SOME HELMİNTH PARASİTES FROM THE CHUKAR PARTRİDGE, ALECTORİS GRAECA, OF TURKEY, WITH NOTES ON THEİR LİFE HİSTORİES, PATHOGENİCİTY, AND CONTROL

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From 1950 to 1952, a number of chukar partridges, **Alectoris graeca,** were imported by the U. S. Fish and Wildlife Service into the United States from Turkey for release and subsequent propagation. While still in quarantine, 40 of these birds became ill and died. They were packed in ice and shipped to the then Pathological Division, Bureau of Animal Industry, Washington, D. C., for determination of the cause of death. They were later sent to the Zoological Division, B.A.I., to be examined for parasites. One of us (EEW) promptly collected and preserved for future study and identification several kinds of helminth and arthropod parasites from them.

On learning that this collection of parasites from the chukar partridge in Turkey was still available for study, the senior author who had been recently assigned to the Animal Parasite Laboratory, ADP, Beltsville, Maryland, to study poultry parasites undertook the identification of the helminth parasites included in it. The present paper includes a short description of them, notes on their nomenclature, available information on their life histories, pathogenicity, and control, and a list of all other helminth parasites reported from this host by other authors. Data on life history, pathogenicity, or control are lacking for some of the species encountered. In such cases information for closely related species is supplied.

Materials and Methods

Eleven hundred and forty-five helminth parasites were collected from the 40 chukar partridges that were submitted for necropsy. Of these, 1,089 were nematodes, 30 were acanthocephalids, and 25 were trematodes. In addition, several fragments of cestode material were recovered.

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Since the birds had been dead for some time, all of the parasites encountered were also dead. Many had undergone some degree of decomposition before they were preserved in a solution consisting of 62 percent of 95 percent ethyl alcohol, 19 percent glycerine, and 19 percent tap water. For examination, the nematodes were cleared in a mixture of 80 percent phenol and 20 percent absolute alcohol, whereas the trematode and cestode material was stained in acid carmine and mounted permanently on microscopic slides. The tapeworm material proved to be unsuitable for identification as to species; however, most of the nematodes and trematodes were in excellent condition for study.

The helminth parasites recovered from these chukar partridges, with their location in the host, are recorded in Table 1.

Table : 1

Name of Parasite	Location	No. of Worms Recovered: Males	Females	Total
NEMATODES:				
Heterakis dispar	Ceca	208	266	474
Subulura suctoria	Ceca	179	265	444
Tetrameres lhuillieri	Proventriculus	28	56	84
Cheilospirura gruveli	Gizzard and intestine	28	24	52
Seurocyrnea eurycerca	Gizzard	16	16	32
Capillaria annulata	Crop	1	—	1
Ascaridia galli	Intestine	1	—	1
Heterakis gallinarum	Ceca	1	—	1
ACANTHOCEPHALA:				
Mediorhynchus sp.	Intestine	12	18	30
TREMATODES:				
Corrigia corrigia	Intestine		25	25
CESTODES:				
Raillietine sp.	Intestine	Mostly fragments		

DESCRİPTİONS, LİFE HİSTORİES, PATHOGENİCİTY, AND CONTROL OF THE PARASİTES

NEMATODES

(Measurements in millimeters)

Heterakis dispar (Schrank, 1790) Dujardin, 1845

Synonyms. - Ascaris dispar Schrank, 1790 **Fusaria dispar** Zeder, 1800; **Ganguleterakis dispar** (Schrank, 1790) Skrjabin and Shikobalova, 1949.

Male. - 8.97 to 15.25 long. Esophagus approximately 1.24 long. Twelve pairs of caudal papillae: 2 pairs in vicinity of preanal sucker, 2 pairs lyiny in region of anal opening, one pair just anterior to and one pair just posterior to genital opening, 4 Pairs of raylike adanals and 4 pairs near terminal portion of tail. Preanal sucker 0.138 to 0.276 in diameter, pedunculated, and about 0.966 from tip of tail. Spicules equal and similar, about 0.55 to 0.72 long and 0.048 wide (fig. 1:2).

Femela.- 14 to 16 long and 0.47 to 0.49 wide. Vulva slightly posterior to middle of body, 6 to 8 from tail end of body and surrounded by a cuticular thickening. Eggs 0.071 to 0.075 long by 0.049 to 0.055 wide.

Life history. - Not known. Probably similar to **H. gallinarum.**
Pathology.- Not known. Probably similar to **H. gallinarum.**
Treatment.- Not known. Probably similar to **H. gallinarum.**

Babic (1936) reported **H. dispar** from **Alectoris graeca** in Jogoslavia and Ergün and Merdivencioğlu (1953) listed it from **Perdix perdix** and/or **A. graeca** in Turkey. We believe that these reports and the present one constitute the only records of this parasite from partridge; however, it has been reported many times from ducks and geese (Petrov, 1926).

Measurements of the specimens which we consider to be **H. dispar** are tabulated in Table 2 together with similar measurements of **H. tenuicauda** as reported by Cram (1927) and those of **H. dispar** as reported by Petrov (1926). We believe that these data support our identification of the specimens from the chukar partridge as **H. dispar** rather than **H. tenuicauda,** which was reported by Cram (1927) from **Perdix graeca** and **Caccabis petrosa.** This conclusion is based mainly on the similarity of the spicule length and the position of the caudal papillae of the male in our specimens and Petrov's.

TABLE : 2

Comparative measurements of **Heterakis dispar** from geese, **H. tenuicauda** prof partridges, and **Heterakis** from **Alectoris graeca.**

	H. tenuicauda[1]	**H. dispar**[2]	**Authors' specimens**
Male			
Body length	22	10 - 15	8.97 - 15.25
Tail length	1/61 and 1/42	0.113	0.1 - 0.12
Preanl sucker in diameter	0.29	0.2028 - 0.2067	0.138 - 0.276
Width of chitinous rim	0.05	0.035*	0.03 - 0.0345
Caudal papillae total number	12 pairs	13 pairs	12 pairs
Location of first two pairs	anterior to sucker	near sucker, only first pair slightly ant. to sucker	Same as **H. dispar**
Spicule length	0.89 - 0.98	0.3574 - 0.4085	0.55 - 0.72
Spicule width	Very wide	0.04	0.0483
Female			
Body length	14	15 - 17	14 - 16
Tail length	1/13 - 1/11	—	1.58
Vulva from ant. end	10.1	6.808 from tail end	6 - 8 from tail end
Eggs	0.06-0.063 by 0.04 - 0.042	0.062 - 0.07 by 0.041 - 0.046	0.071 - 0.075 by 0.049 - 0.055
Hosts	**Perdix graeca, Caccabis petrosa**	**Anser anser, A. albifrons, A. segetum, A. cinereus**	**Alectoris graeca**

1 — Description taken from Cram (1927), after Linstow and Seurat.

