

SOME HELMINTHS RECOVERED FROM RED- AND YELLOW-BILLED HORNBILL FROM THE KRUGER NATIONAL PARK

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Mr. O. P. M. Prozesky, ornithologist at the Transvaal Museum, Pretoria, whilst carrying out studies on hornbills in the Kruger National Park during December, 1962, collected the entrails of 10 red-billed hornbills (*Lophoceros erythrorhynchus*) and nine yellow-billed hornbills (*Lophoceros flavirostris*). The entrails were removed from the birds as soon as possible after death, labelled for identification and placed in a portable freezer for preservation. They were kept frozen until delivered to the writer some two or three weeks later. Upon receipt some of the entrails were thawed at room temperature and examined for the presence of helminths while the remaining were kept in a deep-freeze. As opportunity offered, sets of entrails were thawed at varying intervals over the next month. Three sets, however, were kept frozen for nine months. The helminths found in the preserved material were still in a good condition and suitable for study. All were well extended and retained their shape after fixing in cold 10 per cent formalin. The cestodes yielded good *toto* mounts, but when examined in section their tissues appeared to have undergone a certain amount of maceration. However, where it is impossible to fix freshly collected helminths in the field, this method used above is preferred to fixing the entire entrails in formalin. Formalin-fixed entrails are generally hard and brittle and the recovery of helminths from them unsatisfactory, especially cestodes which become much shrunken and twisted and easily break into fragments on removal or manipulation. A vacuum flask of about one gallon capacity, filled with dry ice, is suitable for field collection when the collector is to be away from a laboratory for four or five days. The flask should be provided with a safety-valve for the escape of carbon dioxide liberated from the dry ice.

The only hornbill (yellow-billed) infected with flat worms harboured one juvenile trematode and seven cestodes. Round worms were well represented, the same species being common to both kinds of hornbills. Nine (four red and five yellow) were infected with *Microtetrameres bucerotidi* sp. nov., 10 (six red and four yellow) carried *Tropisurus prozeskyi* sp. nov., and 16 (eight of each) were parasitized with *Hadjelia inermis* (Ged.). Acanthocephala were recovered from five hosts (four red and one yellow). Only one bird (red-billed) was entirely free of helminths, the remaining hosts generally carried two or three species.

TREMATODA

Lecithodendriidae, Megacetinae

Eumegacestes sp.

A single specimen of a young worm was recovered from the water in which the cloaca was opened. Apparently it was released from this organ.

The specimen is small, flat and oval, only 1.5 mm long and 0.52 mm broad. It contains no eggs and the uterus is not apparent—mature, egg-producing individuals would probably be larger. The cuticle is smooth. The arrangement of the internal organs is represented in Fig. 1. The subterminal anterior sucker is relatively large and

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very muscular; it is roughly circular in outline with a transverse diameter of 0.3 mm and a length of 0.23 mm. The circular ventral sucker situated behind the middle of the body is about equal in size to the anterior sucker and is also very muscular; it has a diameter of 0.29 mm. A large muscular pharynx, 0.2 mm broad and 0.12 mm long, immediately follows the anterior sucker. The two intestinal branches rise immediately behind the pharynx so that an oesophagus is absent; they bend sharply outwards towards the lateral body margins and then pass backwards to terminate near the body end. The two rounded testes are situated transversely in front of the ventral sucker; each is about 0.2 mm in diameter. A powerful cirrus sac curves forwards from between the anterior edges of the testes and opens to the exterior at about the level of the intestinal bifurcation. The ovary is oval, 0.13 mm long and 0.1 mm broad. It is situated behind the ventral sucker in the right side of the body. Some indistinct uterine coils can be seen in the left side of the body at the level of the ovary; no eggs are present. The vitellaria are represented by two lateral bands of follicles extending from the hind level of the testes to the posterior end of the body. These follicles tend to form about four groups on each side, each group being composed of about a dozen follicles. Between the groups other single follicles are scattered irregularly. The excretory pore is terminal. The details of the excretory system could not be followed.

Host: *Lophoceros flavirostris* (Rüppell)

Locality: Kruger National Park

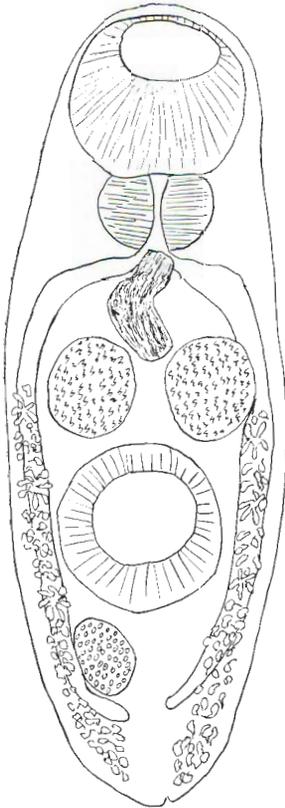


FIG. 1.—*Eumagacetes* sp. Ventral view of mounted specimen.

