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Correspondence may be addressed to the corresponding secretary-treasurer, Edna M. Buhrer, Division of Nematology, Plant Industry Station, Beltsville, Md., or to the editor, Jesse R. Christie, Division of Nematology, Plant Industry Station, Beltsville, Md.

PROCEEDINGS OF THE HELMINTHOLOGICAL SOCIETY OF WASHINGTON

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Thorny-headed worms (Acanthocephala) as potential parasites of poultry.

HARLEY J. VAN CLEAVE, Department of Zoology and Physiology, University of Illinois, Urbana.

Thorny-headed worms are potential parasites of domestic poultry but they have been reported only a few times from fowl of North America. Their occurrence as normal parasites in a wide variety of native animals, particularly in resident and migratory birds, offers opportunity for them to become established as parasites of poultry if suitable intermediate hosts are present. The only species of Acanthocephala definitely recorded from chickens in the United States is *Plagiorhynchus formosus* Van Cleave. This species has been found in the intestine of a wide variety of song birds (Van Cleave, 1942). Dr. Myrna Jones (1928) published a note telling of its occurrence in the intestine of chickens. It is characteristic of all Acanthocephala that the vertebrate hosts become infected only when they feed upon infected arthropod intermediate hosts or reservoir hosts. The latter may be either a vertebrate or an invertebrate which feeds upon the arthropod host and thus becomes the agency for transmitting the parasites to the final host. No reservoir host is known for *Plagiorhynchus*. The evidences for assuming that light individual infections are carried without the intervention of reservoir hosts are discussed in another paper (Van Cleave, 1947). Sinitsin (1929) discovered that *Armadillidium vulgare*, a terrestrial isopod of very wide geographical distribution, is host to the larval or juvenile stages of *Plagiorhynchus formosus*. Presence of song birds infected by *Plagiorhynchus* in a region where *Armadillidium* is common would create proper conditions for transmitting infections to chickens.

E. W. Price (1929: 290) recorded the occurrence of immature worms of *Oncicola canis* in cysts beneath the epithelial lining of the esophagus of turkey poults at San Angelo, Texas. Adults of *Oncicola canis* are normal parasites of the intestines of dogs and coyotes of the southwest. Since arthropods are invariably the first hosts of all species of Acanthocephala whose life cycles have been determined, the first larval host of *Oncicola* is undoubtedly an arthropod, although it has not yet been discovered. It is highly probable that infected insects or other arthropods carrying the larvae were eaten by young turkeys in whose bodies the worms were unable to become established in the digestive tract. Under these circumstances the young worms penetrated into the tissues of the esophagus where they became encysted. Secondary reencystment is a well known phenomenon in a wide variety of species of Acanthocephala. It seems to be an adaptation to prevent the destruction of juvenile worms which are too immature to proceed with their development in the lumen of the intestine. They penetrate the wall of the digestive tract and come to lie in the viscera where they often become surrounded by cyst walls. In nature it is very common for the juveniles of *O. canis* to become encysted in the mesenteries and viscera of the armadillo which then serves as reservoir host transmitting massive infections to dogs feeding upon the vicera of the armadillo. Similarly the cysts in the esophagus of a turkey could readily be transmitted to dogs or other predatory mammals.

Another genus of Acanthocephala, *Mediorhynchus*, which parasitizes native birds, is likewise a potential parasite of chickens. While no member of this genus

has ever been reported from fowls of this continent, several species are normal parasites of our wild birds. In India and in the Philippines a species of *Mediorhynchus* which has been misplaced in another genus has been reported as a specific parasite of domestic chickens.

In 1937, Bhalerao published an account of an acanthocephalan which he regarded as a new species and new genus under the name *Leiperacanthus gallinarum*. The host was the common fowl (*Gallus gallus domesticus*) in India. His description, which was based on a single specimen, contained a number of serious errors in observation as well as several faulty interpretations. Tubangui and Masilungan (1946) have recorded the presence of this same species in chickens of the Philippines. While these authors added materially to the details of the specific description, they made no correction of Bhalerao's errors. The fact that this parasite has unusual capacity for establishing itself in different regions indicates that it might later appear on other continents. The errors in description might impede its recognition, hence corrections are here offered.

On the basis of a critical reexamination of the available evidence, the writer is fully convinced that the genus *Leiperacanthus* is a direct synonym of *Mediorhynchus* and that the family Leiperacanthidae is likewise untenable since it is a direct synonym of Gigantorhynchidae. It seems probable that the Bhalerao species is valid and in its transfer from *Leiperacanthus* it becomes *Mediorhynchus gallinarum* (Bhalerao, 1937). In the original description of the genus and species, a number of fundamental errors were made. In so far as these bear upon the mistaken assignment of the genus and the species they will be discussed here.

Bhalerao found trouble in allocating *Leiperacanthus* and its family in either the order Palaeacanthocephala or the order Archiacanthocephala of the Meyer (1932) classification. He erroneously stated that the new genus "has more affinities to the order Palaeacanthocephala than to the Archiacanthocephala." This statement shows that he was completely misinformed since the species is clearly a representative of the Archiacanthocephala. Bhalerao was particularly confused in his interpretation of the orientation of his specimen. He considered the dorsal and ventral surfaces as lateral, probably because in his sketch they were on the lateral margins as he viewed his drawing. In consequence, he regarded the longitudinal canals of the lacunar system as lateral (as they are in the Palaeacanthocephala) when in reality they are dorsal and ventral (as diagnostic for the Archiacanthocephala).

Furthermore, he mistakenly regarded the proboscis receptacle as inserted at the base of the proboscis. In the single specimen available for his study the neck and the base of the proboscis were folded into the front end of the trunk so that it is probable that the position of the line of attachment of the receptacle could not be made out at all. Tubangui and Masilungan (1946) had the advantage of securing specimens with the proboscis fully extruded but they erred in interpreting the simple thorns on the basal segment of the proboscis as body spines on the trunk.

Bhalerao regarded some sac-like structures which he found in the front part of the body, adjacent to the receptacle of the proboscis, as "altogether a new structure in the organization of the Acanthocephala." He termed these "paraproboscideal sacs" and in his diagnosis of the family and description of the new genus he placed great emphasis on these as distinctive features meriting special taxonomic consideration. Similar structures have been seen in many members of the genus *Mediorhynchus*. Two such structures were clearly shown in Skrjabin's (1913) figure of *Mediorhynchus empodius*.

Another point of morphology in which Bhalerao was seriously confused is regarding the nature of the wall of the proboscis receptacle. In the original char-

acterization of the genus *Mediorhynchus*, the present writer (Van Cleave, 1916: 224) called attention to the fact that the wall of the receptacle in that genus consists of a single muscular layer. Bhalerao (1937: 199) described the proboscis sheath or receptacle of "Leiperacanthus" as "divided into two portions—a long anterior portion having double (outer and inner) wall and a small posterior portion which does not possess the outer wall." Yamaguti (1939: 348), in describing another species of *Mediorhynchus*, observed the condition which Bhalerao had misinterpreted as a double wall for the anterior part of the receptacle. Yamaguti stated that the sheath is composed of circular muscle fibers in addition to which the larger anterior portion of the receptacle is "enclosed in a thick capsule of fine longitudinal muscle fibers." These *longitudinal fibers*, which both Bhalerao and Yamaguti mistook for a part of the wall of the proboscis receptacle, represent a specialized musculature for retraction of the base of the apical segment of the proboscis within the proximal region and have no intimate relation to the receptacle itself other than mere proximity. Lundström (1942: 183), in describing another species of *Mediorhynchus*, observed and figured this same longitudinal muscle sheath. Lundström correctly interpreted this layer of longitudinal fibers as a "muscular cylinder" for retraction of the anterior part of the proboscis and as an invaginator of the basal segment of the proboscis. Attached as it is at the line of union of the two proboscis regions, its contraction produces a fold of the proboscis wall resulting in telescoping of the base of the anterior section within the front end of the proximal section of the proboscis.

No species of the genus *Mediorhynchus* has so far been reported from chickens of North America. Leigh (1940) recorded the finding of *Mediorhynchus papillosus* in the intestine of a prairie chicken (*Tympanuchus cupido americanus*) from southern Illinois. This species had been known previously from native birds but it might readily become established in regions where it could be transmitted to domestic fowl.

The North American species of *Mediorhynchus* having the strongest opportunity for becoming established in domestic flocks is *M. grandis* which lives normally in grackles, meadowlarks, and occasionally in crows. Moore (1945) has recently shown by experimental infection that in Texas certain species of grasshoppers (*Chortophaga viridifasciata australior, Orphuella pelidna* and *Arphia luteola*) are capable of serving as the arthropod host of *M. grandis*. Chickens or turkeys on open range frequented by meadowlarks or grackles might readily become infected by feeding on grasshoppers carrying the larvae or juveniles of *M. grandis*.

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The effect of experimental infections with ascarids on the growth of pigs. L. A. SPINDLER, U. S. Bureau of Animal Industry.

STATEMENT OF PROBLEM

The large intestinal roundworm, *Ascaris lumbricoides*, is considered to be one of the most injurious of the worm parasites of swine. Comparatively little quantitative information is available, however, as to the extent to which a pure infection of this parasite may retard the growth of pigs. An investigation was carried out, therefore, during the period of July to November 1945, at the laboratory of the Zoological Division at the Agricultural Research Center, Beltsville, Maryland, to determine the effect on the growth of pigs of ascarid infections, uncomplicated by the concomitant presence of other worm parasites. In this investigation littermate pigs were fed infective eggs of the swine ascarid, and observations were made of the weight gains of the host animals in relation to the number of worms harbored at necropsy and in comparison with the weight gains of littermate control pigs that were not infected. This investigation is briefly summarized in this paper.

EXPERIMENTAL PROCEDURE

The number of animals involved, the conditions under which they were maintained, the diets fed, the method of infection with the parasites, and other pertinent information are briefly summarized below.

Experimental animals.—Eight littermate pigs of mixed breeds, weaned at 8 weeks of age and divided into 4 groups (Nos. 1 to 4, inclusive) on the basis of weight and sex were involved in the experiment. The pigs were farrowed under conditions that precluded extraneous infections of parasites other than the protozoans *Balantidium* and *Entamoeba*. Low grade infections of these parasites were acquired by all the pigs shortly after birth, and were retained by them without appreciable change in number up to the time of necropsy. At weaning, the 8 pigs were placed in individual concrete pens that were cleaned and washed daily. One pig of each group, the test animal, was fed ascarid eggs in the manner to be described. The remaining pig of each group was the control. Each pig was weighed twice weekly throughout the experimental period, and finally just before slaughter.

Diets fed.—The basic diet fed to the pigs was a balanced grain ration which has been found adequate to promote reasonably satisfactory weight gains in parasite-free pigs.[1] The pigs comprising one of the groups (Group 4) were fed

[1] Shorb, D. A. and Spindler, L. A. 1947. Proc. Helminthol. Soc. Wash. 14(1): 30–34.

exclusively the basic diet. Pigs comprising groups 1 to 3, inclusive, were fed the basic ration into which was admixed fresh cow manure and/or sterile sand, in the proportions shown below.

For group 1, 4 volumes of the basic ration were mixed with 1 volume of manure. For group 2, 4 volumes of the basic ration were mixed with 1 volume of manure, plus an amount of sand equivalent to 20 per cent of the weight of the grain-manure mixture. For group 3, the basic ration was mixed with an amount of sand equal to 20 per cent of its weight. The ingredients of the various diets were mixed fresh each day.

The cow manure and/or sand were added to the diets for the following reasons: (1) Stockmen fattening cattle on corn frequently maintain swine in the same feeding lot in order that the hogs may consume undigested corn passed in the feces of the cattle; hogs so maintained no doubt ingest cow manure during the course of consuming the undigested grain. (2) It has been reported[2] that incorporation of fresh cow manure in the diet of pigs may be conducive to economical weight gains, since cow manure is known to contain quantities of the B-complex vitamins which are essential to the growth of pigs. (3) Swine fed on the ground normally ingest soil which may contain sand and other gritty materials. In view of these facts it was desired to ascertain whether ingestion by pigs of fresh cow manure and/or sand along with feed might alter the resistance of the animals to ascarid infections.

Source of ascarid eggs for infecting the test pigs.—The ascarid eggs were removed from the uteri of gravid females, and stored for 3 days in physiologic saline to remove from them the sticky material which causes clumping of the eggs in aqueous cultures. At the end of the 3-day period the eggs were concentrated and transferred for culturing to Petri dishes, some of which contained tap water to which a few drops of 5 per cent formalin had been added. Others contained a 1 per cent solution of potassium dichromate in tap water. The cultures were kept at room temperature and agitated once or twice each day. Three weeks after the vast majority of the eggs appeared to have reached the infective stage, a quantity from each culture dish was fed to a white mouse. All the mice died from verminous pneumonia and ascarid larvae were recovered from their lungs, this affording conclusive evidence that the eggs were viable. The various cultures were then combined, the eggs concentrated and washed several times, and stored in tap water for feeding to the experimental pigs.

