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On some new members of the Genus *Kiluluma* from the African Rhinoceros.

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IN a recent study (1924) I have given an account of the genus *Kiluluma*, describing six species collected by Prof. Leiper from an African rhinoceros in Uganda, and have elucidated certain interesting points in its anatomy. A further study of the material has revealed the presence of four new species which form the basis of the present communication.

1.—KILULUMA GOODEYI, sp. nov.

There were a large number of specimens belonging to both sexes in a very good state of preservation. The specific name is given in honour of Dr. Goodey, who has been a continuous source of help in this work.

The females are longer than the males and are 18-19 mm. long, while the males are only 15-17 mm. long. The body tapers slightly towards the extremities.

The cuticle is thick and distinctly annulated, each annulus being further marked by fine transverse striations. At the anterior end it is produced into a lobed mouth-collar presenting an irregular margin on its anterior face. It is separated from the body by a deeply notched cephalic groove. The submedian papillæ rest, as usual, on the mouth collar and have the typical character. The lateral papillæ open out anterior to the cephalic groove.

The cervical papillæ are situated behind the œsophageal region at a distance of ·93 mm. in the male and 1·07 mm. in the female from the anterior end. The total length of each is ·1 mm., including the flagellum.

The nerve ring is 0·35 mm. from the anterior end in the male and 0·4 mm. in the female.

The excretory pore is situated in front of the cervical papillæ, and is ·9 mm. in the male and ·98 mm. in the female from the anterior end.

The mouth is an oval aperture and leads into a shallow buccal cavity bounded by the buccal capsule composed of a stout cuticular material. Arising internally from the base of the capsule are a series of eight thick fleshy lips, each of which is produced into an outwardly curved flagelliform process. The outer edges of the lips are rounded off and curve backwards to join posteriorly with the body wall.

The œsophagus is club-shaped, having its greatest diameter of 0·31 mm. near its posterior end. In the region of the nerve ring it is very slightly constricted. The opening of the œsophagus into the buccal cavity is more dorsally situated, and leads into a short œsophageal funnel. Within the œsophagus the cuticular lining forms a spherical œsophageal bulb. Anteriorly the œsophagus is thrown into three conical outgrowths guarding its aperture into the buccal cavity, while posteriorly there are the usual œsophageo-intestinal valves. The cells of the intestine are fairly large and distinct, being full of granular materials.

Male Characters.

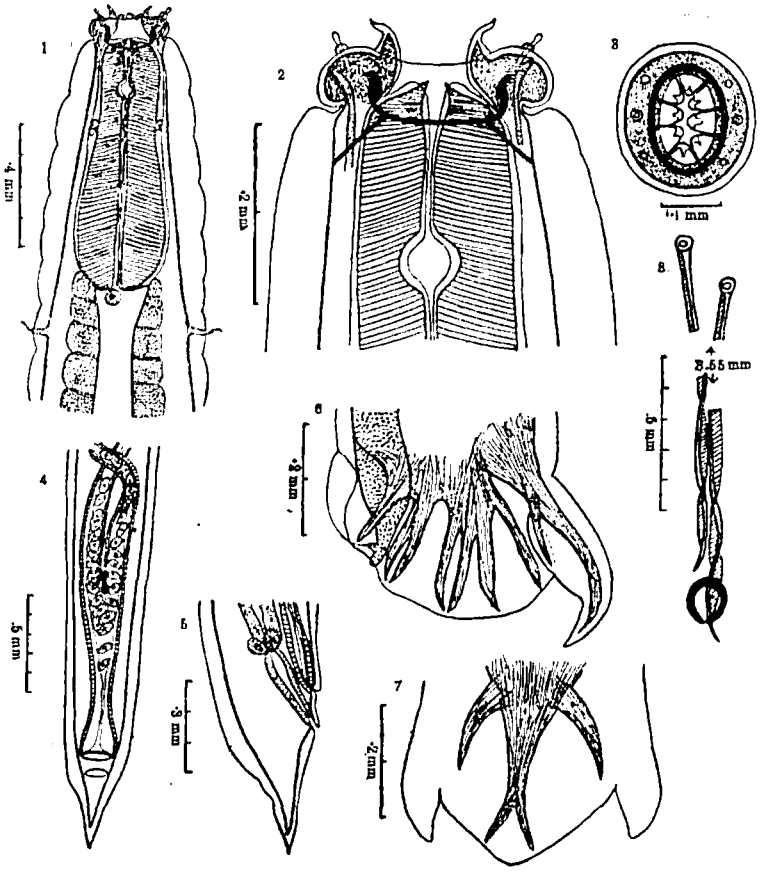
The bursa is well developed and its lobes are quite distinct. The dorsal lobe is longer than the lateral lobes and is slightly bent downwards. The bursal rays have the usual disposition. The pre-ventral ray is the first ray of the bursa on its ventral side. The lateral rays arise together by a stout common stem, and the extra-lateral ray separates off first from the series and the postero-lateral diverges from the rest. All the rays of the lateral lobe reach the edge of the bursa. The dorsal ray gives off the externo-dorsal ray near its base and itself bifurcates in its posterior quarter.

