

LUNGWORMS FROM SOUTH AFRICAN ANTELOPES

R. J. ORTLEPP, Veterinary Research Institute, Onderstepoort

Up to the present only three species of lungworms have been recorded from South African antelopes viz:—

- (1) *Dictyocaulus viviparus* (Bloch, 1782) Raill. & Henry, 1907 from the eland [*Taurotragus oryx* (Pallas)]. (Ortlepp, 1961).
- (2) *D. magnus* (Mönnig, 1932) Dougherty, 1946 originally described from the blesbok [*Damaliscus albifrons* (Burchell)] and subsequently recorded by the writer (1961) from the springbuck [*Antidorcas marsupialis* (Zimmermann)].
- (3) *Pneumostrongylus calcaratus* Mönnig, 1932 from the impala [*Aepyceros melampus* (Lichtenstein)].

In addition the writer (1961) listed two undetermined lungworms from the bontbok [*Damaliscus dorcas* (Pallas)].

In this article further data on the above lungworms are reported and the worms from the bontbok are described and named as well as a species of lungworm from the blue wildebeest [*Connochaetes taurinus* (Burchell)] and gemsbok [*Oryx gazella* (Linnaeus)].

TRICHOSTRONGYLIDAE

Dictyocaulinae

Dictyocaulus viviparus* (Bloch, 1782) Raill. & Henry, 1907

Hundreds of specimens from an eland, about three years old, were forwarded by the State Veterinarian, Cape Town, to the Onderstepoort Laboratories for specific identification. The host maintained at the Groote Schuur Zoo carried a very heavy lungworm infection and the specimens sent represented only a fraction of the worms present. This gross infection was considered by the veterinarian to be responsible for the poor condition and subsequent death of the eland; he stated that the animal had been in poor health for some months and at *post-mortem* a broncho-pneumonia, with masses of worms in the trachea and bronchi, was seen; no worms were seen in the digestive tract.

* The writer is in agreement with Dougherty (1945) that because of the characteristics of the female genital organs and direct life cycle this genus should be classified in the family Trichostrongylidae and not the Metastrongylidae.

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Interesting features of these parasites were their presence in such vast numbers in an antelope, and that among them there were numerous fifth stage worms in various stages of development, from 5·0 mm long to mature females, up to 50 mm long, carrying embryonated eggs. The presence of these various developmental stages would seem to indicate that over an extended period the eland had been picking up larvae which were able to develop to maturity; further, that immunity to reinfection apparently had not developed.

The Groote Schuur Zoo in which the eland was bred is in the nature of a park situated on the slopes of Table Mountain. The various ungulate animals are allowed to roam freely within its confines. During the wet winter months there is considerable grass coverage and conditions are ideal for the maturation of lungworm larvae.

In addition to the above specimens *D. viviparus* was also obtained from the bronchi of a blue wildebeest in the Kruger National Park. The infection was apparently light because only a few male and female fragments were collected.

Dictyocaulus magnus (Mönnig, 1932) Dougherty, 1946

This species was recovered from practically every springbuck shot and examined at the South African Lombard Nature Reserve, Bloemhof District, Transvaal. In this reserve there is a herd of about 600 springbuck and the authorities are obliged to adopt discriminative clearing in order to prevent overcrowding. Specimens of this species were also collected from springbuck from the Mariental District of South West Africa.

METASTRONGYLIDAE

Protostrongylinae

Protostrongylus capensis sp. nov.

Several complete male and female mature worms were collected from the distal ends of the bronchi of bontbok in the old Bontebok Game Reserve, Bredasdorp, Cape Province. Since their collection the bontbok have been removed to far better grazing grounds on the Swellendam commonage. In the old reserve the grazing was very poor and harsh and during wet seasons considerable portions of the reserve were swamped. The animals did not thrive and deaths due to verminosis and mineral deficiency were severe.