Discussion

As far as can be ascertained this is the first record of a member of the genus *Eumegacetes* from a hornbill. Looss (1899) identified and described as *E. triangularis* Diesing, 1850, some trematodes from North African sparrows, bee-eaters and prantincos. Baer (1959) identified trematodes from a swallow from the Congo as *E. contribulans* Braun, 1901. Yamaguti (1958) lists this species as a synonym of *E. crassus* (Sieb. 1836) from European swallows. The general characters of the form described above show some relationship to *E. triangularis*, reported from various avian orders, in that the vitellaria appear to have a somewhat similar structure, the follicles forming groups and extending from the testes to the posterior end. Its suckers are, however, considerably smaller than those seen in Looss' specimens. This difference is probably due to the fact that the writer's specimens are immature. According to Baer the vitellaria follicles in *E. contribulans* are few in number and do not extend forward beyond the anterior level of the ventral sucker; neither are they arranged in groups.

In view of the immaturity of the specimen the writer does not assign it to any particular species.

CESTODA

Cyclophyllidae, Davaineidae

Raillietina (Fuhrmanetta) lophoceri, sp. n.

Eight worms were obtained from the intestine of a red-billed hornbill. Of these, five carried ripe segments, the remaining three were juvenile with no egg capsules. The length of the mature worms varies from 40 to 60 mm with a maximum breadth of 1.6 mm. The head is somewhat acornshaped in specimens with a fully extruded rostellum, about 0.175 mm broad and 0.125 mm long and the rostellum from 0.055 to 0.066 mm thick. Heads with retracted rostella are broader, being 0.22 to 0.23 mm across. The hammer-shaped rostellar hooks are small, 0.0078 mm long, arranged in two circles; their total number is about 250. Some of the extruded rostella have shed most of their hooks. The suckers are somewhat circular to slightly oval and have a diameter of 0.07 to 0.075 mm; no spines are present on their margins. It is not possible to determine whether the absence of spines is normal or due to shedding after death. The head is followed by a distinct neck 0.1 to 0.12 mm broad and 0.26 to 0.3 mm long.

Mature segments are much broader than long, their length varying from 0.27 to 0.4 mm, while their breadth varies from 0.7 to 1.17 mm (Fig. 2). Ripe segments are somewhat barrel-shaped, longer than broad, their length varying from 1.17 to 1.3 mm and their breadth from 0.78 to 0.81 mm. The genital pores alternate irregularly and are situated in the anterior third of the segment. The cirrus sac is oval and thick-walled and reaches the excretory vessels; it is from 0.13 to 0.14 mm long by 0.07 to 0.075 mm thick in mature segments and its wall has a thickness of about 0.02 mm. The cirrus appears to carry no spines and an internal vesicula seminalis is apparently absent. After emerging from the cirrus sac the vas deferens becomes markedly coiled; it extends inwards in the form of an arch to the poral edge of the ovary and its coils fill most of the medullary parenchyma between excretory canals and ovary. There are from 20 to 30 rounded testes, each with a diameter of 0.04 to 0.05 mm when mature. They are arranged, one or two layers deep, lateral to and behind the female glands. The ovary is slightly poral in position and consists of two lateral lobes each

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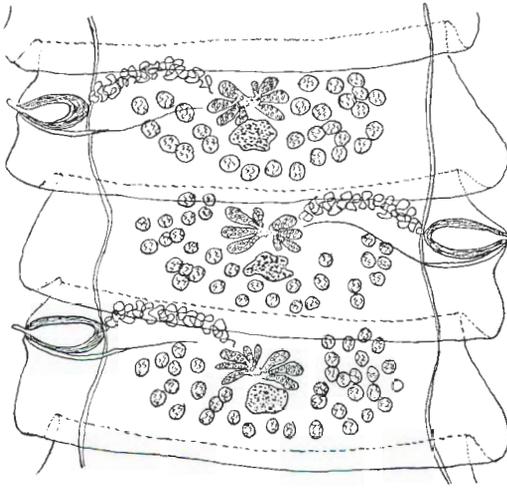


FIG. 2.—*Raillietina* (F.) *lophoceri* sp. n. Mature segments showing genitalia

with a number of finger-like processes arranged fanwise and placed in the anterior half of the segment; its size is from 0.2 to 0.25 mm broad and from 0.1 to 0.12 mm long. The irregularly oval vitelline gland, about 0.1 mm broad and 0.075 mm long, is situated behind the ovary and slightly poral to its midline. The vagina is curved parallel to the posterior edge of the cirrus sac and opens to the exterior behind it. No definite receptaculum seminis was observed. The usual two pairs of excretory vessels are present. The ventral is prominent, from 0.04 to 0.05 mm in diameter; the dorsal is much smaller with a diameter of 0.01 mm or less. The genital duct passes dorsal to the excretory vessels. There are from 30 to 50 egg capsules filling the whole segment and pressing the excretory canals against the lateral edges of the segments. Each capsule harbours from 5 to 10 eggs.