The genital cone is highly contractile, and is represented as being protruded out in Fig. 6, and the dermal cone is very prominent as in *K. rhinocerotis*.

The spicules are very long and narrow and bear along one of the margins a finely striated ala that coils round the axis of the spicule. The axis of the spicule is narrow and tapering towards the posterior extremity, where it is also spirally coiled. The ala in this part fills the hollow of the spicular axis and is absent near the tip. The length of the spicule is 9·5 mm. The ends of the spicules are shown in Fig. 8. The accessory piece is present and is oval in outline.

Female Characters.

The posterior end of the female gradually narrows and bears an elongated conical tail in continuation of its ventral side. The tail is ·24 mm. long.



Kiluluma goodeyi sp. n.

Fig. 1. Anterior end of the adult, ventral view.
Fig. 2. Head end, greatly enlarged, dorsal view.
Fig. 3. End-on view of head, showing papillæ, buccal capsule, lips, etc.
Fig. 4. Posterior part of female genitalia, ventral view.
Fig. 5. Tail of female, lateral view.
Fig. 6. Male bursa, lateral view.
Fig. 7. Same, dorsal view.
Fig. 8. Ends of spicules and accessory piece. 8·55 mm. indicates the length of the spicules left out.

The anus is ·43 mm. in front of the tip of the tail, and leads into a short rectum ·29 mm. long. It is lined with thick cuticle, and is delimited anteriorly from the intestine by the presence of three rectal ligaments.

The vulva is a wide opening ·11 mm. in advance of the anus, and leads into a short vagina about ·83 mm. long. The vaginal horns are very long, attaining the total length of 7·5-8 mm., and are the longest so far found in the genus, as are also the spicules. In their course forwards the vaginal horns are twisted round each other and are full of eggs.

The eggs are thin-walled, and measure ·09 mm. long by ·04 mm. broad.

2.—KILULUMA BREVICAUDA, sp. nov.

The body is elongated cylindrically, narrowing slightly towards the extremities. The females are longer than the males and are 19 mm. long, the males are 18 mm. long.

The cuticle is thick, and shows distinct annulations throughout its length, each annulus being further marked by very fine striations. Anteriorly there is the usual mouth-collar, which is rather flattened out and is separated from the body by a distinct cephalic groove. The circum-oral papillæ stand out on the anterior face of the mouth-collar and have the usual characters. The lateral papillæ, however, open in the cephalic groove.

The cervical papillæ are post-œsophageal in position and have the common characters. They lie at a distance of ·96 mm. from the anterior end and each has the total length of ·1 mm.

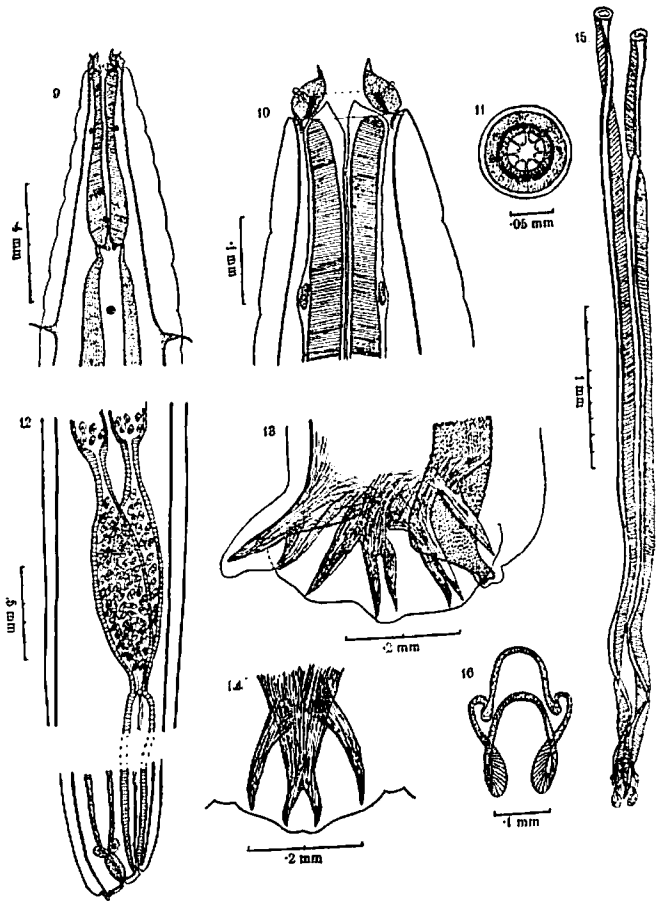
The excretory pore is ventrally situated in front of the cervical papillæ about ·86 mm. from the anterior end.

