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THE PARASITES OF THE SAGE GROUSE

Centrocercus urophasianus

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INTRODUCTION

As far as the writer knows, this work represents the first attempt to catalogue the parasites of the sage grouse. All the known parasites of the sage grouse are listed herein with the essentials of the original descriptions plus supplementary descriptive materials, comments, measurements, and pictures taken from the writer's study of the specimens in hand.

Accurate records of all sage grouse examined were not kept, but the parasites studied were taken from about a hundred birds throughout the State of Wyoming during the last eight years by members of the parasitology staff of the Wyoming Agricultural Experiment Station. Complete systematic autopsies were performed on at least fifty of these birds. Additional material was furnished by George L. Girard (4) who made a number of examinations for parasites during the course of his studies on the life history, habits, and food of the sage grouse in Sublette County, Wyoming, 1934.

Correspondence with parasitologists throughout the range of the sage grouse has extended the distribution records for some parasites, but, with the exception of the ticks reported from Fergus County, Montana, and the one record of *Heterakis gallinae*, has revealed no species which have not been taken from sage grouse in Wyoming.

ENDOPARASITES

PROTOZOA

Eimeria angusta Allen, 1934

Description: From Allen (1).

Oocysts 16.5 to 17.5 μ by 27 to 33 μ ; in lateral view elliptical in one position, but, when turned through an arc of 90°, oocysts in lateral view are more or less oval, tapering toward the operculated end; this tapering varies in different oocysts from very slight to quite distinct. Operculum is a non-refractile outside layer of oocyst wall and not always readily seen.



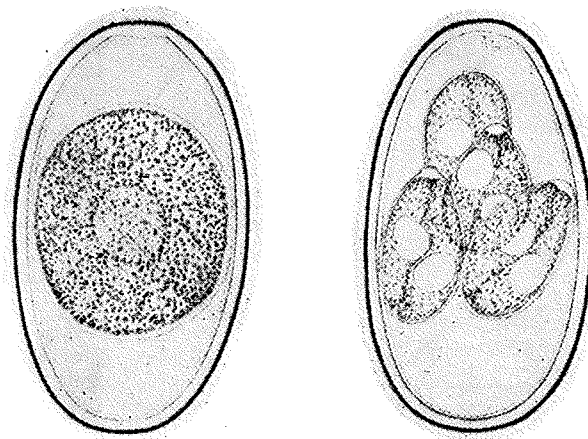


Fig. 1. *Eimeria angusta* (from Allen)

A thin membrane lining the oocyst wall and enclosing the 4 sporonts and a very small residual body.

Hosts: *Bonasa umbellus*, *Canachites canadensis*, *Pedioecetes phasianellus campestris*, *Centrocercus urophasianus*.

Location: Coeca.

Localities: Labrador, Alaska, Minnesota, Wyoming.

Early in September, 1932, the Wyoming Game Commission asked the Research Parasitologist of the University of Wyoming Agricultural Experiment Station to investigate an epizootic among sage grouse in Fremont County. Near the center of the outbreak, on a ranch covering several square miles, it was estimated that about 400 young birds in a total population of 2,000 had died by September 12. The loss was particularly heavy in the alfalfa fields. The investigation disclosed that this high mortality was due to a species of *Eimeria*. The symptoms noted in the field were a diarrhea and a discharge at the nostrils.

Since 1932 this coccidium has been found in the sage grouse in several widely separated localities in Wyoming. In July, 1937, several young sage grouse infested with this coccidium were taken near Battle Mountain, Wyoming, and in August, 1938, several more birds were taken from along the headwaters of the Sweetwater River, and near Cody, Wyoming. These provided the material for measurements and for certain feeding experiments in which pigeons, domestic chicks, and chickens failed to become infested. The oocysts examined by the writer measured 26.7 to 32.1 μ by 15.7 to 19.4 μ ; average 29.24 by 17.52 μ . Sporocysts 13.6 to 16.8 μ by 6.31 to 8.3 μ ; average 15 by 7.3 μ .

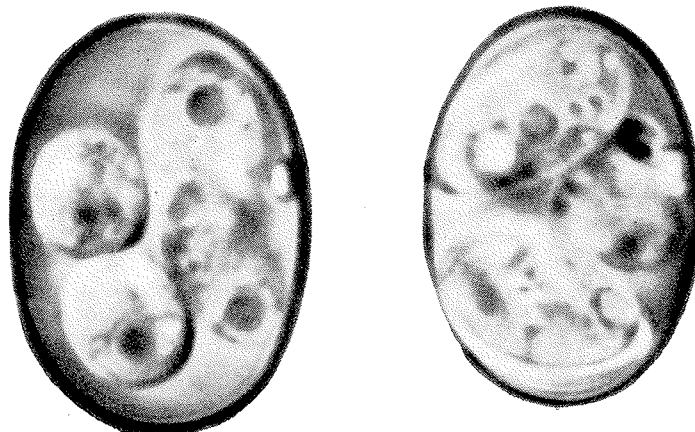


Fig. 2. *Eimeria centroceri*

Eimeria centroceri Simon, 1939

During the epizootic among sage grouse in Fremont County in September, 1932, small numbers of the coccidium here described as *E. centroceri* were observed.

In August, 1938, several young sage grouse were taken along the headwaters of the Sweetwater River, Wyoming. These provided the material for the original description (14) and for certain feeding experiments in which domestic chicks and chickens failed to become infested.

Description: The colorless, ellipsoidal oocysts measure 20.75 to 24.90 μ by 16.60 to 17.84 μ ; average 22.61 by 17.14 μ . Sporocysts 13.28 to 11.20 μ by 8.3 to 6.64 μ ; average 11.76 by 7.63 μ . Operculum present but scarcely discernible. Oocystic residual material present in the form of a very small refractile inclusion. Sporocystic residual bodies and stieda bodies are present.

Location: Coeca and intestine.

Type Host: Sage grouse, *Centrocercus urophasianus*.

Type Locality: Along Sweetwater River, Wyoming.

Discussion: Of coccidia in birds, having elliptical oocysts and an operculum, *E. centroceri* differs from *E. lyruri* and *E. lagopodi* by having residual material, and from *E. angusta* by being smaller and comparatively broader.

Tritrichomonas sp.

Great numbers of a *Tritrichomonas* have been found in the coeca of every sage grouse examined. This form is different from any tritrichomonad yet described from birds.

The active specimens are broadly pear-shaped, measuring about $8 \times 6 \mu$. In Heidenhain preparations after Schaudinn fixation they are more nearly spherical with a maximum diameter from 6.2 to 9.6 μ ; average 8.1 μ . The three anterior flagella are of equal length, and are slightly shorter than the body. The prominent undulating membrane is bordered by the fourth flagellum which projects free posteriorly for a short distance. The costa appears as a rod extending almost to the posterior end of the body. The short, hyaline axostyle is free distally for a short distance. The blepharoplast is at the extreme anterior end. The nucleus is but slightly anterior to the center of the body. A prominent parabasal body (?) lies behind the nucleus.