2 — Description taken from Petrov (1926)

* Based on the illustration of Petrov (1926).

Heterakis gallinarum (Schrank, 1788) Madsen, 1949

Synonyms. - **Ascaris gallinae** (Gmelin, 1790): **Heterakis gallinae** (Gmelin, 1790): **Heterakis vesicularis** (Froelich, 1791); **Heterakis papillosa** Railliet, 1885, not **Ascaris papillosa** Bloch, 1782; **Ascaris gallinarum** Schrank, 1788.

Male. - 9.45 long. Preanal sucker circular, with strong sclerotized wall having a papilliform interruption on posterior rim. Twelve pairs of caudal papillae. Spicules dissimilar and unequal, longer 2.22 long, shorter 0.49 long.

Life history. - The eggs pass out in the feces of the domestic fowl in an unsegmented state. In approximately two weeks or less, under favorable conditions of temperature and moisture, these eggs attain the infective stage. When such eggs are swallowed by a susceptible host, the embryos hatch and develop into adult worms in the ceca. Roberts (1937) stated that the eggs hatch in the upper part of the intestine and at the end of 24 hours the majority of the young worms reach the ceca. Dorman (1928) reported that the young larvae migrate directly to the ceca and all or most all of them reach these organs within 17 to 48 hours after ingestion of the embryonated eggs. Aside from a short period in the cecal mucosa, 2 to 5 days, according to Uribe (1922), the entire life cycle of the cecal worm is spent in the lumen of the cecum. At necropsy, the majority of the adult worms are found in the tips or blind ends of the ceca. Earthworms may ingest the eggs of the cecal worm and can be the means of causing an infection in poultry, which are very fond of earthworms.

Pathology. - Riley and James (1922) observed that the ceca of experimentally infested birds showed marked inflammation and thickening of the walls. These lesions, however ,are only occasionally associated with infestations of this parasite and may be entirely absent.

More important than this is the fact that the cecal worm plays an important role as a carrier of the blackhead organism, **Histomonas meleagridis.** Graybill and Smith (1920) demonstrated by experimental methods that blackhead may be produced in susceptible birds by feeding embryonated eggs of **H. gallinarum** taken from blackhead-infected birds. These authors were of the opinion that the cecal worms lowered the resistance of the host to such a degree that the protozoan parasites already present were able to multiply to disease-producing proportions. Tyzzer (1926) presented evidence which indicated that the protozoan might be incorporated in the worm egg.

Treatment. - McCulloch and Nicholson (1940) reported that phe-

nothiazine, when given either in repeated or single doses, was very effective for the removal of the cecal worm from chicken. Dosages ranging between 0.05 and 0.5 gram were found to be the most satisfactory for individually infected birds.

Wehr (In Beister, H. E., and Schwartze, L. H., 1959) reported that the feeding of a medicated mash containing 15 grams (1 teaspoonful) of a 40 percent solution of nicotine sulfate, 151 grams of phenothiazine, 278 grams of bentonite, and 44 pounds of dry mash, maintained a low level of parasitism in chickens on worm - infested soil. Bentonite is an inert claylike material which serves as a carrier for the nicotine. Nicotine when used alone in doses sufficiently large to remove the worms is toxic to birds. For treatment of infested range birds, this medicated mash is fed for 3 days in succession and at intervals of 3 weeks during the warmer months. Harwood and Stunz (1945) found that a phenothiazine and nicotine-bentonite mixture gave good results in removing **H. gallinarum.**

Madsen (1949) pointed out that the name **H. gallinae** (Gmelin, 1790), the name mostly commonly used today, is not valid. On the basis of priority, he stated that the correct name for this nematoda should be **H. gallinarum** (Schrank, 1788), and not **H. gallinae** (Gmelin, 1790).

Gvozdev (1956) reported this parasite from **A. graeca** in the southeastern Kazakhstan region of the U. S. S. R., but gave no detailed description of it. The present report apparently is the first record of this parasite from **A. graeca** in Turkey.

Subulura suctoria (Molin, 1860) Raillier tand Henry, 1912.

Synonyms. - Ascaris forcipata Rudolphi, 1819 p.p.; **A. subulata** Diesing, 1851 p.p.; **Heterakis suctoria** Molin, 1860; **Subulura strongylina** Travassos, 1913 p.p.; **Allodapa suctoria** (Molin, 1860) Seurat, 1914.

Male.- 12.3 to 12.6 long by 0.47 to 0.49 wide. Lateral cephalic alae small and reaching to middle part of the esophagus. Buccal cavity, cylindrical, with thick chitinous walls (fig. 1:8). Caudal end terminating in a short appendix. Preanal sucker, without chitinous wall, is somewhat ellipsoidal. Caudal papillae 11 pairs: 3 pairs preanal; 2 pairs adanal; 6 pairs postanal. Spicules equal, slightly curved, 1.3 to 1.5 long. Gubernaculum 0.108 to 0.179 long (fig. 1:9).

Female. - 19.5 to 20.8 long by 0.55 to 0.61 wide. Vulva near middle of body length, about 7.7. from anterior end. Eggs 0.065 to 0.091 long by 0.053 to 0.065 wide, thin-shelled, and embryonated at time of deposition.

Life history. - Abdou and Selim (1957) made some observations on the life history of **S. suctoria** in the chicken in Egypt. These authors in connection with studies on the life cycle of tapeworms of chickens noticed in the body cavity of a number of beetles, **Ocnera hispida** and **Blasps polycresta**, several larval nematodes encysted on the intestinal wall. A number of these encysted larvae were collected and fed to chickens. Two months later eggs were recovered from the droppings of these chickens, and many adult **S. suctoria** worms were recovered from the ceca of these birds at autopsy.

