network of the uterus is much more distinct. No. 1484, U.S.N.M.

FIGS. 1–2 and 4–7 are drawn from Riehm's cotypes, taken in Saxony, but very poorly preserved.

N. B.—As the statements regarding the uterus are made upon poorly preserved material, they should be taken with reserve until confirmed by an examination of freshly preserved specimens.

Drawn by Haines.

PLATE VIII.

Andrya rhopalocephala and *Andrya cuniculi.*

FIGS. 1–3. *Andrya rhopalocephala,* from the European Hare (*Lepus timidus*).

1. A gravid segment showing cirrus-pouch, receptaculum seminis, and the uterus; the latter has lost its net-like structure. No. 1484, U.S.N.M.

2. Riehm's original figure. The segment shows: *n.*, longitudinal nerve; *E.*, ventral canals, with transverse canal at distal end of the segment; *t.*, testicles; *e.*, ovary; *d.*, vitellogene gland; *s.*, shell-gland; *r. s.*, receptaculum seminis; *v.*, vulva and vagina; *c. b.*, cirrus-pouch; *v. s.*, vesicula seminalis; *r. d.*, vas deferens; *p.*, elongate prostata; *u.*, uterus. After Riehm, 1881, Pl. VI, fig. 1.

3. Egg. After Riehm, 1881, Pl. V, fig. 18.

4–8. *Andrya cuniculi,* from European Wild Rabbit (*Lepus cuniculus*).

4. Head and neck. After Riehm, 1881, Pl. V, fig. 2.

5. Segment showing: *E.*, ventral canals, connected by transverse canals; *t.*, testicles; *e.*, ovary; *d.*, vitellogene gland; *s.*, shell-gland; *r. s.*, receptaculum seminis; *r. d.*, vas deferens; *p.*, round prostata; *l. m.*, *r. m.*, longitudinal and circular muscles of the cirrus-pouch (*c. b.*); *r. s.*, vesicula seminalis; *r.*, vagina. After Riehm, 1881, Pl. VI, fig. 3.

6–8. Segments in three different stages of development. Drawn from one of Riehm's original specimens labelled "*Tænia rhopalocephala*" from "*Lepus timidus,*" see p. 155. No. 1377, U.S.N.M., poorly preserved.

Drawn by Haines.

PLATE IX.

Andrya cuniculi; Bertia studeri; Bertia mucronata; Bertia conferta.

FIG. 1. *Andrya cuniculi,* gravid segment showing cirrus-pouch, receptaculum seminis, and uterus with eggs. No. 1377, U.S.N.M.

2–3. *Bertia studeri,* from the Chimpanzee (*Anthropopitheeus troglodytes*).

FIG. 2. Strobila with head. After R. Blanchard, 1891A, fig. 2.

3. Three specimens of the pyriform body of the egg. After R. Blanchard, 1891A, fig. 4.

4–5. *Bertia mucronata*, from the Black Howler (*Alouatta caraya*).

4. Tranverse section of segment at genital pore: *H. N.*, lateral nerve trunk; *N. N.*, ventral accessory lateral nerve; *Ex. H.*, ventral canal; *Ex. N.*, dorsal canal; *Ut.*, uterus; *Mi. S.*, middle layer; *R. S.*, cortical layer; *M. tr*, transverse muscles; *M. l.*, transverse section of longitudinal muscles; *Ov.*, ovary; *Ds.*, vitellogene gland; *El.*, ovidnct; *E. Vg.*, "Excavatio vaginae;" *Kl.*, cloaca; *Pr. g.*, genital pore; *Vd. E.*, end portion of vas deferens; *Vg.*, vagina; *V. d.*, vas deferens; *Rec. s.*, receptaculum seminis; *Sblg.*, duct of receptaculum seminis; *Sd.*, shell-gland; *Sbcut.*, subcuticula; *Ho.*, testicles; *Cut.*, cuticle. After Meyner, 1895, Pl. I, fig. 3.

5. Ventral view of segment from one of Meyner's cotypes. No. 1483, U.S.N.M.

6. *Bertia conferta*, from the Bonnet Monkey (*Macacus sinicus*). Transverse section. After Meyner, 1895, Pl. II, fig. 9. For lettering see fig. 4.

Drawn by Haines.

PLATE X.

Bertia americana; Bertia americana leporis.

FIGS. 1–10. *Bertia americana*, from *Erethizon*.

1. Specimen from the Yellow-Haired Porcupine (*Erethizon epixanthus*). Natural size.

2. Specimen from the Canada Porcupine (*Erethizon dorsatus*). Natural size. After Curtice, unpublished.

3–5. Three enlarged views of head. Specimen from *E. epixanthus*. Zeiss, 4–a* 10.

6. Enlarged view of head, after Curtice, unpublished. Specimen from *E. dorsatus*.

7. Dorsal view of anterior portion of strobila from *E. epixanthus*. The figure is combined from a specimen mounted whole, and from several longitudinal and transverse sections. The head is retracted; dorsal canal is between ventral canal and nerve; female anlage appears in second segment; testicles in third segment, and round receptaculum seminis in fourth segment. The testicles become more numerous and the female glands gradually shift position to the right or left of the median line according to the position of genital pore. Zeiss, 4–a*.

8. Diagrammatic transverse section of a very young segment; the dorsal canals are connected with the transverse canal; the female anlage appears in the median line. Host: *E. epixanthus*.

9. Transverse section of segments of a specimen from *E. epixanthus*. Zeiss, 4–16.

10. Gravid segment. Host: *E. epixanthus*. Zeiss, 4–a* 10.

11–15. *Bertia americana leporis*, from *Lepus* sp.

11. Strobila, natural size. No. 1171, U.S.N.M.

12. Head. No. 1170a, U.S.N.M. Zeiss, 4–a* 10.

13. Head. No. 1176a, U.S.N.M. Zeiss, 4–a* 10.

14. Dorsal view of young segments showing nerves, dorsal and ventral canals, cirrus, cirrus-pouch, vas deferens, testicles, receptaculum seminis, and very indistinct anlage of female glands. No. 1171, U.S.N.M. Zeiss, 4–a* 10.

15. Slightly older segments. No. 1170, U.S.N.M. Zeiss, 4–a* 10.

N. B.—All of these figures (except 2 and 6) were made from rather poorly preserved material.

Drawn by Haines.

PLATE XI.

Cittotænia marmotæ, from the Alpine Marmot (*Arctomys marmota*).

FIG. 1. Strobila, natural size.

2–4. Three views of head. Zeiss, 4–a* 10.

5. Enlarged dorsal view of strobila, mounted whole, showing internal anatomy. No. 1370, U.S.N.M.

Attention should be directed to the sudden development and equally sudden atrophy of the ovarian tubules, to the lateral growth between the ovary and lateral canal, and to the form of the uterus and the cirrus-pouch.

6. Diagrammatic transverse section of segment to show topographical anatomy: *P.*, cirrus; *V.*, vagina; *N.*, nerve; *D. C.*, dorsal canal; *V. C.*, ventral canal.

7–8. Two greatly enlarged figures, dorsal view, showing anatomy of segments. Fig. 7 after Stiles (in Stiles & Hassall, 1893, Pl. VII, fig. 6).

All figures were prepared from specimens collected at Briançon, France, by R. Blanchard.

Drawn by Haines.

PLATE XII.

Cittotænia marmotæ and *Cittotænia denticulata*.

FIGS. 1–2. *Cittotænia marmotæ*, from the Alpine Marmot (*Arctomys marmotæ*).

1. Dorsal view of gravid segment. Zeiss, 4–a* 10.

2. Oncosphere in the pyriform apparatus, escaping from the outer eggshell. Greatly enlarged.

3–8. *Cittotænia denticulata*, from European Wild Rabbit (*Lepus cuniculus*).

3. Strobila, natural size. No. 1328, U.S.N.M., one of Riehm's cotypes of *Dipylidium latissimum*. For figures of Rudolphi's cotypes of *Tænia denticulata* see Stiles (in Stiles & Hassall, 1893, Pl. V, figs. 4–7).

4. Head and anterior portion. After Riehm, 1881, Pl. V, fig. 5.

5. Lateral border of segments showing the gradual development of the cirrus. The numbers refer to the segments. After R. Blanchard, 1891B, fig. 22.

6. Injected excretory system. After Riehm, 1881, Pl. V, fig. 15.

7. Transverse section (diagrammatic) of segment to show topographical anatomy. Testicles are dorsal, accessory excretory canals ventral.

8. Ventral view of segment, showing cirrus, cirrus-pouch, vas deferens, testicles, ovaries, vitellogene glands, vagina, dorsal and larger ventral canals. No. 1328b, U.S.N.M. Zeiss, 4–a* 10.

Drawn by Haines.

PLATE XIII.

Cittotænia denticulata, from the European Wild Rabbit (*Lepus cuniculus*).

FIG. 1. Half of segment to show the anatomy: *rc.*, retractor muscle of the cirrus-pouch; *v. d.*, vas deferens; *p.*, prostata; *r m''.*, inner layer of circular muscles of the cirrus-pouch; *l m.*, longitudinal muscles; *r m'.*, outer layer of circular muscles; *sp.*, spongy connective tissue; *c.*, cirrus; *v.*, vagina; *n.*, longitudinal nerve; *x.*, dorsal canal; *E.*, ventral canal system; *rs.*, receptaculum seminis; *d.*, vitellogene gland; *s.*, shell-gland; *e.*, ovary; *u.*, uterus; *t.*, testicles. After Riehm, 1881, Pl. VI, fig. 2.

The topography is not well preserved, but this is probably a dorsal view, as is shown by the position of the dorsal canal. If this interpretation is correct, the vagina and vas deferens should run over the canals and nerves instead of under, as given in the figure. See Pl. XII, fig. 7.

FIG. 2. Ventral view of gravid segment. The peculiar folds of the uterus should attract attention. No. 328f, U.S.N.M., one of Riehm's cotypes of *Dipylidium latissimum*.

3a–h. Oncosphere, pyriform body, and middle and outer envelopes of the eggs. After R. Blanchard, 1891B, fig. 25.

Drawn by Haines.

PLATE XIV.

Cittotænia ctenoides, from European Wild Rabbit (*Lepus cuniculus*).

FIG. 1. Strobila, natural size, from one of Riehm's original specimens.

2. Head. Zeiss, 4–a * 10.

3. Head with dorsal and ventral excretory canals. After Riehm, 1881, Pl. V fig. 13.

4. Posterior segments with injected excretory system. After Riehm, 1881, Pl. V, fig. 16.

5. Half of segment to show the anatomy: *v d.*, vas deferens; *v s.*, vesicula seminalis; *cb.*, cirrus-pouch; *v.*, vagina; *u.*, uterus; *n.*, nerve; *x.*, dorsal canal; *E.*, ventral canal with transverse canal; *s.*, shell-gland; *d.*, vitellogene gland; *t.*, testicles; *e.*, ovary; *r. s.*, receptaculum seminis. After Riehm, 1881, Pl. VI, fig. 5.