Specific Diagnosis

Davaineidae: Maximum length up to 60 mm by 1.6 mm broad. Rostellar hooks about 250, small, not more than 0.008 mm long. Genital pores irregularly alternating. Cirrus sac very muscular, up to 0.14 mm long, not crossing excretory canals. Vas deferens much coiled. Testes lateral and behind female glands, 20 to 30 in number. Ovary two-winged, each wing with a number of finger-like lobes. Vitelline gland oval with slightly irregular border. Egg capsules, 30 to 50 in number, fill whole segment; each capsule carries 5 to 10 eggs. Parasite of hornbills.

Host: *Lophoceros flavirostris* (Rüppell) (Bucerotiformes)

Location: Small intestine

Locality: Kruger National Park, Transvaal

Types: In the Onderstepoort collection

Discussion

The hammer-shaped rostellar hooks, the irregularly alternating genital pores and the presence of several eggs in each capsule place this species in the subgenus *Fuhrmanetta*.

Five species belonging to this subgenus have been described from the African continent viz. *Raillietina (F.) bucerotidarum* Joyeux & Baer, 1928, from *Melanobucca aequatorilis* (Pliciformes-Capitonidae); *R. (F.) crassula* (Rud. 1819) from pigeons (Columbiformes-Columbidae); *R. (F.) leptotrachelo* (Hungerbühler, 1910) from *Turdus semitorquatus* (Passeriformes-Turdiadae); *R. (F.) malakartis* Mahon, 1958 from *Coturnix* sp. (Galliformes-Phasianidae) and *R. (F.) vanderbrandeni* Baylis, 1940 from *Psittacus erythacus* (Psittaciformes-Psittacidae). The species *bucerotidarum* of Joyeux & Baer must be taken out of this list, since in their description of this species these authors state that the genital pores are unilateral and that each egg capsule contains a single egg. These two characters place this species in the subgenus *Paroniella*. *R. (F.) crassula* is a much larger worm, carrying fewer rostellar hooks (about 70) which are much longer, reaching 0.02 mm. Unfortunately a description of *R. (F.) leptotrachelo* is not available and, therefore it is not possible to compare it with the new species. The writer's specimens show some similarities to *R. (F.) malakartis* in that this species is only slightly larger than the writer's. The cirrus sacs in both are very muscular, although slightly bigger in Mahon's species. The number of testes in the two is more or less equal (24 to 33 in Mahon's species) and the vas deferens is heavily coiled in both. The two species differ, however, in that *R. (F.) malakartis* has fewer (150 to 160) rostellar hooks which are longer (0.009 to 0.0097 mm) and its vitelline gland is lobed. In Baylis' species the rostellum carries only about 120 hooks whose length varies from 0.016 to 0.017 mm, i.e. much longer than in the writer's species. In view of the above differences and since no species of cestode belonging to this subgenus has been described from Bucrotiformes, the writer considers his specimens to represent a hitherto undescribed species.

NEMATODA

Spiuroidea, Tropisuridae

***Tropisurus prozeskyi* sp. n.**

This species was recovered from the proventriculus of six red-billed and four yellow-billed hornbills. In one of the red-billed hornbills 23 males and 14 females were present and from one yellow-billed hornbill 25 females and one male were recovered. The rest of the hosts had fewer parasites, the number present varying from three to six females and one or two males in some. For their recovery the thawed, unfixed proventriculus was opened, placed in a petri dish and covered with normal saline. It was then stretched between the index finger and thumb of the left hand, and the inner surface lightly scraped with a finger nail of the right hand. Any males present were thus removed with the mucus and collected from the saline by examination under a stereoscopic microscope. The females were later dissected out of the proventricular glands under the dissecting microscope. In this way about 30 males and 60 females were collected. For fixation the worms were placed direct into cold 10 per cent formalin.