The nerve ring surrounds the œsophagus in the anterior region, and is ·265 mm. in the male and ·31 mm. in the female from the anterior end.

The mouth opening is surrounded by eight lips, the anterior ends of which are thrown out into anterior pointed processes. The buccal capsule is composed of a strong cuticular ring with broad truncated anterior end, and is twice as broad as deep. It is circular in outline.

The œsophagus is an elongated club-shaped structure 0·71 mm. long in the female and 0·63 mm. in the male. It is slightly constricted off in the region of the nerve ring, and swells out posteriorly into a larger bulb

with its maximum diameter of ·15 mm. Anteriorly the cuticular lining of the œsophagus is produced into three conical teeth which project into the buccal cavity. The œsophageal funnel is small, conical, and the



Kiluluma brevicauda sp. n.

Fig. 9. Anterior end, ventral view.
Fig. 10. Head end, greatly enlarged, dorsal view.
Fig. 11. End-on view of head.
Fig. 12. Posterior end of female, lateral view showing part of the genitalia. Vagina is partly not shown.
Fig. 13. Male bursa, lateral view.
Fig. 14. Same, dorsal view.
Fig. 15. Spicules and accessory piece.
Fig. 16. Accessory piece, greatly enlarged, ventral view.

opening is in the centre of the buccal cavity. There are the three usual œsophageo-intestinal valves present at the junction of the œsophagus with the intestine. The intestinal cells are not so distinctly recognisable as in the previous species, and the rectal ligaments occur at the junction of the rectum with the intestine.

Male Characters.

The bursa is well developed, and the dorsal lobe is small and distinct. It slightly overlaps the lateral lobe on either side, from which it is separated by a groove. The bursal rays are stout and have the usual disposition. The preventral ray lies within the bursa. The extra-lateral ray arises independently from the body wall, and has no connection with the lateral series of the rays. The postero-lateral diverges from the externo-lateral and medio-lateral rays which run together side by side. The dorsal ray is very stout at the base and gives off an externo-dorsal ray shortly after its origin from the body wall. The two branches of the dorsal ray are formed at its posterior fourth.

The genital cone has the usual characters and the dermal collar is present.

The spicules are alate and bear a winglike expansion along one edge. The ala follows the spiral coil of the anterior and posterior end of each spicule. The accessory piece is of a peculiar shape. Beginning from behind, it consists of a curved spurlike structure resembling the merry thought of the bird lying in the ventral wall of the cloaca, the apex of the spur extends anteriorly, and the hinder points of the spur turn upwards and forwards laterally in the cloacal wall. Near the anterior end of the cloaca the lateral outgrowths turn backwards dorsally and are continuous with another spurlike process in the anterior dorsal wall of the cloaca, thus becoming a completely closed structure throughout. The lateral pieces near their origin from the ventral spur are transversely striated. This structure on closer examination appears to resemble the " telamon " described by Hall (1921) in Hyostrongylus rubidus. The only difference seems to be that in the present case it has got an additional spurlike process in the dorsal wall of the cloaca. Probably here the gubernaculum has become fused with the telamon of Hall.

Female Characters.

The posterior end of the female tapers slightly and terminates dorsally into a short telescopic tail about ·06 mm. long. The body abruptly slopes down from the base of the tail to the genital aperture, thus giving this extremity of the worm an obliquely truncated appearance.

The anus is 0·13 mm. from the tip of the tail, and leads into a short rectum 0·25 mm. long. The rectum is lined internally by a thick cuticle.

The vulva is situated very close to the anus, and is 0·24 mm. in front of the tip of the tail. The vagina is 3·27 mm. long, and is lined with stout cuticle. It leads anteriorly into two horns formed by its bifurcation. The horns are short as compared with the length of the vagina, being only 1·35 mm. long, and are full of eggs.

The eggs are elongated, thin-walled and measure 0·08 mm. by 0·035mm.

3.—Kiluluma brevivaginata, sp. nov.

The females are 19 mm. long and males are shorter than this, being only 14-15 mm. in length. The worms in both the sexes taper towards the extremities.