The life cycle of **S. brumpti**, a closely related species, is, however more completely worked out. Alicata (1939) reported that **Subulura brumpti** of the chicken required an intermediate host to complete its life cycle and found 4 species of beetles **(Dermestes vulpinus, Gonocephalus (sic; should be Gonocephalum) seriatum, Ammophorus insularis, Alphitobius diaperinus)** and 1 species of earwigs **(Euborellia annulipes)** collected on poultry farms to be naturally infected with encysted larvae of **S. brumpti.** Five years later, Cuckler and Alicata (1944) successfully completed the life history of **S. brumpti** by using beetles **(Alphitobius diaperinus** (larval stage) and **Tribolium castaneum)** and grasshoppers **(Conocephalus saltator and Oxya chinensis)** as intermediate hosts. They reported that the eggs of **Subulura brumpti** passed from the chicken in the cecal droppings in a completely embryonated state. When these eggs were ingested by one of the susceptible intermediate hosts the larvae hatched in four to five hours, penetrated the intestinal wall, molted for the first time, and then became encapsulated on the intestinal wall by the 7th or 8th day after infection. The second molt occurred within the capsule between the 13th and 15th days after infection. The larva was then in the third or infective stage.

The chicken becomes naturally infected with **S. brumpti** by swallowing incects which harbor the infective larvae of this nematode. When chickens were experimentally fed infective larvae which had been removed from the body cavity of intermediate hosts, the larvae immediately migrated to the ceca where they molted twice more and reached sexual maturity in from 5 to 6 weeks.

Pathology. - Unknown.

However, in chickens, Cuckler and Alicata (1944) failed to find any evidence to show that the larvae or the adults of **S. brumpti** caused any appreciable tissue damage. They concluded that the parasite did little damage to the host, except probably in very heavy infestations.

Treatment. - Cuckler and Alicata (1944) found that phenothiazine

administered to chickens in doses of 0.5 to 1.0 gram was effective in removing **S. brumpti.**

Remarks. - At least four **Subulura** species, e. g., **S. brumpti** by Gvozdev, 1956; **S. differens** by Sonsino, 1890, Ergün and Merdivencioğlu, 1953, and Kurtpinar, 1957; **S. curvata** by de Barros Barreto, 1919, Gushanskaia, 1952, Vuylsteke, 1954, and Gvozdev, 1956; and **S. suctoria** by Gagarin, 1954, and Gvozdev, 1956, have been reported to infest **A. graeca.** However, **S. suctoria** has not been reported to occur in this host in Turkey.

Tetrameres lhuillieri (Seurat, 1918)

Synonyms. - **Tropidocerca lhuillieri** Seurat, 1918.

Male. - 4.55 to 4.9 long by 0.14 wide, cuticle provided with transverse striations and 4 rows of longitudinal spines. Buccal cavity 0.029 to 0.032 long by 0.009 wide. Esophagus 1.425 long; muscular portion 0.356 long and glandular portion 1.069 long. Anal opening 0.257 to 0.298 from posterior end.

Spicules unequal and dissimilar, long spicule 0.424 to 0.462 long; short spicule 0.179 to 0.195 long (fig. II:14).

Female.- 2.5 to 2.6 long by 3.5 wide. Body swelled with eggs, with head and tail projecting as conical points (fig. II:15). Buccal cavity 0.024 long by 0.016 wide. Esophagus 1.125 long; muscular portion 0.178 long and glandular portion 1.036 long. Body delineated by 4 longitudinal furrows which correspond to the 2 median and 2 lateral lines, and filled with eggs contained in numerous coils visible through body wall. Eggs 0.052 long by 0.032 wide, containing well developed embryos when deposited.

Life history. - The life history of **T. lhuillieri** is unknown.

Cram (1927) reported, however, the «water flea,»**Daphnia pulex,** and «sand flea,» **Gammarus pulex,** to be suitable intermediate hosts for **T. fissispina.** This same author (1931) demonstrated experimentally that grasshoppers, **Melanoplus femurrubrum** and **M. differentialis,** served as intermediate hosts for**Tetrameres americana** of the chicken. After swallowing the embryonated eggs, the embryos of **T. americana** hatch and develop to the infective stage in the body cavity of the intermediate host. When the intermediate host is ingested by susceptible birds, the worms become mature, male, and the female worms enter the canals of the glands of Lieberkuhn of the host. The males remain in the lumen of the proventriculus. It is, therefore, assumed that **T. lhuillieri** may follow a similar mode of development.

Pathology. - Unknown.

However, in chickens in Guam, Barber (1916) reported that the walls of the proventriculus were thickened to the extent that the lumen was almost obliterated and a severe catarrhal condition was also present due to heavy **T. americana infestations.** Raggi and Baker (1957) reported the enlargement of the proventriculus and the stroma of it was infiltrated with leucocytes in pigeons infested with **T. americana.**

Treatment. - Unknown.

Remarks. - The present finding constitutes the first report of this species from **Alectoris graeca** in Turkey. Seurat (1918) described **Tropidocerca lhuillieri** as a new species and reported it as an endoparasite of **Caccabis petrosa.** This parasite has been reported from **Alectoris barbara** in the U.S.S.R. by Kasimov (1956). Other closely related species reported from **A. graeca are T. timopheevoi** by Gushanskaia, 1952, and Gagarin, 1954; and **T. fissispina** by Kurtpinar, Ergün and Merdivencioğlu, 1954, which are found in the U. S. S. R. and Turkey, respectively. The morphological differences between **T. timopheevoi, T. fississpina, T. lhuillieri** and the authors' specimens are recorded in Table 3. These data show that the measurements of the different characters of our specimens agree most closely with those of **T. lhuillieri.**

Cheilospirura gruveli (Gendre, 1913) Cram, 1927

Synonyms. - **Dispharagus** sp. Gendre, 1912: **Dispharagus gruveli** Gendre, 1913; **Acuaria gruveli** (Gendre, 1913) Gendre, 1913; **Acuaria (Cheilospirura) gruveli** (Gendre, 1913) Lopez-Neyra, 1923.

Male.- 13.83 to 15.87 long and 0.179 wide. Buccal cavity 0.203 long. Anterior portion of esophagus 0.88 long, posterior portion 0.34 long. Caudal alae with two concentric zones extending lengthwise, inner one showing fine transverse striations and outer scalloped and granular. Caudal papillae consisting of four preanal pairs and six postanal pairs. Spicules unequal and dissimilar, longer one ranging from 0.521 to 0.754 long, with an average of 0.635, shorter one ranging from 0.145 to 0.232, with an average of 0.179 (fig. I:3). Cordons reach only to point near posterior portion of esophagus (fig. I:4).