The males are small, the majority being less than 2 mm long. Only one had a length of 2.4 mm, the others varied from 1.3 to 2.0 mm. The body is attenuated towards both ends, the posterior end being sharp and pointed and the anterior truncated. The maximum thickness of 0.06 to 0.07 mm is reached at about the middle of the body. Externally the body carries four longitudinal rows of spines (Fig. 3 A & B), two ventro-lateral and two dorso-lateral. In the oesophageal region and in the area just anterior of the cloaca these spines are fairly close together. Between these two regions their spacing increases toward the posterior end. Typically there are four rows of three spines each behind the cloacal aperture, two rows ventral and two

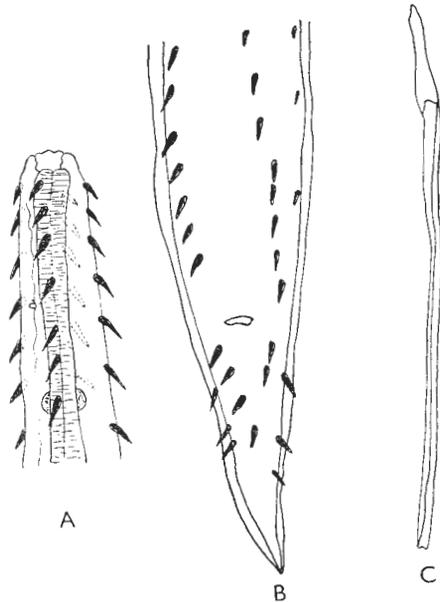


FIG. 3.—*Tropisurus prozeskyi* sp. n.
 A. Anterior extremity of male
 ventro-lateral view
 B. Posterior extremity of male,
 ventral view
 C. Spicule

lateral. The number of spines in each row, however, may be reduced or even four spines may be present in a row in some males. The anterior spines have a length of 0·012 to 0·015 mm. Lateral alae are absent, but a slight raising of the cuticle along each lateral line may give the impression that very narrow alae are present. The cervical papillae are very small and insignificant and are found at about the level of the fourth pair of ventro-lateral spines, some 0·05 to 0·06 mm from the front end. The excretory pore is situated about 0·1 mm behind the papilla. The truncated anterior end has a diameter of 0·023 to 0·025 mm.

The mouth is bounded by insignificant lateral lips, each showing a tendency to be trilobed. The small mouth cavity is about 0·011 to 0·013 mm wide by 0·005 to 0·007 mm deep; its inner lining is not thickened to form a cuticularized mouth capsule.

The oesophagus consists of two portions, a shorter and narrower anterior muscular part, 0·16 to 0·21 mm long, and a longer and thicker posterior glandular portion 0·3 to 0·4 mm long increasing to a thickness of from 0·028 to 0·031 mm. The nerve ring encircles the anterior portion at from 0·1 to 0·15 mm from the front end. The tail tapers to a point and is from 0·14 to 0·16 mm long. No caudal papillae are present.

Typically there is only a single spicule, the right being absent. It varies in length from 0·23 to 0·26 mm and consists of two parts, the posterior, well chitinized and longer, and the proximal somewhat membranous portion 0·043 to 0·05 mm long (Fig. 3 C). A distinct and well chitinized right spicule is present in three of the more than 30 males examined; it has the same structure as the left but is slightly shorter, being 0·19 to 0·22 mm long. As these three males are similar in all essential characters to the monospicular forms there appears to be no doubt but that they are co-specific with them; they appear to represent relics which primarily all possessed two spicules but which in course of time became mono-spicular.

The body of the female is somewhat oval to pear-shaped; it varies in length from 1·8 to 2·26 mm with a maximum thickness of 1·2 to 1·6 mm (Fig. 4). The head end

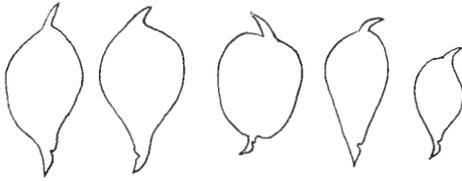


FIG. 4.—*Tropisurus prozeskyi* sp. n.
Females, various shapes.

protrudes above the body for a distance of 0·53 to 0·57 mm. Posteriorly the body tends to taper to a sharp pointed tail about 0·17 to 0·2 mm long. The vulva is situated in a depression, 0·21 to 0·25 mm in front of the anus. Four small, finger-like, sub-medium papillae and two stumpy lateral amphids surround the circular mouth. No distinct lips are present. The buccal capsule (Fig. 5 A) is globular, 0·013 mm broad and 0·01 to 0·013 mm deep; it has a chitinous wall 0·002 mm thick at its base and 0·001 mm thick at its anterior rim. The muscular portion of the oesophagus is from 0·18 to 0·2 mm long; it increases in thickness from 0·016 to 0·02 mm at its anterior end to 0·032 to 0·042 mm at its posterior end. The nerve ring encircles it at 0·12 to 0·143 mm from the anterior end. The glandular portion of the oesophagus is from 1·0 to 1·1 mm long with a thickness of 0·09 to 0·11 mm at its base. The excretory pore is situated just behind the level of the nerve ring. No cervical papillae were seen. The vulva is a transverse oval aperture situated in a deep groove about