Feeding the embryonated ascarid eggs.—Two weeks after the beginning of the experiment, feedings of ascarid eggs to the test pigs were initiated. Approximately 12,000 embryonated eggs were fed by mouth to each test pig each day, just before the morning feeding of the appropriate grain diet. The experimental infections were continued for a period of 11 days, at which time the pigs were thumping badly and were inappetent. These symptoms, which are indicative of the passage of ascarid larvae through the lungs, were not observed in the control pigs. The infections were discontinued, therefore, for a period of 7 days, during which time the infected pigs ceased thumping and regained their appetites. Infections were then resumed for another period of 7 days. During this period, the pigs failed to develop symptoms indicative of passage of ascarid larvae through the lungs. Consequently the infections were discontinued.

As a test of the viability of the remaining eggs, a quantity was fed to each of 6 white mice. All died of verminous pneumonia, which demonstrated that the cultures had not lost their viability during the period eggs were being fed to the test pigs.

[2] Wis. Agr. Expt. Sta. Ann. Rept. 1944, Bull. 463, and 1945, Bull. 466.

Post mortem examinations.—After the experiment had progressed 126 days the test pig of group 2 became moribund. Consequently the experiment was terminated and all the pigs were weighed, slaughtered, and examined for ascarids and other worm parasites. In the case of those pigs that had received sand in the diet, the sand was screened from the intestinal contents and its weight subtracted from the live weights of the pigs.

EXPERIMENTAL FINDINGS

The data are summarized in the accompanying table. Figures 1 to 4 show graphically the growth rates of the infected and uninfected pigs of each group during the test period. The following are some of the more outstanding features of the data.

(1) The control pigs were worm-free; (2) no worm parasites other than ascarids were found in the test pigs; (3) as can be seen in the table, the number

TABLE 1.—*Summary of data on weight gains of pigs experimentally infected with ascarids, and of uninfected littermate controls. Pigs on experiment 126 days.*

Group and pig designation	Weight at beginning	Weight at necropsy	Total weight gained or lost	Average daily weight gain	Ascarids harbored at necropsy
	(*pounds*)	(*pounds*)	(*pounds*)	(*pounds*)	(*number*)
Group 1					
Pig 1521 (infected)	12.50	62.00	+ 49.50	0.39	39
Pig 1520 (control)	17.00	120.00	+103.00	0.81	0
Group 2					
Pig 1518 (infected)	22.00	13.25	− 8.75	.....	109
Pig 1519 (control)	23.00	119.50	+ 96.00	0.76	0
Group 3					
Pig 1514 (infected)	24.50	117.00	+ 92.50	0.72	12
Pig 1517 (control)	25.00	119.75	+ 94.75	0.75	0
Group 4					
Pig 1515 (infected)	20.00	80.00	+ 60.00	0.47	20
Pig 1516 (control)	22.00	131.00	+109.00	0.86	0

of ascarids harbored by the test pigs at necropsy ranged from 12 to 109; (4) the total amount of weight gained by the infected pigs was in inverse relationship to the number of worms harbored, and ranged from no gain to 92.5 pounds, whereas the controls gained from 94.75 to 109 pounds; (5) the incorporation of cow manure in the diet was not conducive to increased weight gains by the pigs so fed (Groups 1 and 2).

DISCUSSION AND CONCLUSIONS

Data presented in this paper provide quantitative data on the extent to which infections of ascarids can affect adversely the growth rate of pigs. In the investigation described in this paper the number of ascarids found at necropsy bore a direct relationship to the extent of the growth retardation observed in the pigs harboring them. For example, an infection of 109 ascarids was sufficient to destroy the health of the host (Pig 1518, Group 2) to the extent that progressive loss of weight occurred so that the animal weighed less at the termination of the experiment than it did at the beginning, the intervening period being 126 days. Although lighter infections were noticeably less injurious, there were, nevertheless,

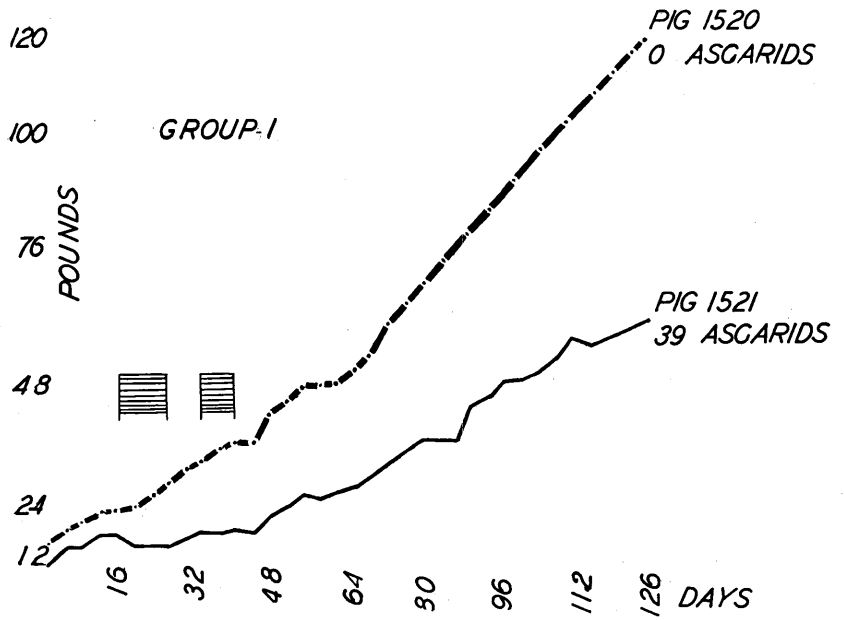

FIG. 1. Showing growth rates of group 1 pigs. Pig 1521, infected; pig 1520, control. Shaded areas cover intervals during which ascarid eggs were being fed to pig 1521. Ascarid eggs were first found in the feces of this animal 69 days after the beginning of the experiment.

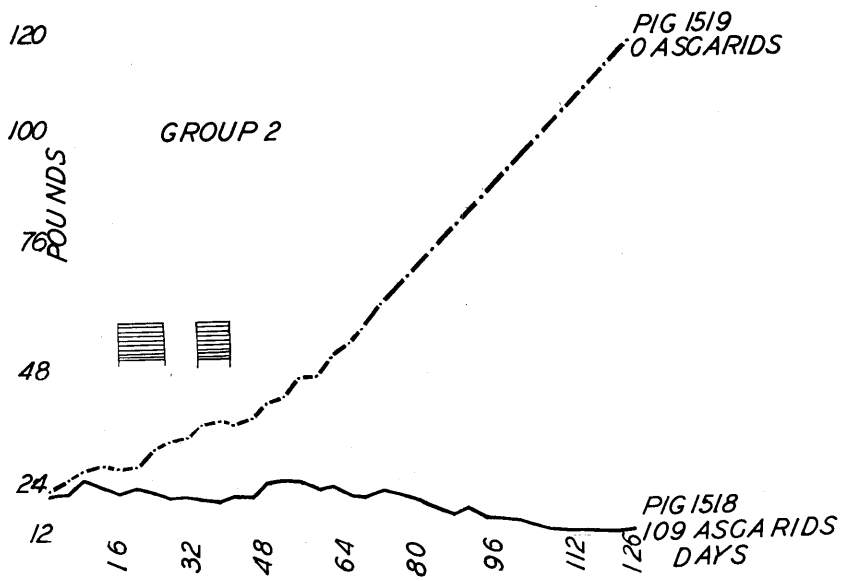

FIG. 2. Showing growth rates of group 2 pigs. Pig 1518, infected; pig 1519, control. Shaded areas cover intervals during which ascarid eggs were being fed to pig 1518. Ascarid eggs were first found in the feces of this animal 69 days after the beginning of the experiment.

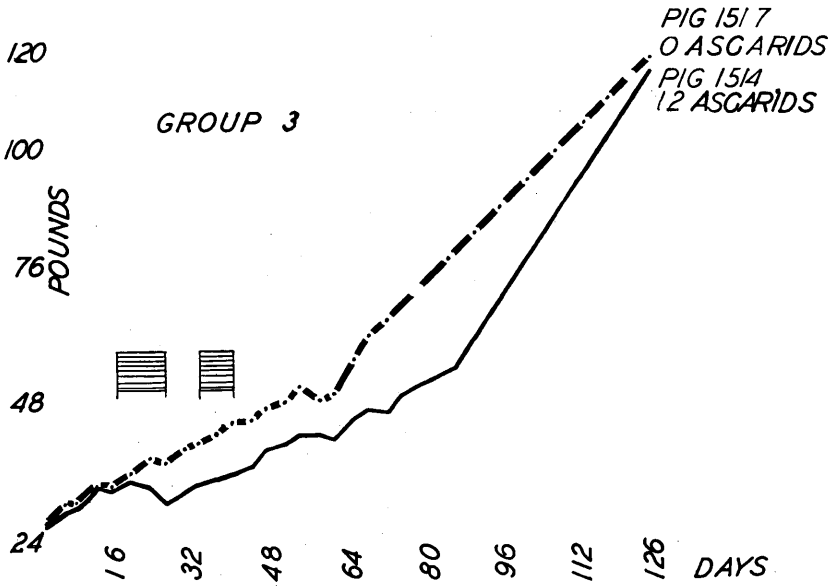

FIG. 3. Showing growth rates of group 3 pigs. Pig 1514, infected; pig 1517, control. Shaded areas cover intervals during which ascarid eggs were being fed to pig 1514. Ascarid eggs were first found in the feces of this animal 79 days after the beginning of the experiment.

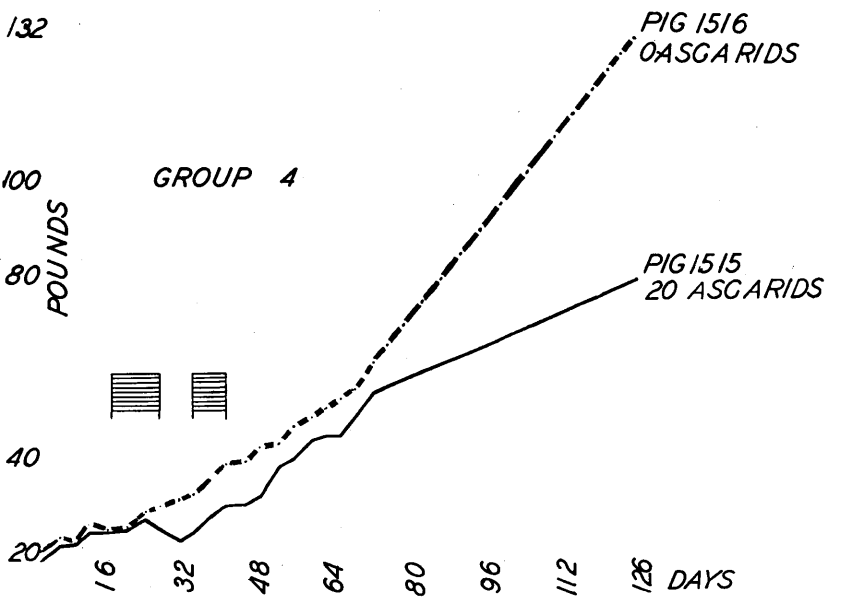

FIG. 4. Showing growth rates of group 4 pigs. Pig 1515, infected; pig 1516, control. Shaded areas cover intervals during which ascarid eggs were being fed to pig 1515. Ascarid eggs were first found in the feces of this animal 79 days after the beginning of the experiment.

significant differences between the weight gains of the infected pigs of groups 1, 2, and 4 and those of the corresponding uninfected control pigs. This is illustrated by the fact that an infection of 39 ascarids was associated with a slowing down of the growth rate of the host (Pig 1521, Group 1) to the extent that it gained during the experiment only 48 per cent as much as the corresponding control. A final infection of 20 ascarids was likewise associated with unthriftiness of the host (Pig 1515, Group 4), which at necropsy had gained only 55 per cent as much as its uninfected control. A final infection of 12 ascarids, however, did not appreciably affect the gains made by the host (Pig 1514, Group 3) which were 97 per cent as much as that made by its control.

As can be seen from the table, and from figures 1 and 2, the incorporation of fresh cow manure in the diet of pigs comprising groups 1 and 2 did not produce superior weight gains in the animals in question. As can be seen from the table, the heaviest ascarid infections occurred in the test pigs of these groups.

