

Boulenger (1928), but the anterior projection of the tridents are blunt and not so prominent in this species as they are in my specimen. The dimensions of the worms are very different as practically all the measurements of *D. pungens*, except those of the spicules, are about twice that of my worm. The spicules in the two species are different, as in *D. pungens*, the short spicule is spirally twisted, whereas it is only curved in my specimen. It is accordingly proposed to name this worm *Diplotriaenia urocissae*, n. sp.

Female.—Unknown.

Host.—*Urocissa flavirostris*.

The type-specimen is in the Indian Museum, Calcutta.

REFERENCES.

- Boulenger, C. L. (1920). On some Filariid parasites of Cattle and other Ruminants. *Parasitol.* Vol. XII, p. 341.
- Boulenger, C. L. (1928). Report on a collection of Parasitic Nematodes, mainly from Egypt. Part V. Filarioidea. *Parasitol.* Vol. XX, p. 32.
- Chandler, A. C. (1924). New Filariae from Indian Birds. *Parasitol.* Vol. XVI, p. 398.
- Chandler, A. C. (1929). Some new genera and species of Nematode worms, Filarioidea, from Animals dying in the Calcutta Zoological Gardens. *Proc. U. S. Nat. Mus.* Vol. 76, Art. 6.
- Vevers, G. M. (1922). On the Parasitic Nematoda collected from Mammalian Hosts which died in the Gardens of the Zoological Society of London during the years 1919-21 ; with a description of Three New Genera and Three New Species. *Proc. Zool. Soc. London*, 1922, p. 405.

PART 6. THE GENUS *KALICEPHALUS* IN INDIAN REPTILES.

Kalicephalus indicus Ortlepp, 1923.

Kalicephalus bengalensis Maplestone, 1929 was described by me as a new species because, from the limited material then available, it appeared to have definite differences from *K. indicus* Ortlepp, 1923. Since that time I have obtained large numbers of these worms, and study of this material has shown that the worm is subject to a certain amount of variation, which indicates that the differences noted are not constant characters. For instance the sharp points in which the bursa ends ventrally and the apparent prebursal papillae in *K. bengalensis* are only artefacts due to pressure of the cover-glass. In the female the degree of prominence of the vulva and the size of the post-vulval swelling vary considerably. The posterior ovejector in a very few instances runs directly dorsally as figured by Ortlepp, it nearly always forms a loop posterior to the vulva which extends from 0.2 to 0.5 mm. before curving forwards. The size of the eggs measured in utero is also of no diagnostic value, and the dimensions given by Ortlepp really represent the minimum size of apparently mature eggs.

It is therefore considered that *K. bengalensis* is a synonym of *K. indicus*.

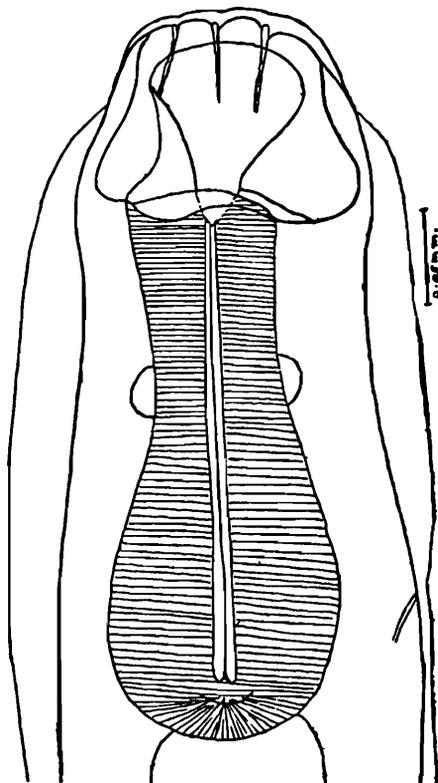
This species has been found by me in the Rat-snake (*Zamenis mucosus*) fifteen times, in the Green snake (*Dryophis mycterizans*) eight times, and single females have been found on one occasion each in the Cobra (*Naia tripudians*), the Snake-eating cobra (*Naia bungarus*), and the Bengal monitor (*Varanus bengalensis*). One female was also recovered from the intestine of a wild cat, but it is probable that this animal is not a true host, and that the worm reached this animal's intestine in a snake devoured by the cat, and it managed to remain alive in this abnormal host.

In the table at the end of the paper (p. 124) the full range of size noted in this species is given. The gubernaculum, of which the length is given, is represented in all the members of the genus in which it has been seen by me, by a chitinous lining of the posterior end of the dorsal wall of the spicule canal.

Kalicephalus elongatus, n. sp.

Specimens of this worm have been found five times in the intestine of the Rat-snake (*Zamenis mucosus*), and once in the Cobra (*Naia tripudians*).

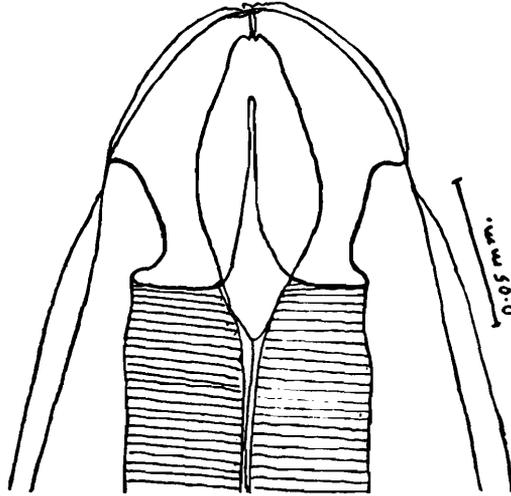
Apart from being considerably larger, these worms are easily recognised from *K. indicus* by the presence of a distinct cuticular swelling, which extends from the middle of the buccal capsule to about opposite the posterior end of the oesophagus, it is more marked dorsally and



TEXT-FIG. 48.—*Kalicephalus elongatus*, n. sp. Anterior end, lateral view.

ventrally than laterally (figs. 48 and 49). Other characteristic points are the presence of a long genital cone in the male, and small rounded prominences at the junction of the externo-dorsal and dorsal bursal rays

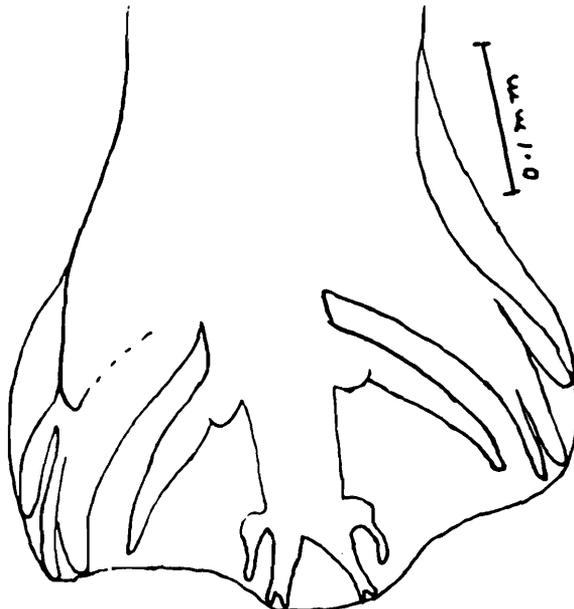
(figs. 50 and 51). The vulva is very prominent in the female; the



TEXT-FIG. 49.—*Kalicephalus elongatus*, n. sp. Anterior end, dorso-ventral view.

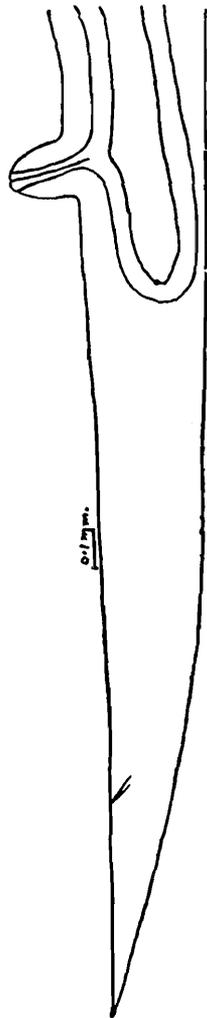


TEXT-FIG. 50.—*Kalicephalus elongatus*, n. sp. Posterior end, male, lateral view.