It is not clear whether this is a dorsal or ventral view; probably it is intended as dorsal; for correct topography see fig. 7.

6. Diagrammatic transverse section of segment; dorsal canal dorsal (in some segments dorso-lateral) of ventral canal; genital canals pass dorsally of nerve and longitudinal canals.

7. Segments showing position of the testicles. No. 1329a, U.S.N.M., from the domesticated rabbit. Zeiss, 4–a * 10.

8. A gravid segment showing uterus, two vaginæ, and two cirrus-pouches.

Drawn by Haines.

PLATE XV.

Cittotænia præcoquis, from the Prairie Gopher (*Geomys bursarius*).

FIGS. 1–2. Anterior portion of strobila (divided), showing the rapid development of the organs. No. 1079, U.S.N.M. Zeiss, 4–a* 10.

3. Three segments more highly magnified. No. 1079, U.S.N.M. Zeiss, 4–16.

4. Older segment. No. 1079, U.S.N.M. Zeiss, 4–16.

5. Transverse section of gravid segment at the pores, to show the anatomy. Attention should be directed to the very large receptaculum seminis.

6. Transverse section in another plane. The testicles extend further ventrad and the uterus is absent in the median line.

Drawn by Haines.

PLATE XVI.

Cittotænia pectinata, from European Mountain Hare (*Lepus variabilis*).

FIGS. 1–2. Enlarged view of strobila showing the gradual development of all of the organs. Ventral view. Specimen No. ——, U.S.N.M., collected by R. Blanchard in France.

Drawn by Haines.

PLATE XVII.

Cittotænia pectinata, from European Mountain Hare (*Lepus variabilis*) and European Hare (*Lepus timidus*).

FIG. 1. Continuation of Plate XVI, figs. 1–2, a few contracted segments omitted.

2. Strobila, natural size. One of Riehm's original specimens from the European Hare (*Lepus timidus*).

Drawn by Haines.

PLATE XVIII.

Cittotænia perplexa, from the Cottontail Rabbit (*Lepus sylvaticus*).

FIG. 1. Strobila with head, natural size. No. 1126, U.S.N.M.
2. Anterior portion of strobila enlarged to show the general appearance. No. 1138, U.S.N.M. Zeiss, 4–a* 5.
3. Ventral view of a single segment, showing nerves, canals, cirrus-pouch, vasa deferentia, testicles arranged in two groups, single uterus, two ovaries and vitellogene glands. No. 1131, U.S.N.M.

Drawn by Haines.

PLATE XIX.

Cittotænia variabilis; Cittotænia variabilis angusta.

FIGS. 1–12. *Cittotænia variabilis*, from the Cottontail Rabbit (*Lepus sylvaticus*).
1. Strobila, natural size.
2–7. Six views of heads.
8. Very young specimen.
9. Very young specimen with beginning segmentation. No. 1373.7, U.S.N.M.
10. Ventral view of segment in which uterus is not developed. No. 1162, U.S.N.M. Zeiss, 4–a* 10.
11. Ventral view of segment with single uterus. No. 1207, U.S.N.M. Zeiss, 4–a* 10.
12. Ventral view of segment with two uteri, only one of which is well developed. No. 1162, U.S.N.M. Zeiss, 4–a* 10.

13–14. *Cittotænia variabilis angusta*, from the Cottontail Rabbit (*Lepus sylvaticus*). Two strobilæ, natural size. For a figure of segments from fig. 14 (No. 119, U.S.N.M.), showing both double and single genital pores, see Stiles, 1895.

Drawn by Haines.

PLATE XX.

Cittotænia variabilis, from the Cottontail Rabbit (*Lepus sylvaticus*).

FIGS. 1–5. Segments showing variations. All ventral views, except fig 1. Nos. 1154, 1122, 1125, 1127, 1152, U.S.N.M. Enlarged about 15 times. Zeiss, 4–a* 10.

Drawn by Haines.

PLATE XXI.

Davainea retractilis, from the Arizona Cottontail Rabbit (*Lepus arizonæ*).

FIG. 1. Head enlarged. No. 1195, U.S.N.M. Zeiss, 4–16.
2. Retracted sucker of same, greatly enlarged.
3. Segments showing unilateral pores, longitudinal nerves and canals, and median female anlage. No. 1192, U.S.N.M. Zeiss, 4–16.
4. Older segments of same strobila, showing testicles.
5. Gravid segment showing one egg in each egg capsule. No. 1188, U.S.N.M.
6. Egg capsule with egg.

Drawn by Haines from poorly preserved specimens.

PLATE XXII.

Davainea retractilis; *Davainea contorta; Davainea salmoni.*

FIG. 1. *Davainea retractilis*, from the Arizona Cottontail Rabbit (*Lepus arizonæ*). Transverse section through gravid segment. Zeiss, 4–16.
2. Segment of *Davainea contorta*, from the Common Indian Pangolin (*Manis pentadactyla*): *h.*, testicle; *u.*, uterus: *ve.*, vas efferens; *vd.*, vas deferens; *ci.*, cirrus; *v.*, vagina; *k.*, ovary; *d.*, vitellogene gland. After Zschokke, 1895, fig. 2.

FIGS. 3–4. *Davainea salmoni*, from the Cottontail Rabbit (*Lepus sylvaticus*).

3. Longitudinal section through very young specimen, showing the rostellum with hooks and four longitudinal canals. Zeiss, 4–8.

4. Gravid segment, dorsal view, showing longitudinal nerve and canals, cirrus pouch, vas deferens, vagina, and numerous egg capsules. No. 1104, U.S.N.M. Zeiss, 4–a* 5.

Drawn by Haines.

PLATE XXIII.

Davainea salmoni, from the Cottontail Rabbit (*Lepus sylvaticus*) and the Eastern Jackass Hare (*Lepus melanotis*).

FIG. 1. Strobila, natural size.

2–5. Four views of head. Alcohol specimens. Enlarged about 15 times. Zeiss, 4–a* 10.

6. A portion of the double row of hooks on the rostellum. Greatly enlarged.

7. View of hooks on the suckers in somewhat contracted condition. Greatly enlarged.

8. Another view of hooks on the suckers. No. 1428, B.A.I.

9. Egg capsule with 5 eggs. Zeiss, 4–4.

Drawn by Haines.

PLATE XXIV.

Davainea salmoni, from the Eastern Jackass Hare (*Lepus melanotis*).

FIGS. 1–2. Dorsal view of segments in different stages, showing longitudinal nerves and canals, cirrus-pouch, vas deferens, testicles, vagina, and female glands. No. 1196, U.S.N.M. Zeiss, 4–16.

Drawn by Haines.

PLATE XXV.

Davainea salmoni, from the Cottontail Rabbit (*Lepus sylvaticus*).

FIGS. 1–11. Various young stages found in the intestine of the Cottontail Rabbit (*Lepus sylvaticus*). None of the forms show segmentation, but several figures show the surrounding membrane, evidently pointing to a recent infection.

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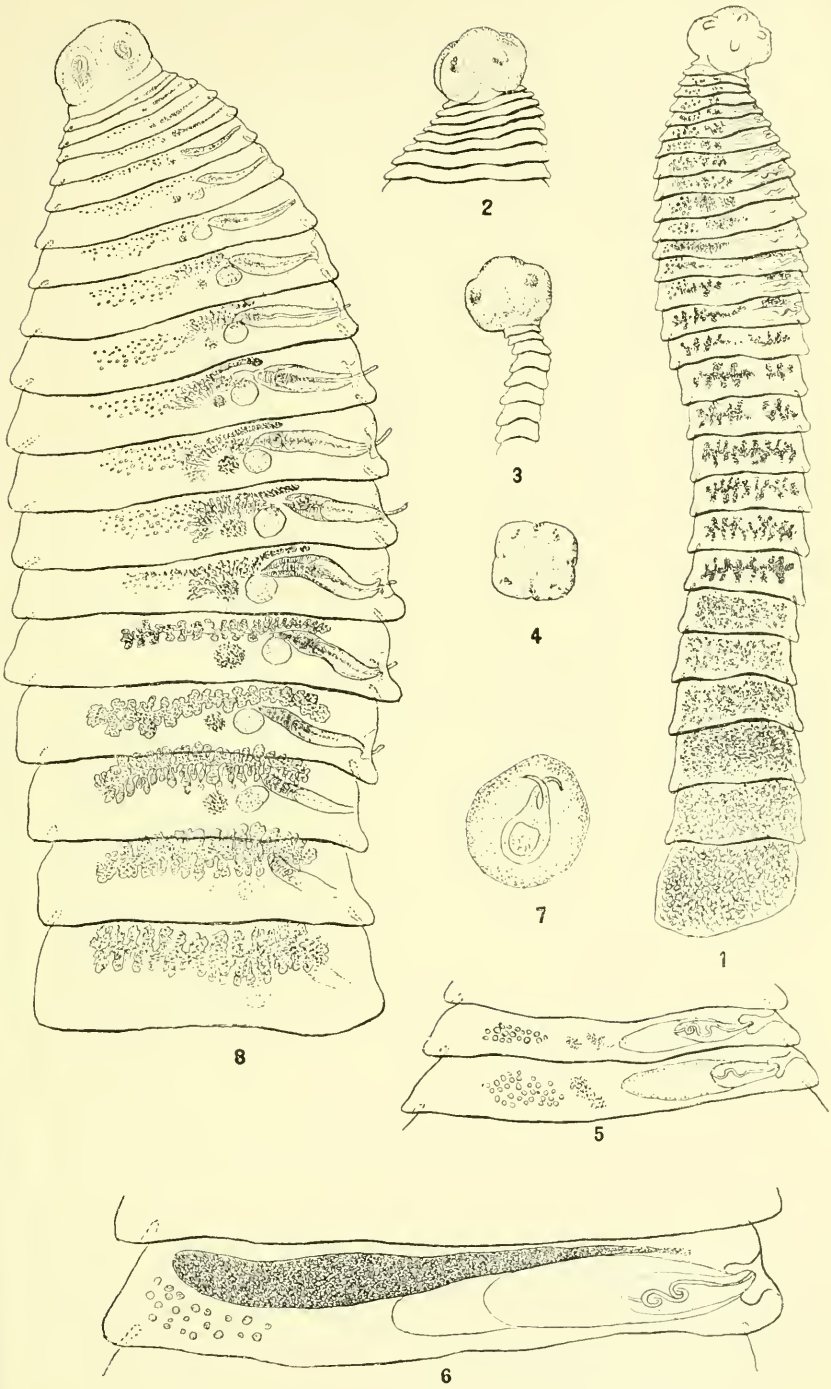
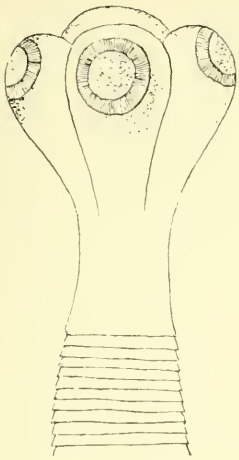
[Italicized figures (*213, 220*, etc.) refer to the more important references.]