CESTODA

Leidy (7), 1887, recovered cestodes from sage grouse in Wyoming, and identified them as *Hymenolepis microps*. This was obviously a case of mistaken identification, for these tapes, according to Leidy's description, exhibited alternating genital pores and were without armature. The present writer is of the opinion that *H. microps* does not occur in sage grouse, and that the tapes which Leidy had in hand were of the genus *Rhabdometra*.

Raillietina centrocerci Simon, 1937 (12)

Diagnosis: *Raillietina*: Genital pores irregularly alternate. Eggs singly dispersed in capsules; average diameter of eggs 28.5 μ in capsules. Length of mature worms 135 to 450 mm.; maximum width 1.5 to 3.0 mm. near middle of worm. Number of proglottids 429 to 516. Average length of scolex 413 μ ; width 431 μ . Length of neck 2.64 to 3.85 mm. Rostellum roughly hemispherical, bearing double crown of somewhat unstable hooks which number 198 to 205; average diameter of rostellum outside of crown 110 μ ; length of hooks 15.7 μ . Suckers armed with several rows of unstable hooks of length 15 μ ; average diameter of suckers 120 μ . Cirrus

Description of Fig. 3. *Raillietina centrocerci*, page 81.

- A. Ventral aspect of mature proglottid.
- B. Rostellar hook.
- C. Frontal aspect of scolex.
- D. Gravid proglottid. (Egg capsules shown only where clearly seen in the preparation.)
- E. Lateral aspect of scolex and neck.

Lettering to figures: C. cirrus; CS. cirrus sac; DV. dorsal excretory vessel; EC. egg capsule; N. nerve; O. ovary; SR. seminal receptacle; T. testis; V. vagina; Vas. vas deferens; Vit. vitellarium; VV. ventral excretory vessel.

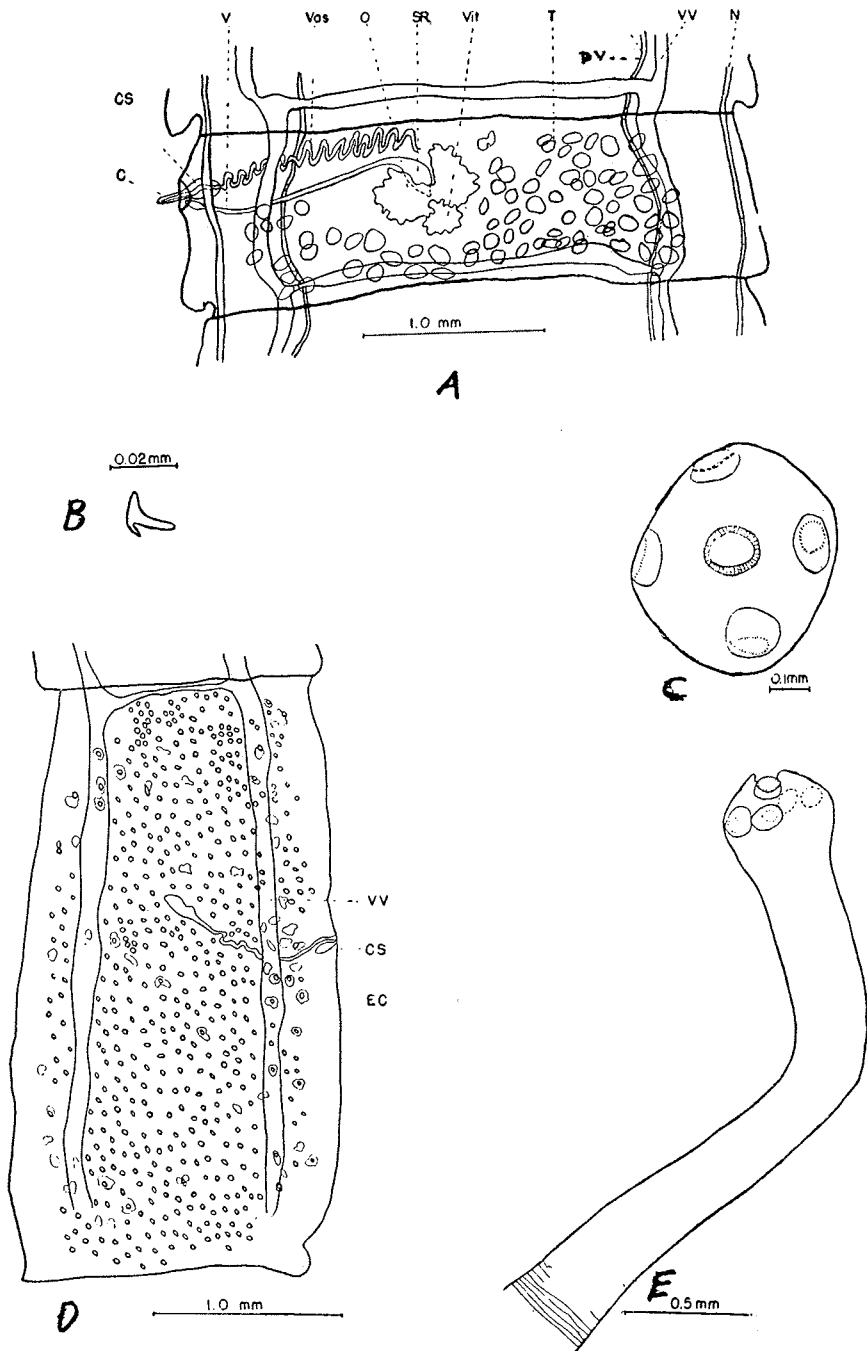


Fig. 3. *Raillietna centroceri*

sac extends slightly less than half way to excretory canal, occasionally half way; length of cirrus sac 149 to 169 μ ; widths 65 to 88 μ . Length of cirrus 64 to 99 μ ; width 14 to 17 μ . Testes number 63 to 118, average 85; diameter 42 to 73 μ . The ovary is a compact, granular rosette slightly to the poral side in the anterior portion of the proglottid. It partly embraces the shell gland in a posterior indentation. The genital anlage appears in the region of proglottids 47 to 50. Eggs appear in the uterus in the region of the proglottids 291 to 299.

This is the most common macroscopic endoparasite of sage grouse in Wyoming, often being found in such numbers as to distend the small intestine. It has also been collected from sage grouse in Montana, Idaho, and Utah.

Since publishing this description the author has examined specimens in which the cirrus sac extends more than half way to the excretory canal.

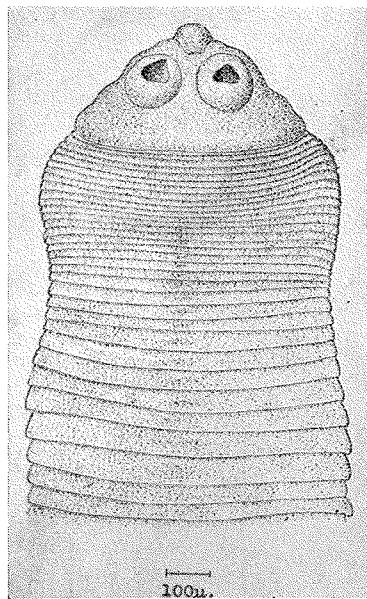


Fig. 4. *Rhabdometra nullicollis* (from Ransom).
Head and anterior portion of strobila.