TEXT-FIG. 51.—*Kalicephalus elongatus*, n. sp. Male bursa, dorsal ray.

arrangement of the ovejectors is similar to that of *K. indicus* and they are subject to about the same degree of variation (fig. 52). It is con-



TEXT-FIG. 52.—*Kalicephalus elongatus*, n. sp. Posterior end, female, lateral view.

sidered that the other characters are adequately demonstrated in the figures, and in the table of dimensions, therefore a detailed written description is omitted.

This worm differs from all other species of the genus *Kalicephalus* so the name *Kalicephalus elongatus*, n. sp. is proposed for it.

Type-host. *Zamenis mucosus.*

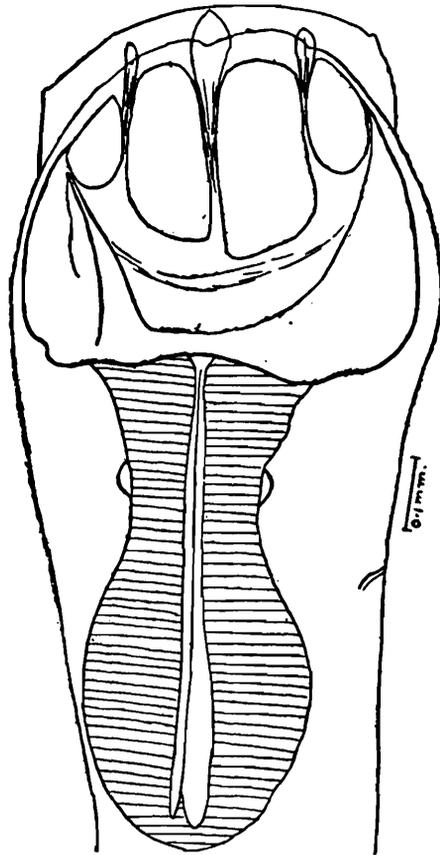
Type-specimens are in the Indian Museum, Calcutta.

***Kalicephalus brachycephalus*, n. sp.**

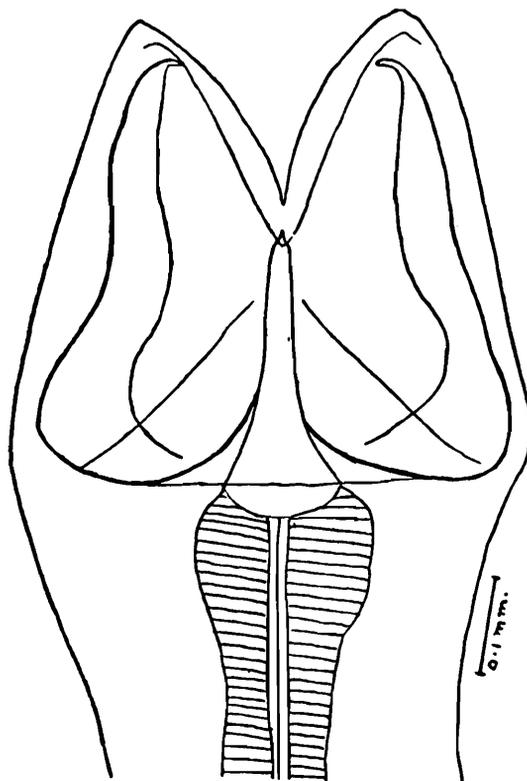
Two female worms of this species were found in collections of *K. indicus* from Rat-snakes. The relatively great size of the buccal capsule made them readily recognized as a different species.

The dorso-ventral diameter of the head is considerably greater than that of the body, so that the anterior extremity has a distinctly swollen appearance even to the naked eye (fig. 53). When viewed from the dorsal aspect the lips were found to be widely separated in both specimens (fig. 54). This is a very unusual condition for the lips in *Kalicephalus*, as they are practically always in close apposition in all species.

The vulva is slightly prominent and the vagina is short, dividing into divergent ovejectors furnished with ovoid muscular organs a short



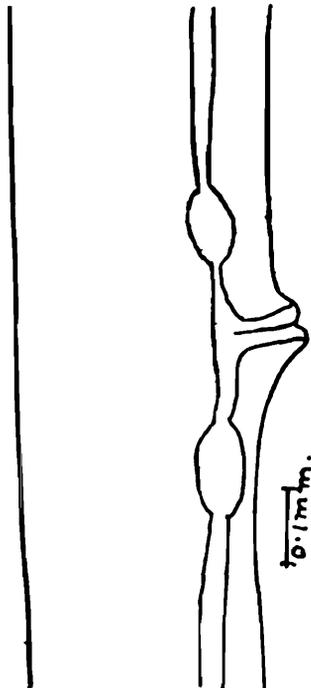
TEXT-FIG. 53.—*Kalicephalus brachycephalus*, n. sp. Anterior end, lateral view.



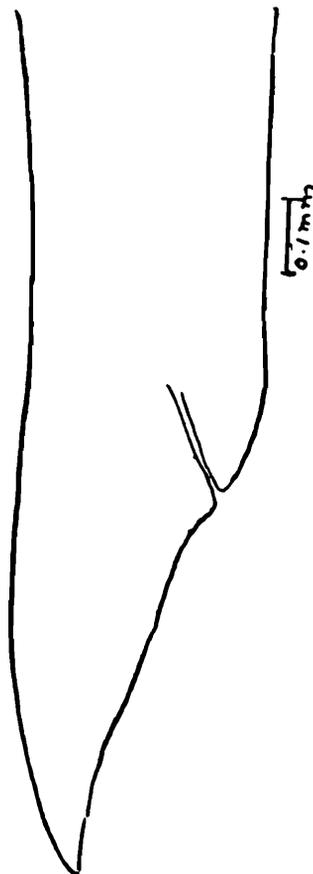
TEXT-FIG. 54.—*Kalicephalus brachycephalus*, n. sp. Anterior end, dorso-ventral view.

distance from the vagina (fig. 55). The uteri are directly continuous with the ovejectors, and they in turn pass into the ovaries which lie towards opposite ends of the worm. The lips of the anus are slightly

prominent and the tail is conical (fig. 56). The relatively great size of the buccal capsule of this worm differentiates it from all other species



TEXT-FIG. 55.—*Kalicephalus brachycephalus*, n. sp. Vulval region.



TEXT-FIG. 56.—*Kalicephalus brachycephalus*, n. sp. Posterior end, female, lateral view.

of *Kalicephalus* so the name *Kalicephalus brachycephalus*, n. sp. is proposed for it.

Male unknown.

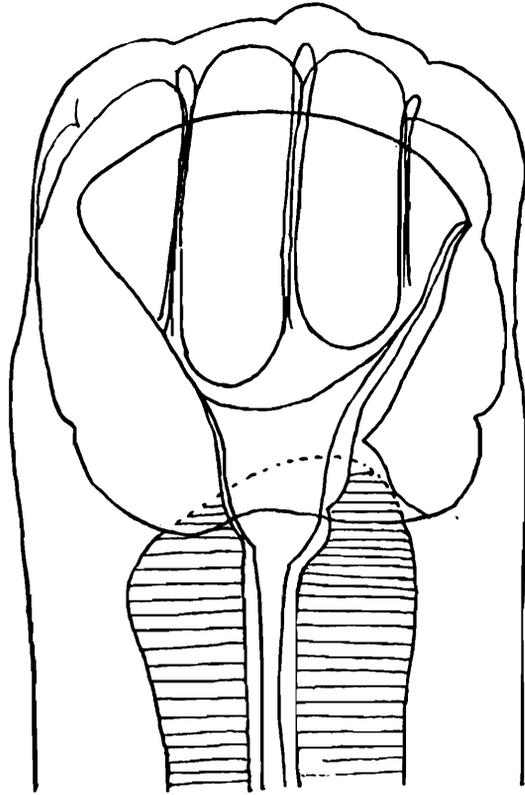
Host. *Zamenis mucosus*.