ANOPLOCEPHALINE TAPEWORMS FROM THE EUROPEAN MOUNTAIN HARE AND THE HORSE.

FOR EXPLANATION OF PLATE SEE PAGE 226.



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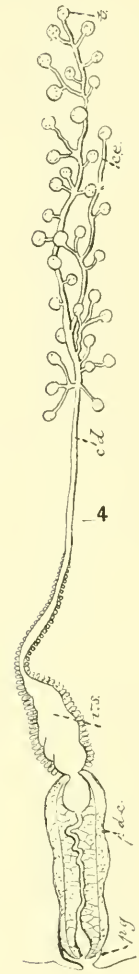

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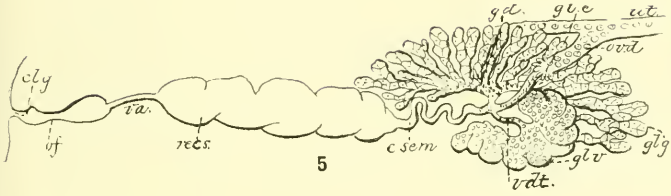

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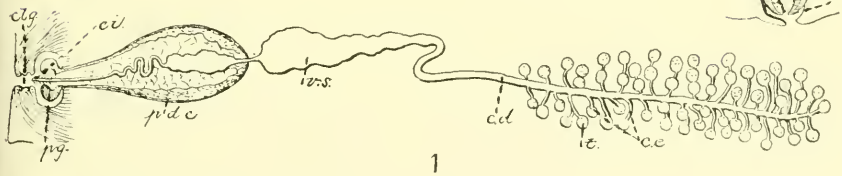

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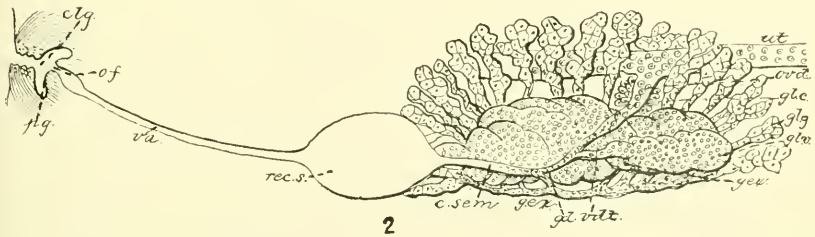

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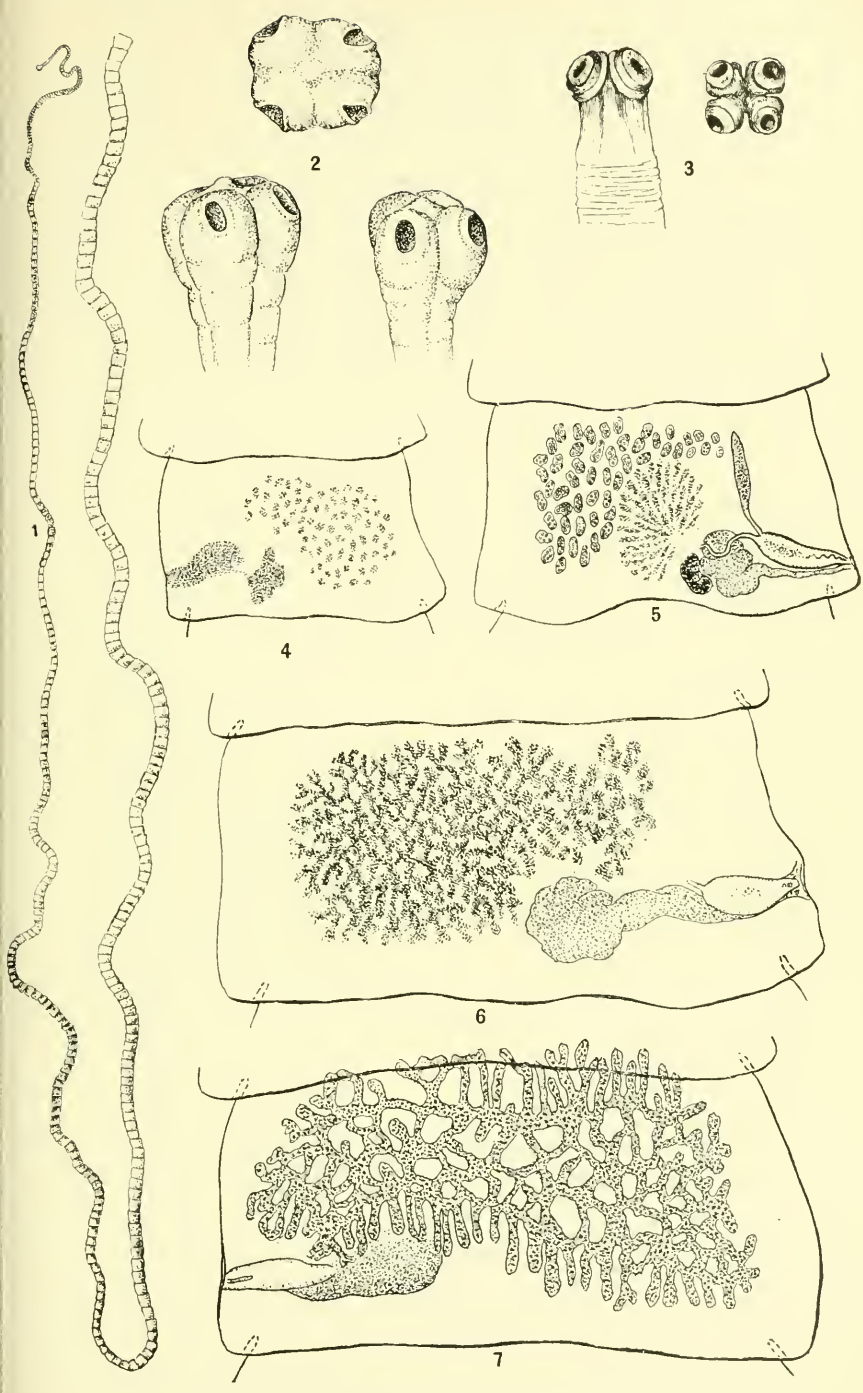
ANOPLOCEPHALINE TAPEWORMS FROM THE HORSE AND THE MARMOT.

FOR EXPLANATION OF PLATE SEE PAGE 226.



ANOPLOCEPHALINE TAPEWORM FROM THE EUROPEAN HARE.

FOR EXPLANATION OF PLATE SEE PAGE 226.

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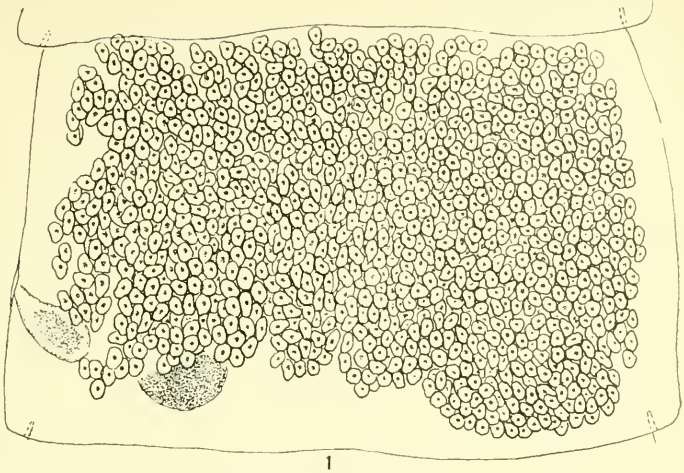

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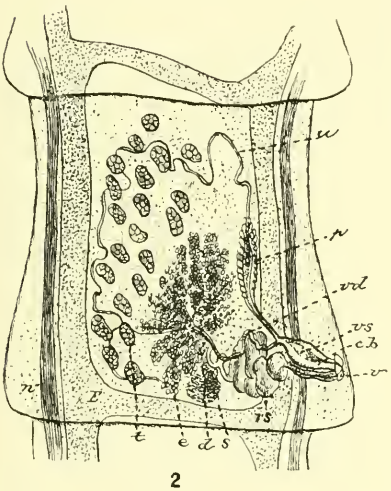

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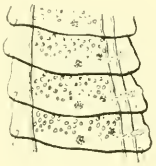

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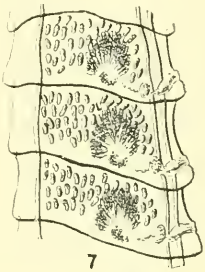

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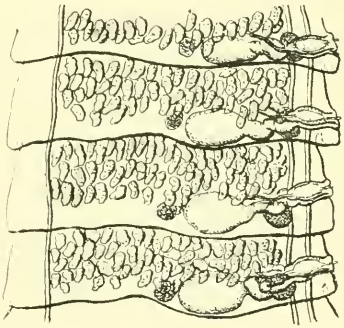

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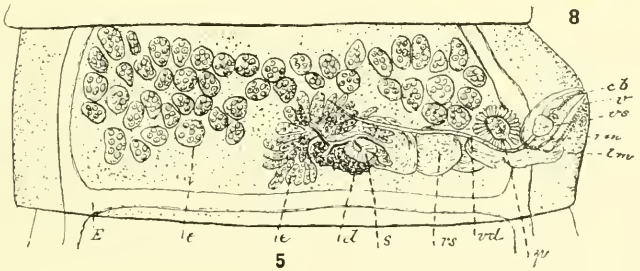