The cuticle is thick and slightly inflated round the œsophageal region of the body. It is distinctly annulated, and each annulus is further finely striated. Of all the grooves that segment the body of the worms of this species there are two that stand out distinctly. The first groove separates the mouth-collar from the rest of the body as the cephalic groove ; the second groove is further down on the body and is very deeply marked. It bears the opening of the excretory apparatus in the mid-ventral line.

The mouth-collar is distinct and is lobed on its anterior face. It bears the sub-median papillæ in the usual position. The lateral papillæ open at the cephalic groove.

The cervical papillæ have the usual characters and are situated in the œsophageal region about 0·86 mm. in the male and 0·95 mm. in the female from the anterior end. They are flagelliform in nature and are ·09 mm. long.

The nerve ring is 0·43 mm. from the anterior end of the body.

The excretory pore is in front of the cervical papillæ about ·75 mm. from the anterior extremity of the body. As has been previously remarked, it is situated in a well-marked groove in the cuticle.

The mouth is circular and is surrounded by four lips, each bearing two cuticular-pointed leaf crowns. The buccal cavity is wide and a little broader than deep ; its walls are supported by a thick cuticular buccal capsule.

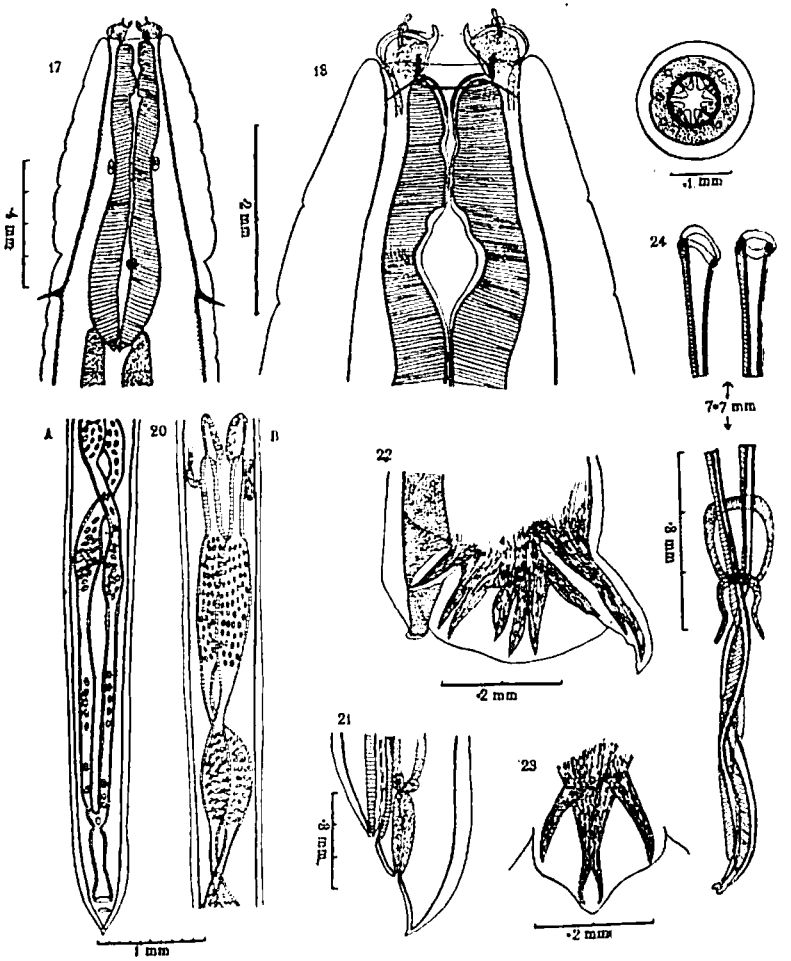
The œsophagus is elongated as in K. magna, and is slightly swollen out in front of the nerve ring, and has a larger swelling, having the maximum diameter of 0·22 mm. behind the nerve ring. The œsophageal funnel is very characteristic in this species, and is strengthened by a thick cuticular lining. At about ·12 mm. from the anterior end of the œsophagus the cuticular lining is folded to form a small oval cavity, and a little behind this it enlarges into another larger cavity of an irregular shape. There are the usual œsophageo-intestinal valves, and the intestinal cells are fairly large and full of granules.

Male Characters.