Type-specimens are in the Indian Museum, Calcutta.

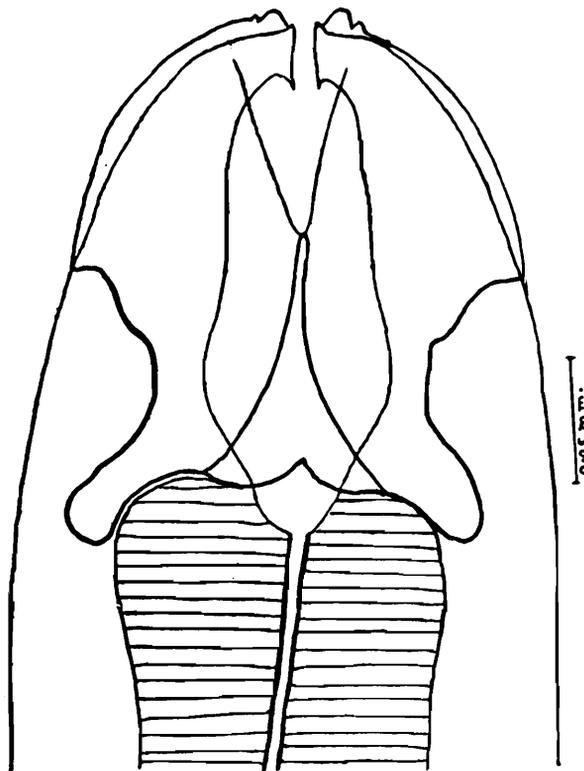
Kalicephalus naiae, n. sp.

This worm has been recovered on six occasions from the Cobra (*Naia tripudians*), and once from the Banded krait (*Bungarus fasciatus*).

It is almost identical in size with *K. minutus* Baylis and Daubney, 1922, but the shape of the buccal capsule appears slightly different on



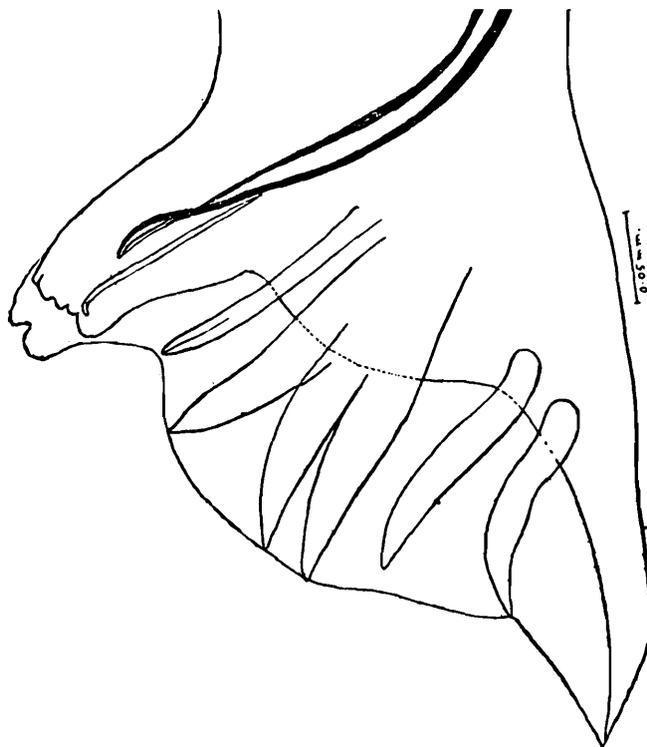
TEXT-FIG. 57.—*Kalicephalu snaiiae*, n. sp. Anterior end, lateral view.



TEXT-FIG. 58.—*Kalicephalus naiae*, n. sp. Anterior end dorso-ventral view.

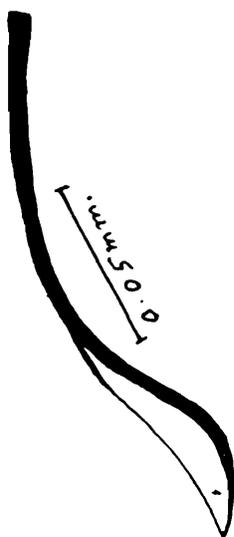
comparing my figures 57 and 58 with those of the above authors. Apart from this the only distinct differences are in the posterior end of the

male. In *K. minutus* no mention of a genital cone is made, and in my species this is a prominent structure about 0.1 mm. in length, and in *K. minutus* Baylis and Daubney say there is no gubernaculum, whereas in my species the dorsal wall of the spicule canal is chitinized for a distance of about 0.12 mm. (fig. 59). In *K. minutus* the spicules are equal,



TEXT-FIG. 59.—*Kalicephalus naiae*, n. sp. Posterior end, male, lateral view.

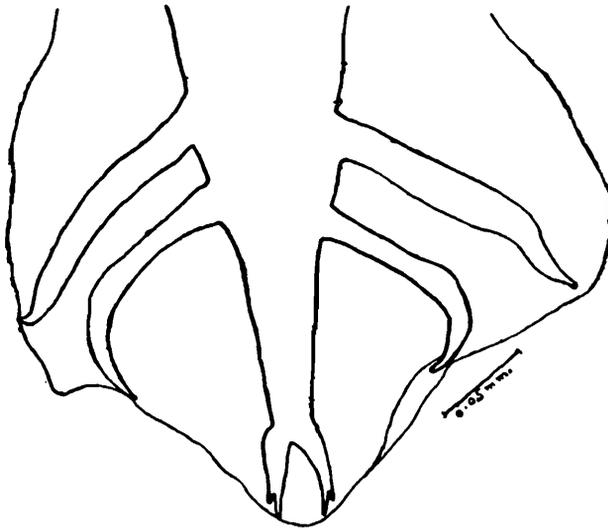
slender and recurved at their tips, and in my species the spicules are distinctly unequal. The short spicule is stouter than the long spicule, its tip is recurved and the concavity of the curve bears a membrane,



TEXT-FIG. 60.—*Kalicephalus naiae*, n. sp. Tip of short spicule.

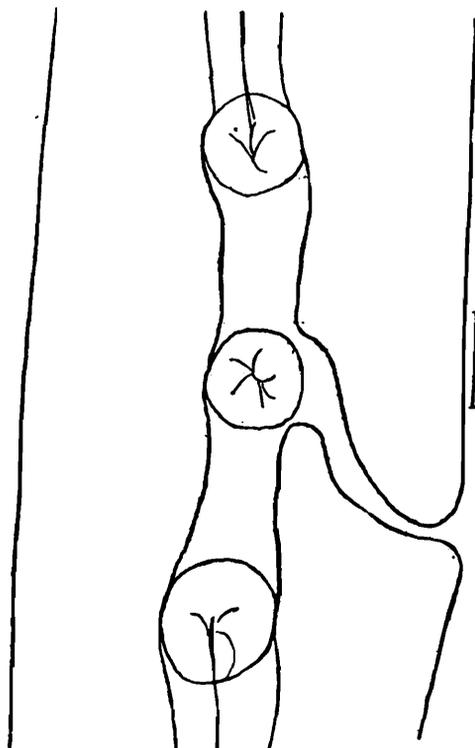
and the tip of the long spicule is straight and much finer than that of the short spicule (figs. 59 and 60). The dorsal ray is similar in both species

(fig. 61). In the female the uteri are completely divergent, in my species there are two circular muscular ejaculatory organs within the



TEXT-FIG. 61.—*Kalicephalus naiae*, n. sp. Male bursa, dorsal ray.

ovjectors a short distance from the vagina (fig. 62). The detailed description of this portion of the worm is not given by Baylis and



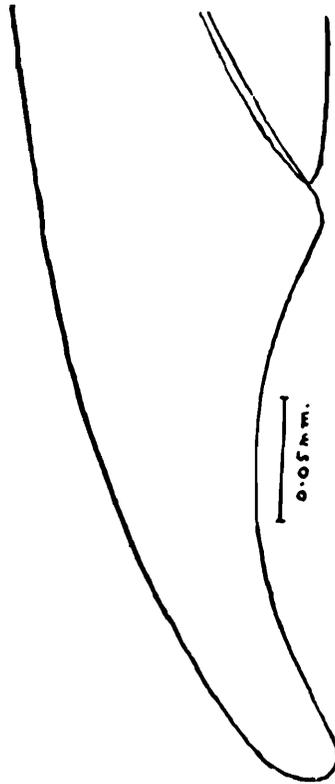
TEXT-FIG. 62.—*Kalicephalus naiae*, n. sp. Vulval region.