The worms have a brownish colour. The males vary in length from 24 to 26 mm with a maximum thickness of 0·125 mm; the females are 34 to 36 mm long with a maximum thickness of 0·15 mm. At the thinner anterior end, the head thickness is 0·03 and 0·045 mm for the males and females respectively; the body thickens posteriorly. In the males there is a neck-like thinning of the body just anterior to the bursa whereas in the females the body is thickest at the level of the vulva; from here attenuation continues backwards and the body ends in a pointed tail slightly bent ventralwards. The body is covered by a smooth cuticle. The mouth, bounded by three small inconspicuous lips, leads into the oesophagus 0·3 and 0·34 mm long for the males and females respectively; at its posterior end the oesophagus has a diameter of about 0·05 mm and the nerve ring encircles it about 0·14 mm from its anterior much thinner end.

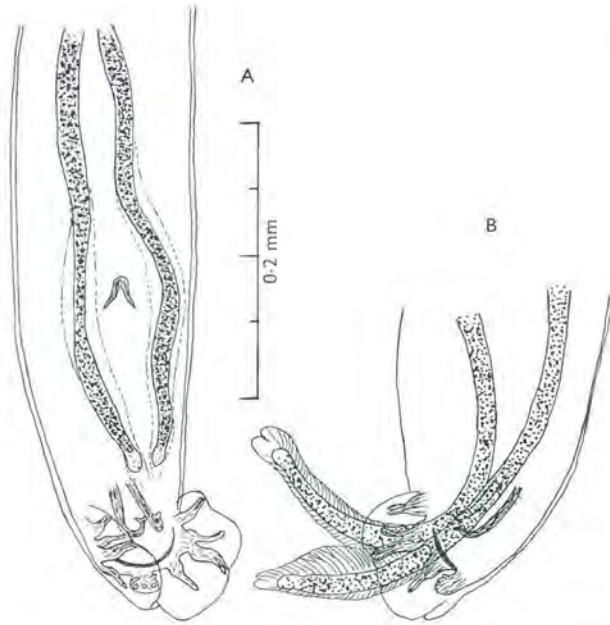


FIG. 1.—*Protostrongylus capensis* sp. nov.

A. Ventral view of posterior end of male; B. Lateral view of posterior end of male with extruded spicules.

The bursa (Fig. 1A and B) is relatively small, trilobed with a very small inconspicuous dorsal lobe. The ventral rays are fused except for their distal third; they diverge anteriorly from the lateral rays. The lateral rays have a common stem; the antero-lateral diverges forwards from the other laterals; the medio- and postero-lateral rays are fused except for their tips and are the only rays reaching the edge of the bursa. The externo-dorsal ray rises separately from the dorsal and only extends about half way to the edge of the bursa. The dorsal ray is cushion-shaped and from each of its anterior lateral-ventral sides it gives off a short finger-like papilla; posterior to these there is a row of three smaller ventral papillae. The spicules are deeply pigmented, equal and similar and have a granular structure; they are 0.33 to 0.36 mm long and 0.021 mm thick at their proximal ends; the posterior half of each spicule is enveloped in what appears to be double fan-like lamellae or wings supported by fine cuticular rays. The gubernaculum consists of a pair of well developed dark coloured crura, 0.065 to 0.07 mm long, recurved ventrally and terminating in boot-shaped distal ends; the corpus is very weakly cuticularised and indistinct; the capitulum is in the form of an inverted V and is found about 0.1 mm anterior to the crura. The end of the body is supported by a simple arc-shaped arcus.

The pointed female tail is from 0.045 to 0.09 mm long. The vulva is a simple opening 0.135 to 0.165 mm anterior to the anus; it is not covered by a vulval flap; in some specimens there is an inflation of the cuticle round the body in the region of the vulva. Provagina is absent. Vagina is simple, 1.2 to 1.7 mm long, extending forwards and is provided with a muscular sphincter, 0.06 to 0.08 mm long just posterior to the origin of the two uteri. Eggs *in utero* have a thin shell, are 0.075 to 0.081 mm long by 0.039 to 0.042 mm thick, and at time of being laid are in an advanced stage of morulation.