Female.- 39.33 to 45 long, and about 0.3 wide. Cordons 1.102 long, terminating near posterior end of esophagus. Esophagus 1.199 long; muscular portion 0.243 long and glandular portion 0.956 long. Vulva near middle part of body, about 16 from anterior end (fig. I:5). Eggs 0.033 to 0.042 by 0.017 to 0.026.

TABLE : 3

Comparative measurements of Tetrameres timopheevoi, T. fissispina, T. lhuillieri and Tetrameres from Alectoris graeca.

	T. timopheevoi [1]		T. fissispina [2]		T. lhuillieri [3]		Authors' specimens	
	Female	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**
Body length	3.4	3.3-6.4	1.67	3.48	3.925	4.950	3.5	4.554-4.968
Maximum diameter	2.0-2.5	0.13-0.21	1.08	0.09	2.710	0.150	2.6	0.170
Tail length		1.9-3.1	0.11	0.175	0.272	0.260		0.257-0.298
Buccal cavity:								
Length			0.017	0.021	0.021	0.028	0.025	0.029
Width							0.016	0.009
Esophagus:								
Total length					1.640	1.622	1.215	1.425
Muscular			0.275	0.42	0.300	0.470	0.178	0.356
Glandular			1.025	0.876	1.340	1.152	1.036	1.069
Eggs			0.05 by 0.025		0.051 by 0.029		0.052 by 0.032	
Spicules:								
Long		.35-.42		0.31		0.400		0.424
Short		.13-.17		0.14		0.158		0.195

1 as reported by Gagarin (1954).

2 and 3 As reported by Seurat (1918) under genus **Tropidocerca**, now designated as **Tetrameres.**

Life history. - Unknown.

İnvestigations have shown, however, that grasshoppers (Cram, 1931), beetles, weevils, and sandhoppers (Alicata, 1937, 1938) serve as intermediate hosts of a closely related species, **Cheilospirura hamulosa**, of chickens. Grasshoppers were also incriminated by Cram as intermediate hosts of **Cheilospirura spinosa** of the bobwhite quail and the ruffed grouse under experimental conditions.

According to Cram (1931) the larvae which hatched from the eggs of **C. spinosa** migrated from the digestive tract of the intermediate host into the body tissues, chiefly into the muscles of the legs and of the inner surface of the body wall. At the end of 22 to 25 days they had reached the infective stage and had become loosely encysted. Infective larave of **C. hamulosa** and **C. spinosa** were administered to chickens, ruffed grouse, and bobwhite quail. Those of **C. hamulosa** were also given to pigeons and turkeys. Adult worms of **C. hamulosa** were obtained only in the chicken, whereas adults of **C. spinosa** were obtained only from the bobwhite quail and the ruffed grouse. Two or three weeks were required for the worms to reach sexual maturity under the corneous lining of the gizzard.

Pathology.- Unknown.

However, **C. hamulosa** and C. **spinosa** cause no noticeable effect on the health of the birds when present in small numbers, according to Cram, 1931. In such infestations the lining of the gizzard may show small local lesions which may also involve the muscular tissue. In heavy infestations, the wall of the gizzard may be seriously damaged. Le Roux (1926) reported that **C. hamulosa** weakened the wall to such an extent as to cause it to rupture, with the ultimate formation of a sac or pouch.

Treatment. - Unknown.

Remarks. - Gagarin (1954) found this worm in the under-lining of the muscular stomach of **A. graeca** in the Kirgiz area of the U. S. S. R. Gvozdev (1956) reported it from **A. graeca** in the southeastern Kazakhstan area of the U. S. S. R. This author also pointed out that the occurrence of such worms is common in closely related hosts such as the partridges, **Coturnix coturnix** and **Perdix daurica.** Other reports include the finding of this worm in **A. graeca caucasica** from the Georgian area of the U.S.S.R. by Kurashvili in 1957. So far, the present writers are not aware of any report of this worm from **A. graeca** in Turkey.

C. gruveli normally occurs in the gizzard, although a few specimens have been reported as being taken from the upper portion of the intestinal tract.

Seurocyrnea eurycerca (Seurat, 1914) Strand, 1929

Synonyms.- Cyrnea eurycerca Seurat, 1914.

Male.- 10.4 to 12.38 long by 0.276 wide. Buccal cavity 0.04 long. Muscular portion of esophagus 0.222 long, glandular portion 2.02 long; total length of esophagus 2.242. Caudal alae transversely striated, 0.374 long. Nine pairs of caudal papillae: 3 pairs preanal, 1 pair adanal or near anal opening, 5 pairs postanal. Anal opening 0.154 from posterior end. Spicules unequal and dissimilar; left spicule 1.239 long, with a pear-shaped posterior end; right spicule 0.453 long. Gubernaculum designated as gorgeret by Cram in 1927) 0.04 long (fig. I:10).

Female. - 21.39 long by 0.469 wide. Buccal cavity 0.032 long (fig.: I:11). Muscular portion of esophagus 0.379 long; glandular portion 2.415 long; total length of esophagus 2.794. Vulva not salient, 1.4 from the tail end (fig. II:12).

Life history.- Unknown.
Pathology.- Unknown.
Treatment.- Unknown.

Remarks.- This parasite has been reported from **Coturnix coturnix** by Gvozdev (1956), Gushanskaia (1952), and Kurashvili (1954); from **Phasianus colchicus** or its varieties by Gushanskaia (1952), Kasimov (1956), Gvozdev (1955), and Dubinina and Serkova (1951); from **Alectoris barbara, A. graeca,** and **A. rufa** by Kasimov (1956). These reports are all from birds of the U.S.S.R. We were unable to find any record of this parasite having been found in **A. graeca** in Turkey.

Capillaria annulata (Molin, 1858) Cram, 1926

Synonyms.- Trichosoma annulatum Molin, 1858; **T. strumosum** Reibisch, 1893; **T. delicatissimum** Perronicito and Tomiolo, 1899; **Capillaria strumosa** (Reibisch, 1893) Travassos, 1915; **Thominx strumosa** (Reibisch, 1893) Travassos, 1915; **T. annulata** (Molin, 1858) Cram, 1925; **Eucoleus strumosa** (Reibisch, 1893) Wassilkowa and Gouchanskaja, 1930.