Rhabdometra nullicollis Ransom, 1909

Description: (Condensed from Ransom) (10)

This species has been found in the sagecock (*Centrocercus urophasianus*) and in the sharp-tailed grouse (*Pedioecetes phasianellus columbianus*). The type-specimens (No. 6018, U. S. Nat. Mus.) were collected from the first-named host in Colorado.

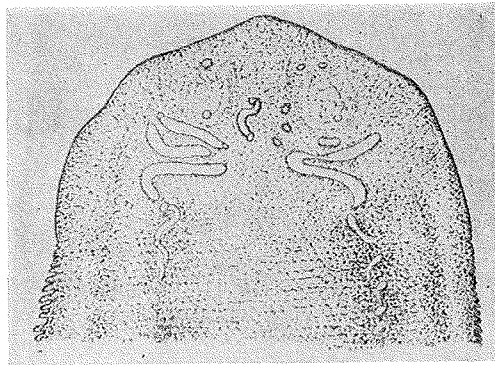


Fig. 5. *Rhabdometra nullicollis* (from Ransom).
Head and anterior portion of strobila, median horizontal section.

External anatomy. The various specimens of this species which have been studied measured 50 to 100 mm. in length by 2 to 2.5 mm. in maximum width. The head (Figs. 4, 5,) is obtusely pointed anteriorly, 560 to 650 μ wide, about 360 μ thick, and 280 to 330 μ long, without rostellum. The suckers are 140 to 160 μ in diameter. A neck is absent, segmentation beginning immediately behind the head. The segments are at first of the same width as the head, or slightly wider, and gradually increase in width, finally decreasing again at the posterior end of the strobila. The first segments are less than 20 μ in length, sexually active segments measure 330 μ in length by 1.25 mm. in width; the largest segments measure 1.25 mm. in length by 2 to 2.5 mm. in width, and the final segments 2.8 mm. in length by 1.3 mm. in width. The posterior border of each segment overlaps the anterior end of the following segment only very slightly, and is but slightly wider than the anterior border, so that the segments are nearly quadrate in shape.

The sexual pores are irregularly alternate, located in the anterior third of the segment.

Internal anatomy. The lateral longitudinal nerves are large and well developed. The longitudinal muscles are arranged in numerous small bundles disposed in two layers close together. Dorsoventral fibers are numerous. Transverse fibers are comparatively few.

The excretory system is well developed. The dorsal and ventral canals (Fig. 7) are located a considerable distance mediad from the lateral nerves.

The vagina and cirrus pouch pass between the dorsal and ventral excretory canals and dorsal of the lateral nerve.

Male reproductive organs: The testicles (Figs. 6, 7, 9t.) are about 60 in number, arranged in two layers in the middle field in the posterior

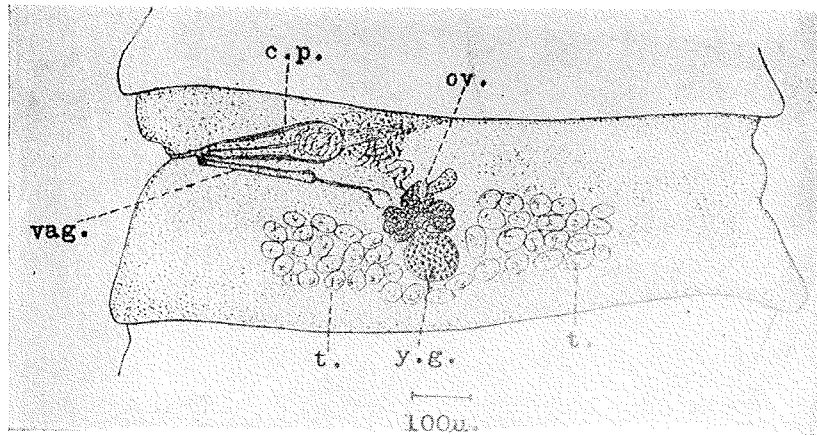


Fig. 6. *Rhabdometra nullicollis* (from Ransom). Sexually mature segment.

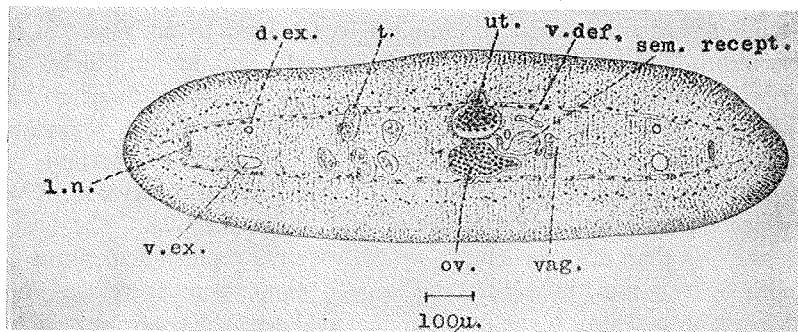


Fig. 7. *Rhabdometra nullicollis* (from Ransom). Sexually mature segment, transverse section.

c. p.: cirrus pouch
 v. def.: vas deferens
 t.: testis
 ov.: ovary
 vag.: vagina
 y.g.: yolk gland
 sem. recept.: seminal receptacle
 ut.: uterus
 d. ex.: dorsal excretory vessel
 v. ex.: ventral excretory vessel
 l. n.: nerve cord

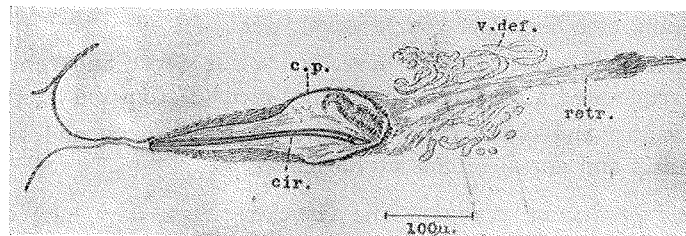


Fig. 8. *Rhabdometra nullicollis* (from Ransom). Section through cirrus pouch.

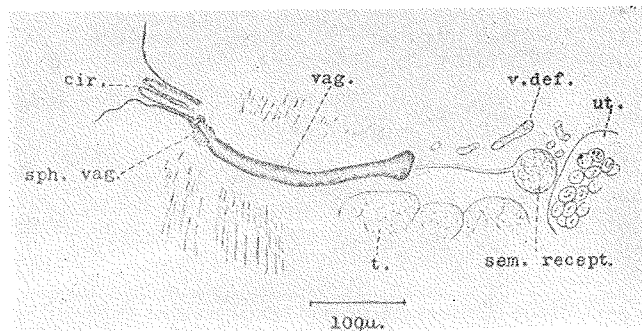


Fig. 9. *Rhabdometra nullicollis* (from Ransom).
Section through vagina, seminal receptacle, and extruded cirrus.

portion of the segment. They measure from 80 to 100 μ in diameter when fully developed. The vas deferens (Figs. 9, 10) forms a mass of coils in the anterior third of the segment. The cirrus pouch (Figs. 6, 8, 10, 11) is elongated, broadest near the base and tapering toward its outer end. It measures 350 to 380 μ in length by 80 to 100 μ in thickness. The cirrus (Figs. 8, 9) is from 250 to 350 μ in length, about 10 μ in diameter when evaginated, with a lumen about 2 μ in diameter, and is armed with short spines 2 to 3 μ long.