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No fully developed larvae were found in the lungs, but in freshly passed faeces two types of larvae were encountered, one with a bayonet-type tail similar to thousands of larvae found in consolidated lung tissue in association with the second species from the same host described below, and smaller numbers of slightly larger larvae with simple pointed tails. As the host was infected with these two lungworm species only, and as the wigly-tailed larvae were the only type present in association with the second species, the assumption is justified that the straight-tailed larvae are those of *P. capensis*.

Specific diagnosis

Protostrongylineae; darkish worms, males up to 26 mm long, females up to 36 mm long. Ventral rays and medio- and postero-lateral fused except for their tips. Dorsal ray reduced to a cushion-like pad carrying five papillae, two forwards and somewhat ventral and three on its ventral surface. Spicules equal, similar and granular, up to 0.36 mm long and carrying wing-like expansion on their posterior half. Gubernaculum with well-developed and recurved crura, about 0.07 mm long, weakly cuticularised corpus and inverted V-shaped capitulum. Females and larvae with simple pointed tails. Found in smaller lung bronchi.

Host: *Damaliscus dorcas* (Pallas, 1766). (Bontbok)

Location: Smaller bronchi

Locality: Bredasdorp, Cape Province

Types: Deposited in the Onderstepoort Helminthological collection

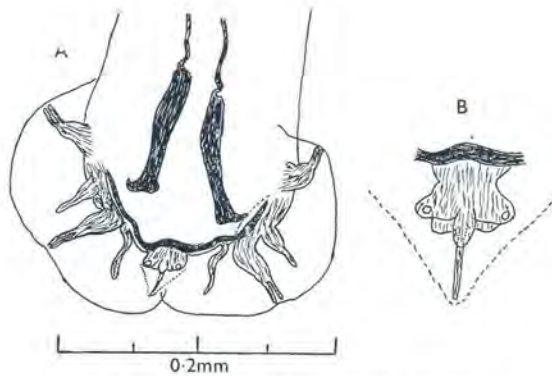
Discussion

No species of *Protostrongylus* has been described previously from South African ungulates. From East Africa, Yeh (1956) described the species *P. gazellae* from a Thomson's gazelle (*Gazella thomsoni*); this is the only record of a species of this genus from antelopes. Several species, however, have been described from deer in the Northern hemisphere. Yeh's species differs from those described now in that its spicules are larger (over 0.36 mm), the ends of the crura of the gubernaculum are not boot-shaped, the corpus is well cuticularised, the vulva opens on a pronounced swelling and the vagina is much shorter (0.67–0.72 mm).

Attempts were made to infect various species of slugs collected in the vicinity of Onderstepoort with this parasite. Fresh faeces from an infected captive bontbok were added daily to over a hundred slugs (species not determined) kept on moist sand in a wooden box and fed on fresh lettuce leaves. Dissection of two to four slugs daily over a period of two months failed to reveal the presence of any larvae in the tissues.

***Protostrongylus etoshai* sp. nov.**

The description of this species is based on fragments of worms obtained after teasing sections of consolidated lungs of blue wildebeest and gemsbok from South West Africa. In the preserved lung specimens the consolidations were easily seen from the surface; they were reddish grey in colour and varied in size from a centimetre to about 10 cm in diameter; on section the affected portions were firm and greyish white in colour extending several centimetres into the lung. Towards the posterior edges of the lungs the consolidations extended from surface to surface.

FIG. 2.—*Protostrongylus etoshai* sp. nov.