Some investigators consider that unthriftiness commonly associated with ascarid infections is the result of injuries inflicted by the larvae during their migration through the liver and lungs, and that the adult worms are of comparatively little importance. This idea had its inception, no doubt, in the fact that the clinical manifestations of an invasion of the lungs by large numbers of ascarid larvae are sometimes spectacular and easily recognized, and that adult swine often harbor ascarids without apparent ill effects. That portion of the life cycle of *Ascaris* that occurs within the host may be divided, roughly, into three stages, namely (1) the stage of invasion of the liver and lungs by the migrating larvae; (2) the stage of growth and development to maturity of the worms in the intestine; and (3) the stage when mature worms are present in the intestine of the host. In the experiment herein reported, embryonated ascarid eggs were fed daily to the test pigs during the intervals from the 14th to 25th, and the 32nd and 39th days of the experiment. The intervals in question may be considered to approximate the period of invasion. As evidenced by the appearance of ascarid eggs in the feces of the host pigs, development of the worms to sexual maturity was completed, in the case of the pigs of groups 1 and 2, 56 days after the first administration of eggs or 69 days after the beginning of the experiment. In the case of the test pigs of groups 3 and 4 eggs first appeared in the feces 65 days after the first feeding of infective eggs, or 79 days after the beginning of the experiment. The period from the time of first appearance of eggs in the feces of the host to the end of the experiment is the stage of maturity of the worms. When the growth curves of the infected pigs involved in this experiment (Figs. 1 to 4) are considered from the standpoint of the three stages outlined, the following facts become apparent: (1) During the period of invasion of the lungs and liver of the host by the migrating larvae rather marked reductions in the growth rate of the individual animal occurred; (2) during the stage of growth and development of the worms, the growth rates of the infected pigs were approximately equal to those of the corresponding control pigs, except in the case of group 2, indicating that little, if any, deleterious effects were being exerted by the developing worms; and (3) beginning at approximately the time when eggs first appeared in the feces of the test pigs (period of maturity of the worms) a rather marked slowing down of the growth rates of the infected pigs occurred, except in the case of the lightly infected pig of group 3. This slowing down of the growth rate, coincident with attainment of sexual maturity by the worms, indicates that an adverse effect on the health of the host was being exerted by the mature worms. It is not considered that the data presented offer positive proof that conditions of unthriftiness commonly seen in ascarid-infected pigs can be attributed solely to the adult worms but they do provide strong support for such contention.

A new intermediate host (*Protoschelobates seghettii*, n. sp.: Acarina: Scheloribatidae) of the sheep tapeworm, *Moniezia expansa*. C. E. RUNKEL and K. C. KATES, U. S. Bureau of Animal Industry.

In the summer and fall of 1946, at the Zoological Division, Agricultural Research Center, Beltsville, Md., droppings from sheep containing large numbers of eggs of *Moniezia expansa* were spread in a thick layer over the surface of a small pasture plot. This plot had not been grazed by sheep for approximately 4 years. Prior to the distribution of the droppings, numerous soil samples were taken from this plot and found to contain considerable numbers of oribatid mites previously reported as intermediate hosts of sheep tapeworms and many additional species. Upon dissection these mites were found to be free from infection with the larval stages of this tapeworm. In the spring of 1947 oribatid mites were collected from turf samples from this experimentally infected plot by means of drying cones (somewhat modified from those described by Jacot (1936)) and several species of oribatid mites were found to contain cysticercoids of *M. expansa*. Among these infected mites one species was collected which appears to be an undescribed species of the genus *Protoschelobates* Jacot 1934, a genus of the family Scheloribatidae Grandjean (1933). The purpose of this paper is to describe this new vector of *M. expansa*. The terminology employed in the description follows that used by Jacot (1934, 1937). Detailed discussion of collection data, ecology, etc., of this oribatid mite and others collected will be reported in a later paper.

The writers gratefully acknowledge the very considerable assistance in the identification of this mite given by Dr. E. W. Baker, Acarologist, U. S. Bureau of Entomology and Plant Quarantine.

Protoschelobates seghettii, new species

Description.—This mite is a relatively small species, thinly sclerotized and light brown or amber in color. Length, based on numerous specimens, varied from 350 to 430 μ and the greatest width from 236 to 265 μ, Notogaster oval, slightly elongate; cephalothorax at base broader than long and tapering to rounded distal end of rostrum. Lamellae well developed; interlamellar, lamellar, and rostral bristles barbed, the rostral bristles appearing more distinctly barbed than the others; insertions of interlamellar bristles nearer to anterior rim of notogaster than to the lamellae. Rostral bristles (Fig. 1, C) stout and curve outward beyond distal end of rostrum; rostral bristle insertions more dorsal and more anterior than those of species of *Protoschelobates* described by Jacot (1934) and appear to be the main differential characteristic of this species. Lamello-rostral ridges and translamellae absent, but the rostral bristles are inserted at the anterior tips of slight rostral ridges, which do not extend posteriorly to connect with the lamellae. A transverse line is distinctly visible mid-way between rostral and lamellar bristle insertions. Pseudostigmatic organs extending anterior to pteromorphae, curving outward beyond tectopedia II (Figs. 1, A & C), and having slender pedicils and oval heads, which are longer than broad and covered with fine hair-like barbs. Pteromorphae flexible, not hinged to notogaster, curving ventral to form leg covers and confluent with body wall posteriorly. Anterior rim of pteromorphae not extending forward to be in line with anterior rim of notogaster. Abdomino-cephaloprothoracic or midthoracic suture distinct. Dorsal abdominal bristles and porose area pattern as illustrated (Fig. 1, A). Adalar porose areas small and perpendicular to lateral body line, their mesal edges being more rounded than distal edges nearest pteromorphae. A pseudofissura is located anterior to point of fusion of posterior edge of pteromorpha and wall of notogaster. Ventral plate well developed; tectopedia I absent, tectopedia II distinctly visible from dorsal

and ventral views, extending beyond plane of interlamellar bristle insertions, smooth in outline; tectopedia III as figured (Fig. 1, B), not clearly notched on external surface. Apodemata I, II–III, and IV distinct (Fig. 1, B), the mesal ends of fused

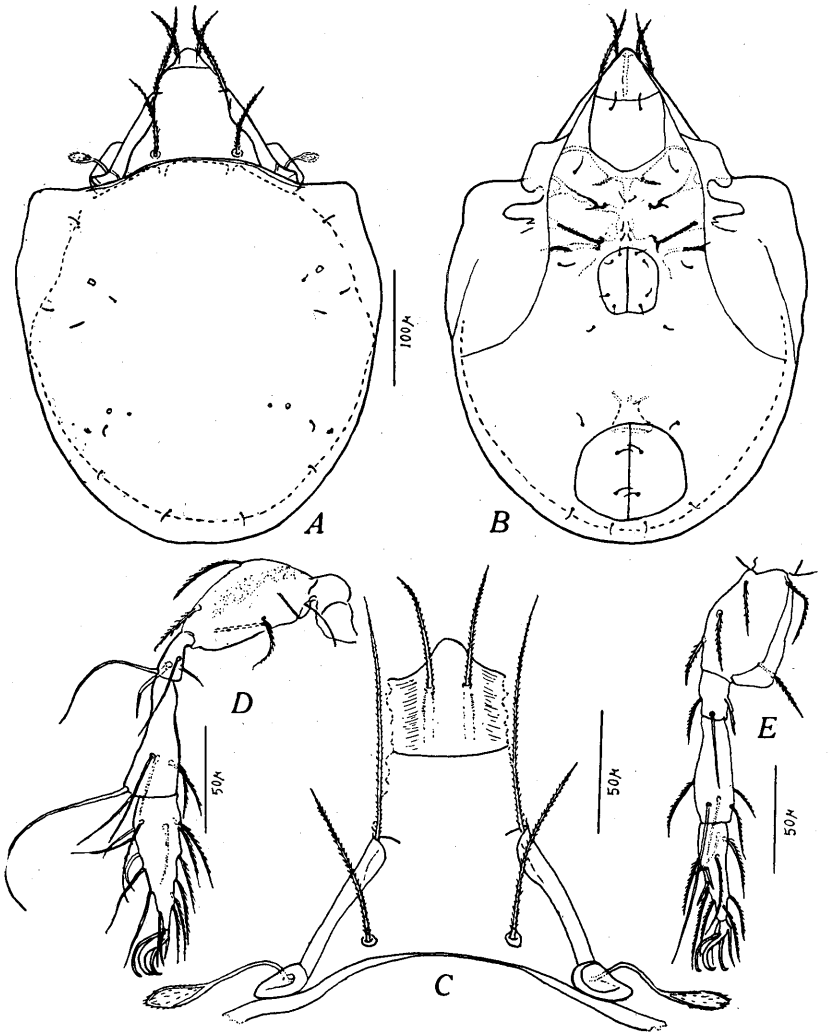

FIG. 1. *Protoschelobates seghettii*, n. sp. A—Dorsal view, specimen slightly flattened, to show pteromorphae extended; legs are omitted. Note far anterior insertion of rostral bristles. B—Ventral view showing important morphological features; legs are omitted. Note short apodemata IV, characteristic of the genus. C—Dorsal view of cephalothorax showing pseudostigmatic organs, interlamellar, lamellar and rostral bristles, lamellae, and absence of lamello-rostral ridges (a generic character). Portion of mite drawn was dissected and somewhat flattened to show the far forward insertion of rostral bristles and the slight rostral ridge extending a short distance posteriorly from bristle insertions, but not connecting with tips of lamellae. D—Leg I, showing arrangement of setae. E—Leg II, showing arrangement of setae.

apodemata II–III extending to marginal rim of genital aperture; mesal ends of apodemata IV remote from rim of genital aperture, the main generic character of *Protoschelobates* Jacot 1934. The genital plate has 4 pairs of bristles and anal

plate 2 pairs; small bristles of ventral plate (Fig. 1, B), exclusive of those on genital and anal plates, very similar in position and number to those of other species of the genus and apparently of little specific significance. Terminal ends of leg tarsi with three hooks, the median hook being larger than the laterals. Ventral setae of tarsus I ciliate and dorsal setae smooth (Fig. 1, D). The femur of leg II has 5 barbed setae (Fig. 5).

Type specimens.—U. S. Nat. Mus. No. 1782 (25 paratypes).

Discussion.—*P. seghettii* differs from *P. insularis* (Syn. *Murcia insularis* Oudemans), *P. insularis sandvicensis*, *P. vanzwaluwenburgi*, *P. pembertoni*, and *P. castlei*, as described by Jacot (1934), in that the rostral bristles are inserted more anteriorly toward the terminal end of rostrum and somewhat more dorsally. According to figures of known species, *P. seghettii* also appears to differ slightly in the conformation of tectopedia II and III.

As previously mentioned, prior to the distribution of sheep droppings containing eggs of *M. expansa* upon the experimental pasture plot in the spring of 1946, several thousand oribatid mites of various species were collected and examined by dissection for tapeworm cysticercoids. Cysticercoids were not found and this result is in accord with the fact that sheep had not grazed this pasture for a period of about 4 years. In the spring of 1947 cysticercoids were removed from several thousand oribatid mites of various species collected from this plot. Cysticercoids obtained from *P. seghettii* and other species were fed to parasite-free lambs and infections of *M. expansa* resulted in each case. Although to date cysticercoids obtained from *P. seghettii* alone have not been fed to parasite-free lambs, it appears certain that the cysticercoids obtained from this species were those of *M. expansa*. Of the numerous specimens of this mite examined approximately 6 per cent contained cysticercoids, the number per individual mite varying from 1 to 3. Three cysticercoids almost completely fill the body cavity of this mite, which is not a large species.

Potemkina (1941, 1944) found that in Russia *Galumna obvius* and *Scheloribates laevigatus* may act as intermediate hosts of *M. benedeni* as well as *M. expansa*. Baker (1945) described *Scheloribates chauhani* collected by B. S. Chauhan of the Zoological Survey of India while conducting sheep tapeworm studies. Oribatid mites of the genus *Scheloribates* are closely related to those of the genus *Protoschelobates*, as Jacot (1934) proposed the latter genus to receive those mites formerly placed in *Scheloribates*, but differing from other members of this genus by lacking lamello-rostral ridges and having short apodemata IV.

It is of interest that of certain related oribatid mites in the U. S. National Museum collection of Acarina which were referred to the writers by Dr. E. W. Baker, 14 specimens appear identical with the mite described herein. These mites were collected in 1945 from grass on winter bedding grounds of a band of sheep near Albion, Montana, by Dr. Lee Seghetti and sent to the U. S. National Museum for identification. This mite was the most numerous one in the sample submitted and was tentatively identified at the time by Dr. E. W. Baker of the U. S. Bureau of Entomology and Plant Quarantine as *Protoschelobates* sp. We, therefore, have named this mite in honor of Dr. Seghetti who first collected it in Montana.

In addition to the species described in this paper, the following mites have been reported as intermediate hosts of *M. expansa:*

Galumna sp.	Stunkard (1937, 1938)
Galumna sp.	Stoll (1938)
Galumna nigra	Stoll (1938)
Galumna emarginata	Krull (1939a, 1939b)
Galumna obvius	Potemkina (1941)
Scheloribates laevigatus	Potemkina (1941)

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The unsuitability of sodium fluoride as an anthelmintic for chickens. F. D. ENZIE and D. S. JAQUETTE, U. S. Bureau of Animal Industry.

On account of the significant anthelmintic action of sodium fluoride against large roundworms in swine,[1] inquiries have been received by the Department of Agriculture regarding the feasibility of employing the drug as an ascaricide for poultry.

The only published reference to the use of sodium fluoride as an anthelmintic in chickens is that of Habermann *et al.*[1] Feed containing 1.5 per cent of the drug, given for 10 consecutive days, was devoid of anthelmintic action in 2 chickens. The birds refused to eat an appreciable amount of the mixture, and the droppings consisted largely of urates. Congestion of the mucosa of the small intestine was observed in one bird at autopsy.