The bursa in this species shows a very well marked resemblance with that of the *K. goodeyi*. The bursal lobes are quite distinct, and the dorsal lobe slightly overlaps the laterals. The peculiar character of the bursa in this species is that the preventral ray appears to be stouter at the base than in the other species, and sometimes bears a part of the bursal lobe which is apparently separated from the lateral lobe by a shallow groove. Fig. 22 indicates the separation of this piece in the bursa. The other rays of the lateral lobe are also stouter at the base and pointed at the tips. Of the ventral rays the latero-ventral is the stouter of the two. The externo-lateral and the extra-lateral rays of the lateral series do not reach the edge of the bursa. The externo-lateral, the medio-lateral and the postero-lateral rays all run parallel to each other, and the extra-lateral ray diverges sharply from the lateral series. The dorsal ray has the common characters. It gives off the externo-dorsal ray near its origin from the body wall, and itself bifurcates in its posterior fourth.

The genital cone is contractile and has well-developed dermal collar.

The spicules are very long and narrow and attain the length of 8·7 mm. The axis of the spicule gradually tapers towards the posterior end, where it is spirally coiled. The alar expansion is of the usual type, and is spirally twisted round the spicular axis occupying the hollow of the spire in the posterior part of the axis. The tips of the spicules are rounded.



Kilulumа brevivaginata sp. n.

Fig. 17. Anterior end, ventral view.
Fig. 18. Same, greatly enlarged, dorsal view.
Fig. 19. End-on view of head.
Fig. 20. Female genitalia.
A. Showing vagina and posterior part of the horns.
B. Continuation forwards of the same, showing anterior part of the horns and uteri short and the beginning of the ovaries.
Fig. 21. Tail end of female, lateral view.
Fig. 22. Male bursa, lateral view.
Fig. 23. Same, dorsal view.
Fig. 24. Spicules and accessory piece. Figures 7·7 mm. indicates the length left out in the drawing.

The accessory piece is of a double character. The anterior part consists of an oval ring from the posterior edge of which arises on either side a rodlike process bent somewhat like a knee-joint.

Female Characters.

The female is peculiarly shaped at its posterior extremity. Beginning from a little in front of the vaginal orifice, the body wall gradually tapers towards the dorsal side till it ends posteriorly in a slightly bent pointed tip. The tail in this species is, therefore, to be considered as the whole of the body behind the anus, which is ·2 mm. from the tip of the tail. The rectum is short and is ·28 mm. long. The rectal ligament cells are of the usual character and mark the anterior limit of the rectum.

The vulva is ·35 mm. from the tip of the tail and leads into a very short vagina on which character the specific name is based, measuring ·7 mm. in length. The horns of the vagina are very long and possess several swellings full of eggs in their course forwards. Each horn is 7·4 mm. long, and leads into an extremely short uterus ·8 mm. long. In this species the uteri are also the shortest so far observed.

The eggs measure ·08 mm. by ·05 mm. and are thin-shelled.

4.—Kiluluma cylindrica, sp. nov.

There were several specimens belonging to this species, a few of which were in a very good state of preservation to afford an adequate study of the material.

The females are, as in every other species, slightly longer than the males; their relative lengths are: females 12 mm. and males 11 mm. The body is approximately of a uniform diameter throughout, only slightly narrowing in the females at the posterior end.

The cuticle is thick, especially at the anterior end, where it is inflated to give the worm a cylindrical appearance. In this region the cuticle presents a double contour as far back as the nerve ring. The inner layer of the cuticle slopes slightly inwards anteriorly, and corresponds to the usual cuticle in other species; the outer layer of cuticle is thickened as it

proceeds towards the anterior end, thereby making the body appear cylindrical. Anteriorly the inner layer of cuticle is produced forwards to form the mouth-collar, which is indistinctly marked off from the lips. It is produced into four lobes on its anterior face, where it bears the submedian papillæ in the usual position. Posteriorly the mouth-collar is separated from the body wall by a distinct cephalic groove. The lateral papillæ are situated a little in front of the cephalic groove, and the submedian papillæ pierce through the lips and are without the collarlike basal expansion found in other species of the genus.

The cervical papillæ are very slender. Each has a total length of ·07 mm. and they are situated in the post-œsophageal region about 0·73 mm. in the male and 0·74 mm. in the female from the anterior end.

The nerve ring is ·2 mm. from the anterior end in the male and ·22 mm. in the female.

The excretory pore is in front of the cervical papillæ and is ·68-·7 mm. from the anterior end.

The mouth opening is circular and is surrounded by six lips arising from the inner side of the base of the buccal capsule. Anteriorly the lips are produced into short pointed outgrowths along their inner side, while the outer end is rounded off to join the body wall.

The buccal cavity is circular in outline and is surrounded by the thick cuticular ring of the buccal capsule. The capsule is thickest in its middle and gradually narrows posteriorly.