A. Ventral view of bursa; B. Ventral view of dorsal ray.

The consolidations contain myriads of lungworm eggs and coiled larvae in various stages of development; in among them the adult worms are intricately sewn through the alveoli; in the preserved material it was thus not possible to extricate complete worms. The posterior ends of a few males and two head ends were obtained. The body has a thickness of 0.035 to 0.045 mm; the head is 0.03 mm thick and is capped by three small lips. The oesophagus is from 0.28 to 0.31 mm long, 0.024 mm thick at its anterior and 0.06 mm thick at its posterior end. The general shape of the bursa, spicules and gubernacula (Fig. 2A) are very similar to those of the previous species. The bursa, however, is much longer and the lateral rays have a different mode of origin; their common base, instead of being vertical to the body, lies parallel to the edge of the body and the rays are placed at right angles to this base; the dorsal ray is reduced and cushion-like, with two lateral swellings on either side (Fig. 2B); a small papilla is lodged on the ventral side of each of the most ventral swellings; between the two dorsal swellings a central, thin finger-like process, about 0.035 mm long, extends backwards beyond the main mass of the dorsal ray; it supports a tent-like cuticular expansion which probably represents a much reduced dorsal bursal lobe. Ventral to this process, and also centrally placed, there is a shorter and stouter additional process probably representing a papilla. The spicules vary in length from 0.39 to 0.44 mm with a thickness of 0.014 mm at their proximal ends; they are provided with membranous wings for the greater portion of their length; these membranes are supported by cuticular rays originating from the stem of the spicules. The stem or body of each spicule has a mosaic and granular structure and each is terminated by a somewhat hyaline oval point. The crura of the gubernacula are dark brown and boot-shaped with hooked toe, their posterior ends being slightly bent towards the ventral surface; they vary in length from 0.09 to 0.108 mm; the corpus is also well cuticularised and 0.067 to 0.072 mm long; the capitulum is wish-bone shaped, each limb about 0.05 mm long. At the junction of the two arms there is a dorsal keel-like chitinous structure passing backwards between the arms. The posterior end of the body is strengthened by a conspicuous curved arcus; on its posterior edge there are three indentations, one opposite each of the externo-dorsal rays and one opposite the dorsal ray. The single female tail recovered was unfortunately much shrunken; it appears to be pointed and about 0.1 mm long. The vulva is situated about 0.06 mm anterior to the anus. The numerous eggs and larvae in the tissues were in all stages of development; the coiled mature larvae all had simple pointed tails, 0.01 mm long, and their cuticle is finely annulated. Hatching apparently takes place

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at an early stage because all the eggs seen contained only morulating embryos, all vermiform larvae having escaped from their egg-shells. The eggs are very thin-walled, oval, and measure from 0·08 to 0·09 mm long by 0·027 to 0·03 mm thick.

Specific diagnosis

Protostrongylineae. Light brown in colour; length of adults unknown. Spicules similar to those of *P. capensis* sp. nov. up to 0·44 mm long. Crura heavily cuticularised, boot-shaped with recurved toe, up to 0·11 mm long; corpus also well cuticularised and up to 0·072 mm long; capitulum an inverted V, arms up to 0·05 mm long. Lateral rays of bursa inserted vertically on a transverse base. Dorsal ray reduced, with two small ventro-lateral papillae and a single ventral larger papilla; ray carries a terminal relatively long finger-like process supporting a tent-like cuticular expansion. Female tail apparently pointed; vulva close to anus. Eggs morulated *in utero*, 0·08–0·09 mm long by 0·027–0·03 mm thick. Adults in alveoli of lungs.

Type host: *Connochaetes taurinus* (Burchell, 1823) (Blue wildebeest)

Additional host: *Oryx gazella* (Linn, 1758) (Gemsbok)

Location: Alveoli of lungs

Locality: Etosha Nature Reserve, South West Africa

Types: Deposited in the Onderstepoort Helminthological collection

Discussion

P. etoshai is closely related to *P. capensis* as seen from the similarities in their male accessory genital structures; it differs, however, from *P. capensis* in that the bursa is much larger, the crura are stouter and longer, a well developed corpus is present, the arms of the capitulum are longer, and the lateral bursal rays are implanted vertically on a transverse base. In addition the location of the adults is in the alveoli of the lungs, where the eggs are deposited, and not in the smaller bronchi.