Daubney, so it is not possible to say whether the structure is similar to mine or not.

Although there is a very close similarity in these species the spicules and the posterior end of the male present distinct differences so it is necessary to consider mine as a new species, for which the name *Kalicephalus naiae*, n. sp. is proposed.

Type-host. *Naia tripudians*.

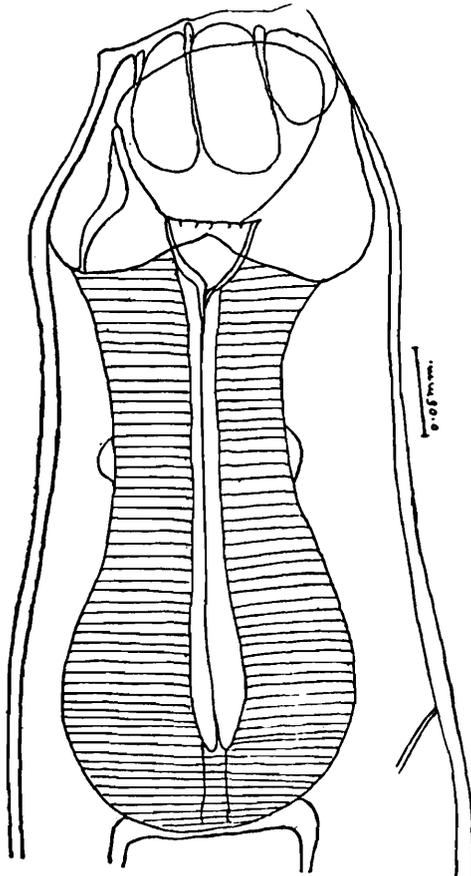
Type-specimens are in the Indian Museum, Calcutta.



TEXT-FIG. 63.—*Kalicephalus naiae*, n. sp. Posterior end, female, lateral view.

***Kalicephalus longior*, n. sp.**

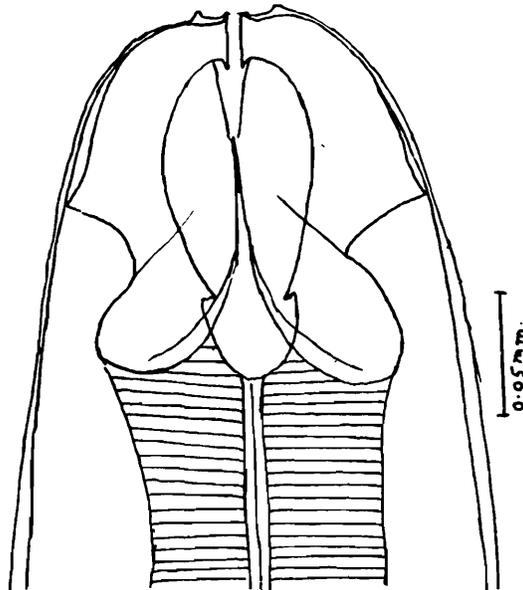
On two occasions specimens of this worm were found in the intestine of Cobras (*Naia tripudians*), and on one occasion in a Banded krait



TEXT-FIG. 64.—*Kalicephalus longior*, n. sp. Anterior end, lateral view.

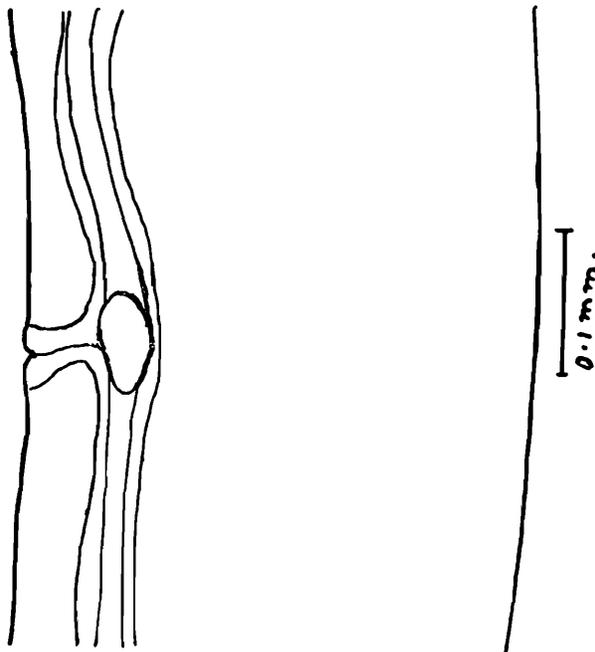
(*Bungarus fasciatus*). Only female worms were found on all occasions, and they were never in company with other worms.

The worms are distinctly larger than *K. naiiae*, and the buccal capsule and oesophagus are considerably smaller than in this species (figs.



TEXT-FIG. 65.—*Kalicephalus longior*, n. sp. Anterior end, dorso-ventral view.

64 and 65). The uteri are completely divergent as in *K. naiiae*, but no muscular enlargements in the ovejectors could be made out (fig. 66).

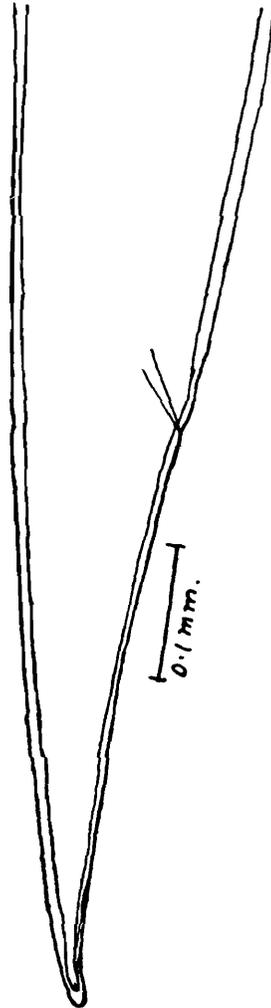


TEXT-FIG. 66.—*Kalicephalus longior*, n. sp. Vulval region.

The vulva is relatively much further forward in this species than it is in *K. naiiae*, the distance from the anus to tip of tail is much longer, and this portion of the worm is of different shape (fig. 67).

This worm resembles *K. willeyi*, which is discussed below, regarding the proportion into which the vulva divides the body of the worm, but in *K. willeyi* the buccal capsule is set obliquely in the anterior end of

the worm as well as the mouth opening being slightly oblique as it is in this species (fig. 64). Another difference is that the present species is only half the length of *K. willeyi*. It is accordingly proposed to name it *Kalicephalus longior*, n. sp.



TEXT-FIG. 67.—*Kalicephalus longior*, n. sp. Posterior end, female, lateral view.

Male unknown.