Male.- 23.88 long and 0.097 wide. A bulbous cuticular swelling appears just behind head (fig. I:6). Esophagus 4.38 long, muscular portion 0.45 and posterior portion 3.93. Cuticle of body appears in wavy

transverse folds except at anterior and posterior portions. Caudal end formed py a pair of rounded flaps whish are fused dorsally (fig. I:7). Spicule not grossly observed. From an examination of histologically prepared stained sections of several male specimens of this species from the chicken, however, the present writers were able to see a weakly sclerotized spicule which was enclosed within the spiny sheath.

Life history.- According to Wehr (1936), the complete development of this parasite is dependent upon the intervention of an intermediate host. This author demonstrated that two species of earthworms, **Helodrilus foetidus and H. calligninosus,** were suitable intermediate hosts for this parasite. He also showed that chickens became infected after ingesting either of these two species of earthworms that harbored infective larvae of **C. annulata** acquired under natural conditions.

Pathology.- Allen and Gross (1926) reported that ruffed grouse infested with **C. annulata** showed severe anemia before death. Cram (1926) pointed out that in heavy infestations, the inner surface of the crop is greatly thickened and nonelastic. Hung (1926) made a histopathological study of three cases of **C. annulata** infestation of varying intensity and reported that (1) in the first stage hyperemia and lymphocytic infiltrations are present; (2) in the second stage, the lymphatic apparatus is enlarged and gives the appearance of nodules; and (3) in the third stage, a pseudomembrane, containing fibrin, covers the mucosa.

Treatment.- Unknown. However, Emmel (1939) reported that feeding of regular mash containing 5 percent of flowers of sulphur seemed effective against **Capillaria contorta** in the turkey. At the end of 3 weeks of treatment, recovery occurred in all affected birds which were able to eat when treatment was started.

Remarks;- Ciurea (1914) pointed out that the length of the spicule could not be determined due to the indefinite outline of the spicule, but the diameter was measured as 0.004. Wassilkowa and Gouchanskaja (1930) and Cram (1936) believed that the spicule was lacking.

A single adult male of **C. annulata** was recovered from the crop of **A. graeca.** This finding constitutes the first record of this worm from this host.

Ascaridia galli (Schrank, 1788).

Synonyms.- Ascaris galli Schrank, 1788; **Ascaris gallopavonis** Gmelin, 1790; **Ascaris perspicillum** Rudolphi, 1803; **Ascaris gibbosa** Rudolphi, 1809; **Fusaria inflexa** (Zeder, 1800) Dujardin, 1845; **Heterakis inf-**

lexa (Zeder, 1800) Schneider, 1866; **H. perspicillum** (Rudolphi, 1803) Railliet, 1893; **Ascaridia perspicillum** (Rudolphi, 1803) Dujardin, 1845.

Male.- Only one specimen, a male of **A. galli**, was recovered from **Alectoris graeca.** Ten pairs of caudal papillae are present (fig. II:13). Preanal sucker, with chitinous wall, is circular in shape, with a papilliform interruption on the proximal rim. Spicules equal, 2.8 long, with buttonlike enlargement at proximal end.

Life history.- **A. galli** has a direct life cycle. Itagaki (1927) stated that, following the ingestion of the infective eggs, the embryos may be released in the proventriculus or duodenum. Ackert (1931) found that the larvae live freely in duodenum for the first 9 days and then penetrate the mucosa. They remain in the mucosa about 8 or 9 days and then return to the lumen where development is completed. From the time of ingestion of embryonated eggs until the worms reach maturity is usually about 50 days under experimental conditions.

Pathology.- Ackert (1940) indicated that chickens harboring large numbers of this ascarid suffer from reduced sugar content, retarded growth, loss of blood, increased urates, and shrunken thymus glands, and they have a high mortality rate. Diarrhea, droopiness, and emaciation are the usual symptoms manifested by heavily parasitized birds.

Treatment. - Reidel (1951) investigated the anthelmintic value of Caricide in chickens infected with **A. galli.** At the end of the first and second weeks of treatment, 89.2 percent of the worms were eliminated. Bradley (1955) reported a very high recovery of **A. galli** from chickens treated with piperazine citrate. Shumard and Eveleth (1955) reported that piperazine citrate when administered at the rate of 8, 10, and 16 grams per 1 gallon of drinking water for 1 to 4 days removed all **A. galli.** Vianello and Vicenzoni (1955) gave piperazine citrate to fowls in doses of 300-400 mg. per kilogram body weight and found that both mature and immature **Ascaridia** were eliminated. Horton-Smith and Long (1956) tested three piperazine compounds (piperazine bisulphate, piperazine adipate, and piperazine citrate) against **A. galli,** in chickens and found that all adult worms were completely removed. None of the piperazine compounds is particularly dangerous to the administrator or its recipients. Skin contact over a long period of time may produce a mild irritation, but washing of the exposed areas with copious amounts of water will alleviate the condition. Most of the piperazine derivatives have a very low toxicity to the host. They exert a narcotic effect on **A. galli.** Thus the worms are removed by means of natural peristalsis and are expelled alive.

Remarks.- **Ascaridia galli** is one of the commonest intestinal roundworms of chickens, and is world-wide in distribution. It has been reported as a parasite of many gallinaceous birds and others not so closely related to the common domestic fowl. It is the authors' opinion that some of these reports probably are not valid and might well be questioned until a more critical morphological study of the worms is made. These studies might well be supplemented with life history studies.

Tolgay (1957) reported **A. galli** from the chicken in Turkey. The partridge, **Caccabis saxtilis chukar**, in Minnesota (Boughton, 1937) and the chukar partridge in Alabama (Christenson, 1940) have been listed as hosts of this parasite in the United States of America. The present report apparently constitutes the first record of **A. galli** from the partridge, **Alectoris graeca**, in Turkey. Many records of this parasite from gallinaceous birds in Czechoslovakia (Vojtechovska-Mayerova, 1953), in Denmark (Madsen, 1952), and from the U.S.S.R. (Kasimov, 1956) are reported.

Experimental evidence is available to show that chickens three months old or older manifest considerable resistance to infection with **Ascaridia galli.** It has been shown by Ackert and Beach (1933) and Alicata (1938) that diets consisting chiefly of animal proteins and with little or no plant protein were important in aiding the chickens to build up resistance to infection with ascarids, and that diets consisting chiefly or wholly of vegetable proteins lowered the resistance to ascarid invasion.