***Pneumostrongylus calcaratus* Mönnig, 1932**

This lungworm is a very prevalent parasite of impala in the Eastern Transvaal Lowveld; all lungs from this host from the Kruger National Park and from areas adjacent to the western boundary of the Park were found to be infected. In some cases nearly a quarter of each lung was consolidated due to the effects of this parasite. On the other hand all impala (about 15) from Swaziland examined by the writer in the field did not show any visible signs of infection.

No entire worms could be recovered from the lung tissues. The male genital characters are as described by Mönnig (1932). Each spicule consists of two distinct parts, a proximal portion having a granular appearance, and a distal portion which carries two membranous alae supported by chitinous rays. The former, which may be considered to represent the handle of the spicule, is rounded and comprises nearly three fifths of the total length of the spicule; the distal portion, which may be considered as the blade, is broad and flattened and its posterior half is split into two branches. Each blade is provided with two alae, one along each of its outer latero-ventral borders; these alae take their origin near the anterior end of the blade and are continued backwards to beyond the end of the spicule, one along each of its two branches. The total length of the spicules including their alae was found to vary from 0·36 to 0·42 mm.

***Pneumostromglylus cornigerus* sp. nov.**

This parasite of the bontbok was recorded tentatively (Ortlepp 1961) as a species of the genus *Muellerius*; this diagnosis was based on the larvae which carried a tail similar to that found in the larvae of *M. capillaris* (Mueller, 1889), which parasite is known to occur in sheep in the Western Province and possibly extends south eastwards into the Bredasdorp District.

The parasite is found in extensive consolidations of the lungs and its presence was probably one of the major causes of the poor condition and deaths among the bontbok in the old Bontebok National Park. After repeated dissection it was possible to obtain the posterior portions of only five males; in addition four anterior ends were found; repeated search failed to reveal the presence of a single female tail. The longest portion of worm obtained was 15 mm long with a maximum thickness of 0.12 mm.

The mouth is bounded by three simple convex lips on which no papillae could be seen; it leads direct into the oesophagus. The thickness of the head is 0.045 mm and the thickest body portions obtained had a diameter of 0.138 mm. The oesophagus is straight and it gradually becomes thicker towards its posterior end; at its anterior end its thickness varies from 0.024 to 0.03 mm and at its posterior end from 0.052 to 0.06 mm; its total length is from 0.33 to 0.36 mm; the nerve ring encircles it about 0.18 mm from its anterior end.

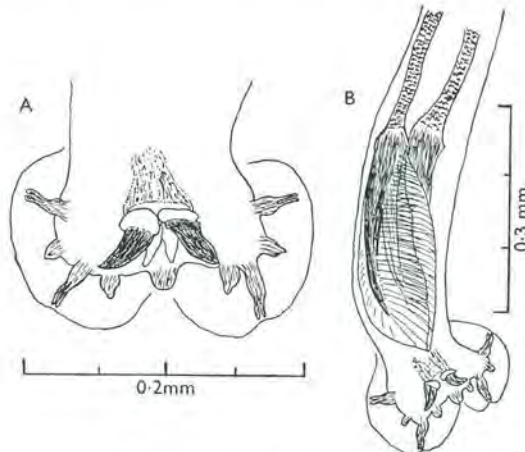


FIG. 3.—*Pneumostromglylus cornigerus* sp. nov.
A. Ventral view of bursa; B. Posterior end of male.