Female reproductive organs: The vagina (Figs. 6, 7, 9, 10, 11) which opens into the genital sinus immediately behind the male opening, has three distinct portions. The first is very short with a narrow lumen and is surrounded by a spherical muscle bulb 25 to 30 μ in diameter which serves as a sphincter (Fig. 9). The second portion is 250 to 300 μ long, and possesses a muscular wall by the expansion or contraction of which the size of the lumen may be varied; this portion is lined with closely set cilia-like projections 8 to 10 μ long. The third portion has a thin membranous wall, and its lumen is at first very narrow, about 2 μ , but toward its inner end it swells out to form a seminal receptacle (Fig. 7) about 50 μ in diameter and 75 to 100 μ long.

The ovary (Figs. 6, 7) is small, compact, and but slightly lobed. At its maximum of development it does not exceed 175 μ in width. It is located about in the center of the segment nearer the ventral than the dorsal surface. Immediately behind the ovary is the rounded yolk gland (Fig. 6) which measured 100 to 130 μ in diameter. Dorsal to the yolk gland is the shell gland slightly smaller. The uterus (Figs. 7, 9, 10, 11) develops immediately in front of and dorsal to the ovary, as a simple sac-like organ. As the uterus develops, growing anteriorly and posteriorly, the ovary disappears.

The parenchyma in front of the uterus develops into a prominent para-uterine organ (Figs. 10, 11). The eggs are oval, with a thin outer mem-

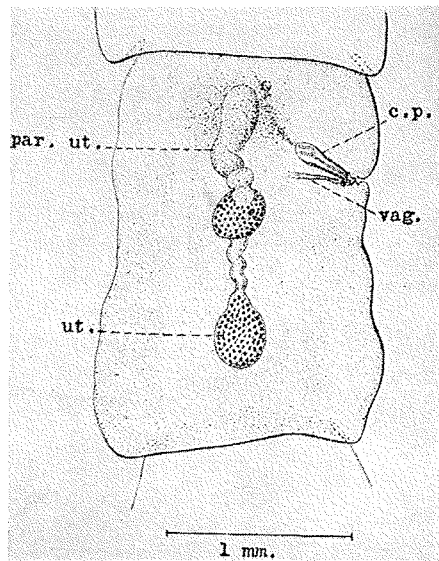
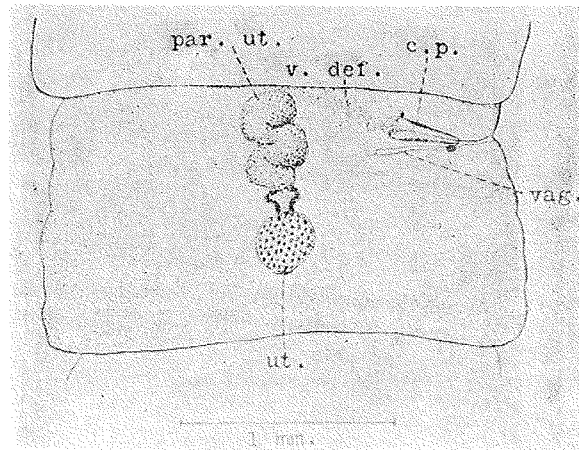


Fig. 10 and Fig. 11. *Rhabdometra nullicollis* (from Ransom). Gravid segment.

c.p.: cirrus pouch
 retr.: retractor or cirrus pouch
 cir.: cirrus
 sem. recept.: seminal receptacle
 v. def.: vas deferens
 t.: testicle
 vag.: vagina
 sph. vag.: sphincter of vagina
 ut.: uterus
 par. ut.: para-uterine organ

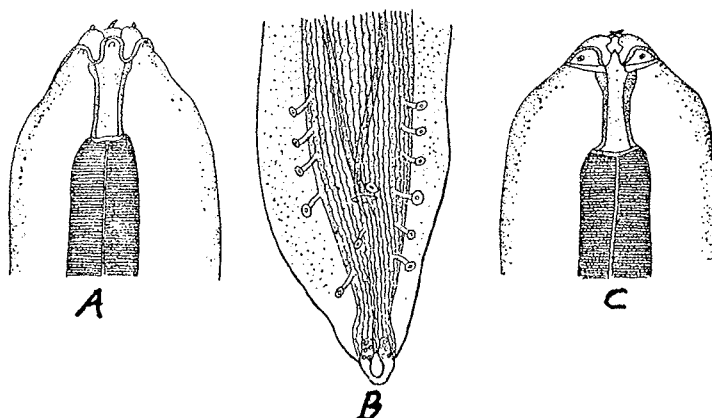


Fig. 12. *Habronema urophasiana* (from Wehr).
Male. A. head, lateral view; B. tail, ventral view; C. head, dorsal view.

brane 36 to 40 μ in diameter, a thicker middle shell 24 to 27 μ in diameter, and a thin inner membrane closely enveloping the oncosphere, which measures 18 μ in diameter. When the eggs first enter the uterus they are surrounded by a single membrane, the others developing later.

Only one mature and about forty immature specimens have been collected from the Wyoming sage grouse examined during the last eight years.

The immature specimens (maximum length of strobila 26 mm.) show considerable variation from Ransom's description. For instance, a short neck may be present; suckers measure up to 262 μ ; scoleces may measure over 500 μ in length; the genital pore while always in the anterior half of the proglottid is not always in the anterior third; the first segments are often narrower than the scolex. Although these and many other less significant differences are apparent, these immature cestodes are probably *R. nullicollis*.

Sixteen specimens were also taken from the blue grouse, *Dendragapus obscurus obscurus* near the Sandstone Ranger Station, Wyoming.

NEMATODA

Habronema urophasiana Wehr, 1931

Description: From Wehr (17)

Specific diagnosis: *Habronema*:

Male: 14.5 millimeters long by 324 μ wide. The cuticle over the entire body is distinctly cross-striated. The head (Fig. 12) is provided with four lips, two large laterals, a dorsal, and a ventral. Each of the lateral lips is divided externally into three lobes, each lobe bearing a more or less distinct

tooth on its inner surface. Slightly external to the row of teeth there appears to be a horizontal row of two or three small papillae. The dorsal and ventral lips have keel-like projections. The lateral ala is 4.16 millimeters long. It arises about 277μ from the anterior extremity of the body. The cervical papillae, which are indistinct except under high magnification, are a short distance anterior to the ala, about 245μ from the head end. The narrow chitinized pharynx is 50μ long. The esophagus is 3.02 millimeters long and is surrounded by the nerve ring 367μ from the anterior extremity of the body. The caudal extremity is coiled spirally. The caudal alae are broad; they are supported by eight pairs of pedunculated papillae and bear four or five pairs of sessile papillae (Fig. 12b) arranged as follows: Four pairs of preanal, two pairs of adanal, and two pairs of postanal pedunculated papillae, and four or five pairs of small sessile ventral papillae at the caudal extremity. The spicules are unequal, 1.1 millimeters and 410μ long, respectively. Accessory piece present.