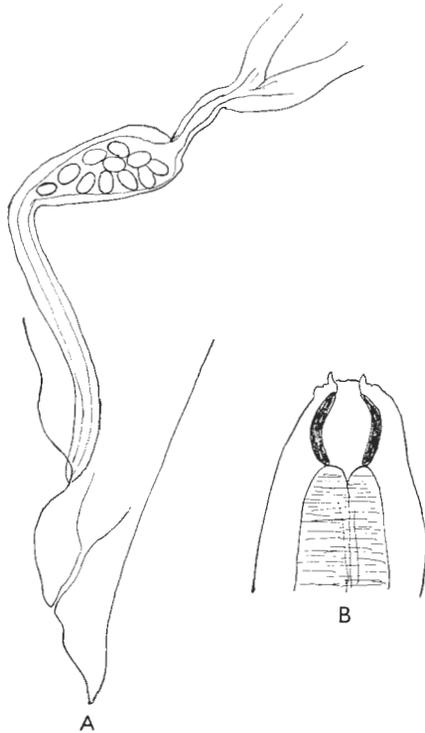


FIG. 5.—*Tropisurus prozeskyi* sp. n.
A. Female tail and genitalia

B. Anterior extremity of female

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0.4 mm from the tail tip; it leads into an elongate vagina, about 0.5 mm long and 0.05 mm thick, which enlarges proximally into a kind of vestibule or egg chamber (Fig. 5 B). From this emerges a Y-shaped tromp with a short common stem and long limbs; no sphincter muscles are present at the junction of the vestibule and tromp. A diverticulum or copulatory receptaculum is absent. The eggs are numerous, oval, thick-walled and embryonated, from 0.048 to 0.053 mm long and 0.032 mm thick.

Spesific Diagnosis

Tropisuridae: Males up to 2.4 mm long; provided with four rows of simple spines, lips not distinctly demarcated. Single spicule generally present, 0.23 to 0.26 mm long; when a right spicule is present it is of same build but shorter; tail typically with four rows of three spines each, two rows ventral and two rows lateral. Female somewhat pear-shaped to oval, 1.8 to 2.26 mm long; mouth capsule globular; tail pointed, up to 0.2 mm long; vulva in depression about 0.4 mm from tail to tip. Eggs oval and morulated, 0.048 to 0.053 mm long by 0.032 mm broad. Parasites in proventriculus of Bucerotidae.

Type host: *Lophoceros erythrorhynchus* (Temm.)

Additional host: *Lophoceros flavirostris*

Location: Proventriculus

Locality: Kruger National Park, Transvaal

Types: In the Onderstepoort collection

Discussion

To the 46 species of *Tropisurus* from birds listed by Yamaguti (1961), seven must be added, viz. *Tropisurus cygni* (Ryzekov & Koslov, 1960) n. comb. from *Cygnus bewickii*, Russia; *Tropisurus oxylabiatus* (Baschkerova, 1960) n. comb. from Woodgrouse, Russia; *Tropisurus uxorius* (Mamaev, 1959) n. comb. from *Tringa hypoleucas*, Siberia; *Tropisurus monospicules* (Rasheed, 1960) n. comb. from *Porphyrio poliocephalus*; *Tropisurus minutes* (Rasheed, 1960) n. comb. from *Ardeola grayii*; *Tropisurus singhi* (Rasheed, 1960) n. comb. from *Ciconia ciconia* and *Tropisurus cordoniferens* (Rasheed, 1960) n. comb. from *Dendrocygna javanica*. The last four species from India. Only seven of these 53 species are reported from the African continent viz. *T. coccineus* (Seurat) from Ciconiiformes, *T. fisispinus* (Dies.) chiefly from Galliiformes and Anseriformes, *T. gynaeophilus* (Molin) from Ciconiiformes and Anseriformes, *T. lhuillieri* (Seurat) from Galliiformes and Columbiformes, *T. nouveli* (Seurat) from Charadriiformes, *T. paradisea* (Ortlepp) from Gruiformes and *T. plectropteri* (Thwaite) from Anseriformes. Among all the species listed not a single one appears to be a parasite of hornbills (Bucerotidae).

Of the African species, *T. fisispina* and *T. lhuillieri* have much larger males and a copulatory diverticulum is present in the females. The male of *T. gynaeophilus* carries no spines and the female is unknown. The males of *T. plectropteri* have four large lips, the head end carries two pairs of cordons and the left spicule measures 0.85 mm. These characters easily differentiate these species from the species described above. The male of *T. paradisea* is large, 5.8 mm long, carries only two rows of spines and the single spicule reaches a length of 0.48 mm. Only the female of *T. coccineus* is known; it has a globular body and its ovejector (vagina) is very short. The writer's species appears to have *T. lhuillieri* as its closest relative; in both the males are small, and possess four rows of spines; both have only one spicule and both lack a copulatory vestibulum. They differ, however, in that Seurat's species has a much longer spicule (0.48 mm) and the eggs are provided with polar filaments.