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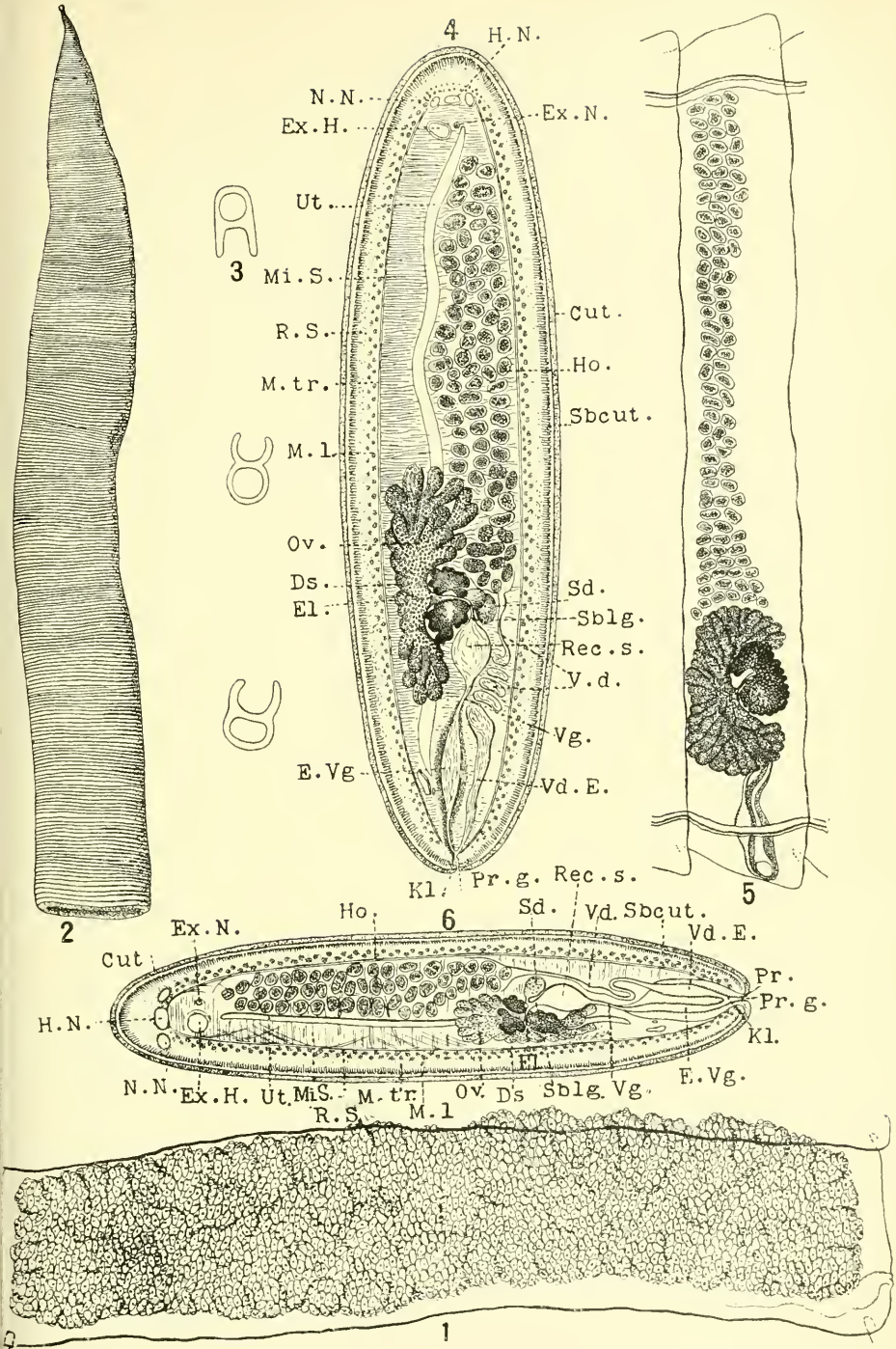
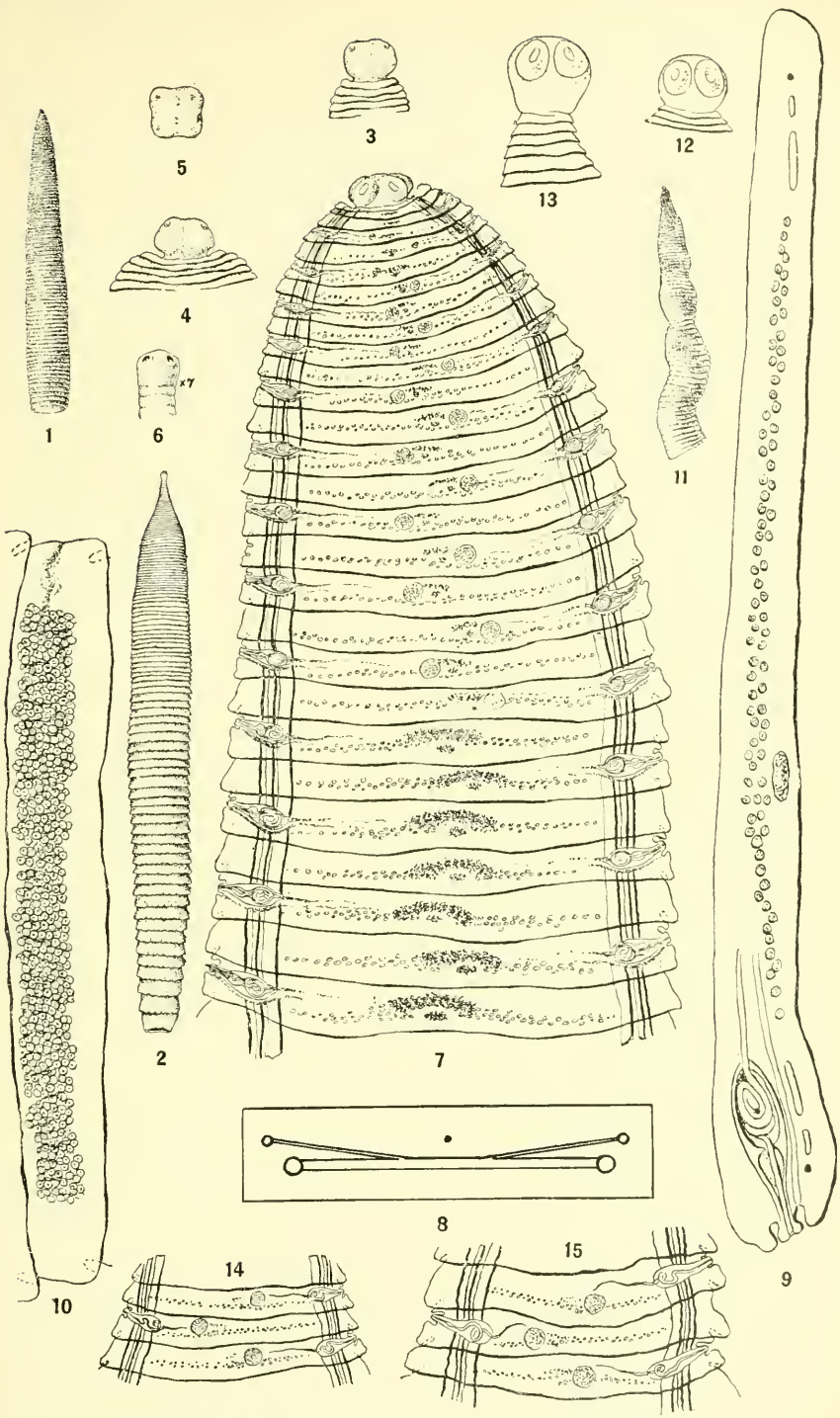
ANOPLOCEPHALINE TAPEWORM FROM THE EUROPEAN HARE AND THE EUROPEAN WILD RABBIT.

FOR EXPLANATION OF PLATE SEE PAGE 227.



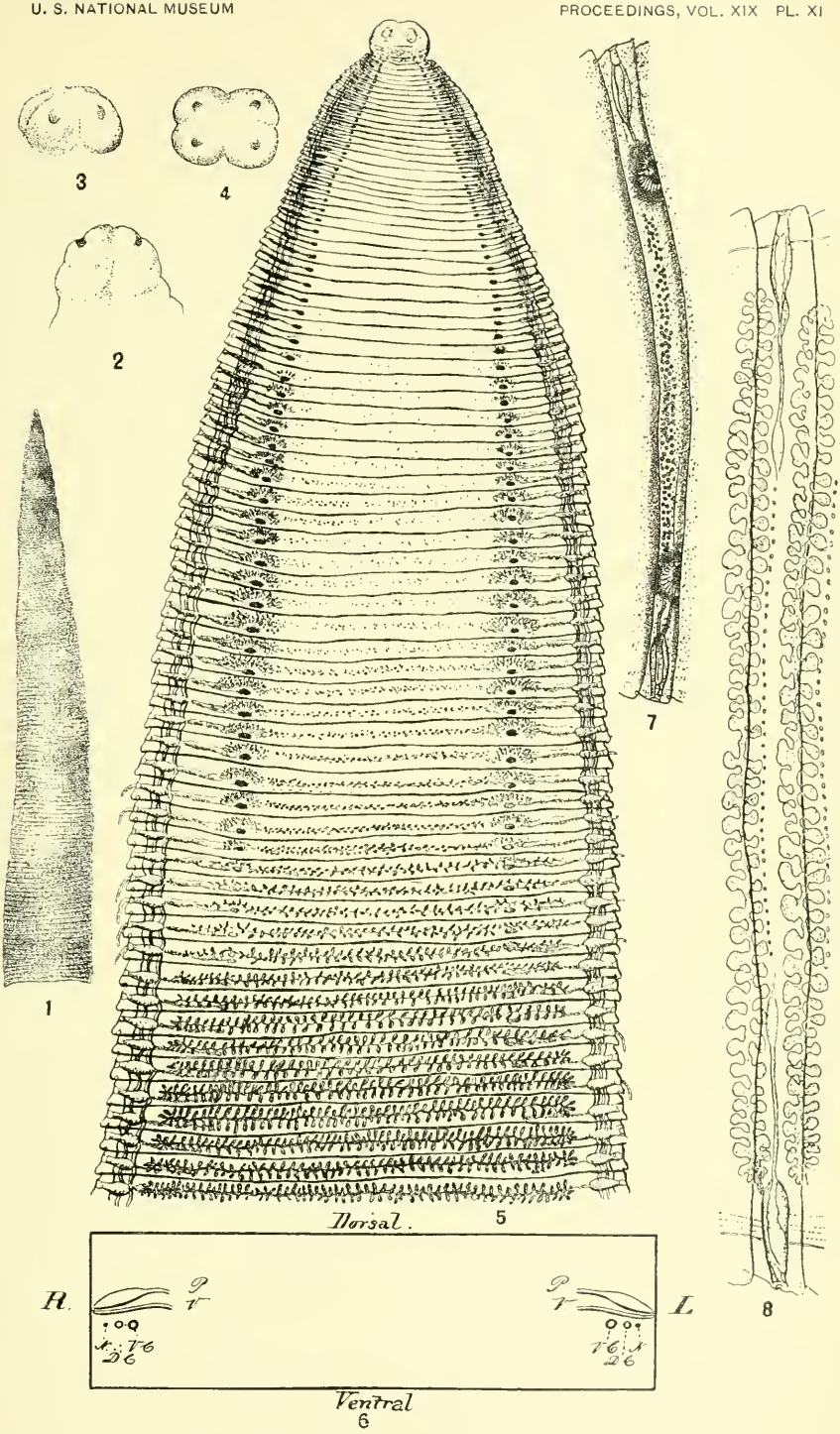
ANOPLOCEPHALINE TAPEWORMS FROM THE EUROPEAN HARE, THE CHIMPANZEE, THE BLACK HOWLER, AND THE BONNET MONKEY.

FOR EXPLANATION OF PLATE SEE PAGE 227.