Female: 23.5 millimeters long by 438μ wide. The ala is 4.81 millimeters long. The vulva is distinctly visible and is situated anterior to the middle of the body, 10.58 millimeters from the head end. The ovejector is 324μ long and claviform. The nerve ring surrounds the esophagus at a point 394μ from the tip of the head. The pharynx is 72μ long; the esophagus 3.28 millimeters long. The tail is 148μ long. Eggs are 27 to 42.5μ long by 25.5 to 27μ wide.

Host: *Centrocercus urophasianus*.

Location: Gizzard.

Wehr's specimens were taken near Miles City, Montana; fifteen specimens have been collected by the writer from sage grouse in Wyoming.

Cheilospirura centrocerci Simon, 1939 (14)

Morphology: Mouth with two broadly rounded lips; at the base of each are a pair of papillae which may project beyond the margins of the lips. The four cordons extend from the origin between the lips to the mid region of the anterior esophagus; i. e., to the region between 34 to 68 per cent of the length of the anterior esophagus; average 45.5 per cent in the male, 60 per cent in the female. Each cordon is composed of two discrete rows of elements which in different regions of the same specimen may appear blunt or sharply pointed, the latter appearance predominating. The cordons are of the same shape throughout, the difference in appearance at different levels depending upon the aspect from which they are viewed. Fig. 13, C. shows the appearance of the cordons in two regions of the body (*b* is seen when *a* is rotated 90 degrees to the right; *c* is seen when *b* is

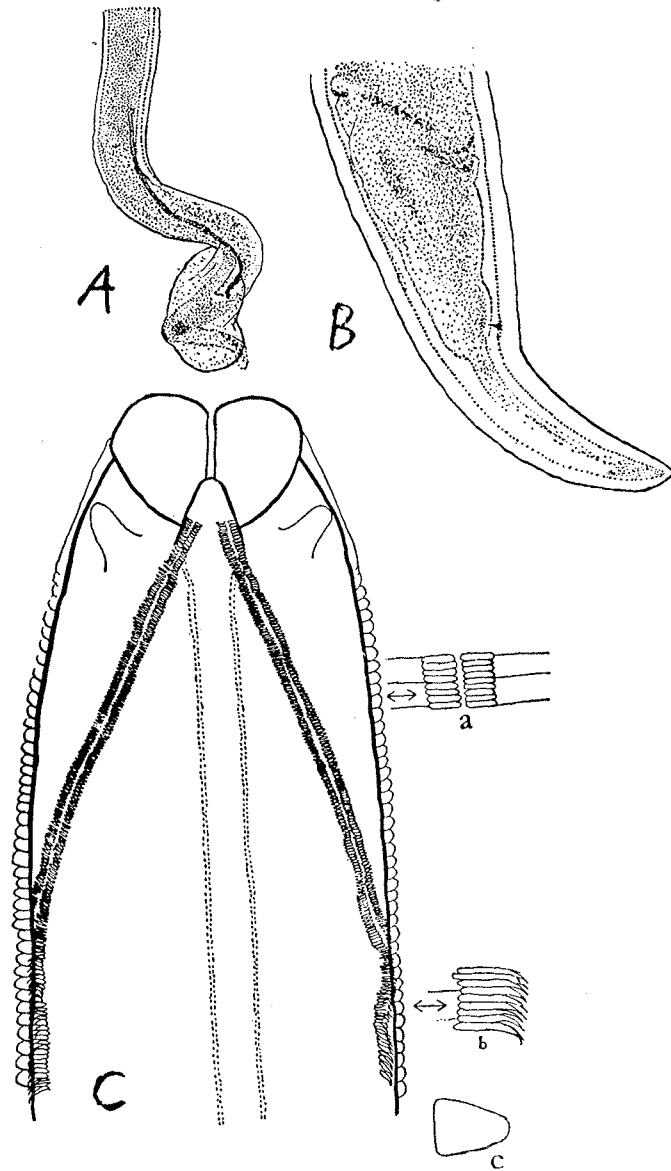


Fig. 13. *Cheilospirura centroceri*

- A. Male tail.
- B. Female tail.
- C. Female head, dorsal view.
- D. Anterior end. a, end view of cordons; b, side view of cordons; c, anterior or posterior view of cordon element (seen only in dissections.)

rotated 90 degrees forward or backward). Cervical papillae at the level of the union of pharynx and esophagus.

Male: Length, 16.76 to 20.22 mm., average 17.86 mm. Width 265 to 382 μ , average 311 μ , at the level of the posterior end of the esophagus; 313 to 418 μ , average 350 μ , at the middle of the body. Cords 558 to 783 μ , average 668 μ . Pharynx 261 to 292 μ , average 273 μ . Anterior esophagus 770 to 962 μ , average 870 μ . Posterior esophagus 2.04 to 2.46 mm., average 2.26 mm. Caudal extremity tightly coiled; alae broad. Five pairs of preanal papillae; six pairs of postanal papillae arranged as follows: two pairs not far posterior to the cloacal aperture, two pairs near the caudal extremity, the other two pairs more widely spaced between. The two papillae of any pair may or may not be symmetrically placed. Cloacal aperture to end of body 540 to 756 μ , average 633 μ . The slender spicule 936 to 1080 μ , average 1012 μ ; the thick spicule 183 to 261 μ , average 235 μ .

Female: Length 42.69 to 51.67 mm., average 46.87 mm. Width 360 to 418 μ , average 383 μ , at the level of the posterior end of the esophagus; 400 to 522 μ , average 487 μ at the middle of the body. Cords 837 to 1008 μ , average 947 μ . Pharynx 270 to 378 μ , average 306 μ . Anterior esophagus 924 to 1155 μ , average 1036 μ . Posterior esophagus 2.04 to 3.39 mm., average 2.7 mm. Vulva from anterior end of body 15.43 to 19.28 mm., average 17.42 mm., dividing body length in about the ratio 17:29. Anus to end of body 351 to 450 μ , average 395 μ . Eggs 43.2 to 45 μ by 27 to 31.5 μ , average 44.5 by 28.4 μ .

The writer has collected about forty specimens from the gizzards of sage grouse.

Since describing this species the author has examined a number of specimens from young sage grouse. These specimens were definitely smaller than those from which the description was written, although anatomical relations were the same, and it was therefore assumed that they had not achieved their full growth in the young birds.

Heterakis gallinae (Gmelin) 1790, Freeborn, 1923.

J. E. Shillinger (11) upon one occasion, found this nematode in a sage grouse. The writer has no other records.

Hosts: *Gallus gallus*, *Anas boschas domestica*, *Anser anser*, *A. cinereus domesticus*, *Bonasa sylvestris*, *B. umbellus*, *Centrocercus urophasianus*. Also infects more than thirty species of other birds including turkeys, quail, pheasants, ptarmigan and grouse.

Description: From Cram (3)

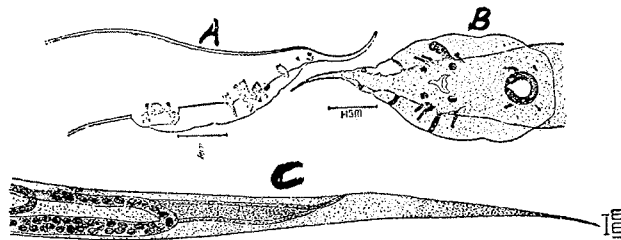


Fig. 14. *Heterakis gallinae* (Cram after Lane, 1917).
A. male tail, lateral view; B. ventral view; C. female tail.