***Microtetrimeres bucerotidi* sp. n.**

This parasite was recovered from the proventriculus of nine birds, from four red-billed and five yellow-billed hornbills. In all about 20 females and five males were obtained; on four occasions they were found associated with *Tropisurus prozeskyi* sp. n. described above.

The males are from 4.3 to 4.8 mm long and have a maximum thickness of 0.15 at about their middle. The body is devoid of any spines and the cuticle is coarsely annulated, the most anterior annulus being thickened to form a cuticular collar around the mouth (Fig. 6). The head end is about 0.028 mm across and its mouth is bounded by what appear to be two small lateral lips, having slightly wavy anterior borders.

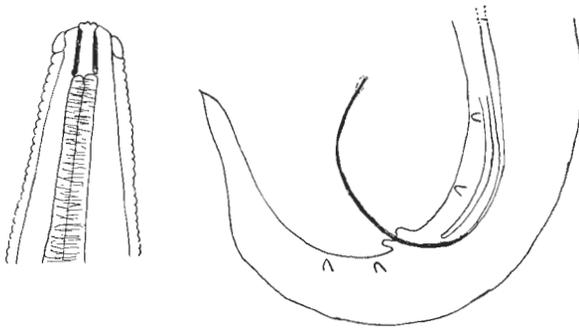


FIG. 6

FIG. 7

FIG. 6.—*Microtetrimeres bucerotidi* and 7. sp. n. Fig. 6: Anterior extremity of male. Fig. 7: Lateral view of male tail

The mouth leads into a small, thick-walled, tubular, buccal capsule 0.018 mm deep and 0.01 mm in diameter. The muscular portion of the oesophagus is 0.35 mm to 0.37 mm long and is encircled by the nerve ring about 0.2 mm from the anterior end. The second, glandular portion is just over 1 mm long; it is club-shaped, its maximum diameter at its posterior end being 0.065 mm. The tail is non-alate, pointed and curved ventralwards; it varies in length from 0.29 to 0.3 mm. Only two pairs of inconspicuous papillae were observed, located on the anterior quarter of the tail (Fig. 7). The cloaca has protuberant lips and anterior to it are two pairs of small papillae. The spicules are markedly dissimilar both in their length and shape. The left is remarkably long, and when not extruded its proximal end is located just behind the end of the oesophagus; its length appears to vary from 4.0 to 4.5 mm; it is well chitinized and its tip is somewhat rounded to spatulate. The right spicule is less heavily chitinized and is consequently not so evident; it is arcuate in shape and about 0.1 mm long with a maximum thickness of 0.007 mm.

The female is generally rolled in a close spiral of two to three turns to form a globular mass with the anterior and posterior ends just showing above the surface; the rolled ball has a diameter of 0.6 to 1.2 mm and its thickness varies from 0.24 to 0.4 mm. Both ends are pointed, the head end having a thickness of only about 0.008 mm. The small mouth does not appear to carry any lips; it leads into a small, flask-shaped, buccal capsule, 0.018 mm deep, 0.006 mm wide at the anterior end and 0.013 mm across the body of the flask (Fig. 8 A). The length of the oesophagus could not be measured accurately due to the crinkled state of the specimens examined.

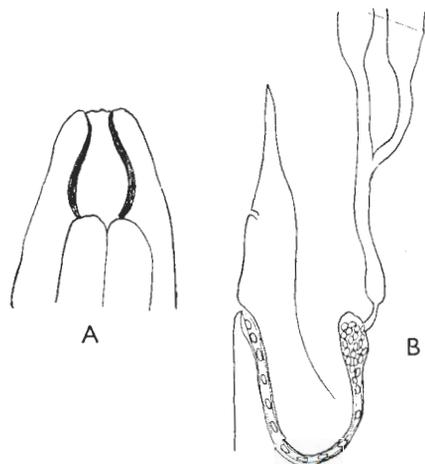


FIG. 8.—*Microtetrameres bucerotidi* sp. n. A. Anterior extremity of female. B. Female tail and genitalia

Its anterior muscular portion appears to be about 0·18 mm long and the posterior glandular portion about 0·7 mm. Excretory pore and cervical papillae were not located. The tail is from 0·18 to 0·2 mm long and ends in a sharp point. The vulva is located about 0·15 mm in front of the anus; it leads into an elongate vagina nearly 2·0 mm long and 0·05 mm thick; its anterior end is slightly enlarged to join a kind of egg chamber or vestibule, 0·15 mm long and 0·075 mm thick, containing a number of embryonated eggs (Fig. 8 B). The sphincter, about 0·1 mm long and 0·035 mm thick, originates from its anterolateral border; it joins a Y-shaped tromp, whose unpaired limb is about 0·4 mm long and its two forks about half as long. These join the two uteri which completely fill the rest of the body except for its anterior portion. The eggs *in utero* are oval, smooth and thick-shelled, and each contains a coiled larva; their size varies from 0·042 to 0·045 mm long by 0·03 to 0·032 mm broad.