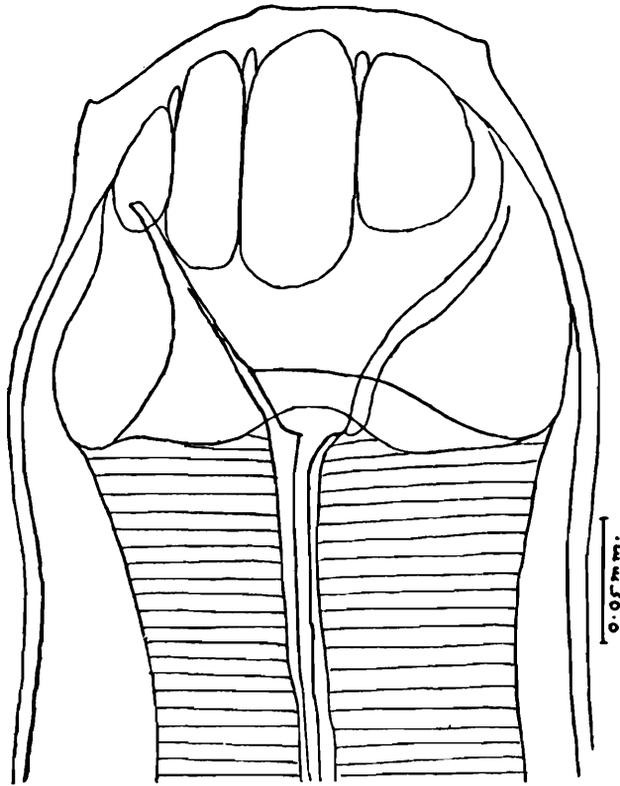
Type-host. *Naia tripudians*.

Type-specimens are in the Indian Museum, Calcutta.

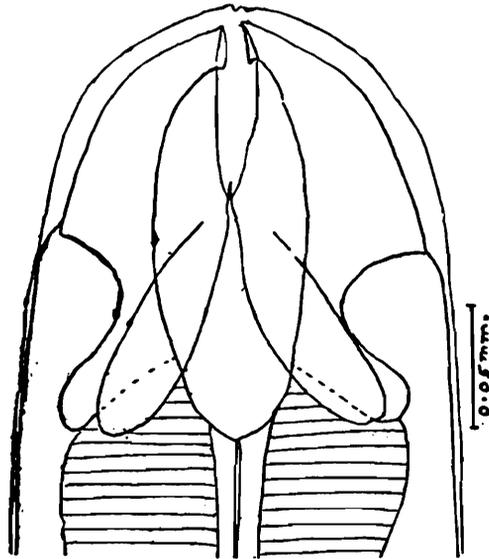
***Kalicephalus gongylophis*, n. sp.**

Two female specimens of this worm were obtained from the intestine of a Sand snake (*Gongylophis conicus*).

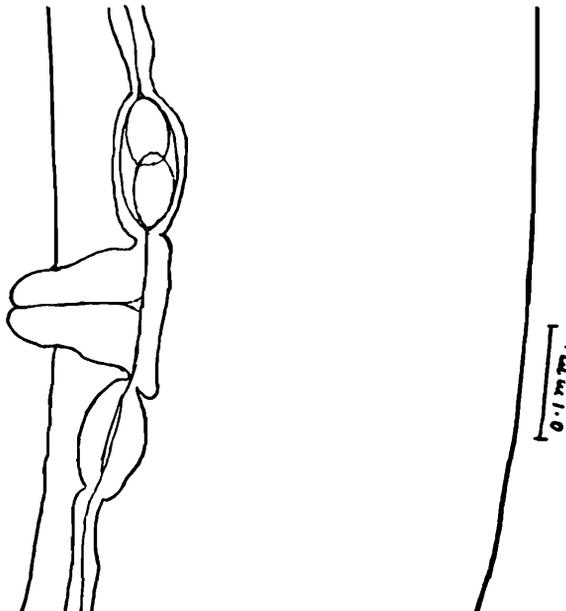
This worm is very like *K. longior* but both specimens are somewhat larger than the largest specimen of this species. The mouth opening, however, looks directly forwards (figs. 68 and 69), the vulva is markedly prominent, and the vagina is much more muscular. The ovejectors are divergent and in immediate contact with the vagina there are two large muscular ejaculatory organs, one of which contains two eggs (fig. 70). These structures are not present in *K. longior* in which the ovejectors are in the form of simple tubes without special ejaculatory



TEXT-FIG. 68.—*Kalicephalus gongylophis*, n. sp. Anterior end, lateral view.

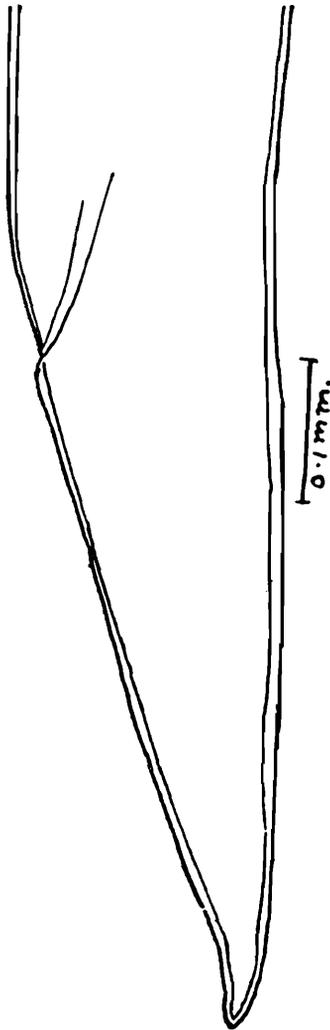


TEXT-FIG. 69.—*Kalicephalus gongylophis*, n. sp. Anterior end, dorso-ventral view.



TEXT-FIG. 70.—*Kalicephalus gongylophis*, n. sp. Vulval region.

organs (fig. 66). It is accordingly proposed to name this worm *Kalicephalus gongylophis*, n. sp.



TEXT-FIG. 71.—*Kalicephalus gongylophis*, n. sp. Posterior end, female, lateral view.

Male unknown.

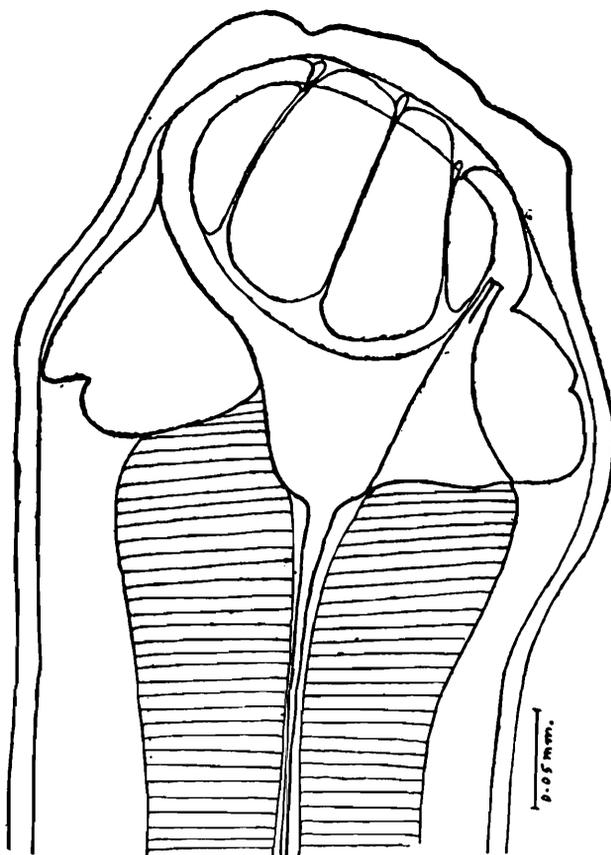
Type-specimens are in the Indian Museum, Calcutta.