Location: In cecum, usually; in small intestine, colon and rectum, rarely.

Morphology: *Heterakis*: Small, rigid, white worms, the head end bent dorsally from the region of the esophageal bulb. Mouth with 3 small, equal lips without teeth and each with 2 papillae, according to Lane. Two narrow lateral membranes extend almost the entire length of the body. Esophagus with 6 longitudinal rows of transversely placed chitinous rods and with a well-developed bulb.

Male: 7 to 13 mm. long. The straight tail (Fig. 14) terminates in a subulate point and has 2 large lateral bursal wings. Cloacal aperture $450\ \mu$ from caudal extremity. There are 12 pairs of papillae and a well-developed preanal sucker 60 to $75\ \mu$ in diameter with strongly chitinized walls (Fig. 14); there is a small semicircular incision in the posterior margin of the wall of the sucker. Four pairs of papillae are between the cloacal aperture and the end of the tail, 4 pairs of ray-like papillae and 2 pairs of sessile papillae are in the vicinity of the cloacal aperture, and 2 pairs of ray-like papillae are in the vicinity of the sucker. The spicules are dissimilar, the right being 2 to 2.17 mm. long and the left $700\ \mu$ to 1.1 mm. long.

Female: 10 to 15 mm. long. The tail (Fig. 14) is long, narrow, and pointed, the anus 1 mm. or more (?) from the tip. Vulva not salient, situated slightly posterior to the middle of the body. From vulva to bifurcation of the uterus is about 4.5 mm. Eggs thick-shelled, ellipsoidal, 63 to $71\ \mu$ long by 38 to $48\ \mu$ wide, according to most authors, or 68 to $75\ \mu$ long by 33 to $38\ \mu$ wide, according to Uribe, not yet segmenting when deposited; Uribe notes that the shell is thickened at one end of the eggs, and that this thickening may enclose a lenticular clear space.

Cram, 1927, gives a detailed account of the life history and biology of this parasite.

Distribution: Cosmopolitan. This species is very common in the United States.

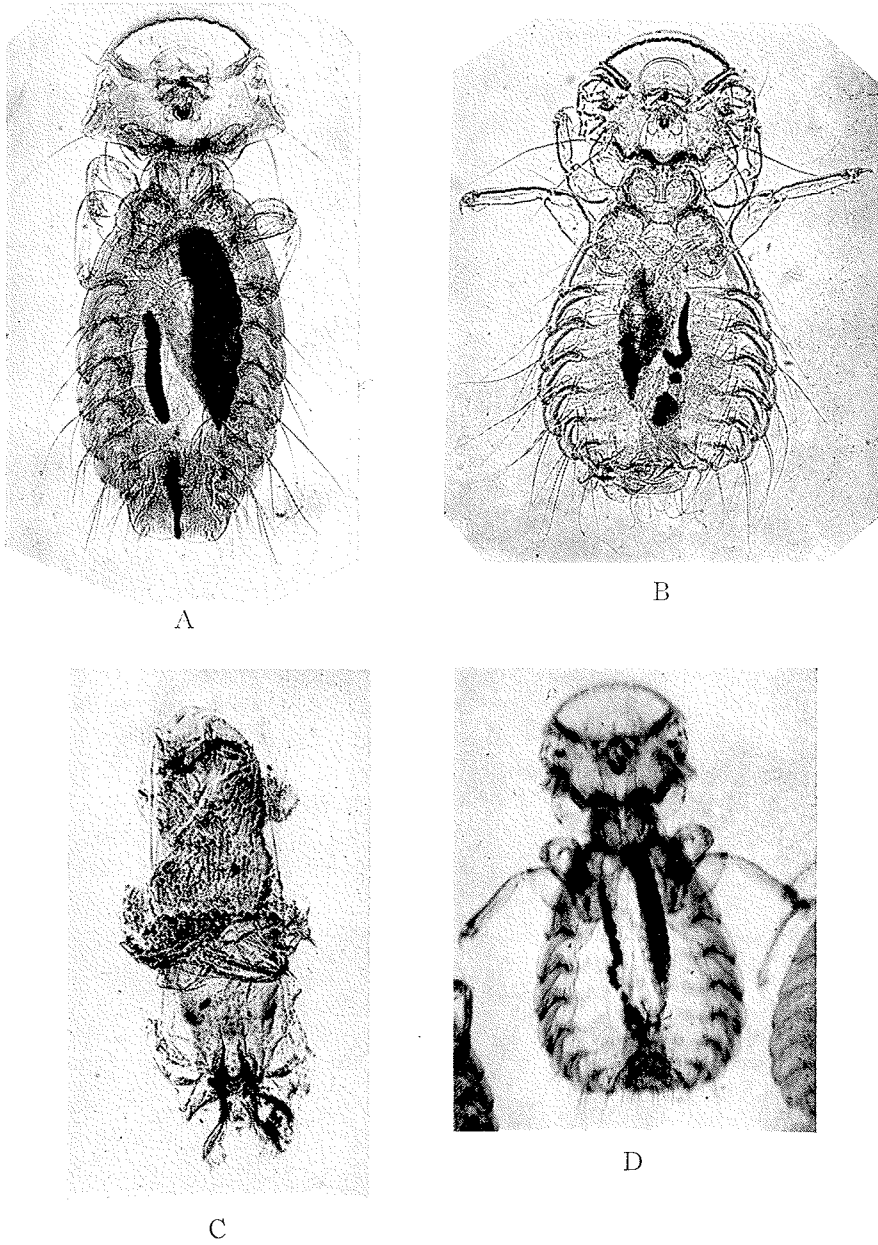


Fig. 15. *Goniodes centrocerci*

- A. Female
- B. Male
- C. Male genital armature 97X
- D. Male showing genital armature in situ.

ECTOPARASITES

MALLOPHAGA

Goniodes centroceri Simon, 1938 (13)

Description of male: *Goniodes*: Head 1.24 times as wide as long; widest at apex of angulate temples; forehead widest just in front of antennae. Occiput concave posteriorly. Trabeculae absent, but postero-lateral expansion of forehead partially covering antennal fossa anteriorly. Eyes prominent, bordering antennal fossa posteriorly; thick cornea clear, bearing single, long ocular seta. Pharyngeal sclerite prominent. Color light brown. Antennae short, capable of extending backwards as far as the lateral apexes of the temples; first segment greatly enlarged and as long as the last three combined; second segment not quite so long as the last three combined; process of third segment projects mediad and is larger than the rest of the segment; fourth and fifth segments about the same size. One long seta mediad to each eye; one in the fossa just anterior to each antenna; one long seta and one very short, spike-like seta on each lateral apex of the temples; and one, rarely two, long setae in each posterior concave face of the temples.

Thorax two-thirds as long as head, light brown in color with darker margins. Prothorax roughly trapeziform, with a dorso-lateral seta near each posterior angle. Pterothorax with two dorso-lateral setae near each posterior angle, and two dorsal setae a third of the way mediad from each side. Progressing posteriorly the legs become successively longer, and the coxae more widely separated.