The œsophagus is an elongated club-shaped structure with its maximum diameter of ·09 mm. towards its posterior end. Its cuticular lining is thrown out anteriorly into three short conical teethlike processes within the buccal cavity, and the outer anterior margin is slightly protruded forwards along the outer edge of the buccal capsule for a short distance and probably supports the latter. The œsophageal funnel is very small and at ·03 mm. from the anterior end of the œsophagus its cuticular lining is folded out to form an oval bulb within the œsophagus. The œsophageo-intestinal valves are small and have the usual disposition. The intestine is cylindrical and its lumen is lined by a thick cuticle. The intestinal cells are full of fine granules.

Male Characters.

The bursa is divisible into three lobes and the dorsal lobe is equal to the lateral lobe in length. The bursal rays have the common disposition of parts and are relatively long and narrow. The preventral ray is slightly curved and the common stem of the ventral rays is rather longer than in the other species. Of the lateral rays the postero-lateral is the stoutest of the series. The extra-lateral ray arises from the common stem of the lateral series. The dorsal ray gives off the externo-dorsal ray at its anterior third, and itself divides into two branches in its posterior third. The externo-dorsal ray, after a short course, gives off a small narrow branch on its inner side, and itself continues backwards to reach the edge of the bursa. The branch of the externo-dorsal ray curves outwards and its tip lies beneath the externo-dorsal proper.

The genital cone is contractile, as in other species, and there is a well-developed dermal collar present.

The spicules are equal and similar, and attain the length of 1·8 mm. The head end is flanged out, and the axis tapers to its extremity. It has the maximum diameter of ·05 mm. In the posterior fourth of its length the axis is coiled like an open corkscrew. Running along one of its edges there is a transversely striated cuticular alar expansion, which, in the spiral portion of the axis, coils with the spiral twist of the spicular axis and fills up the hollow of the spire. The ends of the spicules are, as usual, devoid of the alar expansion.

The accessory piece is ring-shaped, and is produced back into two lateral processes running in the lateral wall of the cloaca. (Fig. 32.)

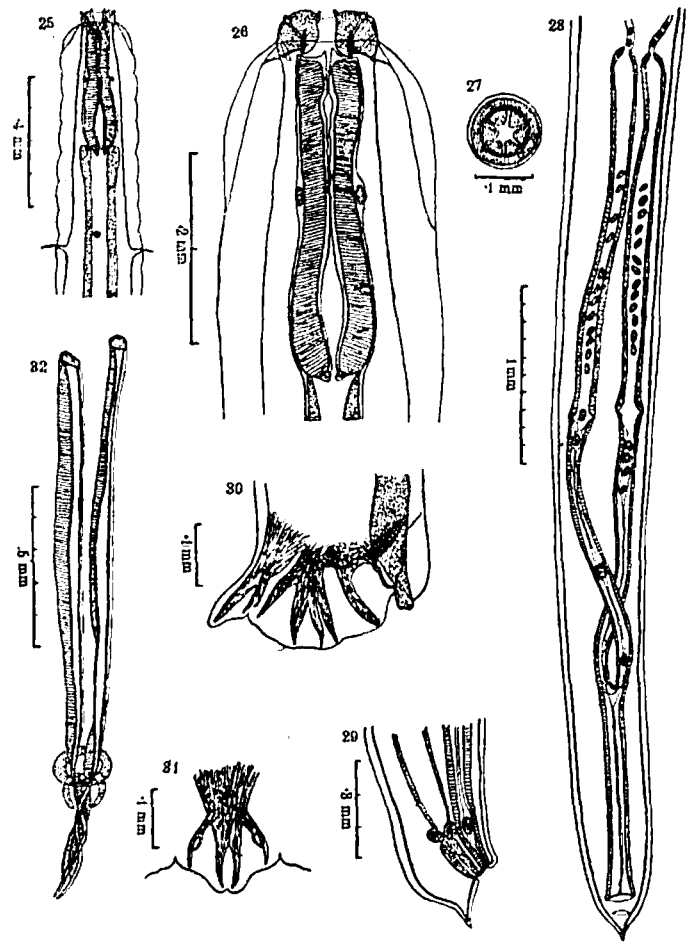
Female Characters.

The body of the female narrows slightly towards the extreme posterior end, where it rounds itself off and bears at its extremity a short conical tail.

The anus is ·16 mm. from the tip of the tail and is continued into a short rectum about ·16 mm. long, which is lined by thick cuticle. Anteriorly the rectum is limited by three rectal cells which mark the position of its connection with the intestine.