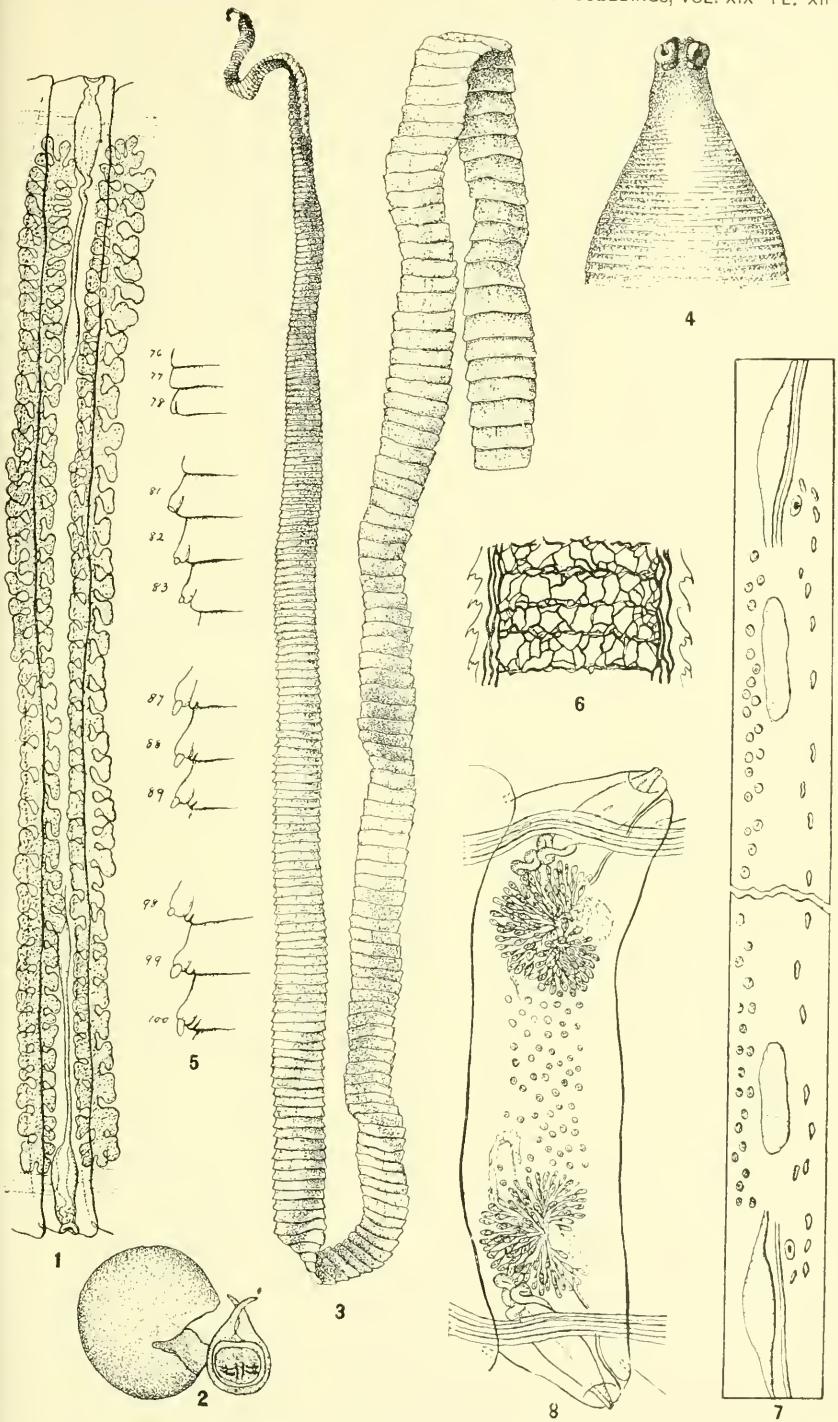
ANOPLOCEPHALINE TAPEWORMS FROM PORCUPINES AND HARES.

FOR EXPLANATION OF PLATE SEE PAGE 228



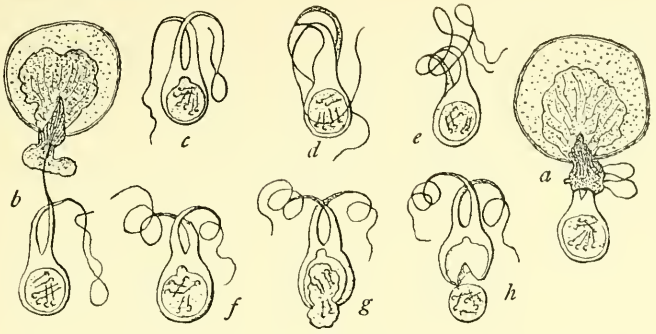
ANOPLOCEPHALINE TAPEWORM FROM THE ALPINE MARMOT.

FOR EXPLANATION OF PLATE SEE PAGE 229.



ANOPLOCEPHALINE TAPEWORMS FROM THE ALPINE MARMOT AND THE EUROPEAN WILD RABBIT.

FOR EXPLANATION OF PLATE SEE PAGE 229.



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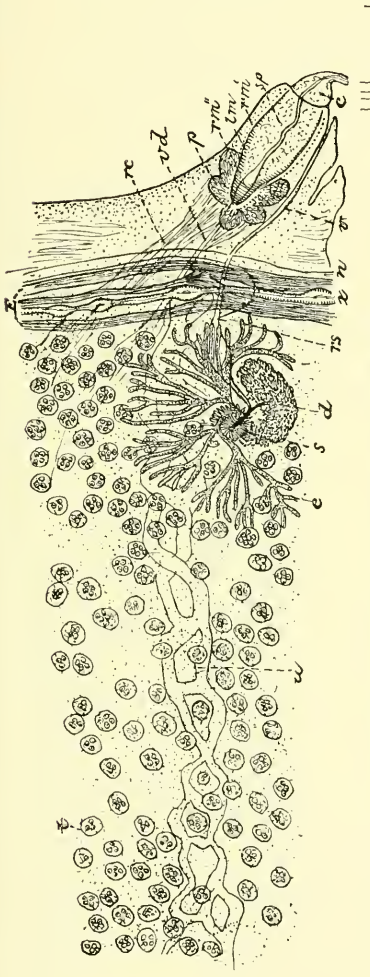

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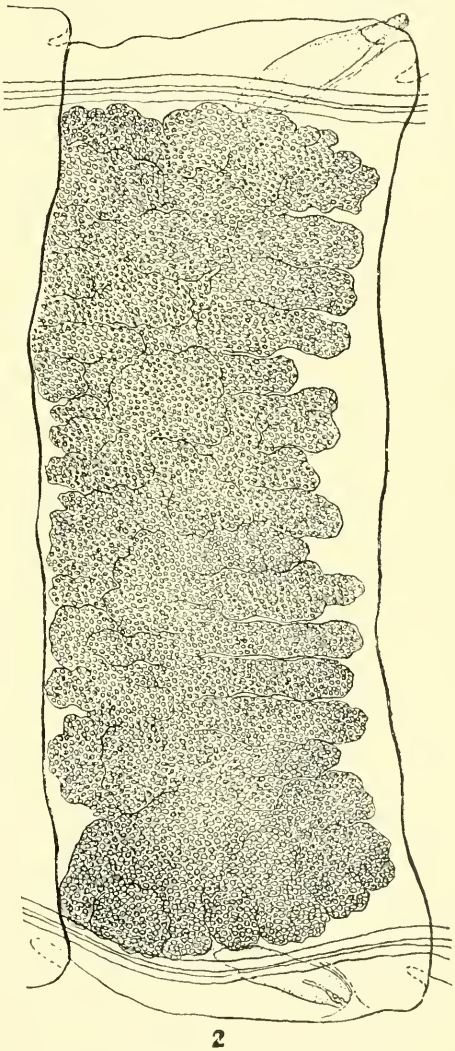

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ANOPLOCEPHALINE TAPEWORM FROM THE EUROPEAN WILD RABBIT.

FOR EXPLANATION OF PLATE SEE PAGE 229.


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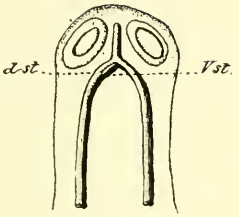

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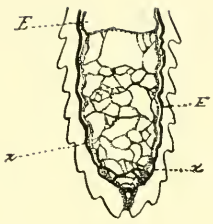

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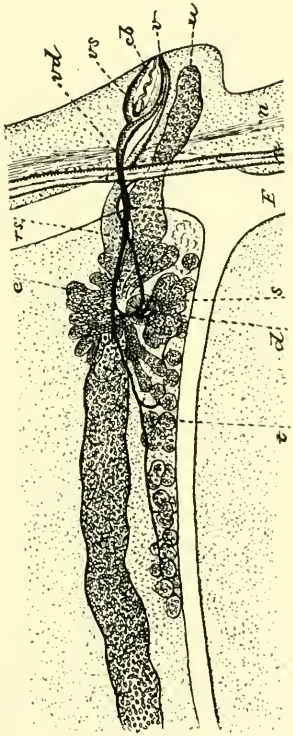

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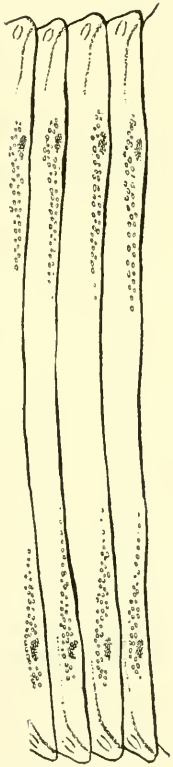
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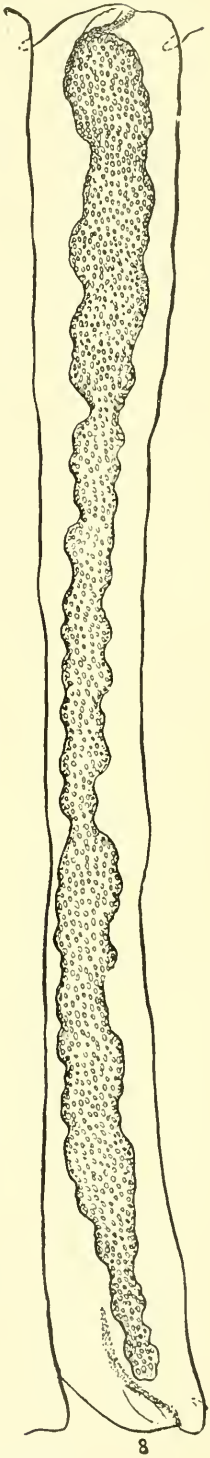
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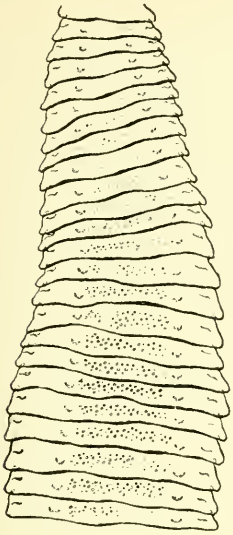
ANOPLOCEPHALINE TAPEWORM FROM THE EUROPEAN WILD RABBIT.

FOR EXPLANATION OF PLATE SEE PAGE 230.