The tests reported herein were conducted with 27 mature birds, weighing from 4 to 7 pounds each, which previously had been given undetermined numbers of embryonated eggs of the large roundworm, *Ascaridia galli.* From 2 to 4 days before treatment, the birds were confined in a laying battery and the droppings screened daily in order to check upon the rate of spontaneous elimination of parasites. In one group of birds the chemical was administered in single doses in capsules at the rate of 0.1, 0.2, and 0.3 gram per pound of body weight. In a second group of birds it was given for 3 consecutive days at the rate of 0.5, 0.75, and 1.0 per cent of the feed; regular feed was withheld for approximately 18 hours before treatment. The droppings were collected and examined for parasites for 4 days after treatment in the former group and for 7 days after the start of treatment in the latter. At the end of the test period the birds were autopsied and examined for parasites and lesions.

The results are given in table 1. In single doses, the chemical exhibited increased ascaricidal action with increased dosage. The efficacy of the drug

[1] Habermann, R. T., Enzie, F. D., and Foster, A. O. 1945. Amer. Jour. Vet. Res. 6: 131–144. Allen, R. W. 1945. No. Amer. Vet. 26: 661–664. Allen, R. W. and Jones, L. D. 1946. *Ibid.* 27: 358–360.

TABLE 1.—*Data on the action of sodium fluoride as an anthelmintic in chickens*

No. of birds	Dosage	Method of administration	Parasites	Removed	Left	Efficacy (per cent)	Remarks
4	0.1 gm./lb.	In capsules	Ascaridia	9	12	42	5 ascarids and 1 heterakid eliminated before treatment
			Heterakis	3	404	0.7	
4	0.2 gm./lb.	do	Ascaridia	59	19	75	3 ascarids eliminated before treatment; 2 birds died
			Heterakis	3	512	0.5	
4	0.3 gm./lb.	do	Ascaridia	61	2	96	2 birds died
			Heterakis	43	207	17	
5	0.5 per cent	In feed	Ascaridia	38	52	42	2 ascarids and 1 heterakid eliminated before treatment
			Heterakis	21	260	7.4	
5	0.75 per cent	do	Ascaridia	20	23	46	4 ascarids and 7 heterakids eliminated before treatment
			Heterakis	25	347	6.7	
5	1.0 per cent	do	Ascaridia	52	17	75	3 ascarids and 1 heterakid eliminated before treatment; ascarids not present in 1 bird
			Heterakis	9	354	2.4	

against heterakids, however, was insignificant at all dosages. Approximately 5 hours after treatment all of the birds seemed depressed and were passing fluid feces. The droppings were mucoid and diarrheal for several days after treatment, the severity of these symptoms depending somewhat on the size of the dose. Two birds in each of the two groups receiving the highest dosages died, and a slight to severe enteritis was found in these birds at autopsy. In 6 of the 8 surviving birds, a slight to moderate enteritis was found.

An increase in ascaricidal action was again exhibited as the percentage of the chemical in the feed was increased, but the efficacy against heterakids was likewise insignificant at all dosages. In all groups, the feed mixtures were consumed less readily than regular feed, and the droppings were mucoid and less abundant on the second and third days after treatment. In general, the alteration in the character and amount of the feces was correlated with the percentage of sodium fluoride in the feed. The feces returned to normal promptly when the birds were returned to regular feed. All of the birds survived the treatment, and a slight or moderate enteritis was found in only 3 of the 15 birds at autopsy.

It was impossible to obtain an accurate measurement of the medicated feed consumed because of wastage by the birds. Nevertheless, a conservative estimate of the feed consumption indicated that these birds received at least as much of the drug during the test period as those that were given the chemical in single doses in capsules. It is noteworthy that, with the two methods of administration, comparably increased ascaricidal action was exhibited by proportionate increases in dosage, whereas greater morbidity and mortality were associated with administration of the chemical in capsules.

In the trials described, an ascaricidal action of sodium fluoride in chickens was demonstrated by administering the chemical in capsules and in the feed, but effective dosages of the drug administered in capsules were extremely toxic, and significant ascaricidal action was not exhibited by tolerated dosages given in feed. While the compound appeared, therefore, to be somewhat less toxic when given in the feed, effective doses by either method were so toxic as to preclude any practical anthelmintic use of sodium fluoride in chickens.

Observations on the fat content of hermit crabs parasitized by a bopyrid. EDWARD G. REINHARD, THEODOR VON BRAND, and SARAH F. MCDUFFIE, Catholic University of America, Washington, D. C.

Although parasites derive their food from their hosts, the quantity of food withdrawn from the latter is usually not significant and in any case hardly sufficient to bring about metabolic disturbances. Where such changes occur it is more likely that they are caused by toxic metabolic endproducts that may be produced directly or indirectly by the parasite. It has been claimed (Smith, 1911, 1913; Robson, 1911) that the fat consumption of sacculinids is responsible for the disturbed fat metabolism of infected crabs. However, more recent studies (Reinhard and von Brand, 1944) have led to the view that the production of the sacculinid of toxic substances may lie at the root of these disturbances.

Physiologically, the relationships between parasitic crustacea and their hosts are complex. This is especially true of the rhizocephalids studied by the above workers, where the organism possesses a system of roots, probably absorptive in nature, which ramify through the host body. The bopyrids, on the other hand, are purely external parasites that obtain their food by piercing the integument of the host with their mouth parts and imbibing its body fluids. Only one case among the Bopyridae has been studied with respect to fat relationships. Hughes (1940) stated that the fat content of male *Upogebia* parasitized by *Gyge branchialis*

was increased from 1.04 to 1.6 per cent, while normal and parasitized females showed no difference. In the present paper an additional case is presented, that of *Pagurus longicarpus* Say parasitized by the bopyrid *Stegophryxus hyptius* Thompson.

MATERIAL AND METHODS

Parasitized and non-parasitized *Pagurus longicarpus* of all available sizes were collected in July and August 1943 and 1946 at Woods Hole, Mass. They were gathered by hand from shallow water at low tide. After removal from the snail shell they were preserved in 8 per cent formalin. The hermit crabs were then separated into groups according to size and sex, parasitized and non-parasitized, and subjected to chemical and morphological observations. Only parasitized crabs infested with a well-developed female *Stegophryxus* were used to eliminate any possible differences in the host material arising from major differences in size of the parasites. The parasites, however, were removed from the crabs before the latter were subjected to chemical analysis in order to secure data on the hosts alone.

For the chemical study, groups of entire crabs were employed, the size categories ranging from 4 to 8 mm. carapace-length; but for the morphological study, single animals of approximately average size (5 and 6 mm. carapace-length) were selected.

The analytical procedures used in the chemical determination of fat have been described previously (Reinhard and von Brand, 1944). The morphological fat observations, based on 20 μ-thick sections cut on the freezing microtome and stained in an aqueous solution of Sudan IV (Govan, 1944), were restricted to the liver, since preliminary investigations had shown that no morphologically demon-

TABLE 1.—*Chemically determined fat content of normal Pagurus longicarpus and crabs parasitized by Stegophryxus hyptius*

Crabs			Dry weight per animal	Chitin	Ether extract	
Number used	Parasitized (P) or Normal (N)	Carapace length mm.	in gm.	per cent	Per cent of total dry weight	Per cent of dry weight less chitin
			Females			
92	N	5	30	60	2.05	5.02
40	P	5	30	60	1.83	4.60
62	N	6	57	60	2.54	6.38
25	P	6	52	62	2.60	7.07
30	N	7	76	59	2.90	6.99
8	P	7	86	63	3.32	8.80
16	N	8	102	56	4.58	10.20
			Males			
144	N	4 to 5	25	56	2.45	5.55
29	P	4 to 5	33	58	2.01	4.79
42	N	6	53	55	3.27	7.13
26	P	6	54	61	1.94	5.07
30	N	7	118	55	3.18	7.06
11	P	7	84	61	3.63	9.06
18	N	8	147	63	3.38	9.30

TABLE 2.—*Histologically determined fat content of the liver of normal Pagurus longicarpus and crabs parasitized by Stegophryxus hyptius*

	No. of normal male crabs			No. of parasitized male crabs		
	5 mm. Cp.L.[a]	6 mm. Cp.L.	Total	5 mm. Cp.L.	6 mm. Cp.L.	Total
Stage 0	1	1	2	0	0	0
Stage 1	1	3	4	2	1	3
Stage 2	1	1	2	0	1	1
Stage 3	4	4	8	3	2	5
Stage 4	1	0	1	1	4	5
Total cases	8	9	17	6	8	14
Average fat	2.4	1.9	2.1	2.5	3.1	2.9

	No. of normal female crabs			No. of parasitized female crabs		
	5 mm. Cp.L.	6 mm. Cp.L.	Total	5 mm. Cp.L.	6 mm. Cp.L.	Total
Stage 0	0	0	0	0	0	0
Stage 1	1	0	1	1	0	1
Stage 2	0	1	1	1	0	1
Stage 3	6	2	8	3	4	7
Stage 4	1	3	4	1	3	4
Total cases	8	6	14	6	7	13
Average fat	2.9	3.3	3.1	2.7	3.4	3.1

[a] Cp.L. = carapace length.

strable fat occurs in the other chief organs of the crabs. The stained sections, mounted in glychrogel were individually rated for fat content, and an average taken for each animal. An arbitrary scale, ranging from 0 (no fat droplets at all) to 4 (the cells of the tubule, with the exception of the ferment cells, almost completely filled with fat droplets) was used to establish a semi-quantitative picture of the morphological fat distribution.

RESULTS AND DISCUSSION

The results of our chemical and morphological observations are summarized in tables 1 and 2. The former shows clearly that the fat content of both normal and parasitized female and male hermit crabs is dependent on their age. The largest, that is oldest, crabs contained considerably more fat than the youngest, smallest ones. The differences between parasitized and non-parasitized crabs of one and the same size are irregular and cannot be considered as significant. In addition to the data of table 1 a quantitative fat determination was carried out in the parasites themselves. Ninety specimens, weighing 297 mgm. yielded 56 mgm. ether extract corresponding to 18.9 per cent. This is only slightly less than found previously (Reinhard and von Brand, 1944) in the external sacs of *Peltogaster paguri.*

The morphological data revealed rather pronounced variations in the fat content both between liver tubules of the same crab and between livers of various crabs belonging to the same class. Liver tubules showing but little fat usually had all the fat globules restricted to a few adjoining cells instead of being scattered throughout the cross-section. Sometimes the fat globules were in the bases of the ferment cells, sometimes the cluster of fat was found in the fat cells at the opposite side of the tubule. This latter condition was especially characteristic of

Stage 2 (Fig. 1, A). When much fat was present it was found in practically all fat cells, thus forming an almost complete ring in tubules seen in cross-section (Fig. 1, B). In all cases, however, the distal vacuolated parts of the ferment cells were entirely fat-free.

Despite the great range of individual differences, the average numerical fat values for parasitized and non-parasitized crabs of the same sex and size are quite similar if we except the 6-mm. males. The non-infected males of this particular group yielded an abnormally low value. We are inclined to believe that this result is due to the variations in fat content noted above, which in this case were not eliminated because of the small numbers of animals employed. In any event, the chemical analysis of the same size group, gave exactly the opposite picture from the morphological study; that is, the infected specimens yielded somewhat less fat than the uninfected ones.

We therefore reach the conclusion that *Pagurus longicarpus* parasitized by *Stegophryxus hyptius* shows no definite change in its fat content. This agrees, in so far as females are concerned, with Hughes' (1940) findings on *Upogebia*

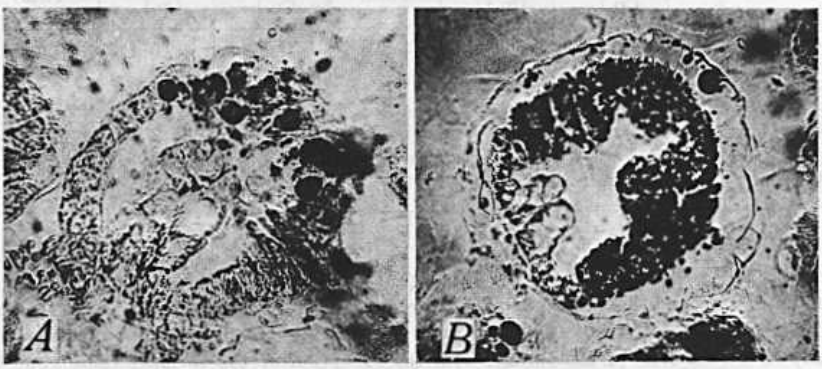

FIG. 1. A—Cross section of liver tubule of *Pagurus longicarpus* stained with Sudan IV showing stage 2 fat content. B—Liver tubule of another crab showing stage 4 fat content.

infested by *Gyge;* it disagrees with his findings on males. *Stegophryxus,* unlike *Gyge,* does not cause any noticeable alteration in the primary or secondary sex characters of the host. In this respect the two cases are not exactly comparable. But inasmuch as Hughes does not mention whether or not his parasitized and non-parasitized specimens had the same size, in view of the differences we found in fat content between smaller and larger pagurids, the case of *Upogebia* will require reinvestigation before Hughes' findings can be accepted as proven beyond doubt.

SUMMARY

1. Young specimens of *Pagurus longicarpus* have less fat than older ones.

2. No significant difference exists in fat content between normal crabs and specimens parasitized by *Stegophryxus,* if identical size classes are compared.