Abdomen of nine segments, short, with rounded sides; widest at segment four; the first segment longest; segments two to five about equal; six to eight becoming successively reduced with sides increasingly rounded forming a truncate posterior end, the truncate appearance being broken by the extrusion of the ninth segment. Lateral abdominal bands are deep and conspicuous. Spiracles on segments two to seven inclusive. Chaetotaxy: Segment one: two or three lateral setae near each posterior angle, and two to four dorsal setae about a third of the way mediad from each side. Segments two, three, and four: three lateral setae near each posterior angle; two or three behind each spiracle. Segments five and six: four lateral setae near each posterior angle; two or three behind each spiracle. Segment seven: the setae near the posterior angle and those behind the spiracle are confluent, forming a row of eight or nine on each side. Segment eight: two setae at each posterior angle. Segment nine: more than twenty setae in all. There are a few mid-dorsal setae on all segments except six, seven, and eight. Each of segments two to seven bears two setae near the middle

of the sternite. Segments eight and nine have a few ventral setae. There may be one or two small, adventitious setae with those behind the spiracles on segments two to seven, or with those a third of the way mediad on segment one.

Description of female: Head as in male except larger and angles of temples sharper. Antennae shorter; segment two is longer than segment one, though not so long as the last three segments combined. Segment three bears no process.

Thorax as in male but comparatively shorter and wider.

Abdomen similar to male but longer and more ovoid, being without the truncate appearance. Ninth segment not extruded beyond eighth. Segments one to seven bear five to six mid-dorsal setae. There are two lateral setae at the anterior angle of the eighth segment, as well as two at the posterior angle. Only one large seta on each side of the ninth segment. Seventh segment bears a pair of cerci.

TABLE I
Average measurements in mm. of *Goniodes centroceri*

	Male		Female	
	Length	Width	Length	Width
Head	0.623	0.784	0.708	1.009
Thorax	0.421	0.641	0.440	0.716
Abdomen	1.067	1.101	1.476	1.224
Total	2.111		2.624	

Immature forms with the same chaetotaxy and of the same general shape except for comparatively larger and more rounded abdomens.

Seventy-nine specimens have been collected by the writer in Wyoming.

Lagopoecus perplexus (Kellogg), 1899

Synonyms: *Lipeurus perplexus* Kellogg and Chapman, 1899; *Esthiopterum perplexum* (Kellogg) Harrison, 1916.

In 1916 Harrison (5) split the genus *Lipeurus*, designating the non-circumfasciate members by the new generic name of *Esthiopterum*. His inclusion of *Lagopoecus perplexus* in this genus was an error.

Genotype: *Nirmus cameratus* Lyonet (1830).

Type host: *Lyrurus tetricus*.

This genus has affinities both with *Lipeurus* Nitzsch (sens. str.) and *Degeeriella* Neum. (sens. str.). It does not, however, include forms like *Lipeurus docophoroides* Piag., from which a careful examination of the head should secure its separation.

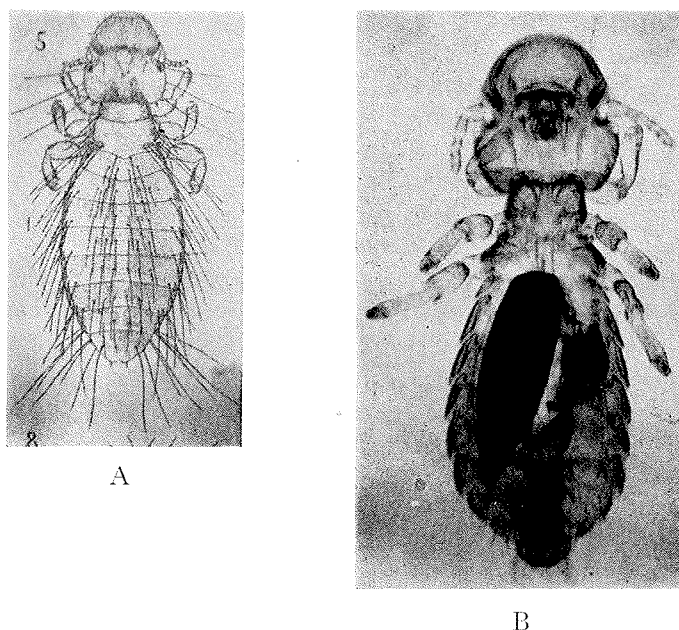


Fig. 16. *Lagopoccus perplexus*.
A. From Kellogg
B. Original

Clay (2), 1938, widens the definition of this genus to include several species which cannot satisfactorily be separated from Waterston's (16) original genus.

Specific diagnosis: From Kellogg (6). Two females from a Columbian Sharp-tailed Grouse, *Pedioecetes phasianellus columbianus* (Pullman, Washington), and many females, differing slightly in shape of metathorax and abdomen, from a Sooty Grouse, *Dendragapus obscurus fuliginosus* (Kings River Canyon, California). A peculiar broad, robust form of the group *circumfasciati*, with rounded front. Resembling Piaget's *L. opimus* (Supplement, p. 78, pl. viii, fig. 6) from *Turacus giganteus* (Museum of Leyden). Resembling also in general outline and characters Osborn's *Nirmus cordatus*, a specimen of which we have taken from *Limosa haemastica*. Perhaps both of these forms should be referred to the same genus. Piaget's *L. opimus* should accompany them. Unfortunately, all of these species are represented by females only.

Description of female: Body, length 2.06 mm., width .59 mm.; short, broadly elliptical body, with short, broad head, broadly rounded in front; clear fulvous with pale golden brown lateral, transverse abdominal blotches.

Head, length 0.53 mm.; width 0.5 mm.; cordate, clypeal front broadly rounded, four short marginal hairs on the front, a short hair on the margin in front of the antennae which are short; segment 2 of the antennae longer than segment 1, segment 5 longer than segments 3 or 4; the anterior end of segment 3 and segments 4 and 5 pale fulvous, a few short hairs on the segments; eye prominent, a long hair rising from its dorsal surface, and with a conspicuous black fleck; temples convex, with two long hairs and two or three short prickles; occipital margin slightly concave; antennal bands slightly darker on the posterior tips and continuous as a narrow, even marginal border of pale translucent golden brown on the front; narrow occipital blotch of pale golden brown, also a temporal border and an occipital band of the same color; mandibles dark chestnut-brown, showing through the head.

Prothorax short, lateral margins convex; one hair in the posterior angle; pale fulvous, slightly darker on the lateral margins. Metathorax with sides diverging, posterior angles rounding, with a long hair and short prickle; four hairs on the posterior margin in groups of two in small, uncolored pustulations; posterior margin with a slight angle on the abdomen; pale fulvous, slightly darker on the posterior angle; all of the thorax with a more whitish ground color than the head. Sternal markings consisting of pale intercoxal lines and a very pale median metathoracic blotch. Legs pale fulvous with narrow dark marginal borders.