The vulva is situated very close to the anus, being only ·04 mm. in front of it, and has a prominent ventral lip. The vagina is forwardly

directed and is 1·18 mm. long. It bifurcates anteriorly into its two vaginal horns that are a little longer than the vagina itself, being 1·64 mm.



Kiluluma cylindrica sp. n.

Fig. 25. Anterior end, ventral view.
Fig. 26. Dorsal view of the same, greatly enlarged.
Fig. 27. End-on view of head.
Fig. 28. Female genitalia, ventral view. Ovaries are left out.
Fig. 29. Tail of female, lateral view.
Fig. 30. Male bursa, lateral view.
Fig. 31. Same, dorsal view.
Fig. 32. Spicules and accessory piece.

in length. They coil round each other in their course forward. The uteri are also long, in fact longer than either of the above two described structures, and attain a length of 2 mm. Both the horns of the vagina and the uteri are full of eggs arranged in linear series.

The eggs are elongated, thin-shelled structures and measure ·09 mm. long and ·05 mm. broad.

Discussion.

In my previous communication (1924) I discussed a few points of systematic importance and suggested the creation of a new sub-family, Kiluluminæ, for the reception of the genus *Kiluluma*. The present study further confirms the conclusions arrived at in that communication, and throws some further light on the morphology of certain structures, the discussion of which seems necessary.

First of all, we take up the consideration of the structure described under the name " accessory piece." This structure is formed, as is well known, from the cuticular thickening of the cloacal wall, and assumes various shapes and forms in different nematodes. Thus, in the genera *Mehdiella* and *Tachygonetria* amongst the Oxyuridæ it is found to have the form of a wide V, while in the genus *Œsophagostomum* it is an elongated structure shaped like a small coal shovel. In certain genera of Strongylid parasites it is in the form of a simple rodlike structure, and in others it may be a curved rod. In the genus under discussion we find that whereas in different species it differs in minor details, it is based on a common plan of structure from which the condition in each species could be derived by slight modification. Hall (1921) has introduced a new term, " telamon," for a structure found within the cloaca near its external opening. It is of a variable form in the nematodes belonging to different genera and species. He distinguishes it from the structure known as gubernaculum, which he restricts for the longitudinal structure in the wall of the cloaca along its dorsal anterior aspect, while the telamon is regarded by him as a support for the posterior end of the cloaca. Both of these structures are formed by the cuticularisation of the cloacal wall. This distinction seems quite valid when there are two independent structures present, but when there is only one of these found it is very difficult to decide about its

nomenclature. Let us take the description of telamon in *Hyostrongylus rubidus*. Beginning from the posterior end, we find there is a curved spurlike cuticular structure whose apex is directed forwards. The posterior ends of this spur are turned laterally upwards towards the anterior end as elongated processes, one on either side in the cloacal wall. In addition there is an elongated gubernaculum. In the genus *Kiluluma* the common type of structure present has the shape of an anterior transverse bar on the dorsal wall of the cloaca, and it is turned laterally backwards to assume varying forms in different species. In one of the species described in this communication as *Kiluluma brevicauda* the accessory piece is exactly similar to the telamon of *Hyostrongylus rubidus*, the only difference being that in *K. brevicauda* the lateral processes are slightly curved backwards at their anterior extremities and from the ends arise another spurlike process situated in the dorsal wall of the cloaca, thereby making it a completely closed structure of an irregular shape. It appears that in this form the gubernaculum has become fused with the telamon, and thus it could be compared to both the telamon and the gubernaculum of *Hyostrongylus rubidus*. In other forms it is found in the anterior part of the cloaca, and therefore cannot be compared, according to its position in the cloaca, to the telamon, though it is circular and somewhat obliquely placed within the cloaca like the telamon. Further, in some species of Kiluluma the accessory piece, after forming a complete ring-shaped structure, sends out, in the lateral wall of the cloaca, a posterior process on either side. It would, therefore, be not an easy matter to decide about the exact nomenclature of these two structures. Both gubernaculum and telamon are the local thickenings of the cloacal wall formed by the aggregation of the cuticular material at different places, and are meant to protect the cloacal wall from the sharp-pointed spicules for which they serve, in addition, as guides. It may well be mentioned that it would be safe to restrict the term " accessory piece " when the structure is alone, and when there are both, the terms " gubernaculum " and " telamon " be used, as suggested by Hall, according to their relative position within the cloaca.

Another point deserving attention is the relation between the relative lengths of the spicules and vagina. We find that these structures vary in length in different species ; where spicules are short the length of the

vagina corresponds to it, and where the spicules are long the length of the vagina increases accordingly. This relation between the two structures was pointed out by Goodey (1924) in the genus *Œsophagostomum*. While studying the genus *Kiluluma* the writer has made certain observations that indicate that this relationship between the spicules and the vagina does not always exist. In the following species of the genus in question the relation seems to be fairly constant.