3. The parasites themselves have a very high fat content.

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A redescription of *Taenia taxidiensis* Skinker, 1935. ROBERT RAUSCH, Department of Veterinary Science, University of Wisconsin, Madison.[1]

Since the original description of *Tacnia taxidiensis* Skinker, 1935,[2] was based on an incomplete and apparently immature cestode, a redescription seems desirable.

The following description is based on 28 cestodes, taken from three infected badgers, *Taxidea taxus* (Schreber), all collected in southern Wisconsin. Of these, only one strobila had gravid segments, the others being immature. Most of the data given below are based on the single mature specimen, with additional measurements, where possible, from the immature worms. No sections were made of these specimens, and the measurements given were taken from stained whole-mounts.

Taenia taxidiensis Skinker, 1935

Description.—Strobila 480.0 mm. long, with greatest width, about 3 mm., attained in post-mature segments. Segments increase in length toward end of strobila; gravid segments become narrower, with a length of from 8.0 to 8.5 mm. Strobila with 242 segments; in addition, a few shed proglottids were found in the feces of the host. Calcarious corpuscles abundant.

Scolex (Fig. 1) averages 570 μ in diameter (497 to 596 μ); suckers average 156 μ in diameter. Rostellum armed with from 20 to 27 hooks, arranged in a single row, and from 79 to 99 μ long. Average length of hooks 90 μ; handle and guard nearly of equal length; the former averages 54 μ and the latter 46 μ, both about 16 μ wide at base, tapering toward end to about 10 μ; blade of hook strongly arched.

Ventral excretory canals about 142 μ in diameter; somewhat variable in diameter in the same segment, and tending to narrow at segmental borders. Transverse canals of same diameter as ventral canals. Dorsal canals sinuous, with average diameter of 20 μ; situated medial to ventral canals.

Genital pores irregularly alternate, situated slightly anterior to middle of segment; genital papillae prominent; genital atrium about 56 μ deep. Cirrus sac, from 240 to 330 μ long by about 100 μ wide, extending to, or slightly past, marginal edge of poral ventral excretory canal. Extruded cirrus about 70 μ long by 56 μ wide; without spines. Ductus ejaculatorius somewhat coiled within cirrus sac; vas deferens forms numerous coils medial to ventral excretory canal. Testes, from 200 to about 300 in number, ovoid, measuring in mature segments from 70 to 90 μ, confined to area between ventral excretory canals, and extending posteriorly to slightly past margin of vitalline gland; some overlap the latter, and

[1] Section of Parasitology, B. B. Morgan, In Charge. This work supported in part by the Research Committee of the Graduate School from funds supplied by the Wisconsin Alumni Research Foundation.

[2] Skinker, M. S. 1935. Two new species of tapeworms from carnivores and a redescription of *Taenia laticollis* Rudolphi, 1819. Proc. U. S. Natl. Mus. **83**(2980): 211–220.

appear to be confluent at its posterior margin. Area around lobes of ovary, and between ovary and vitelline gland, free from testes. A solid band of testes extends from anterior edge of ovary forward to margin of the segment, overlapping the uterus.

Vagina, of nearly equal diameter throughout, opening posterior to cirrus sac, and at same level; course direct, inward and downward, without undulations.

Ovarian lobes hemispherical; aporal lobe always larger. Vitelline gland about same size as smaller lobe of ovary, and usually extends full width of latter. Mehlis' gland spherical; about 112 μ in diameter. Uterus extends to anterior margin of segment; lateral branches appear first at anterior end, average 10 on a

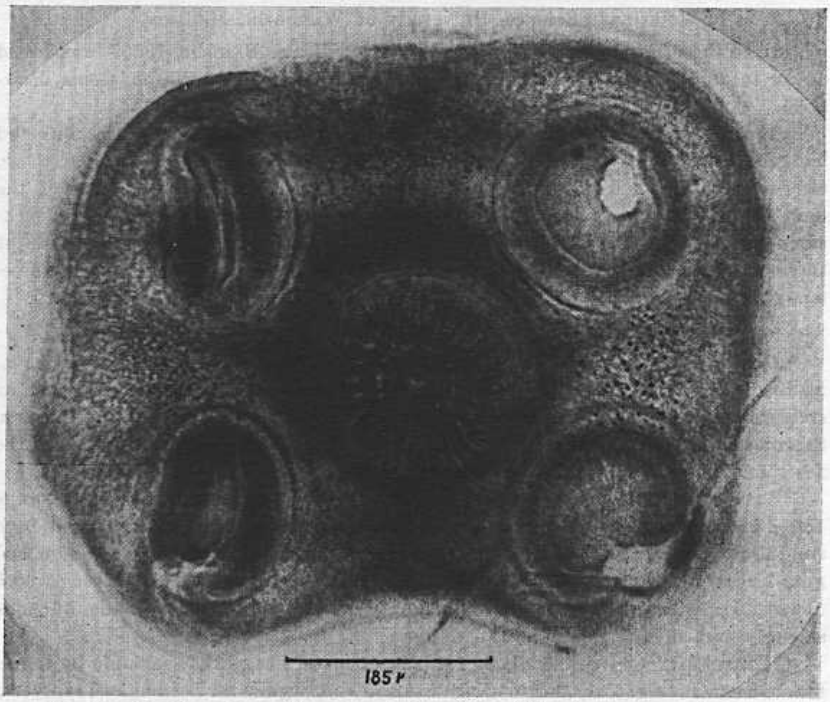

FIG. 1. *En face* view of scolex of *Taenia taxidiensis* showing single row of hooks. Photomicrograph by D. H. Ferris.

side, with secondary branching as segments become older. Uterine branches recognizable in terminal gravid segments.

Eggs spherical, very numerous; shell pitted; average diameter 31 μ; embryo averages 20 μ in diameter.

Host.—*Taxidea taxus* (Schreber).

Habitat.—Small intestine.

Locality.—Described from Granite County, Montana. Recorded by the present writer from Dane and Sauk Counties, Wisconsin.

DISCUSSION

The single row of hooks apparently is unique for North American cestodes of the genus *Taenia*. It was at first the opinion of the writer that one row of hooks had been lost, although there was no apparent cause for this. Subsequent examinations of additional material, obtained from other host animals, disclosed

the scolices armed with a single row of hooks to be complete. Ortlepp[3] lists only one species, *Taenis monostephanos* Linstow, 1905, as having a single row of hooks. This species was described from the lynx in Russia.

Some of the measurements given in the present paper differ considerably from those in the original description, but this can probably be attributed to normal variation, and to the fact that the original description was based on an immature specimen.

The intermediate host of *T. taxidiensis* is not known; however, considering the food-habits of the badger, it may be a species of ground squirrel.

An undetermined parasite in the lungs of a rock rabbit, *Ochotona princeps* Richardson (Lagomorpha: Ochotonidae).[1] WILLIAM L. JELLISON, United States Public Health Service.

An adult male rock rabbit, *Ochotona princeps* Richardson, weighing 146 grams, was collected for parasitological examination along the Meadow Creek Trail in

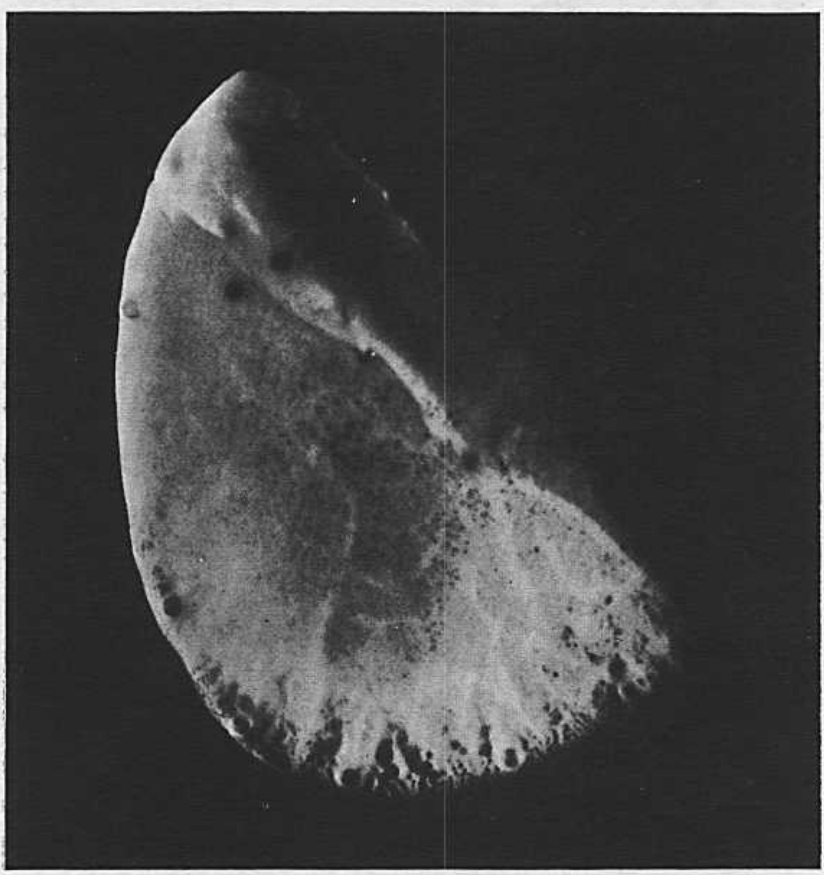

FIG. 1. Tip of lung with imbedded parasites. Photographs for this and following figures by Nick J. Kramis, Photographer, Rocky Mountain Laboratory.

[3] Ortlepp, R. J. 1938. South African helminths—Part II. Some taenias from large wild carnivores. Onderstepoort Jour. Vet. Sci. **10**: 253–274.

[1] From the Rocky Mountain Laboratory of the Division of Infectious Diseases, National Institute of Health.

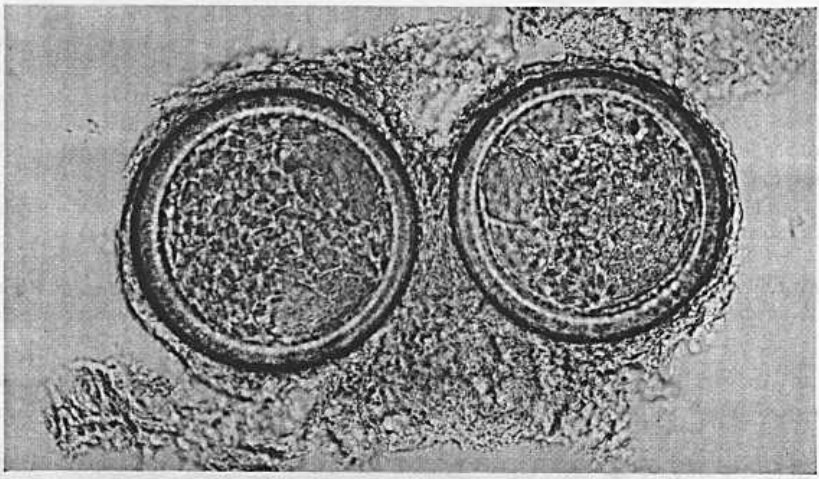

FIG. 2. Small portion of lung tissue with 2 adjacent parasites.

the East Fork Valley, Ravalli County, Montana, July 24, 1944. The lungs of this animal were observed to contain numerous discrete bodies, quite uniform in size but varying in color from white to gray and black. These bodies were distinctly visible to the unaided eye (Fig. 1). Gross appearance suggested necrotic foci characteristic of certain bacterial infections, but microscopical examination revealed spherical parasites 360 μ to 390 μ in diameter. Some were near the surface, others were deeply imbedded in the lung tissues. The darker ones contained black vitreous material which was difficult to crush under a microscope cover slip. They were not found in other tissues. Pieces of lung were preserved in formalin for histological study, but unfortunately suitable tissue was not saved for animal inoculation or culture.

The observed bodies (Figs. 2 and 3) showed some resemblance to the

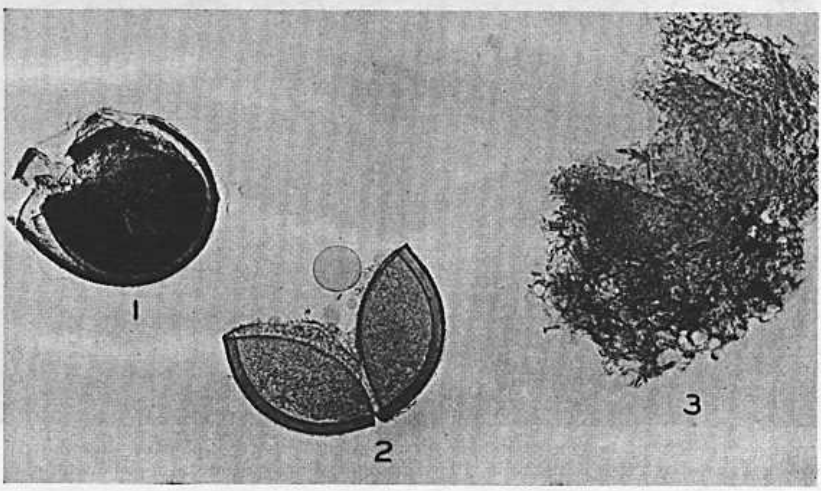

FIG. 3. A parasite (1) freed from its capsule (2) and surrounding lung tissue (3). Ruptured by pressure on coverslip. Whole mount.