Heavier breeds of chickens are considered more resistant to ascarid infestations than the light breeds.

ACANTHOCEPHALA

Mediorhynchus sp.

Male.- 12 to 32 long by 1.8 to 2 wide. Pseudosegmentation slight.

Female.- 60 to 102 long by 2 to 3.4 wide. Body slender, pseudosegmentation prominent. Proboscis conical, 0.448 long and 0.483 wide at base. Hooks on anterior portion of proboscis 0.049 long (including root), and arranged in two spiral rows. Spines on posterior portion of proboscis 0.037 long. Proboscis receptacle a muscular sac 0.828 long by 0.23 wide, with retractor muscles passing through wall near median region. Lemnisci 1.1 long. Eggs thick shelled, 0.074 to 0.09 long by 0.045 to 0.05 wide. Embryo bearing hooks at one end. See figures II:16 a, b, c, and d.

Life history. - Unknown.
Pathology.- Unknown.
Treatment.- Unknown.

Remarks.- The present report appears to constitute the first record of **Mediorhynchus** in the chukar partridge in Turkey. However, **Mediorhynchus micracanthus** (Rudolphi, 1819) has been reported from **Coturnix coturnix** in the U.S.S.R. by Gvozdev (1956).

TREMATODES

Corrigia corrigia (Braun, 1901)

Synonyms. - **Lyperosomum corrigia** Braun, 1901; **Orthorchis corrigia** (Braun, 1901) Travassos, 1944.

Description. - Length 14 to 16, width approximately 1.07 at widest point. Anterior one-third of body slightly narrower than posterior two-thirds. Oral sucker 0.23 in diameter. Acetabulum about 1.54 from anterior end of body, 0.45 in diameter. Pharynx immediately behind oral sucker. Genital pore immediately behind intestinal diverticulum. Testes round, approximately 3.7 and 4.77 from anterior end. Ovary slightly smaller in diameter than testis, about 5.7 from anterior end of body. Vitellaria consisting of numerous follicles and extending from near ovary and terminating near posterior end of middle third of body, asymmetrical. Uterus extending almost full length of body. (fig. II:17). Eggs 0.043 by 0.025.

Life history. - Unknown.
Pathology.- Unknown.
Treatment.- Unknow.

Remarks.- **Corrigia corrigia** has also been reported from the pancreas and/or intestine of **Alectoris graeca** in the U.S.S.R. by Strom (1940), Gushanskaia (1952), Gagarin (1954), Gvozdev (1956), and Kasimov (1956).

Strom (1940) proposed that the genus **Lyperosomum** be divided into three subgenera, namely, (1) **Lyperosomum** ss., (2) **Brachylecithum**, and (3) **Corrigia**, with the species **Lyperosomum corrigia** Braun, 1901 as the type species of the subgenus **Corrigia.** Skrjabin (1952) raised each of Strom's subgenera to generic rank, thus creating the new combination **Corrigia (Corrigia) corrigia.** Dawes (1956) mentioned the fact that Strom proposed the subdivision of the genus **Lyperosomum** into three subgenera, but made no attempt to assign species of each of

the subgenera, apparently believing that the characters which had been used to separate the species were too trivial to justify it.

The present record is believed to be the first report of this species of trematode from **A. graeca in** Turkey.

Three other species of dicrocoelid trematodes have been reported from the chukar partridge in the U.S.S.R. They are **Corrigia plesiostomum** (Linstow, 1883) Strom, 1940, **Lyperosomum schikobalova** Kasimov, 1952 (from **Alectoris graeca caucasia**), and **Brachylecithum papabejani** (Skrjabin and Udintsev, 1930) Strom, 1940.

CESTODES

Raillietina sp.

All of the cestode fragments were identified to the genus **Raillietina**, but the condition of them prevented specific determination.

At least six species of **Raillietina** have been reported from the intestine of **A. graeca.** They are: **Raillitina (Paroniella) urogalli**, by Gushanskaia (1952); **R. (Raillietina) penetrans,** by Gushanskaia (1952); **R. (R.) korkei,** by Gvozdev (1956): **R. (R.) graeca,** by Gvozdev (1956); **R. (R.) echinobothrida** by Kurtpinar, Ergün and Merdivencioğlu (1954); **R. (Skrjabinia) circumvallata,** by **Gvozdev (1956).**

Life history. - Those species of **Raillietina** of which the life histories are known require intermediate hosts such as beetles, slugs, or ants to complete their development. The insects frequently visit fresh droppings and swallow the mature segments which they find there. The eggs contained within these segments develop inside the body cavity of the intermediate host into infective bladderworms or cysticercoids. A susceptible host acquires infection by ingesting the intermediate hosts which contain these cycticercoids with the drinking water or feed.

Pathology.- R. echinobothrida causes the formation of tubercles on the intestinal wall of infested birds. **R. cesticillus** has been reported to cause degeneration and inflammation of the intestine. Stoddard (1931) observed that **R. tetragona** may be the principal or only cause of death in cases of heavy infestation in quail.

Treatment. - A number of drugs have been recommended for the removal of tapeworms from poultry, but none has proved to be satisfactory for all species. Kerr (1922) presented data to show that di-n-butyl tin dilaurate (butynorate) was an effective and safe drug for the removal of **R. cesticillus** from chickens. When administered as a single dose by capsule, 75-150 mg. per kilogram og body weight gave efficaci-

es ranging from 86 to 100 percent. Edgar (1956) reported this compound to be highly effective in removing six species of tapeworms, **R. cesticillus, R. tetragona, Hymenolepis carioca, Choanotaenia infundibulum, Davainea proglottina** and **Amoebotaenia sphenoides,** from field - infected chickens when administered in the feed as follows: 500 mg. per kilogram of feed for 2 to 6 days, or by capsule at the rate of 125 mg. per bird, or in combination with nicotine and phenothiazine. Birds treated with the combination showed a temporary drop in egg production, which persisted from the third through the tenth day after treatment.

Remarks.- Raillietina echinobothrida is the only species that has been reported from this host in Turkey.

Table 4.