	Spicules.	*Vagina.*
K. pachyderma	1·95 mm.	1· 6 mm.
K. solitaria	1· 9 mm.	1·32 mm.
K. cylindrica	1· 8 mm.	1·18 mm.

This indicates that the length of the vagina varies approximately with the variations in the length of the spicules. But the case is different in the following species of the genus *Kiluluma*, though the correspondence of the relative length of the two structures is, in my opinion, apparent.

The species in which this correspondence does not exist are *K. rhinocerotis*, *K. brevivaginata*, *K. goodeyi*, and *K. brevicauda*. Here the relationship does not hold as expressed by Goodey. From a consideration of the morphology of the female genitalia of these forms and other species it appears that the vagina in the genus *Kiluluma* divides into its two horns anteriorly and these horns attain a variable length in different species and then lead into the corresponding uterus. There are no ovejectors, as are found in the genus *Œsophagostomum* and certain other Strongylids. The horns of the vagina have, as has been stated, a similar constitution of the wall to that of the vagina, and differ from that of the uterus into which they lead or from that of the ovejectors of other Strongylids. Consequently, both vagina and the horns of the vagina are to be considered together as one structure. The horns are simply the anterior portions of the vagina that has split up into two branches like the bicornuate uterus of the mammals. If we accept this hypothesis we can proceed further to consider the relationship between the vagina and the spicules, in the species in question.

	Spicules.	*Vagina.*	*Horns.*
K. rhinocerotis	2·1 mm.	0·87 mm.	0·78 mm.
K. goodeyi ...	9·5 mm.	0·83 mm.	7· 5 mm.
K. brevicauda	4·9 mm.	3·27 mm.	1·35 mm.
K. brevivaginata	8·7 mm.	0· 7 mm.	7· 5 mm.

In taking the total length of the vagina and the horns we find that it accords with the variations in the length of the spicules themselves. Thus, where the spicules are 4·9 mm. long, as in *Kiluluma brevicauda*, the vagina with its horns measures 4·62 mm., and when the spicules are longer, as in *Kiluluma goodeyi*, they are 9·5 mm. long, the total length of the vagina and its horn has increased to 8·33 mm. Similarly we can trace a like correspondence in other species of the genus. Therefore we can modify the general statement for this genus thus :—

"The length of the spicule ordinarily corresponds to the length of the vagina, and where this relation does not hold it will be found that the length of the spicules varies with the total length of the vagina and its horn taken together."

This relation seems to be of importance in the isolation of species from one another.

In conclusion, I wish to express my indebtedness to Prof. R. T. Leiper, F.R.S., and Dr. T. Goodey for the constant help and encouragement received from them in the course of this work.

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Starlings as Distributors of "Gapes."

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"GAPES," a disease of Poultry caused by the presence of *Syngam trachealis* in the windpipe, is a common disease in the Aberystwy area, and is generally known among the Welsh farmers and poultr keepers as "Clefyd-y-big" (the disease of the beak).

In 1920, R. H. Waite published a paper on "Earthworms—Th Important Factor in the Transmission of Gapes in Chickens," in whic he claimed that earthworms ingest the eggs and embryos of *S. tracheal* which have contaminated the soil of an infected area, and thus hel to transmit the disease to other non-infected birds, which swallow th infected earthworms. Numerous investigators have dealt with th question of "Gapes," but none have attached much importance t the fact that *S. trachealis* also occurs in wild birds.

In 1837, Nathusius records *S. trachealis* from a Starling in Germany Dujardin (1845) found five pairs of this worm in the tracheæ of tw magpies (*Corvus pica*) at Rennes; and Megnin (1883) states that thi parasite was discovered in the tracheæ of the swift (*Cypselus apus*) starling (*Sturnus vulgaris*), green-woodpecker (*Picus viridis*), pheasan (*Phasianus gallus*) common partridge (*Perdix cinerea*): and the blac stork (*Ciconia nigra*). Megnin also states that "in various pheasantrie of Central France, as well as around Paris, where this terrible epidemi has made thousands of victims that the parasite that causes it is n other than *S. trachealis*." H. D. Walker (1886) makes the statement "That the robin (*Turdus migratorius*), may act as a host for *Syngamus* and thus be instrumental in spreading the disease, ..."

The Ministry of Agriculture & Fisheries' Leaflet No. 58, adds th following list of birds which harbour *Syngamus*:—

"Sparrow, Linnet and Rook."