"spherules" of *Coccidioides immitis*, a fungus infecting man and animals which has been found in several species of native rodents in the arid regions of the southwestern states by Emmons.[2] Formalin-preserved tissues were sent to Dr. C. W. Emmons, mycologist, and Dr. L. L. Ashburn, pathologist, at the National Institute of Health, U. S. Public Health Service. Both replied that the large size of the organisms and other characters excluded the probability of these bodies being *Coccidioides immitis*, and that definite identification would have to wait culture or animal inoculation with fresh material. It is not certain that these bodies represented a fungus parasite, nor have they been identified as any known stage of a protozoan or a metazoan parasite.

Several rock rabbits were collected in the same area and other places in Ravalli County but only the one infected animal has been found.

New species of the genus *Parafilaroides* Dougherty, 1946 (Nematoda: Metastrongylidae), from sea-lions, with a list of the lungworms of the Pinnipedia.

ELLSWORTH C. DOUGHERTY, Department of Zoology, University of California, Berkeley, California, and CARLTON M. HERMAN, California Division of Fish and Game, Strawberry Canyon, Berkeley, California.

INTRODUCTION

During the year 1940 one of us (Herman), while at the Biological Research Institute of the San Diego Zoölogical Society, had the opportunity of autopsying a number of captive sea-lions indigenous to the coast of California, including 24 California sea-lions (*Zalophus californianus*) and one Steller sea-lion (*Eumetopias jubata*). Subsequently, on March 23, 1943, the other (Dougherty) was present at the autopsy of a male California sea-lion performed by Dr. Stuart Lindsay of the Division of Pathology, University of California Medical School, San Francisco. This animal had died in the outdoor sea-lion pool of the California Academy of Sciences, San Francisco. In the lung parenchyma of two of the 24 *Z. californianus* and the single *E. jubata* examined in 1940 and of the male of the former species autopsied in 1943 we have found small nematode worms. In *Z. californianus* there has been encountered only one type of worm, of which numerous females were collected from the three infected animals, but of which males were recovered only from the sea-lion autopsied by Dr. Lindsay. Males of this form are much smaller than the female worms and must be sought very carefully. From *E. jubata* were recovered three types of worms, a very small species, of which several females and but one male were collected, and two larger forms represented by female worms only.

As indicated, the sea-lions from which lungworms are reported in this paper were all captive "zoo" animals. The exact geographical origins of the individual infected animals are not known further than that they were caught in California waters; therefore, the type localities for the new species of lungworms described herein cannot be given more precisely than as "California coast." As given by the bureau of Marine Fisheries of the California Division of Fish and Game (1947), California sea-lions occur from Point Reyes, California, southward into Mexican waters, and Steller sea-lions occur from Alaska southward to the islands off southern California.

I. HISTORICAL SUMMARY

Nematodes in the lungs of pinnipedes (seals and their relatives) were first recorded by Henrik Krøyer (1841), editor of Naturhistorisk Tidsskrift, as a foot-

[2] Emmons, C. W. 1943. Coccidioidomycosis in wild rodents. A method of determining the extent of endemic areas. Pub. Health Rept. 58: 1–5.

note to a paper by Eschricht;[1] Krøyer reported finding them in the Common harbor seal (*Phoca v. vitulina*) of European waters. He did not describe or name them, however. Huet (1882) found, but also did not name, lungworms in a California sea-lion, captive in the zoo of the Muséum d'Histoire Naturelle, Paris; they were probably the same species as described from this host and named herein for the first time.

Railliet (1899) described two species from the Common harbor seal and named them *Pseudalius gymnurus* and *Strongylus circumlitus*. In placing the former species in the genus *Pseudalius* Dujardin, [1844], he recognized its strongyline affinities despite the fact that it lacked the bursa typical of the suborder Strongylina. *Pseudalius* was at that time used for strongyline nematodes with greatly reduced bursae, occurring mostly in porpoises. Baylis and Daubney (1925) in a review of the lungworms of porpoises placed *Pseudalius gymnurus* in their new genus *Halocercus*, which otherwise was composed of porpoise lungworms exhibiting extreme reduction of the bursa and bursal rays. Subsequently the fact has been recognized (Dougherty, 1943, 1944, 1946a) that the affinities of this species are actually with certain metastrongylids of terrestrial mammals rather than with those of odontocete cetaceans (porpoises and their relatives). It was first placed (Dougherty, 1943, 1944) in the genus *Filaroides* v. Beneden, 1858, but more recently (Dougherty, 1946a) a new genus, *Parafilaroides*, has been raised with it as genotype and placed in the subfamily Filaroidinae Skriabin, 1933, of the family Metastrongylidae.

For *Strongylus circumlitus* Railliet, 1899, a new genus, *Otostrongylus*, was erected by de Bruyn (1933). Later that same year Skriabin (1933) described a new genus and species, *Kutassicaulus andrecwoi*, from two subspecies of the Ringed seal (*Phoca hispida ochotensis*[2] and *P. h. pomororum*[3]). Schuurmans Stekhoven (1935) later synonymized *Kutassicaulus* Skriabin, 1933, with *Otostrongylus* de Bruyn, 1933. This genus thus has two species and is peculiar to seals. Recently *Otostrongylus* has been transferred by one of us (Dougherty, 1945) to the family Trichostrongylidae Leiper, 1912, from the family Metastrongylidae Leiper, [1909], to which it had been referred up to that time.

Since Huet's report in 1882 lungworms have only recently been recorded from sea-lions again. Specimens recovered from the California sea-lion (by Herman, 1942) were first referred to as "Pseudaliids" (*i.e.*, members of the subfamily Pseudaliinae Railliet and Henry, 1909, of the family Metastrongylidae); but in two subsequent papers (Dougherty, 1943, 1946a) these same specimens and also previously unrecorded lungworms from the Steller sea-lion have been successively termed *Filaroides* spp. and *Parafilaroides* spp. and placed in company with the species now known as *Parafilaroides gymnurus* (Railliet, 1899) Dougherty, 1946. In the second of these two papers Herman (1942) was erroneously quoted as having referred to the species in *Zalophus californianus* as *Halocercus* sp. In both papers only two species have been indicated as occurring in *Eumetopias jubata*, but further study has revealed a single female of a third form that may represent a new species. The one species in *Z. californianus* and two of the three forms in *E. jubata* are described and named herein for the first time. The third form in the latter host is described as *Parafilaroides* sp., not being more exactly identified for lack of sufficient morphological data.

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[1] This footnote (p. 221) reads: "Derimod har dette Tidsskrifts Redaktør fundet Strongyler i talløs Mængde i Luftrøret af Sælhunde (*Phoca vitulina*) fra Øresundet. [On the contrary the editor of this journal has found strongyli in countless numbers in the trachea of the Harbor seal (*Phoca vitulina*) from Øresundet.]"

[2] Given by Skriabin as *Phoca hispida*.

[3] Given by Skriabin as *Phoca foetida*.

II. THE GENUS PARAFILAROIDES

The genus *Parafilaroides* Dougherty, 1946, forms a compact group of lungworm species restricted to the suborder Pinnipedia of the order Carnivora as their host group.

Parafilaroides is the most degenerate genus of the Filaroidinae, somewhat comparable to *Halocercus* Baylis and Daubney, 1925, in the Pseudaliinae. Although these two genera are similar in the extreme reduction of bursal rays in the male, *Parafilaroides* is the more degenerate, being in fact the most regressive of the whole family Metastrongylidae. Furthermore, as indicated in an earlier paper (Dougherty, 1946a), we feel that these two genera represent the end products of two separate, though convergent lines, in the Filaroidinae and Pseudaliinae respectively. In a recent reclassification of the suborder Strongylina (Dougherty, 1946b), these two subfamilies constitute two of the four (Filaroidinae, Pseudaliinae, Metastrongylinae, and Protostrongylinae) into which the family Metastrongylidae Leiper, [1909], may be subdivided.

The species of *Parafilaroides* include *Parafilaroides gymnurus* (Railliet, 1899) Dougherty, 1946 (genotype), from the Common harbor seal (family Phocidae); *Parafilaroides decorus*, sp. nov., from the California sea-lion (family Otariidae); and *Parafilaroides nanus*, sp. nov., and *Parafilaroides prolificus*, sp. nov., from the Steller sea-lion (family Otariidae); in addition there is the unnamed *Parafilaroides* sp. from the last-named host.

For the diagnosis of the genus we refer to the recent paper by Dougherty (1946a).

III. NEW SPECIES OF PARAFILAROIDES

Phylum Nematoda
Class Phasmidea
Order Rhabditida—Suborder Strongylina
Family Metastrongylidae Leiper, [1909]
Subfamily Filaroidinae Skriabin, 1933
Genus *Parafilaroides* Dougherty, 1946

Parafilaroides decorus,[4] sp. nov.
Fig. 1

Synonymy.—Pseudaliid, of Herman, 1942; *Filaroides* sp., of Dougherty, 1943; "*Halocercus* sp., of Herman, 1942," of Dougherty, 1946; *Parafilaroides* sp., of Dougherty, 1946.

Diagnosis.—Relatively long, slender worms in comparison with *P. nanus* and *P. prolificus;* paired subventral glands clearly evident, 170 to 215μ long; anterior end narrow; nerve ring 62 to 78μ from anterior end. *Male* (2 specimens completely measured): 6 to 7 mm. long, 92μ in maximum width; oesophagus, 120 to 125μ long, 12μ in maximum width; bursa totally lacking, and only two subterminal papillae (?phasmids) present on the tail; spicules slender, delicate, essentially equal, 35μ long, each exhibiting a small capitulum constricted from the lamina; gubernaculum present, less than 10μ long, with exact configuration not determinable in present specimens. *Female* (15 specimens more or less completely measured): 16 to 21 mm. long, 165μ in maximum width; oesophagus, 155 to 170μ long, 21μ in

[4] Decorus (L., graceful); so named because worms of this species present a gracefully coiled appearance when freed from the host tissues. *Parafilaroides* is here treated as being of masculine gender. In Greek the suffix "-oides" may occur on words that are masculine or feminine, depending upon their intrinsic meaning. But in the neo-Latin of zoölogical nomenclature the gender of genera ending in "-oides" can only be arbitrarily decided. We prefer to fix it as masculine in this case.

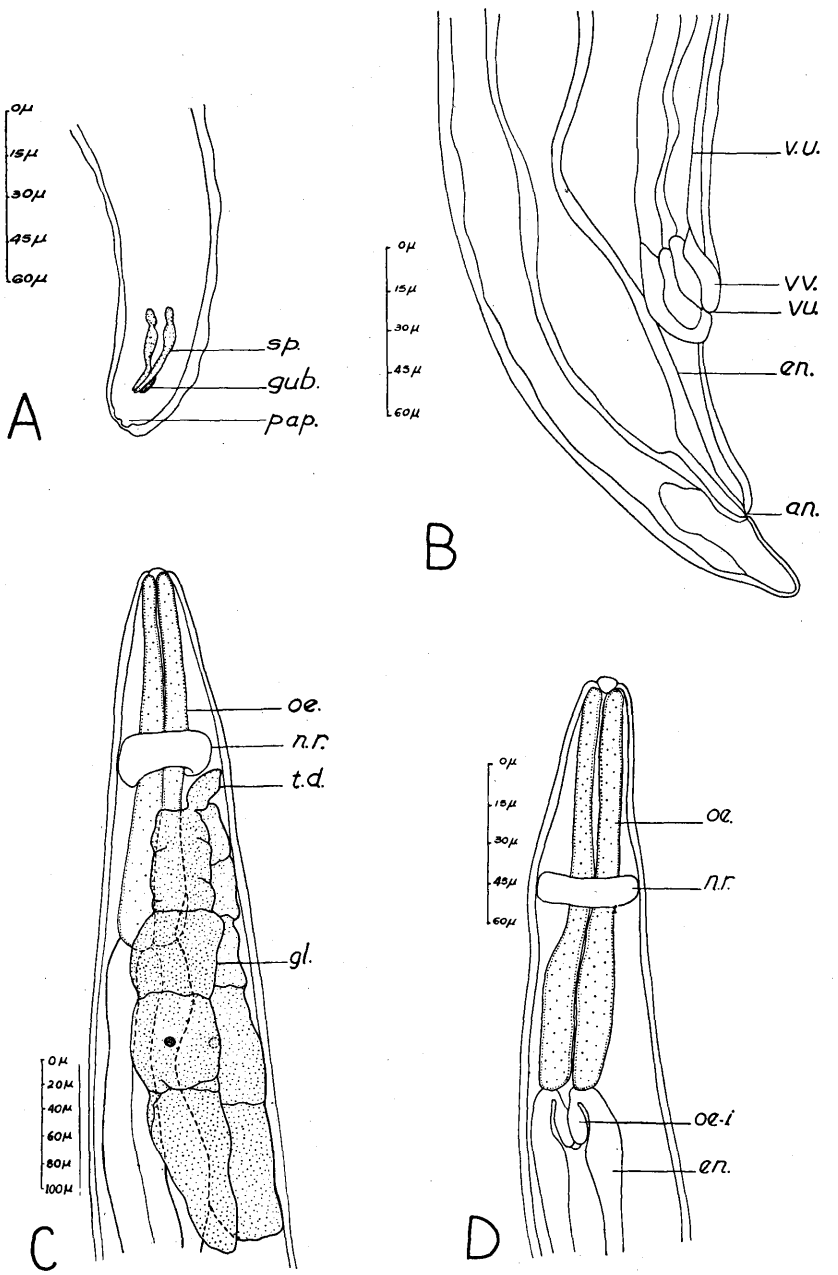

FIG. 1. *Parafilaroides decorus*, sp. nov. A—Male posterior end, ventrolateral view. B—Female posterior end, lateral view. C—Female anterior end, lateral view, showing subventral glands. D—Female anterior end, showing oesophagointestinal valve. *an.*, anus; *en.*, mesenteron or intestine; *gl.*, subventral gland; *gub.*, gubernaculum; *n.r.*, nerve ring; *oe.*, oesophagus; *oe-i.*, oesophagoïntestinal valve; *pap.*, terminal papilla; *sp.*, spicule; *t.d.*, terminal duct of subventral gland system; *vu.*, vulva; *v.u.*, vagina uterina; *v.v.*, vagina vera. Original. All figures drawn with the aid of the camera lucida.

maximum width; anus, 18 to 32μ from posterior end; vulva, 47 to 59μ anterior to anus; vagina vera, 27 to 33μ long; vagina uterina, 155 to 290μ long; uteri filled terminally with hundreds of tightly packed embryos.