***Kalicephalus willeyi* Linstow, 1904.**

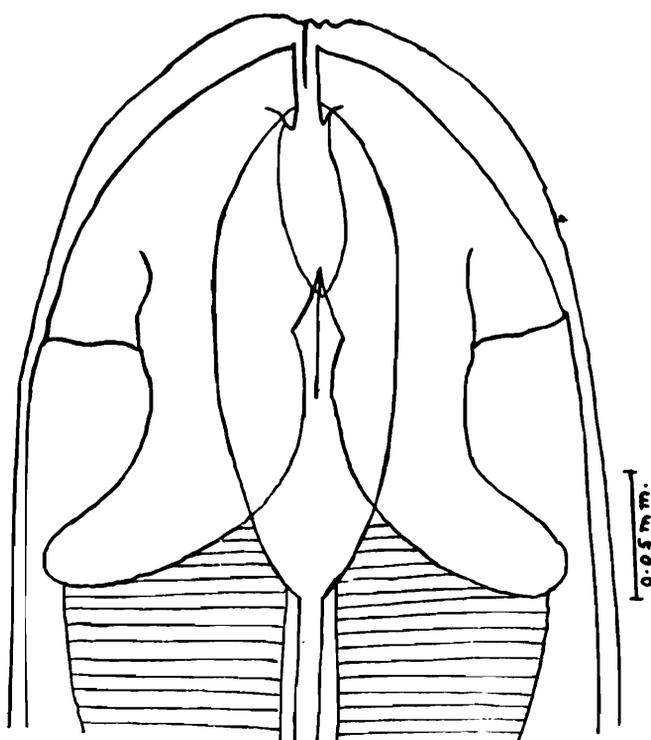
Two large collections of this worm were recovered from the intestine of Russell's vipers (*Vipera russelli*), and as in the case of previous workers only females were found.

This worm was originally described by von Linstow (1904), and Ortlepp (1923) points out the doubt that exists as to the correctness of von Linstow's description, which doubt is confirmed as a result of his own examination of this species, and that of Baylis and Daubney (1922). The latter authors have given a description of the worm under the title "*Diaphanocephalus* sp.", but they give no drawings. No satisfactory drawings of this worm are in existence and also a certain amount of confusion has been caused owing to Baylis and Daubney (1922), and Daubney (1923) having described and figured as *K. willeyi*, a worm which Ortlepp (1923) has shown to be a distinct species, and for which he has erected the genus *Occipitodontus*. It is therefore considered worth while to draw and describe this worm afresh.

The mouth capsule is of the usual *Kalicephalus* type (figs. 72 and 73), but although the anterior portion of the worm looks straight forwards,



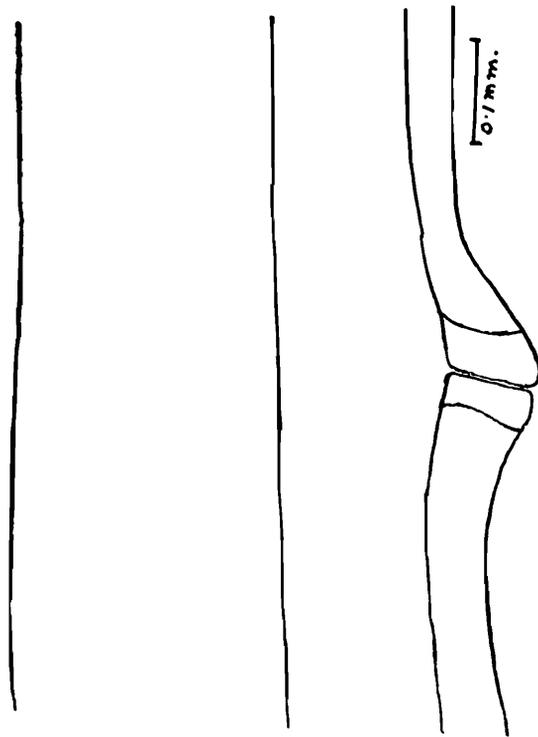
TEXT-FIG. 72.—*Kalicephalus willeyi*. Anterior end, lateral view.



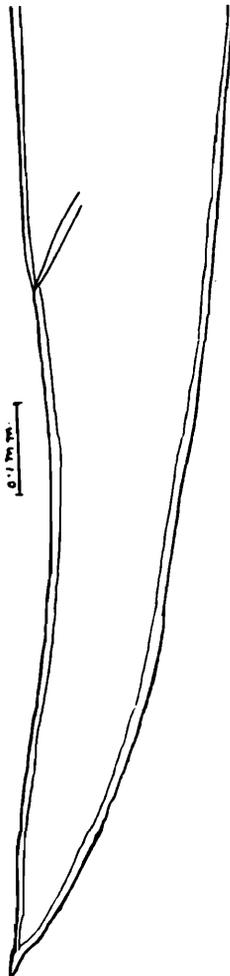
TEXT-FIG. 73.—*Kalicephalus willeyi*. Anterior end, dorso-ventral view.

the buccal capsule lies obliquely within the body, so the buccal cavity and the mouth opening faces towards the dorsal surface (fig. 72). The vulva is slightly prominent and a short vagina divides into completely divergent ovejectors in which no special ejaculatory organs could be

made out (fig. 74). The tail is relatively long and it ends in a cuticular point (fig. 75).



TEXT-FIG. 74.—*Kalicephalus willeyi*. Vulval region.



TEXT-FIG. 75.—*Kalicephalus willeyi*. Anterior end, female, lateral view.

Kalicephalus fimbriatus (Ortlepp, 1923).

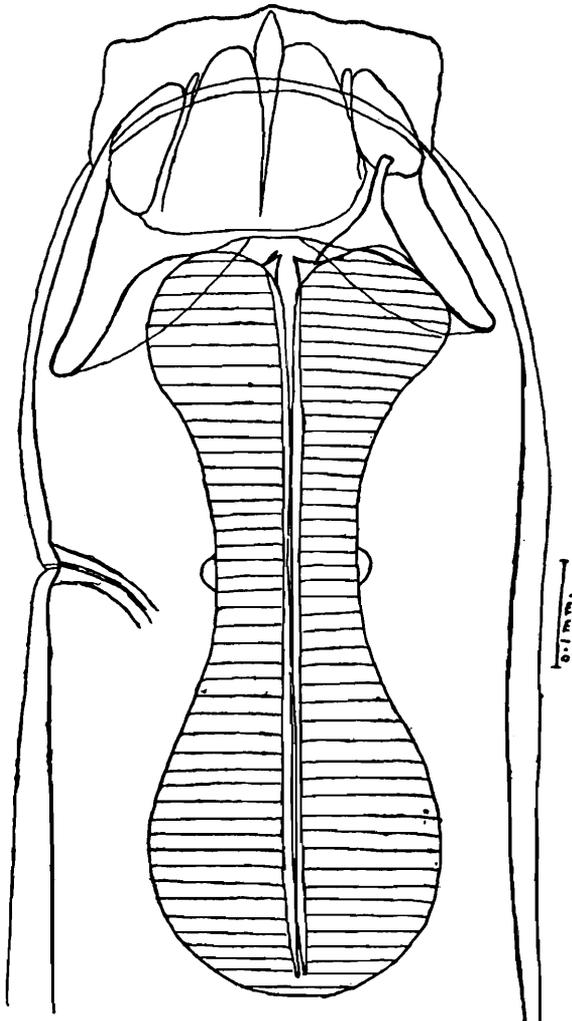
Synonym *Occipitodontus fimbriatus*, Ortlepp, 1923.

This worm, which is typically found in the Banded krait (*Bungarus fasciatus*), was differentiated from *K. willeyi*, which usually occurs in Russell's viper, by Ortlepp, (1923) who, on account of its distinctive characters, created for it the genus *Occipitodontus*, but he gives an incomplete description of the worm and no definition of the genus. Baylis and Daubney (1922) give a figure of the head in lateral view, and Daubney (1923) gives a fuller description of the worm, but no drawings except those of the anterior end. Moreover, the worm on both these occasions has been described under the name *K. willeyi*, and this is liable to lead to confusion unless the paper by Ortlepp (1923) is consulted.