The bursa is small and carries two distinct lateral lobes; whether a dorsal lobe is present or not could not be determined (Fig. 3A and B). The ventral rays are fused for about two-thirds of their length and are directed forwards and ventrally. The antero-laterals are separate from the other laterals and are relatively short and stumpy; medio- and postero-laterals are fused except for their distal third; they are the longest rays and are the only rays to reach the edge of the bursa. The externo-dorsal rays are also short and are situated away from the dorsal ray. The appearance of the dorsal ray could not be determined definitely; the impression is that it is much reduced and cushion-shaped. The equal and similar spicules are

similar to those of the genotype; their total length up to the posterior ends of their alae varies from 0·465 to 0·56 mm, of which the anterior 0·18 to 0·23 mm constitute the handle and the rest the blade. As in *P. calcaratus* the distal two-thirds of each spicular blade is split and each branch is provided with a well developed ala supported by cuticular ribs. The gubernaculum is similar to that of the genotype. The two darkly coloured crura are from 0·048 to 0·054 mm long, and may extrude from the body as two short divergent horns; each is provided with a lighter coloured appendage lying along its inner border; the corpus is poorly chitinised and gradually fades away anteriorly; its total length is from 0·075 to 0·09 mm; no signs of a capitulum are seen. In the lung tissue numerous eggs and larvae in different stages of development are present. The eggs are thin-walled and oval, 0·078 to 0·09 mm long by 0·042 to 0·045 mm broad; in the lung tissues they contain embryos in various stages of morulation. The coiled larvae are about 0·285 mm long and 0·015 mm thick and have all hatched; they possess simple unornamented heads; the oesophagus is about 0·08 mm long and the body is terminated by a bayonet-like wavy tail about 0·008 mm long, generally provided with a small dorsal spike at its base.

Specific diagnosis

Protostrongylinae. Worm, light brown, thin and elongate with simple head and oesophagus. Spicules equal and similar up to 0·56 mm long, darkly coloured; each consists of a shorter, rounded and granular handle and a longer and broader blade split for the greater part of its length, each branch carrying a broad ala. Crura of gubernaculum well developed and shaped like short horns; corpus poorly chitinised; capitulum apparently absent. Antero-lateral and externo-dorsal bursal rays shorter and stouter than other rays. Larvae with short wavy tails with dorsal spike.

Host: *Damaliscus dorcas* (Pallas, 1766). (Bontbok)

Habitat: Alveoli of lungs

Locality: Bredasdorp District, Cape Province

Types: Deposited in the Onderstepoort Helminthological collection

Discussion

From the above description and figures it will be seen that this species is very closely related to *P. calcaratus* Mönnig; in both species the general organisation of the body structures is on the same plan, both have similar types of larvae, and both are located in the alveoli of the lungs. The specimens diagnosed as *P. cornigerus*, however, differ from *P. calcaratus* in that the spicules are much longer (maximum 0·56 as against a maximum of 0·42 mm), the handle of the spicule is considerably shorter than the blade and the antero-lateral and externo-dorsal rays are shorter and stumper, whereas the reverse is the case in *P. calcaratus*.

Dougherty (1945) described the second species of this genus—*P. tenuis*—from a white tailed or Virginia deer (*Odocoileus v. virginianus*) in the United States. His description was based on a single entire male 45 mm long, recovered from a small bronchiole of the lung. This worm differs from *P. cornigerus* mainly in that its spicules are much shorter (0·195 mm), the laterals and externo-dorsal rays are all carried on a common stem, and the dorsal ray carries three long ray-like papillae; in addition, the crura of the gubernaculum are much shorter and have a different shape.

The species *Pneumostrongylus alpenae* Dikmans, 1935 was transferred by Dougherty (1945) to the genus *Varestrongylus* Bhalerso, 1932, because its male characters showed greater resemblances to the latter than to the former genus: Dougherty came to this conclusion after an examination of and comparison with Dikman's species and material of the *V. pneumonicus*, the type species of Bhalerso's genus.

SUMMARY

The various species of lungworms recorded from South African antelopes are discussed. Three new species of protostrongyliids are described viz. *Protostrongylus capensis* and *Pneumostrongylus cornigerus* from the bontbok [*Damaliscus dorcas* (Pallas)] and *Protostrongylus etoshai* from the blue wildebeest [*Connochaetes taurinus* (Burchell)] and the gemsbok [*Oryx gazella* (Linnaeus)].

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