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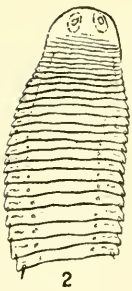

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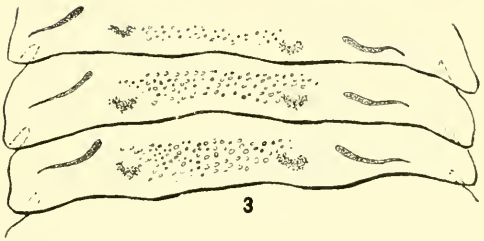

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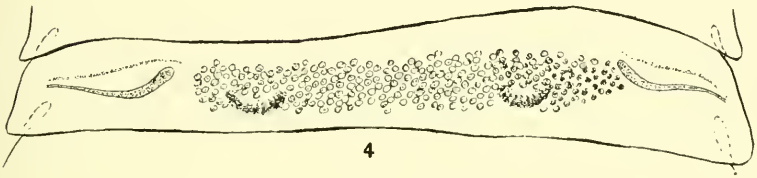

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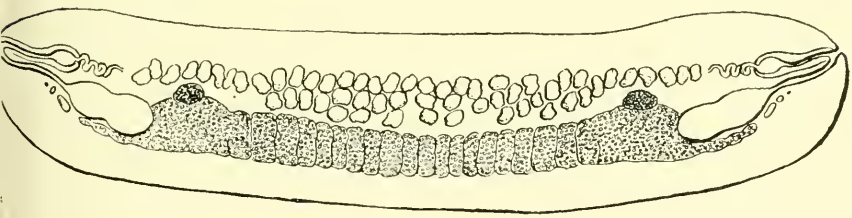
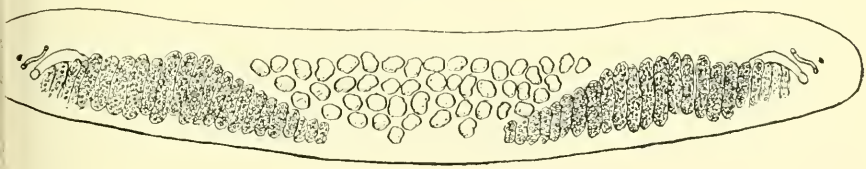


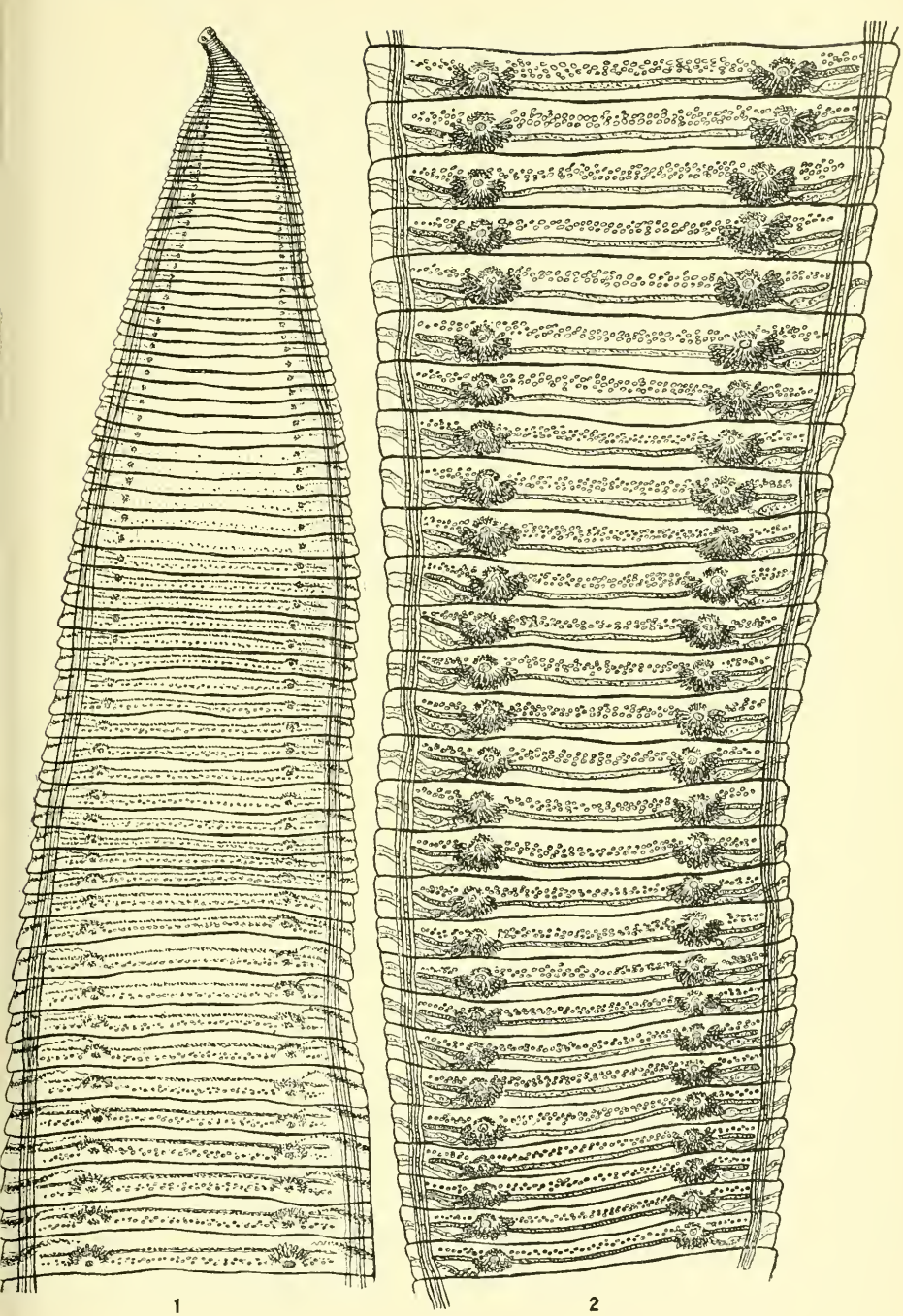
5



6

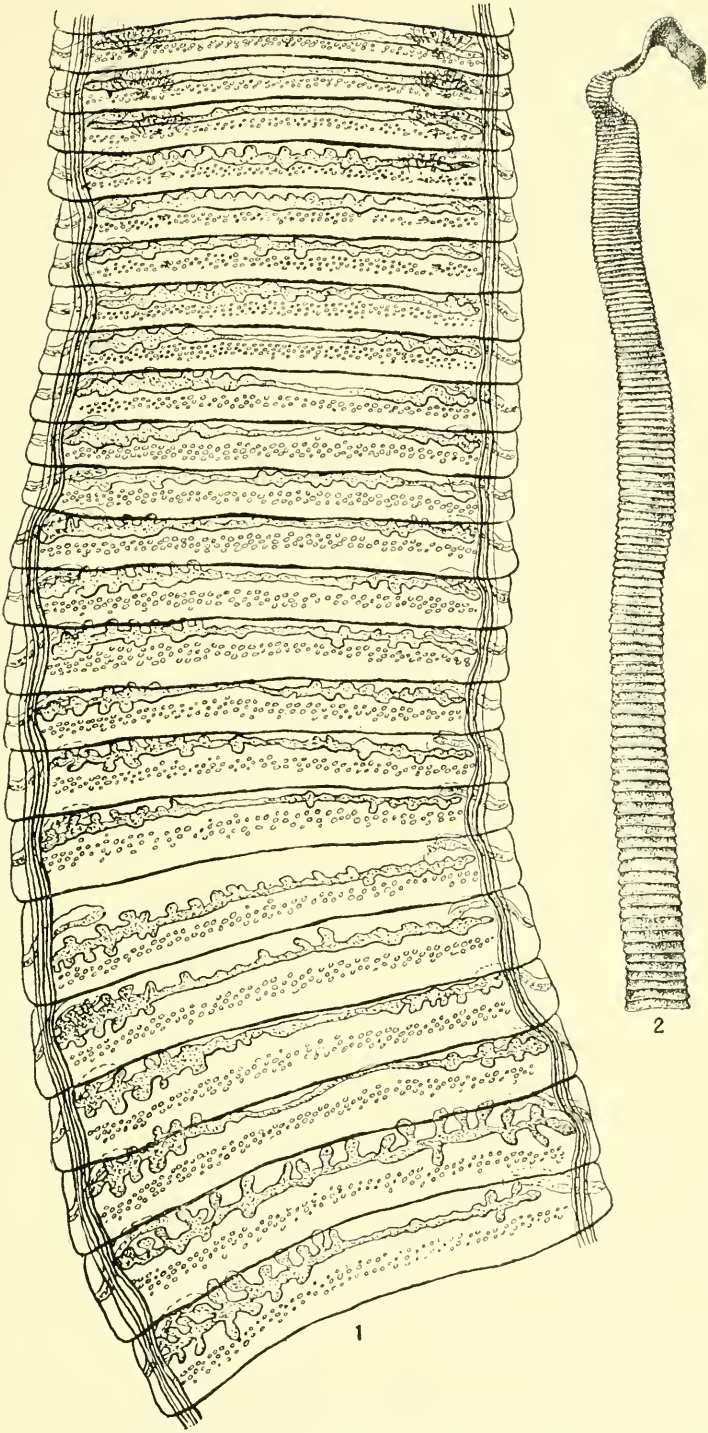
ANOPLOCEPHALINE TAPEWORM FROM THE PRAIRIE GOPHER.

FOR EXPLANATION OF PLATE SEE PAGE 230.



ANOPLOCEPHALINE TAPEWORM FROM THE EUROPEAN MOUNTAIN HARE.

FOR EXPLANATION OF PLATE SEE PAGE 230.

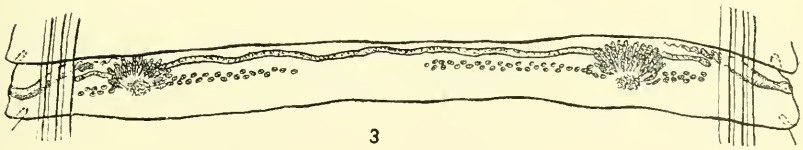


ANOPLOCEPHALINE TAPEWORM FROM THE EUROPEAN MOUNTAIN HARE AND THE EUROPEAN HARE.

FOR EXPLANATION OF PLATE SEE PAGE 230.