Baylis and Daubney (1926) place *Occipitodontus* as a synonym of *Kalicephalus* on the ground that the corona radiata is very minute in this species, and that traces of this structure occur in other members of the genus *Kalicephalus*, and they further point out that teeth in the oesophageal funnel may or may not be present in species of the genera *Oesophagostomum* and *Globocephalus*. Their objection seems well founded, and it is followed by me in the present instance.

A single collection of this species has been found in the intestine of a Banded krait, and as the only adequate descriptions and drawings exist under an incorrect name it is proposed to give the following brief description.

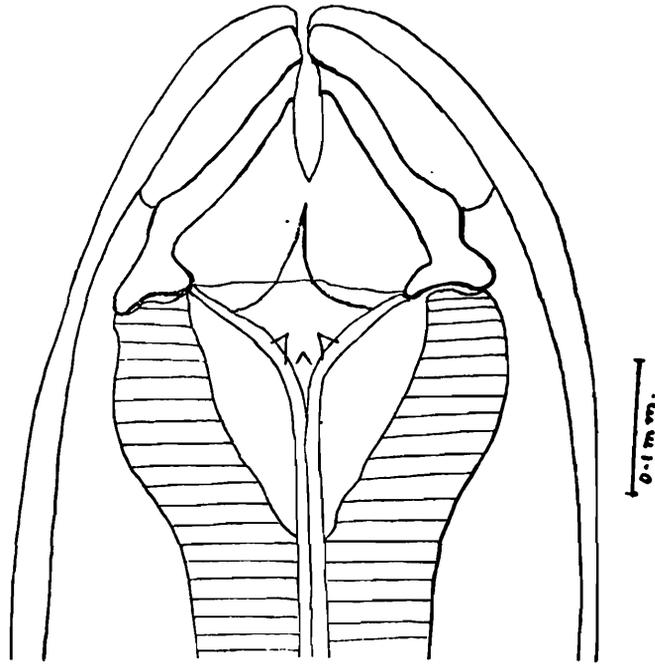
The buccal capsule differs somewhat from the type usually seen in *Kalicephalus*, as chitinous prolongations extend backwards dorsally and



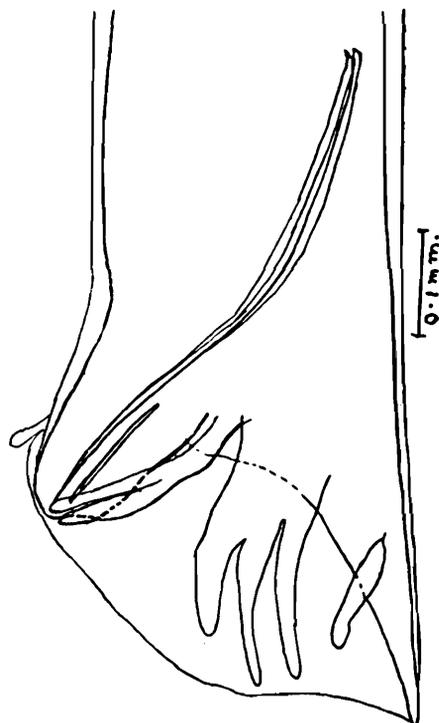
TEXT-FIG. 76.—*Kalicephalus fimbriatus*. Anterior end, lateral view.

ventrally over the expanded anterior end of the oesophagus (fig. 76). There is a very minute corona radiata situated on the inner surface of the two large rectangular cuticular lips, and the lateral papilla is much larger than the subventral and subdorsal papillae. There are two subventral teeth and one dorsal tooth projecting forwards from the anterior end of the chitinous lining of the oesophagus (figs. 76 and 77). Viewed from the dorsal aspect, the mouth cavity and the lining of the oesophageal funnel form a rhomboidal figure (fig. 77). The oesophagus is almost dumbbell-shaped as it has both anterior and posterior expansions with a narrower central portion. The excretory pore is large and it opens relatively far forwards, being opposite the nerve ring (fig. 76).

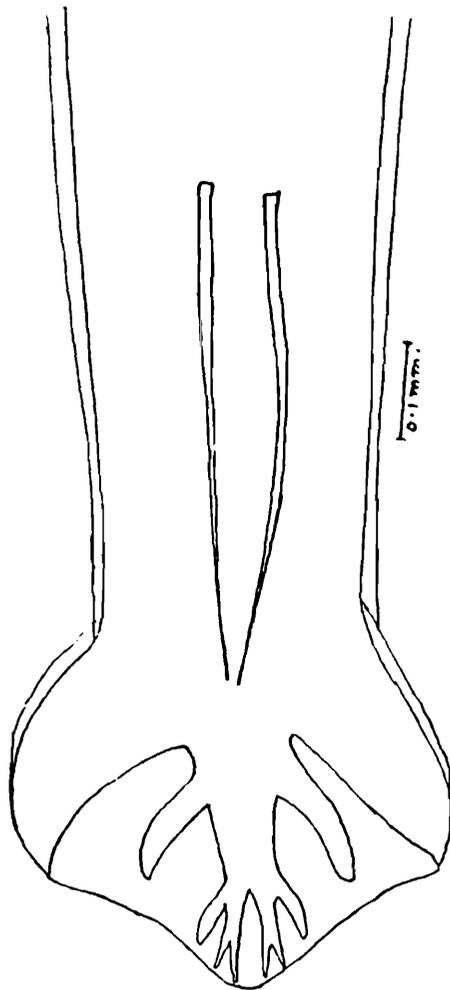
Male.—There is a prominent genital cone, and the bursal rays are arranged as shown in figs. 78 and 79. The spicules taper evenly from



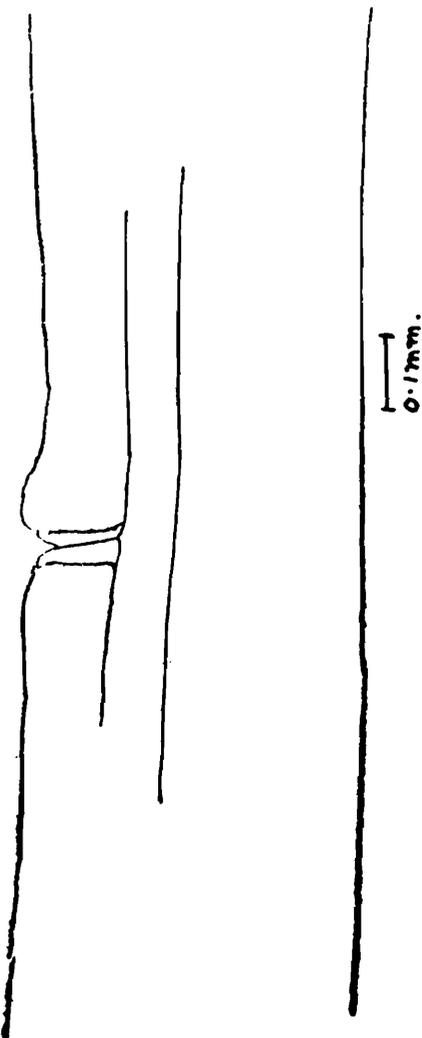
TEXT-FIG. 77.—*Kalicephalus fimbriatus*. Anterior end, dorso-ventral view.



TEXT-FIG. 78.—*Kalicephalus fimbriatus*. Posterior end, male, lateral view.