Other helminths reported from **Alectoris graeca**

A. Nematodes

Parasite	Reported by:
Ascaridia sp.	Leiper (In Hammerton, A.E., 1934)
A. alectoris Gagarin, 1954	Gagarin, 1954
A. compar (Schrank, 1790)	Baylis, 1936
A. numidae (Leiper, 1908)	Canavan, 1928
A. petresa Canavan, 1929	Canavan, 1929
Capillaria longicollis (Rudolphi, 1819)	Madsen, 1945
C. contorta (Creplin, 1839)	Gagarin, 1954
Chanderella lienalis Ortloff, 1949	Gushanskaia, 1952
Ganguleterakis altaicus (Spaul, 1929)	Gvozdev, 1956
Oxyspirura schulzi Skrjabin, 1929	Gvozdev, 1956
Syngamus trachea (Montagu, 1811)	Chapham, 1940; Herman, 1945
Trichostrongylus tenuis (Mehlis, 1846)	Ergün and Merdivencioğlu, 1953

B. Cestodes

Davainea crassula (Rudolphi, 1819)	Meggitt, 1921
D. proglottina (Davaine, 1860)	Gvozdev, 1956
Hymenolepis carioca (Magahlaes, 1898)	Gvozdev, 1956
H. linealis (Goeze 1782)	Hughes, 1940
Metroliasthes lucida Ransom, 1900	Kurtpınar, Ergün and Merdivencioğlu, 954
Raillietina circumvullata (Krabbe, 1869)	Gvozdev, 1956
R. echinobothrida (Megnin, 1881)	Kurtpınar, Ergün and Merdivencioğlu, 954
R. graeca Davies and Evans, 1938	Davies and Evans, 1938
R. indica Meggitt and Subramanian, 1927	Meggett and Subramanian, 1927
R. korkei Joyeux and Houdemer, 1927	Gvozdev, 1956
R. penetrans (Baczynska, 1914)	Gushanskaia, 1952
R. urogalli (Modeer, 1790)	Gushanskaia, 1952
Rhabdometra nigropunctata (Crety, 1890)	Gvozdev, 1956
Tetrathyridium variable (Diesing 1850)	Gvozdev, 1956
Botriocephalus pusillus Galli-Valerio, 1935	Rivolta and Delpracto, 1881

C. Trematodes

Brachylaemus fuscatus (Rudolphi, 1819)	Gvozdev, 1956
Cladocoelium sulcatum (Linstow, 1883)	Stossich, 1892
Dicrocoelium petrovi Kassimov, 1952	Gvozdev, 1956
Distomum lineola Diesing 1850	Galli-Vallerio, 1940
Postharmastomum gallinum Witenburg 1923	Gagarin, 1954
Tamerlania zarudnyi Skrjabin, 1924	Gvozdev, 1956

SUMMARY

1. The helminth parasites of 40 chukar partridges, which were shipped to the United States of America from Turkey, were studied and identified.

2. A total of 1,089 nematodes, 30 acanthocephalids, 25 trematodes, and a few fragments of a cestode were collected from the birds.

3. All of the species of helminths included in this study have been described before, but a number of them are reported from the chukar partridge in Turkey for the first time. These are **Heterakis gallinarum, Cheilospirura gruveli, Capillaria annulata, Subulura suctoria, Seurocynea eurycerca, Ascaridia galli, Tetrameres lhuillieri, Mediorhynchus** sp., and **Corrigia corrigia.**

4. A list of all other helminths (13 nematodes, 13 cestodes, and 6 trematodes) which have been reported from the chukar partridge, is included.

TURKISH SUMMARY

ÖZET

1. 1950 - 1952 yıllarında Türkiye'den Birleşik - Amerikaya gönderilmiş olan 40 kekliğe ait helmintler üzerinde çalışmalar yapılmış ve teşhisleri konmuştur.

2. Yukarıda adı geçen kanatlılardan 1089 Nematod, 30 Acanthocephala, 25 Trematod ve bir miktar Cestod parçaları toplanmıştır.

3. Bu çalışmaya dahil olan bütün helmintlerin tavsifleri evvelce yapılmış fakat bunlardan bir kısmının Türkiye'deki kekliklerde mevcudiyeti ilk olarak kaydedilmiştir. Bunlar da, **Heterakis gallinarum, Cheilospirura gruveli, Capillaria annulata, Subulura suctoria, Seurocynea eurycerca, Ascaridia galli, Tetrameres lhuillieri, Mediorhynchus** sp., ve **Corrigia corrigia** nevileridir.

4. Kırmızı kekliklerde şimdiye kadar kaydedilmiş olan helmintlerin bir listesi verilmiştir.

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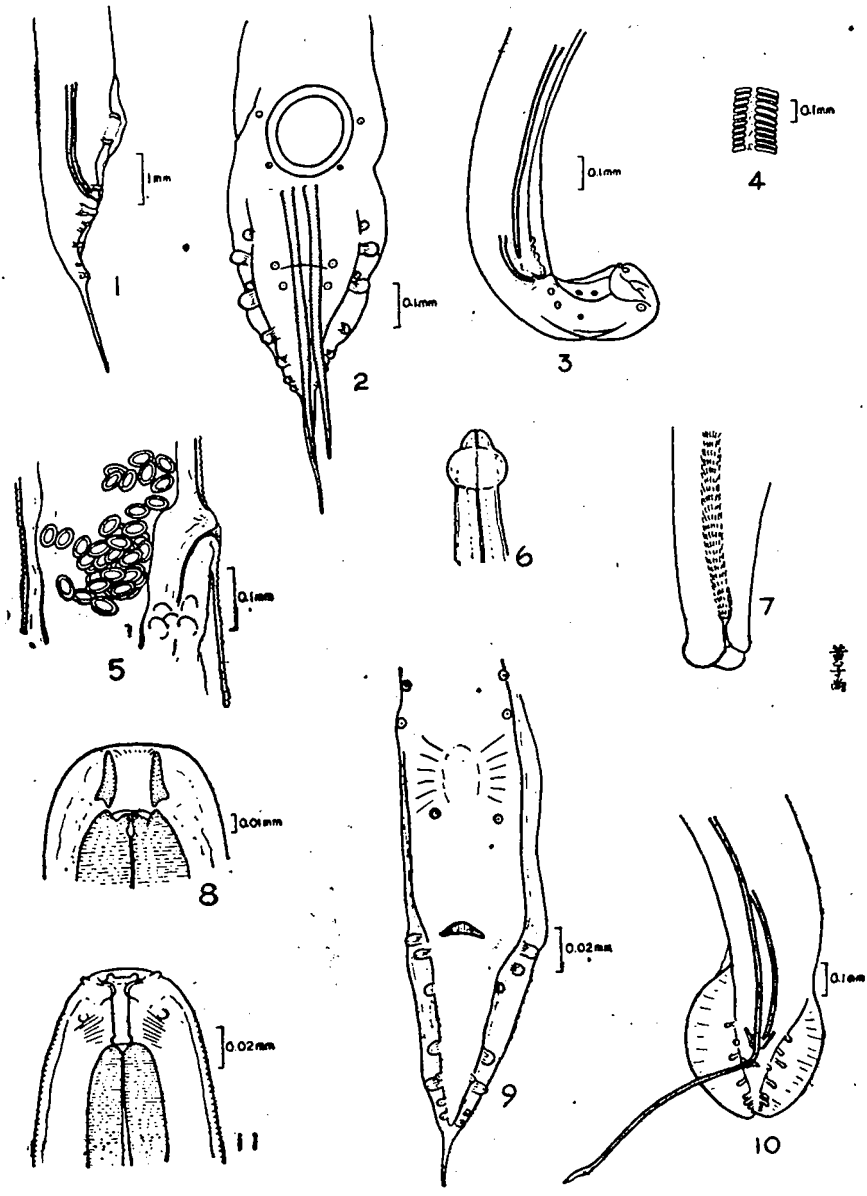
PLATE 1