Specific Diagnosis

Tropisuridae: Female body spirally coiled, flask-shaped buccal capsule, tail about 0·2 mm long, and vulva 0·15 mm anterior to anus. Males slender, up to 4·8 mm long without body spines. Buccal capsule small and cylindrical; tail curved ventralwards about 0·2 mm long; only two pairs pre-anal and two pairs post-anal papillae apparently present, all very small; spicules very unequal and dissimilar, left 4·0 to 4·5 mm long and right 0·1 mm long. Parasitic in proventriculus of Bucerotidae.

Type Host: *Lophoceros flavirostris*

Additional Host: *Lophoceros erythrorhynchus*

Location: Proventriculus

Locality: Kruger National Park, Transvaal

Types: In the Onderstepoort collection

Discussion

Twenty-two species of this genus have been described from birds. Of these only one species, *M. spiralis* (Seurat, 1915), is from the African continent and one species, *M. contorta* (Weideman, 1913), from a bucerotiform bird. In *M. spiralis* the female

genitalia are of the same pattern as in the species described above, but its left spicule is much shorter, being less than 2.0 mm long. The new species appears to be related to *M. contorta*. The latter, however, has larger males, longer spicules, longer female tail and the distance between its vulva and anus is also much greater. According to the literature available all the remaining species have spicules less than 4.0 mm long.

***Hadjelia inermis* (Gedoelst, 1919).**

This helminth appears to be a very common parasite of red- and yellow-billed hornbills, as it was present in 16 of the 19 sets of entrails examined. It lives in burrows in the soft tissue immediately under the horny layer of the gizzard. No sign of their presence is seen when examining the outer surface of the horny layer. When, however, this layer is stripped from the muscular gizzard and its undersurface examined under a dissecting microscope using transmitted light, the worms can be seen as reddish, straight or curved lines in the soft tissue. They can be easily removed from their tunnels by means of a dissecting needle. The infested tissue appears to be perfectly normal except for the presence of tunnels.

The reddish worms are fairly straight and smooth. The males are from 6.0 to 7.0 mm long with a body thickness of 0.12 to 0.16 mm in the posterior body third. The females are nearly three times as long, varying in length from 17.0 to 19.0 mm with a maximum thickness of 0.15 to 0.2 mm in their middle. The body tapers towards the anterior end, which is about 0.026 mm thick in the males and about 0.03 mm thick in the females. The mouth is surrounded by two small lateral trilobed lips, slightly narrowed towards their base (Fig. 9). Dorsal and ventral hemispherical

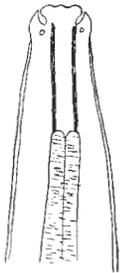


FIG. 9.—*Hadjelia inermis* (Ged.) Anterior extremity, lateral view

interlabia are present; mid-ventrally and mid-dorsally they extend forwards to rear the anterior level of the lips. Opposite the middle of each lip a somewhat triangular and transparent cuticular flap. Two cephalic papillae are present on each side; they are lodged just behind the upper and lower bases of each lip. The mouth leads into a tubular pharynx with a thick cuticular wall; it is from 0.04 to 0.05 mm long and about 0.01 mm in diameter in the males and 0.047 to 0.052 mm long by 0.012 mm thick in the females. The oesophagus consists of two parts, an anterior and thinner muscular portion 0.23 to 0.28 mm long in the males and 0.4 to 0.45 mm long in the females, followed by a glandular portion reaching a length of 1.9 to 2.2 mm in the males and 2.0 to 2.3 mm in the females. Its maximum thickness at its base is 0.06 mm in the males and 0.075 mm in the females. The nerve ring encircles the muscular oesophagus just anterior to its middle; the very small cervical papillae and excretory pore are placed about 0.02 mm further back. The tail of the male is slightly twisted and bent ventralwards; on each side it carries a well developed caudal ala about 0.06 mm wide in its middle and about 0.2 mm long. It is supported by six pairs of pedunculated papillae, four pairs in front of the cloacal aperture and two pairs post-cloacal; their stalks which may reach 0.01 mm decrease in length towards the posterior end (Fig. 10). There are two well chitinized and unequal spicules:

HELMINTHS RECOVERED FROM RED AND YELLOW-BILLED HORNBILLS

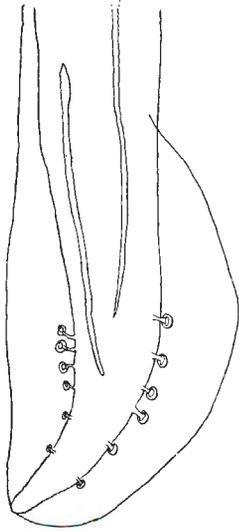


FIG. 10.—*Hadjelia inermis* (Ged.) Male tail, ventral view

the left is from 1.2 to 1.5 mm long, thinner and with somewhat pointed tip, while the right is shorter and more robust, with a somewhat rounded tip and ranges in length from 0.215 to 0.28 mm. A gubernaculum is absent. The vulva is situated some 0.15 to 0.2 mm in front of the posterior end of the oesophagus; it is a rounded aperture with a thickened cuticular edge; it leads into an elongate vagina, up to 1.0 mm long with a uniform thickness of 0.02 mm; it passes backwards more or less in a straight course, but may show a few wave-like bends; it divides into two horns which pass backwards to join the two uteri. The uteri practically fill the whole body except for its anterior and posterior portions. They are filled with numerous oval and thick-walled eggs, 0.032 mm long by 0.02 mm wide; these become embryonated *in utero*. The tail is short with a bluntly rounded tip; it varies in length from 0.1 to 0.12 mm.

Hosts: *Lophoceros flavirostris*, *Lophoceros erythrorhynchus*

Location: Under horny layer of gizzard

Locality: Kruger National Park, Transvaal

Discussion

The genus *Hadjelia* was created by Seurat (1916) to accommodate his species *H. lhuillieri* from *Caccabis petrosa* (Galliformes), Algeria. Since then six species have been assigned to this genus of which one, *H. inermis* (Gedöelst, 1919) is from Bucerotidae, viz. *Cranorrhinus corrugatus* from Malucca. Cram (1927) also lists his species from *Lophoceros semifaciatus*, apparently from Africa. The helminths described above agree very closely with Gedöelst's species and are tentatively identified as such; the only noteworthy difference being the smaller eggs in the specimen at the writer's disposal. Chabeaud & Campana identified this species as a synonym of *H. truncata* (Crepl., 1925).

The measurements in mm in Table 1 show the close relationship, if not complete identity, of the two species.

TABLE 1.—Measurements in mm of the two species, showing close relationship

Measurements	<i>H. inermis</i> (Gedoelst)	<i>H. inermis</i> (Cram)	<i>H. truncata</i> (Cram)	<i>H. inermis</i> (Ortlepp)
	mm	mm	mm	mm
Length—male.....	6.1–6.45	6.1–6.7	5.0–7.0	6.0–7.0
Length—female.....	18.0–21.8	12.0–21.0	10.0–16.0	17.0–19.0
Size pharynx—male...	0.045–0.055	0.045–0.055		0.04–0.05
Size pharynx—female..	0.05–0.06	0.05–0.06		0.047–0.052
Length tail—male....	0.12	0.12		0.12–0.14
Length tail—female...	0.09–0.12	0.09–0.13		0.10–0.12
Length oesophagus— male	2.0	2.0		2.13–2.48
Length oesophagus— female	2.4–3.5	2.4–3.6		2.4–2.75
Vulva from front.....	1.86–2.97	1.8–2.9	2.6	2.2–2.5
Length ovejector.....	0.79			1.0
Size eggs.....	0.054–0.057× 0.03–0.033	0.046–0.057× 0.03–0.033	0.027	0.032–0.037× 0.025–0.027
Length R. spicule....	0.2	0.2–0.28	0.22	0.215–0.28
Length L. spicule....	1.6–1.9	1.6–2.1	1.6	1.2–1.5
Caudal papillae.....	4 pre- & 2 postanal	4 pre- & 2 postanal	4 pre- & 2 postanal	4 pre- & 2 postanal

Unfortunately Seurat's (1916) description of *H. ihuillieri* is based on the examination of females only; it is thus not possible to make a close comparison between his species and that described above. Seurat, however, states that his species shows affinities with *H. truncata* (Crepl.).

SUMMARY

Helminth parasites from two species of hornbills (Bucerotidae) are described. These helminths are: a young trematode of the genus *Eumegacetes*, which is not specifically identified; a new species of cestode—*Railletina (Fuhrmanetta) lophoceri*; two new species of proventriculus nematodes—*Tropisurus prozeskyi* and *Microtetrameres bucerotidi* and a gizzard nematode—*Hadjelia inermis* (Gedoelst). All these helminths are described and figured.

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