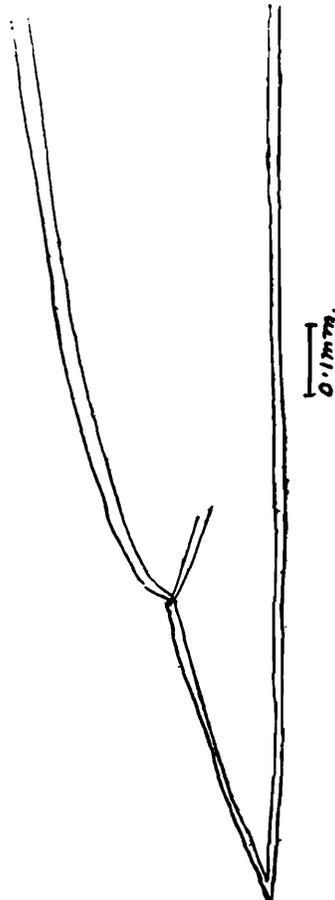
TEXT-FIG. 79.—*Kalicephalus fimbriatus*. Posterior end, male, dorsal view.



TEXT-FIG. 80.—*Kalicephalus fimbriatus*. Vulval region.

base to tip, and the posterior end of the spicule canal is chitinized along its dorsal wall, forming an indistinct gubernaculum.

Female.—The lips of the vulva are very slightly prominent and a short vagina leads into completely divergent ovejectors, which are in the form of simple tubes (fig. 80). The tail is relatively short and it ends in a straight tapering point (fig. 81).



TEXT-FIG. 81.—*Kalicephalus fimbriatus*. Posterior end, female, lateral view.

REFERENCES.

- Baylis, H. A. and Daubney, R. (1922). Report on the Parasitic Nematodes in the Collection of the Zoological Survey of India. *Mem. Ind. Mus.* Vol. VII, No. 4, p. 263. Calcutta.
- Baylis, H. A. and Daubney, R. (1926). A Synopsis of the Families and Genera of Nematoda. *British Mus. (Nat. Hist.)*.
- Daubney, R. (1923). Note of the genus *Diaphanocephalus* (Nematoda: Strongylidae, parasitic in reptiles, with a description of three new species. *Parasitol.* Vol. XV, p. 67.
- Linstow, O. von (1904). Nematoda in the Collection of the Colombo Museum. *Spolia Zeylanica*, Vol. I, No. 4, p. 9.
- Maplestone, P. A. (1929). Two new species of Nematodes from Indian Hosts. *Rec. Ind. Mus.* Vol. XXXI, Part II, p. 87.
- Ortlepp, R. J. (1923). Observations on the Nematode Genera *Kalicephalus*, *Diaphanocephalus*, and *Occipitodontus* g. n. and on the larval development of *Kalicephalus philodryadus* n. sp. *Journ. Helminthol.* Vol. I, p. 165.

DIMENSIONS OF THE SPECIES OF THE GENUS *KALICEPHALUS* MENTIONED IN THIS PAPER.

	<i>K. indicus</i>		<i>K. elongatus</i>		<i>K. brachycephalus</i>	<i>K. naiae</i>		<i>K. minutus</i> (Baylis and Daubney)	
	♂	♀	♂	♀	♀	♂	♀	♂	♀
Length	4.2—6.2	6.4—9.2	7.8—8	10.9—12.7	9.2—10.4	4.5—5.4	4.5—6.2	4.9—5.0	5.1—5.3
Diameter, maximum	0.188—0.32	0.32—0.39	0.277—0.297	0.356—0.426	0.356	0.237—0.247	0.237—0.297	0.2	0.21
Dorso-ventral diameter, head . . . . .	..	..	0.237	0.277—0.317	0.455—0.515	..	..	..	..
Lips, width	0.14—0.16	0.140—0.188	0.116—0.128	0.128—0.164	..	0.158	0.198—0.22	..	..
Buccal caps, length	0.128—0.138	0.136—0.16	0.1—0.108	0.128—0.140	0.396—0.495	0.188—0.218	0.198—0.218	..	..
Oesophagus, length	0.267—0.297	0.27—0.33	0.287—0.297	0.336—0.356	0.614—0.654	0.455—0.475	0.495—0.554	0.45	..
Oesophageal bulb, diameter	0.128—0.148	0.128—0.188	0.12—0.136	0.132—0.172	0.277	0.188	0.198—0.208	0.15	..
Nerve ring from ant. end, oesoph.	0.07—0.08	0.08—0.1	0.088—0.1	0.104—0.124	0.148	0.16	0.16—0.18	0.09	..
Ex.pore from ant. end, oesoph.	0.14—0.19	0.2—0.29	0.208	0.208—0.24	0.22—0.25	..	0.416—0.436	0.38	0.44
Genital cone, length . . . . .	..	..	0.2	..	..	0.1	..	..	..
Spicules, length	0.35—0.47	..	0.416—0.436	..	..	0.317—0.327 and 0.415—0.515	..	0.255—0.275	..
Gubernaculum, length	0.12—0.13	..	0.14—0.148	..	..	0.12	..	..	..
Vulva to tip of tail . . . . .	..	0.99—1.9	..	2.03—2.65	3.06—3.38	..	1.3—1.8	..	..
Proportion into which vulva divides body length. . . . .	..	5:1—4:1	..	4.3:1—3.8:1	2:1	..	2.2:1—2.4:1	..	2.5:1
Anus to tip of tail . . . . .	..	0.138—0.198	..	0.614—0.673	0.317	..	0.218—0.277	..	0.28—0.3
Eggs . . . . .	..	0.068—0.08 × 0.036—0.04	..	0.068 × 0.044	0.076 × 0.060	..	0.08 × 0.04	..	0.068 × 0.031

DIMENSIONS OF THE SPECIES OF THE GENUS *KALICEPHALUS* MENTIONED IN THIS PAPER.

	<i>K. longior</i>	<i>K. gongylophis</i>	<i>K. willeyi</i>		<i>K. fimbriatus</i>			
			(Self)	(B. & D.)	(Self)		(Daubney)	
					♂	♀	♂	♀
Length	♀ 7.38—10.5	♀ 11.1—12	♀ 19.2—19.7	♀ 16—18	♂ 9.7—12.2	♀ 12.3—17.3	♂ 10.5—11.5	♀ 15—17
Diameter, maximum	0.22—0.37	0.436—0.495	0.554—0.594	0.46—0.51	0.396—0.436	0.544—0.614	0.35	0.5
Dorso-ventral diameter, head	..	0.237	0.297—0.317	..	0.435—0.455	0.515—0.594	0.45	..
Lips, width	0.188	..	0.237—0.257	0.225	0.297	0.356	..	..
Buccal caps, length	0.128—0.144	0.178	0.218—0.228	0.21	0.218	0.257—0.297	..	0.23
Oesophagus, length	0.3—0.34	0.396	0.495—0.515	..	0.752—0.772	0.872—0.89	0.87—1.1	..
Oesophageal bulb, diameter	0.172—0.180	0.188—0.198	0.277	0.22	0.237—0.297	..	..	0.3
Nerve ring from ant. end, oesoph.	0.118—0.12	0.118	0.198	0.14	0.217—0.237	0.237—0.257	..	0.24
Ex.pore from ant. end, oesoph.	0.25	0.237	0.396	0.19	0.217—0.237	0.237—0.257	..	..
Genital cone, length	..	..	..	..	..	..	..	..
Spicules, length	..	..	..	..	0.495	..	0.435	..
Gubernaculum, length	..	..	..	..	0.136	..	..	..
Vulva to tip of tail	2.65—4.2	4.4—4.7	7.1—7.7	..	..	4.5—6.2	..	..
Proportion into which vulva divides body length.	1.6:1—1.5:1	1.5:1	1.7:1—1.5:1	1.5:1	..	1.8:1—1.7:1	..	2:1:1
Anus to tip of tail	0.336—0.396	0.475—0.495	0.792—0.852	0.72—0.75	..	0.396—0.416	..	0.37
Eggs	0.080 × 0.044	0.076 × 0.040 —0.042	0.070—0.072 × 0.040	0.080—0.048	..	..	..	0.07 × 0.55