Type host.—California sea-lion, *Zalophus californianus* (Lesson).

Location.—Rolled up in tiny knots in lung parenchyma.

Geographical distribution.—California coast (type locality).

Type specimens—Holotype male and allotype female, U. S. Nat. Mus. Helm. Coll. No. 36948; paratypes in authors' collections.

Parafilaroides nanus,[5] sp. nov.
Fig. 2

Synonymy.—*Filaroides* sp., of Dougherty, 1943; *Parafilaroides* sp., of Dougherty, 1946.

Diagnosis.—Very short worms, relatively thicker than *P. decorus;* cuticle marked by faint, closely spaced, annular striations and rather loosely applied to hypodermis in both sexes; anterior end broad, with rough outline of hypodermal cells clearly evident, but without easily defined subventral glands; nerve ring not distinguished. *Male* (1 specimen): 2.8 mm. long, 105μ in maximum width; anterior end damaged and oesophagus not measurable; spicules slightly less delicate than those of *P. decorus*, 39μ long, distal ends possibly fused; gubernaculum about 10μ long. *Female* (4 complete specimens): 4.5 to 5.2 mm. long, 215μ in maximum width; oesophagus, 185 to 195μ long, 35μ in maximum width; anus, 40μ from posterior end; vulva, 55 to 60μ anterior to anus; vagina vera, 40 to 45μ long; vagina uterina, up to 340μ long; relatively few embryos present in uteri.

Type host.—Steller sea-lion, *Eumetopias jubata* (Schreber).

Location.—In lung parenchyma.

Geographical distribution.—California coast (type locality).

Type specimens.—Holotype male and allotype female, N. S. Nat. Mus. Coll. No. 36949; paratypes in authors' collections.

Parafilaroides prolificus,[6] sp. nov.
Fig. 3, A–B

Synonymy.—*Filaroides* sp., of Dougherty, 1943; *Parafilaroides* sp., of Dougherty, 1946.

Diagnosis.—Worms resembling *P. nanus*, but almost twice as long. *Male:* unknown. *Female* (1 complete and several fragmentary specimens): 9 mm. long (1 fragment about 10 mm. long), 240μ in maximum width; oesophagus, 185μ long, 38μ in maximum width; anus, 45μ from posterior end; vulva, 65μ anterior to anus; vagina vera, 40μ long; vagina uterina, 255μ long; uteri containing hundreds of embryos, although not so uniformly distributed nor so numerous as in *P. decorus.*

Type host.—Steller sea-lion, *Eumetopias jubata* (Schreber).

Location.—In lung parenchyma.

Geographical distribution.—California coast (type locality).

Type specimen.—Holotype female, U. S. Nat. Mus. Helm. Coll. No. 36950.

Parafilaroides sp.
Fig. 3, C

Synonymy.—None.

Description.—Single female, resembling *P. decorus* in general shape and size, although fixed in a very sinuous condition, apparently while still rolled up tightly in lung tissue; exact length thus not determinable but at least 15 mm.; oesophagus,

[5] Nanus (L., dwarf).
[6] Prolificus (L., prolific).

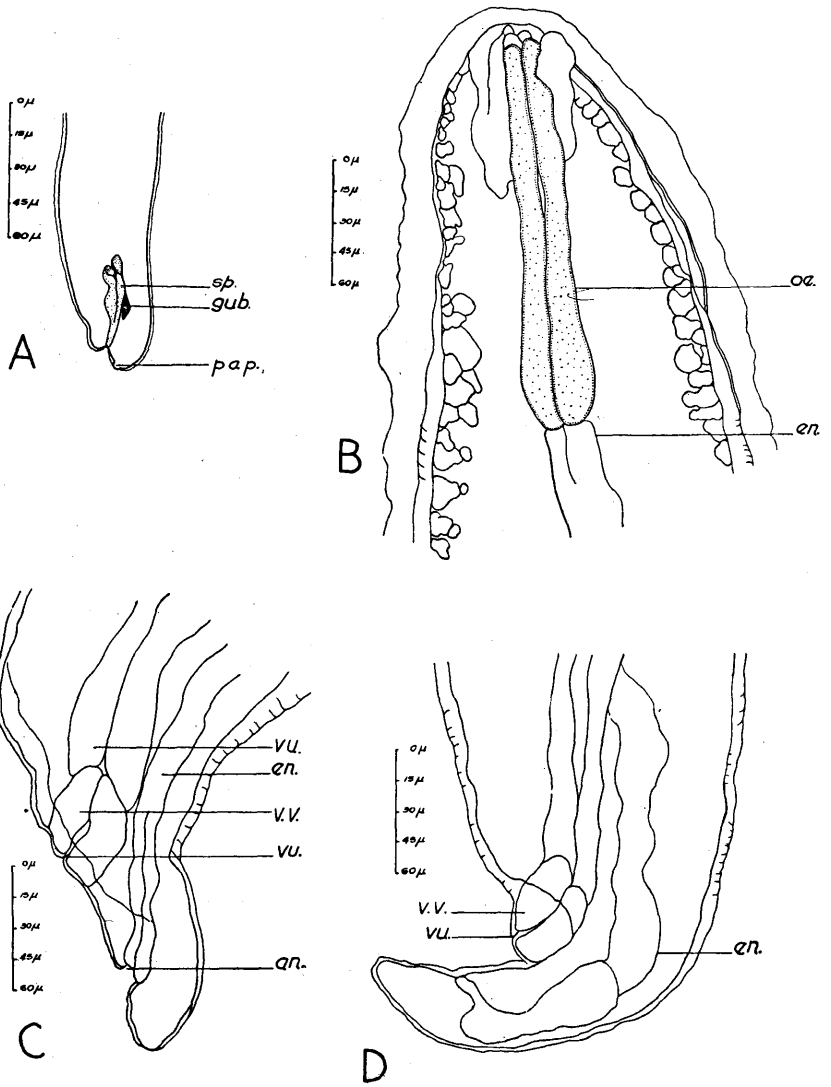

FIG. 2. *Parafilaroides nanus*, sp. nov. A—Male posterior end, lateral view. B—Female anterior end. C—Female posterior end, lateral view, extended. D—Female posterior end, lateral view, folded ventrally. *an.*, anus; *en.*, mesenteron or intestine; *gub.*, gubernaculum; *oe.*, oesophagus; *pap.*, terminal papilla; *sp.*, spicule; *vu.*, vulva; *v.u.*, vagina uterina; *v.v.*, vagina vera. Original. All figures drawn with the aid of the camera lucida.

155μ long, 33μ in maximum width; nerve ring, 52μ from anterior end; female posterior end contracted, and parts not accurately measurable, but similar to those of other species; uteri filled terminally with segmenting eggs and embryos, uniformly packed as in *P. decorus*, but much less numerous.

Host.—Steller sea-lion, *Eumetopias jubata* (Schreber).

Location.—In lung parenchyma.

DISCUSSION

In the three species of *Parafilaroides* in which the male is known there are minute and delicate spicules, and by gross study of the posterior end there can be seen no vestige of the bursa and only a suggestion of two terminal papillae, which presumably represent degenerate rays (see Figs. 1, A, and 2, A). Other papillae may well exist, but more precise methods are necessary to demonstrate them. The females of the four forms studied at first hand, and probably of *P. gymnurus* as well, have what appears to be a vulvar sphincter (see Figs. 1, B; 2, C, D; and

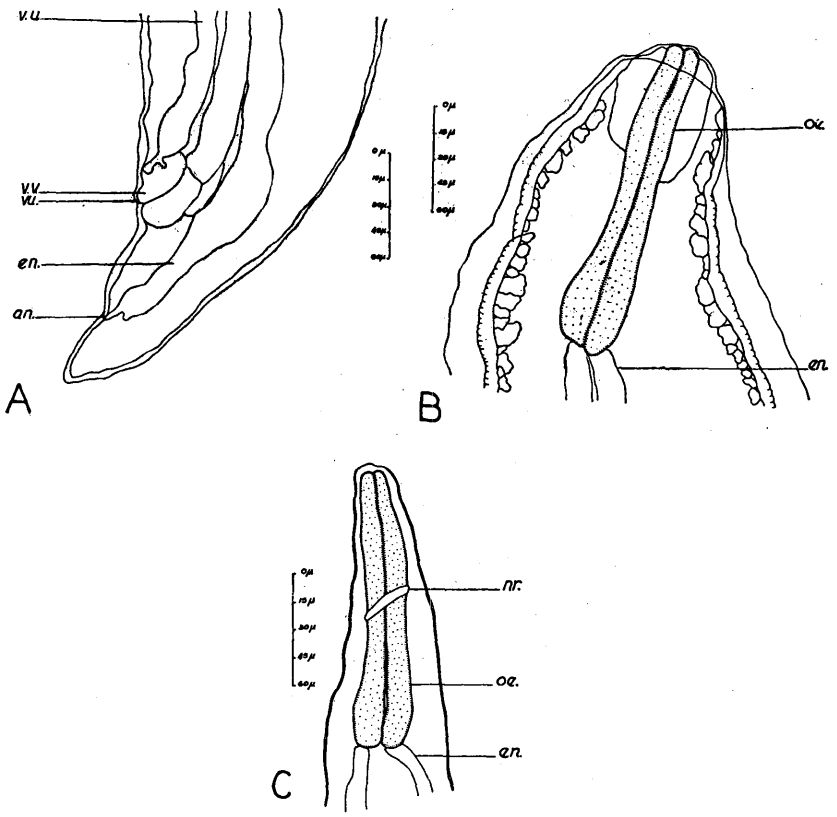

FIG. 3. A—*Parafilaroides prolificus*, sp. nov., female posterior end, lateral view. B—*P. prolificus*, female anterior end. C—*Parafilaroides* sp., female anterior end. *an.*, anus; *en.*, mesenteron or intestine; *n.r.*, nerve ring; *oe.*, oesophagus; *vu.*, vulva; *v.u.*, vagina uterina; *v.v.*, vagina vera. Original. All figures drawn with the aid of the camera lucida.

3, A). This is composed of a transparent matrix and is thought by us to represent the vagina vera. In general shape it is much like a similar sphincter figured for *Metathelazia massino* (Davtian in Skriabin, 1933) Dougherty, 1943, by Davtian (1933). The nature of the "vagina vera" in these filaroidins brings up the question as to whether the interpretation of the ovejectoral apparatus in the Pseudaliinae already made by one of us (Dougherty, 1944) is correct; this question will be treated in a later paper.

The three new species of *Parafilaroides* present rather limited diagnostic criteria by which they may be distinguished from one another and from *P. gymnurus*.

This is in part due to the fact that, so far, insufficient material of *P. nanus* and particularly of *P. prolificus* has been available to permit wholly adequate diagnoses. However, it is also in part due to the very degenerate nature of these organisms, in which certain diagnostically useful features characteristic of almost all strongyline nematodes are vestigial or entirely lacking. *P. gymnurus* appears to be the largest of known species, although the females are little longer than those of *P. decorus*. The spicules of the male in *P. gymnurus*, according to data given by Railliet (1899), measure 42 to 47μ, dimensions exceeding those of the males in *P. decorus* and *P. nanus*. In general the most obvious differences are those of total body length in the four named species. But with a larger series of specimens such differences may well become much less distinctive. The dimensions of the body parts presented in table 1 also reveal certain distinguishing features.

TABLE 1.—*Comparative measurements for species of Parafilaroides (in millimeters)*

	P. gymnurus (Railliet, 1899) Dougherty, 1946	*P. decorus*, sp. nov.	*P. nanus*, sp. nov.	*P. prolificus*, sp. nov.	*Parafilaroides* sp.
Male					
Length	15–18	6–7	2.8	.....	.....
Maximum width	0.120	0.092	0.105	.....	.....
Length of oesophagus	.....	0.120–0.125	.....	.....	.....
Length of spicule	0.042–0.047	0.035	0.039	.....	.....
Female					
Length	22–23	16–21	4.5–5.2	9 +	at least 15
Maximum width	0.170	0.165	0.215	0.240	.....
Length of oesophagus	.....	0.155–0.170	0.185–0.195	0.185	0.155
Anus to posterior end	0.030	0.018–0.032	0.040	0.045	.....
Vulva to anus	0.048	0.047–0.059	0.055–0.060	0.065	.....
Length of vagina uterina	.....	0.155–0.290	up to 0.340	0.255	.....