1

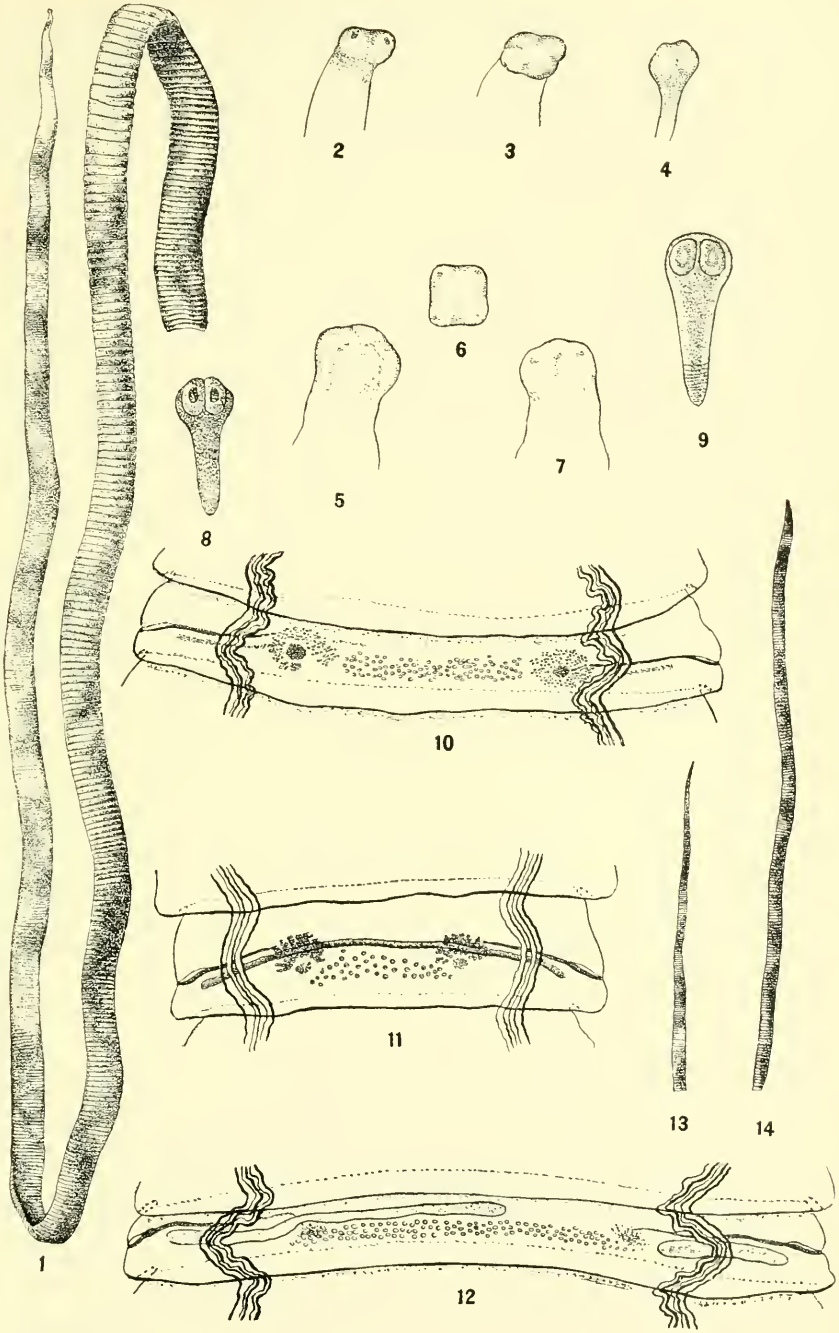
2



3

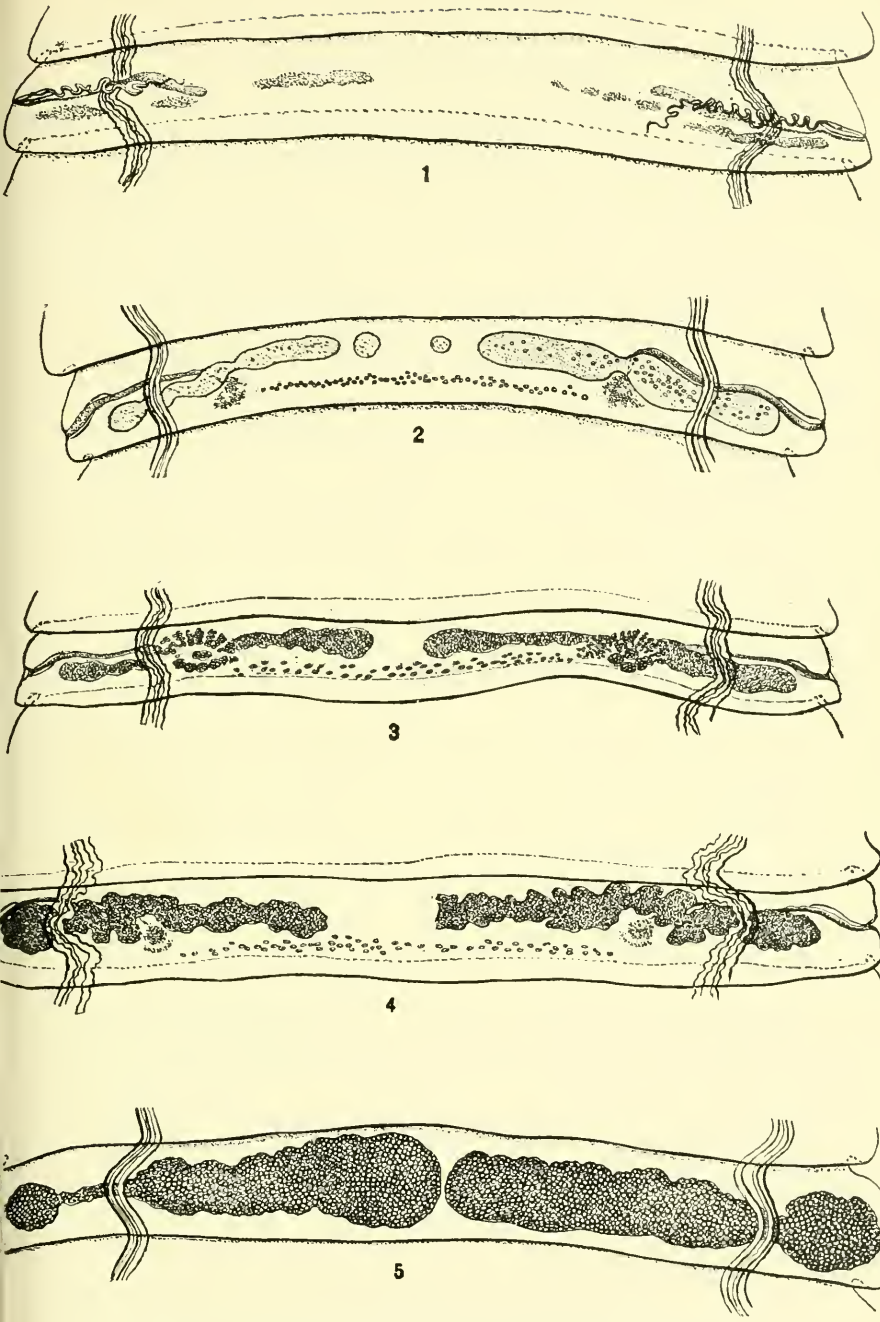
ANOPLOCEPHALINE TAPEWORM FROM THE COTTONTAIL RABBIT.

FOR EXPLANATION OF PLATE SEE PAGE 231.



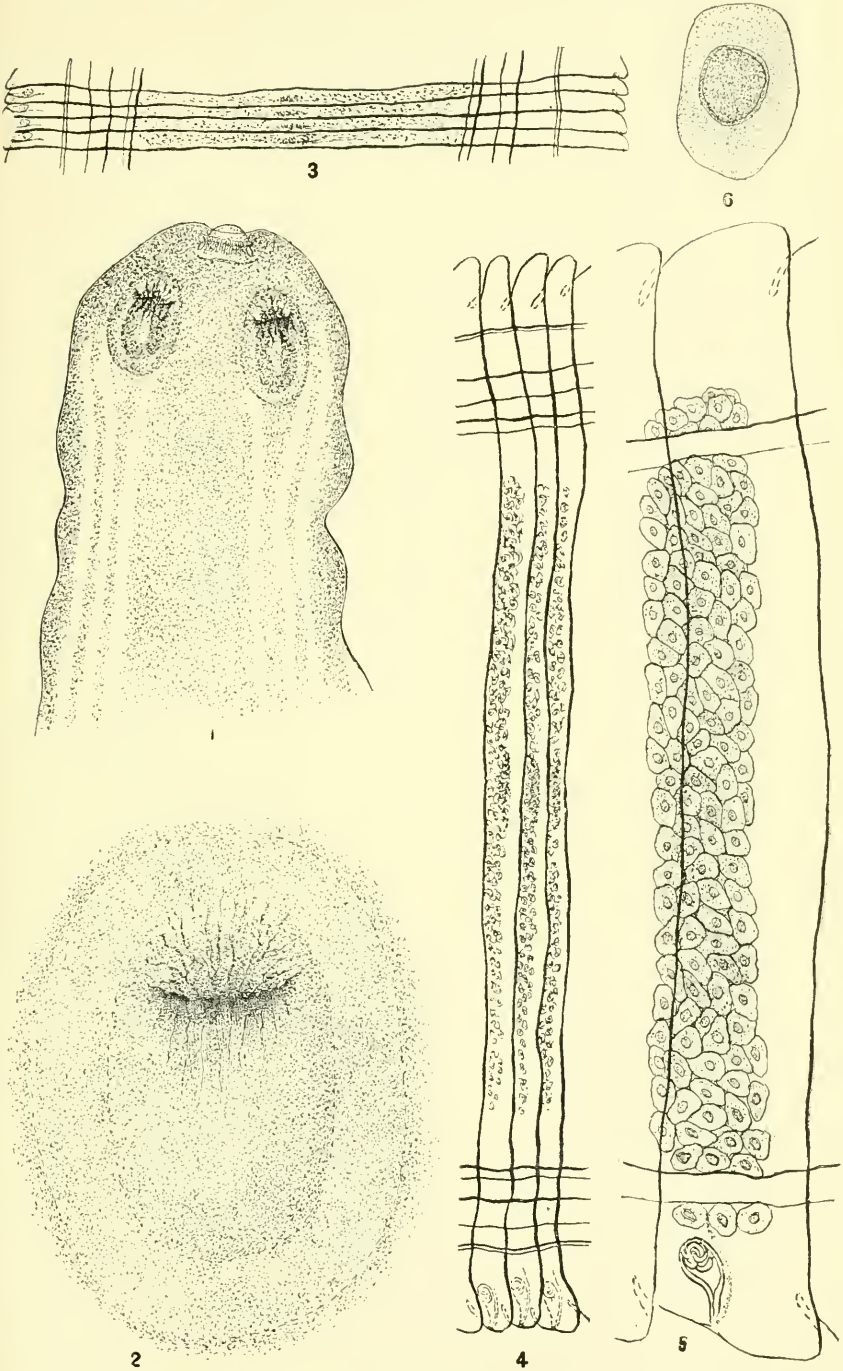
ANOPLOCEPHALINE TAPEWORMS FROM THE COTTONTAIL RABBIT.

FOR EXPLANATION OF PLATE SEE PAGE 231.