Abdomen elongate-ovate, tapering rapidly posteriorly; segments with their posterior angles slightly produced, each with from one to three hairs; a transverse series of a few long dorsal hairs near the middle of the segments; ground color pale fulvous, narrow translucent brown bands on the lateral margins; broad transverse pale brown blotches on segments 2 to 7, darker on their inner ends, separated by a broad pale median line, also a broad pale band on the posterior margin of each segment; segment 8 entirely colored, with slight median emarginations on the anterior and posterior margins of the blotch; no distinct lateral bands; last segment round, narrowly emarginate, with one short hair on the posterior margin of each rounding angle; two transverse blotches, one on each side of the emargination.

One hundred eighteen specimens have been taken by the writer in Wyoming. This species is also reported from Montana and from Lake County, Oregon.

Average measurements of the specimens in hand:

20 specimens: { Female: Body, 1.50 x 0.67 mm.; head, 0.53 x 0.49 mm.
Male: Body, 1.18 x 0.61 mm.; head, 0.47 x 0.44 mm.

Kellogg gives the body length as 2.06 in the female, but this measurement probably includes the head.

ACARINA

The writer knows of no record of ticks from sage grouse in Wyoming; however, Parker, Philip, and Davis, 1932 (9), found sage grouse in northeastern Fergus County, Montana, heavily infested with *Haemaphysalis cinnabarina*, and regarded this tick as the probable vector of *Bacterium tularensis* which they isolated from the sage grouse tissues as well as from the infesting ticks. These authors incidentally report a single specimen of *Haemaphysalis leporis-palustris* from a sage grouse in the same locality.

Haemaphysalis cinnabarina Koch, 1844

Description: From Nuttall and Warburton (8).

Male: Scutum: 1.9 × 1.3 to 2.7 × 1.5 mm., elongate, strongly and irregularly punctate, the punctations being coarse and often confluent in the middle regions; cervical grooves very short, well marked; lateral grooves very long and deep, including three festoons; festoons short; dorsal, median and postero-lateral grooves are present. *Capitulum:* base not much broader than long, punctate, with strong cornua; palps massive; article 2 slightly salient laterally; no dorsal spines; a slight ventral retrograde point under article 3 at its inner angle; hypostome, dentition 4/4 to 5/5, very small sharp teeth without any median interval. *Venter:* spiracle large, short, comma-shaped. *Legs:* coxal spurs strong, longest on coxa IV; tarsus IV short, tapering rather abruptly.

Female: Scutum: 0.9 × 0.9 to 1.6 × 1.2 mm., usually distinctly longer than broad, broadest near the anterior border, punctations coarse; cervical grooves deep and converging to the middle of the scutum, then shallower and diverging. *Capitulum:* base twice as broad as long; cornua very slight and blunt; porose areas large, almost reaching the posterior border, not always definite, *except where bounded by the lateral ridge*; but in some specimens distinctly oval, converging in front; palps and hypostome as in the ♂. *Venter:* spiracle large, subcircular, with distinct dorsal process. *Legs:* as in the ♂, except that the spur on coxa IV is short. (Replete specimens may attain 9 × 6.6 mm., according to Hooker, Bishopp and Wood.)

Nymph. Scutum: 0.62 × 0.6 to 0.45 × 0.55 mm., variable, generally cordate, with few punctations and well-marked cervical grooves. *Capitulum:* base hexagonal, with lateral angles, and with ventral cornua; palps recalling those of the adult; dentition of hypostome 2/2, about 8 teeth per file. *Venter:* spiracle ovoid, with distinct dorsal process. *Legs:* as in the ♀, with coxal spurs usually well-marked for a nymph.

Larva. Scutum: 0.24 × 0.3 to 0.21 × 0.26 mm., cordate broader than long; cervical grooves fairly distinct, parallel. *Capitulum:* base with lateral

angles and with distinct ventral cornua; palps with slight lateral salience; hypostome, dentition 2/2, about 7 teeth per file. *Legs*: coxa I with slight spur, coxa II flanged, coxa III unarmed; tarsus III tapering.

Haemophysalis leporis-palustris Packard, 1869

Description: From Nuttall and Warburton (8).

Male. Scutum: About 2 x 1.3 mm., widest at the posterior third, punctations coarse and confluent but not deep; a pseudoscutum generally indicated; cervical grooves rather long, convergent and deep throughout their length; lateral grooves commencing behind the pseudo-scutum and therefore short, well-marked to the spiracle and faintly continued to include two or three festoons; festoons rather broad. *Capitulum:* base broadest in front, the sides nearly straight and converging posteriorly; cornua slight, but *there are also ventral cornua*; palps longer than broad, sub-cylindrical, article 2 very salient beyond the base, but the lateral contours of articles 2 and 3 form normally nearly a straight line, only slightly recurved at the base of article 2; no dorsal spurs, but a slight point under article 3, hypostome 3/3. *Venter:* anal grooves slightly ogival; spiracle large with slight dorsal process. *Legs:* two short spurs, internal and external, on coxa I; a slight spur on coxae II-IV; very slight trochantal spurs; tarsus IV long, stout, tapering rapidly.

Female. Scutum about 0.9 x 0.8 mm., appearing decidedly longer than broad, oval, narrowing posteriorly, with coarse confluent punctations; cervical grooves long and deep. *Capitulum:* base broader than in ♂; porose areas oval, converging anteriorly, far apart; cornua slight, *ventral cornua well-marked*; palps with all the characters of the ♂ but relatively longer. *Venter:* spiracle sub-circular, with slight dorsal process. *Legs* as in the ♂. When replete the ♀ may attain 11.3 x 7.5 mm.

Nymph. Scutum relatively broader than in the ♀. Hypostome 2/2. Other characters as in the ♀; the dorsal and *ventral cornua* being evenly emphasized. When replete the nymph may attain 2.5 x 1.75 mm.

Larva. Resembles the nymph with still shorter palps and broader, almost diamond-shaped scutum; the latter measuring 0.26 x 0.3 mm. *Capitulum* with *ventral cornua*. *Legs:* coxae feebly armed. When replete the larvae may attain 1.33 x 0.9 mm.

Parker, Philip and Davis (9) reported a single specimen collected from sage grouse in Fergus County, Montana.

PATHOGENICITY

Great numbers of *Tritrichomonas* sp. were found in every sage grouse whose coecal contents were examined microscopically. *Tritrichomonas* sp. seems to be harmless although it occurs in vast numbers and the incidence is very high.

The incidence of all other parasites was definitely higher in the young than in the adults; also, the young were more heavily infested.

Eimeria have been known to decimate sage grouse populations in several localities.

Although there is a high incidence of *Raillietina centroceri* and many of these large tapes are often present in a single host, no serious ill effects were noted.

Cheilospirura centroceri produces necrosis in the horny tissue of the gizzard as well as in the underlying muscles. Also a slight hemorrhage sometimes accompanies the necrotic condition, but in no case did the general health of the bird seem seriously affected.

Habronema wrophasiana, whenever found, was associated with *E. centroceri* and therefore its pathogenicity could not be judged.

Haemaphysalis cinnabarina was shown by Parker et al (9) to be the probable vector of tularemia, and is therefore a great menace. Also these ticks were found in such numbers that they must have been a considerable nuisance to the grouse.

No untoward effects were attributable to the other parasites.

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