P. nanus in its very short body length is clearly set off from *P. gymnurus* and *P. decorus;* but, interestingly enough, the dimensions of the oesophagus and genitalia in the "dwarf" species are actually greater than those in the larger ones. The question may certainly arise as to whether *P. prolificus* is actually distinct from *P. nanus*. It is possible that the single complete and several large fragmentary females designated by us with the former name represent larger female specimens of the same species as the smaller females. However, the size difference, when seen by the naked eye, is so striking that we consider this unlikely. Another possibility is that the holotype male of *P. nanus* belongs not with the smaller, but with the larger females. If such should prove true, then *P. prolificus* would fall as a synonym of *P. nanus*, and the smaller females would have to be renamed. This again seems unlikely to us, however, as the male and smaller females agree rather well in comparative size and appearance.

The single female that we have designated *Parafilaroides* sp. possibly belongs to *P. decorus* since it resembles the latter species in general dimensions. However, unlike all other specimens so far recovered from sea-lions, it has a large proportion of segmenting eggs in the uteri by comparison with the number of embryos. We suspect that it may well represent a new species.

IV. THE INCIDENCE AND NATURE OF PARAFILAROIDES INFECTION IN SEA-LIONS

It is interesting to note that several species of filaroidins may occur in a single sea-lion, just as several protstrongylins often occur in a ruminant and several pseudaliins in a porpoise.

From present evidence no reliable conclusions can be drawn concerning the incidence of *Parafilaroides* infection in sea-lions in the wild state. The fact that only 3 out of the 25 California sea-lions were found to be infected may on the one hand be due to an elimination of lungworms acquired in the wild when the chance for reinfection through a possible obligatory intermediate host is removed; in this case there would be a lower than normal incidence in captive animals. On the other hand, if the life cycle is a direct one, the confinement and close proximity to one another to which these animals are subjected should increase the incidence of infection.

However, we doubt that lungworm infection can increase in captive sea-lions because we believe that development in these parasites in all probability requires an intermediate host. All members of the Filaroidinae in terrestrial hosts for which life cycle studies have been carried out have been shown to require certain gastropod molluscs as obligatory intermediate hosts. This is also true of all of the Protostrongylinae so far as known. The Metastrongylinae require earthworms for development. It is true that nothing is known of development in the Pseudaliinae, but nevertheless it seems logical that, like other metastrongylids, they and also the species of *Parafilaroides* require intermediate hosts. However, if this represents a feature basic in the evolution of the Metastrongylidae, it is obvious that, when the ancestral cetaceans and pinnipedes evolved from a terrestrial to a marine habitat, their lungworms had to adapt themselves to a new intermediate host group or groups.

On gross examination the lungs of the sea-lion autopsied by Dr. Lindsay showed areas of emphysema and atelectasis, and numerous tiny, tubercle-like bodies were scattered in the parenchyma. Some of these were removed fresh, placed on a slide in a drop of saline solution, and examined under the compound microscope. Living female worms and numerous highly active larvae were observed in this way. On microscopic examination of fixed tissue a picture of acute bronchitis was to be seen. In each section at least one worm was present in dilated and coalesced alveoli.

Whether in this case the lungworms had predisposed their host to the bronchitis to which it apparently succumbed cannot be definitely said. However, such a possibility can, we feel, be seriously entertained. It is difficult to imagine how the massive infections that we have seen in sea-lions and also in porpoises can fail to have a serious effect upon the health of these hosts.

California sea-lion herds occur abundantly along rocky parts of the California coast. Periodically these animals must be slaughtered in considerable numbers to protect the fishing industry. Conditions are thus ideal for an extensive study of lungworm disease in sea-lions in the wild, as well as general studies on their parasitic fauna.

V. A LIST OF THE LUNGWORMS OF THE PINNIPEDIA

The following is a list of the six named species and one unnamed form of lungworms so far discovered in hosts belonging to the suborder Pinnipedia (order Carnivora). They are all nematodes of the suborder Strongylina Pearse, 1936.

Family METASTRONGYLIDAE Leiper, [1909]
Subfamily FILAROIDINAE Skriabin, 1933
Genus *Parafilaroides* Dougherty, 1946

1. *P. gymnurus* (Railliet, 1899) Dougherty, 1946 (genotype)
   Host.—Common harbor seal, *Phoca v. vitulina* Linné.
   Location.—Fine bronchioles (according to Railliet, 1899).
2. *P. decorus,* sp. nov.
   Host.—California sea-lion, *Zalophus californianus* (Lesson).
   Location.—Rolled up into tiny knots scattered in the lung parenchyma.
3. *P. nanus,* sp. nov.
   Host.—Steller sea-lion, *Eumetopias jubata* (Schreber).
   Location.—In lung parenchyma.
4. *P. prolificus,* sp. nov.
   Host and location.—Same as for *P. nanus.*
5. *Parafilaroides* sp.
   Host and location.—Same as for *P. nanus.*

Family TRICHOSTRONGYLIDAE Leiper, 1912
Subfamily SKRJABINGYLINAE Skriabin, 1933
Genus *Otostrongylus* de Bruyn, 1933

6. *O. circumlitus* (Railliet, 1899) de Bruyn, 1933
   Host.—Common harbor seal, *Phoca v. vitulina* Linné.
   Location.—Bronchi and larger bronchioles, and right chambers of the heart (according to Railliet, 1899).
7. *O. andreewaae*[7] (Skriabin, 1933, emend. nov.) Schuurmans Stekhoven, 1935
   Hosts.—Okhotsk ringed seal, *Phoca hispida ochotensis* Pallas; White Sea ringed seal, *P. h. pomororum* Smirnov.
   Location.—Bronchi and bronchioles, and venous sinusoids of liver (according to Skriabin, 1933).

We believe that there are as yet several, possibly many lungworm species to be found parasitizing the genera and species of pinnipedes not yet reported for such parasites.

SUMMARY

Three new species of lungworms belonging to the nematode genus *Parafilaroides* Dougherty, 1946, are herein described from sea-lions (family Otariidae); a fourth, possibly distinct species is recorded, but not named. These are: *P. decorus,* sp. nov., from the California sea-lion (*Zalophus californianus*); and *P. nanus,* sp. nov., *P. prolificus,* sp. nov., and *Parafilaroides* sp. from the Steller sea-lion (*Eumetopias jubata*). The hosts were captive animals obtained from along the California coast; we have no records giving their original geographic habitat more precisely.

The pathology of lungworm infection in sea-lions is very briefly described and the suggestion made that the parasites represent pathogenic organisms. The belief is expressed that an intermediate host is required.

[7] Skriabin (1933), as already noted, spelled this trivial name *andreewoi.* This is the transliteration (according to German orthography) of the genitive of the Russian name Andreeva, or Andreewa (Андреева), *viz.* Andreevoĭ, or Andreewoi (Андреевой). Skriabin used this name to honor N. K. Andreeva, Soviet woman helminthologist and scientific artist. Article 14 of the Rules of Zoological Nomenclature states in part: "... If the [trivial] name is a modern patronymic, the genitive is always formed by adding, to the exact and complete name, an *i* if the person is a man or an *ae* if the person is a woman, even if the name has a Latin form; ..." Strictly interpreted, Article 14 requires "andreewaae"; therefore we emend the trivial name in question from *andreewoi* to *andreewaae.* The question of a uniform system of transliteration from the Cyrillic alphabet for nomenclatorial purposes, should be brought up before the International Commission on Zoological Nomenclature.

Six named and one unnamed species of lungworms in pinnipedes are listed and under each are given its host or hosts and predilection site or sites therein. The trivial name of the species originally described as *Kutassicaulus andreewoi* by Skriabin (1933) is emended to *andreewaae* and reasons given for this change; *K. andreewoi* thus becomes *Otostrongylus andreewaae* (Skriabin, 1933, emend. nov.) Schuurmans Stekhoven, 1935.

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The incidence of *Capillaria annulata* in chickens of the Middle West. REX W. ALLEN, U. S. Bureau of Animal Industry.

In the process of obtaining experimental material for studies on the life history of *Capillaria annulata*, the writer has examined, during the past three years, a large number of chicken crops. These examinations involved chickens raised in the Middle West.

Apparently only one previous report has been published on the incidence of the parasite in question in the Middle West, namely, that of Nelson,[1] who examined 326 chickens in Kansas and found 9.2 per cent infected. Nelson did not identify the parasites as to species; however, since *C. annulata* is the only capillarid known to occur in the esophagus of the chicken, there can be little, if any, doubt concerning the parasites he found.

[1] Nelson, T. H. 1934. Vet. Med. **29**: 296.

Subsequent to the publication by Cram,[2] of a summary of the available information on the distribution and incidence of the parasite, Wehr[3] and Todd,[4] contributed additional pertinent data. Wehr examined the crops of 698 turkeys at Washington, D. C., and found 9.2 per cent infected with *C. annulata*. Todd found an incidence of 8.9 per cent in 390 chickens examined in Tennessee, and he reported that the average number of parasites occurring in an infected bird was 6.4, with a ratio of 1 male to 2.9 females.

In the present work, crops from 463 chickens were examined, and of these, 43 (9.3 per cent) harbored *C. annulata*. In 24 of the infected crops the average number of worms was 7.7, with a ratio of 1 male to 2.2 females. These data constitute additional evidence of the widespread distribution and common occurrence of *Capillaria annulata*.

Report of the Brayton H. Ransom Memorial Trust Fund
December 31, 1946

STATEMENT FOR THE YEAR 1946

ON LOAN, Jan. 1, 1946		$1400.00
BALANCE ON HAND, Jan. 1, 1946		183.22
RECEIPTS:		
Semi-annual interest on loan @ $28	$ 56.00	
Interest on bank account	1.90	
TOTAL RECEIPTS		$ 241.12
DISBURSEMENTS:		
Rent, safe deposit box	$ 4.20	
Award to Proceedings Helminthological Society of Washington	25.00	
TOTAL DISBURSEMENTS		$ 29.20
BALANCE ON HAND, Dec. 31, 1946		211.92
		$ 241.12

A meeting of the Trustees was held on May 25, 1946.

ELOISE B. CRAM,
Secretary-Treasurer

MINUTES

Two Hundred Sixty-first to Two Hundred Sixty-eight Meetings

The 261st meeting was held on October 9, 1946, at the U. S. National Museum. Papers were presented by Ashburn and Kates.

The 262nd meeting was held on November 20, 1946, at the Bureau of Animal Industry, Beltsville, Md. William G. Jahnes, Preston M. Bauman and Dr. J. E. Tobie were elected to resident membership, and Robert Rausch to non-resident membership. Dr. Willard Wright was elected to serve for five years on the Editorial Committee. Papers were presented by Bartlett, Spindler, Schwartz and Hunter.

The 263rd meeting was held on December 11, 1946, at the U. S. National Museum. Captain Robert Traub was elected to membership. Dr. Foster was elected to serve as the Society's representative in the Washington Academy of Sciences. The following officers were elected: President, K. C. Kates; Vice-president, M. M. Farr; Corresponding Secretary-treasurer, E. M. Buhrer; Recording

[2] Cram, E. B. 1936. U. S. Dept. Agr. Tech. Bull. 516.
[3] Wehr, E. E. 1937. Vet. Med. 32: 230–233.
[4] Todd, A. C. 1946. Trans. Amer. Micros. Soc., 65: 228–236.

Secretary, E. G. Reinhard. Papers were presented by Wehr, Farr, Mollari and Steiner.

The 264th meeting was held at the Catholic University of America on January 15, 1947. Dr. Spindler was appointed to the Executive Committee as member-at-large for a term of two years. The report of the treasurer for the year 1946 was read and approved. The report of the Executive Committee regarding the budget for 1947 was also read and approved. Papers were presented by von Brand, Reinhard and Otto.

The 265th meeting was held on February 12, 1947 at the Army Medical Center. Colonel Rufus Holt gave an address of welcome. Moving pictures dealing with schistosomiasis and scrub typhus were shown and a paper was presented by Captain Traub.

The 266th meeting was held on March 12, 1947 at the National Institute of Health, Bethesda, Md. Papers were presented by Jacobs, Johnson and Cram.

The 267th meeting was held on April 18, 1947 at the School of Hygiene and Public Health of Johns Hopkins University. Dr. R. D. Turk and Mr. Joseph J. DiLorenzo were elected to membership. Dr. Cort gave an address of welcome. Papers were presented by Adler, Rozeboom, Spindler, Dikmans, Otto, Reese, Brackett and Sadun.

The 268th meeting was held on May 17, 1947 in conjunction with the annual picnic at the Log Cabin, Beltsville Research Center, Beltsville, Md. The Society voted to continue the present system of holding meetings.

EDWARD G. REINHARD,
Recording Secretary

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