Description of Figures:

1. **Heterakis dispar.** Lateral view of tail of male.
2. **Heterakis dispar.** Ventral view of tail of male.
3. **Cheilospirura gruveli.** Tail of male.
4. **Cheilospirura gruveli.** Enlarged portion of cordon.
5. **Cheilospirura gruveli.** Vulva
6. **Capillaria annulata.** Anterior end of male showing bulbous cuticular swelling.
7. **Capillaria annulata.** Tail of male.
8. **Subulura suctoria.** Anterior end of male showing buccal cavity
9. **Subulura suctoria.** Tail of male.
10. **Seurocyrnea eurycerca.** Tail of male.
11. **Seurocyrnea eurycerca.** Anterior end of female.

PLATE II

12. **Seurocyrnea eurycerca.** Tail of female.
13. **Ascaridia galli.** Tail of male.
14. **Tetrameres lhuillieri.** Tail of male.
15. **Tetrameres lhuillieri.** Femele.
16. a **Mediorhynchus** sp. Anterior end.
    c. **Mediorhynchus** sp. Spines on posterior portion of proboscis.
    b. **Mediorhynchus** sp. Hooks on anterior portion of proboscis.
    c. **Mediorhynchus** sp. Spines on posterior portion of proboscis.
    d. **Mediorhynchus** sp. Embryonated egg.
17. **Corrigia corrigia.** Showing internal structure.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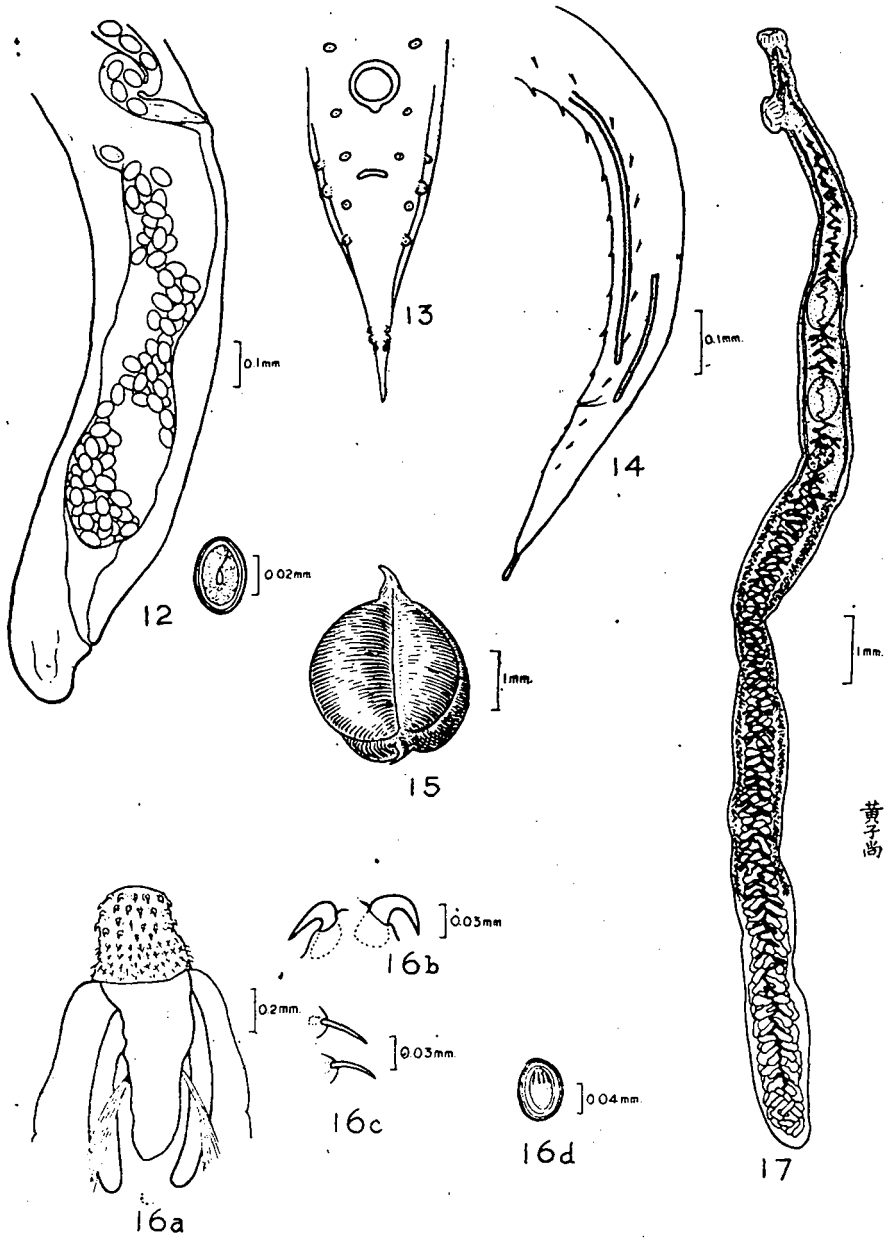
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