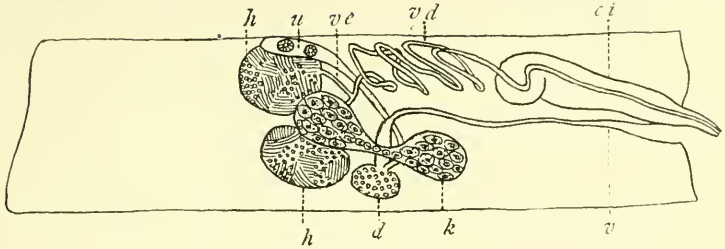
ANOPLOCEPHALINE TAPEWORM FROM THE COTTONTAIL RABBIT.

FOR EXPLANATION OF PLATE SEE PAGE 231.



ARMED TAPEWORM FROM THE ARIZONA COTTONTAIL RABBIT.

FOR EXPLANATION OF PLATE SEE PAGE 231.



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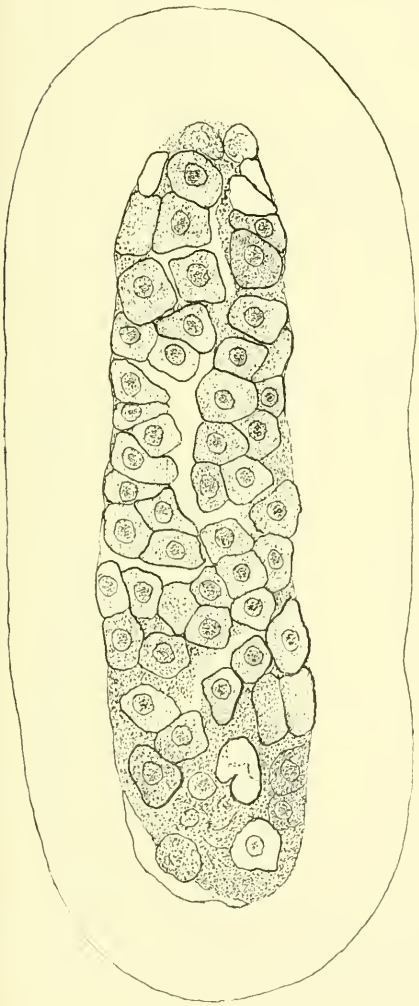
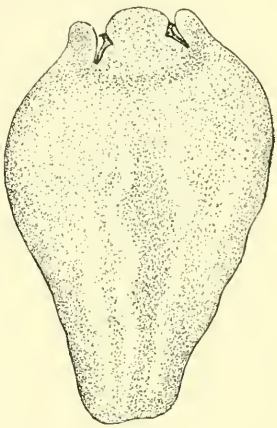


1



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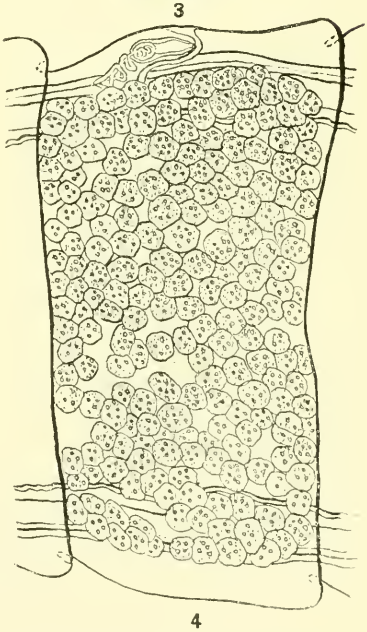


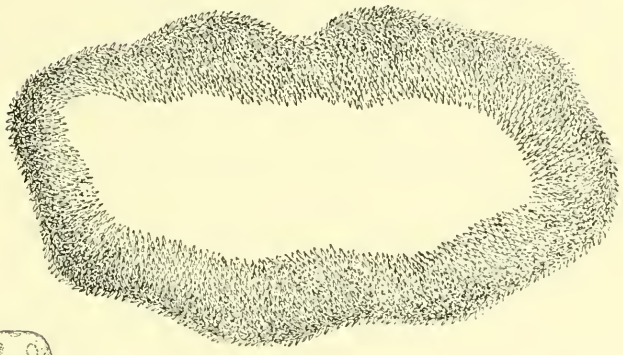
4

ARMED TAPEWORMS FROM THE ARIZONA COTTONTAIL RABBIT, THE COMMON INDIAN PANGOLIN, AND THE COTTONTAIL RABBIT.

FOR EXPLANATION OF PLATE SEE PAGE 231.

1

6



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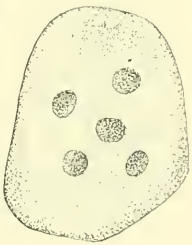
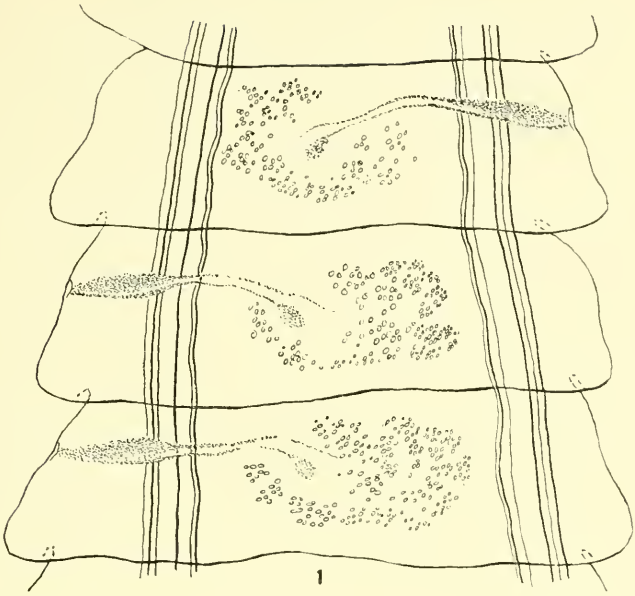
8

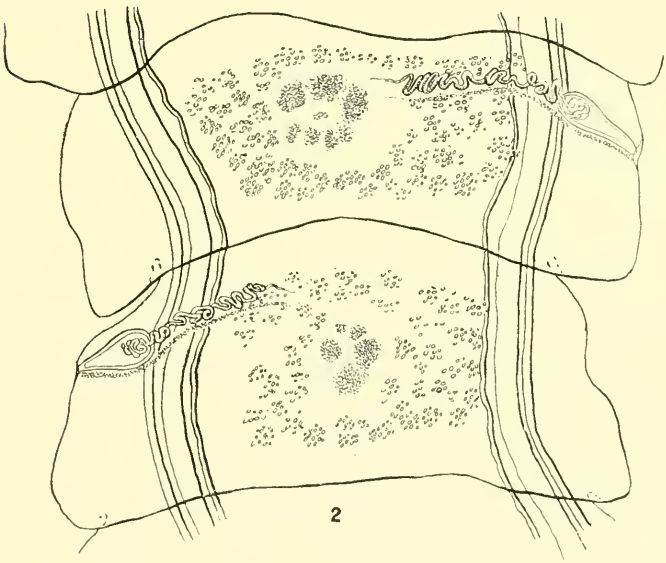


9

ARMED TAPEWORM FROM THE COTTONTAIL RABBIT AND THE EASTERN JACKASS HARE.

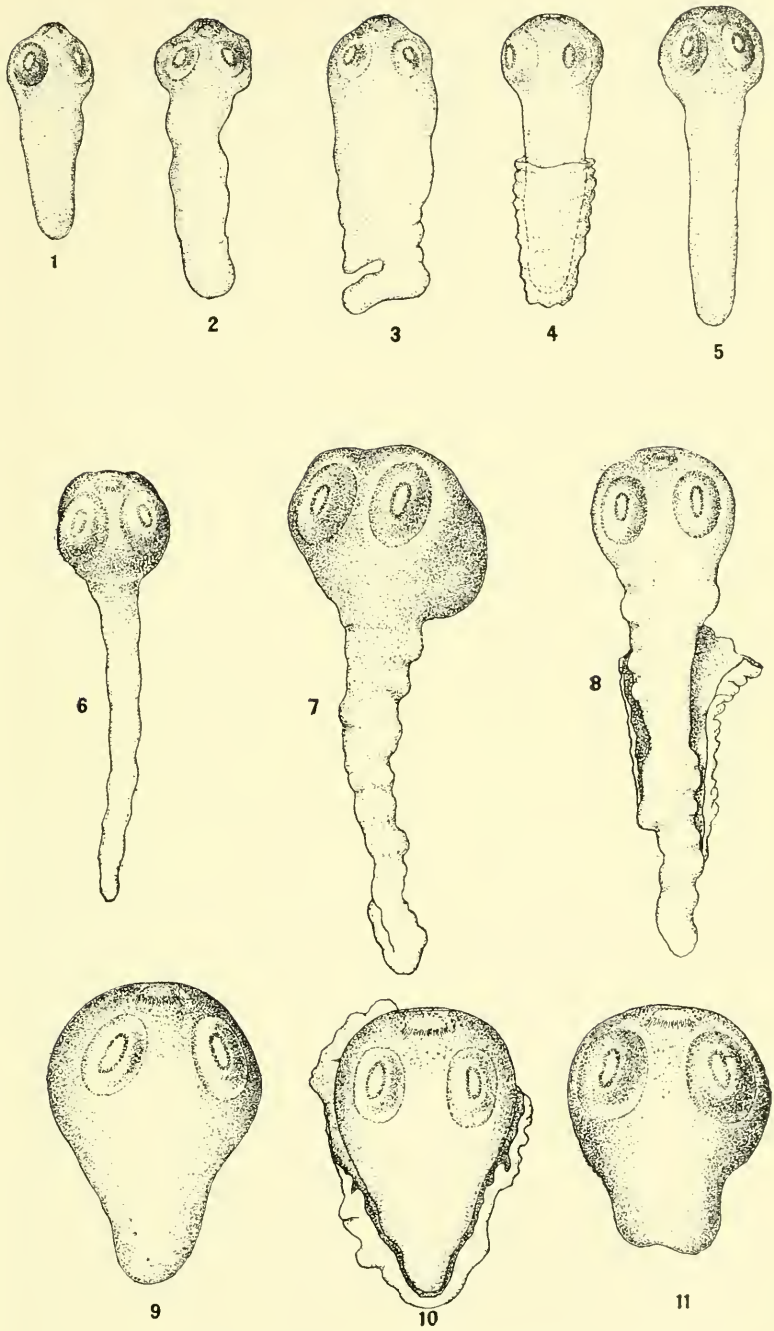
FOR EXPLANATION OF PLATE SEE PAGE 232.





ARMED TAPEWORM FROM THE EASTERN JACKASS HARE.

FOR EXPLANATION OF PLATE SEE PAGE 232.



YOUNG STAGES OF AN ARMED TAPEWORM FROM THE COTTONTAIL RABBIT.

FOR EXPLANASION OF PLATE SEE PAGE 232.