THE HELMINTHS PARASITIC IN THE FRESH-WATER TURTLES OF RANGOON.

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The present account is based on a collection of helminths from the common fresh-water turtles of Rangoon—*Emyda scutata* and *Morenia ocellata*. Two turtles each of the two species were dissected and a large number of intestinal flukes and roundworms were obtained; no blood flukes or other varieties of helminths were found. Of the four species of flukes obtained only one was incompletely described by Bhalerao (1931) from *Batagur baska* of Rangoon, while the other three are new. The roundworms obtained belong to two species of a common genus, one of which is new and a single female specimen of *Camallanus* the specific determination of which remains uncertain. In course of preparation of the present work valuable assistance was rendered by my colleague Mr. B. S. Gogate, to whom I wish to express my sincere thanks. The type-material of the various species is deposited in the Indian Museum, Calcutta.

Class TREMATODA.

Order *DIGENEA.*

Family ALLOCREADIIDAE Stossich 1904.

Subfamily *ALLOCREADIINAE* Looss 1899.

Kaurma longicirra, gen. *et* sp. nov.

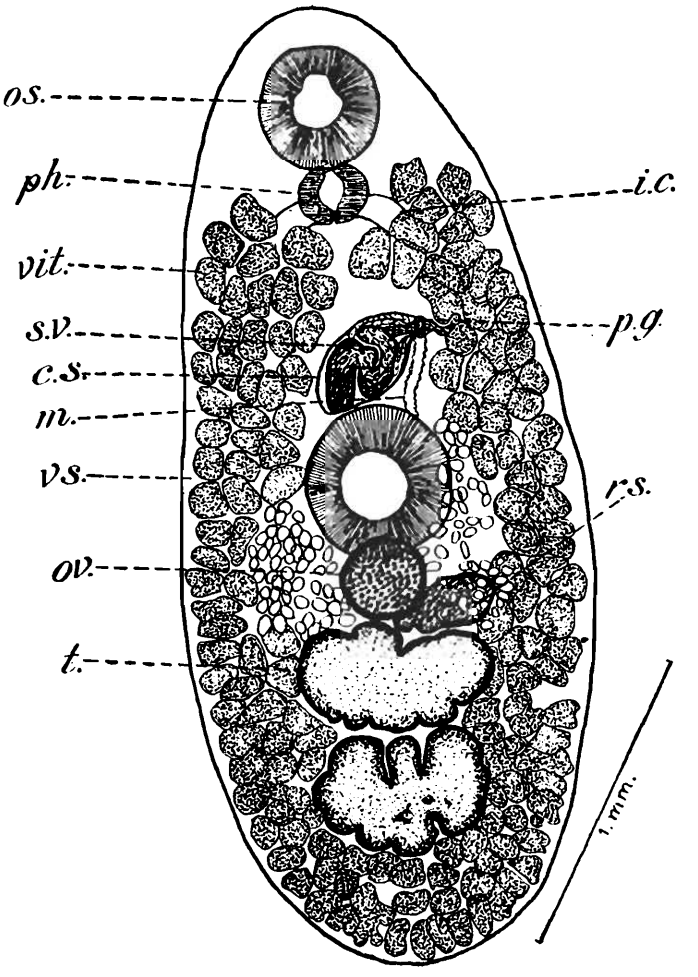
Host:—*Emyda scutata.*

Twenty specimens were obtained from the intestine of one host of which one was very immature showing slight development of the female genitalia. Body oval and elongated with posterior end broader than anterior. Length 2·32—5[1], maximum thickness immediately behind ventral sucker at the region of ovary, 1—2. Spines absent from body but strongly developed on ventral sucker. Suckers present, ventral larger than oral, 0·42—0·72 and 0·36—0·57 in diameter respectively. Oral sucker subventral and well behind anterior margin of body: in some specimens its transverse diameter was found longer than its longitudinal, a case probably due to unequal contraction of body during fixation. Ventral sucker in middle third of body and always spherical. Prepharynx absent. Pharynx muscular, 0·154—0·285 × 0·167—0·342. Oesophagus absent. Intestinal caeca of uniform width, ending a little anterior to posterior end. Genital pore on left side of body, away from intestinal bifurcation and anterior to ventral sucker. Genital atrium small in which side by side lie the male and female genital pores.

Testes median, lobed, situated in posterior third of body except a part. Both the anterior and the posterior testes are longer transversely than antero-posteriorly measuring 0·6—1·14 × 0·23—0·57 and

[1] All measurements are given in millimetres.

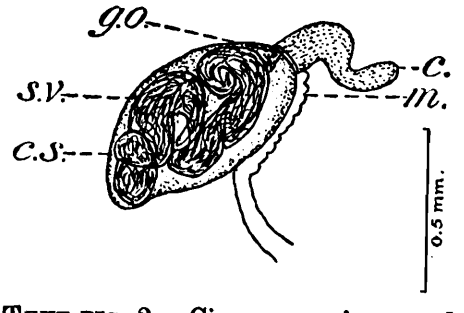
0·58—1·02 × 0·32—0·67 respectively. Cirrus sac large and oval, 0·28—0·7 long, enclosing a very much coiled vesicula seminalis, scattered prostatic cells, and ductus ejaculatorius, and lying obliquely immediate anterior to ventral sucker and opening into the genital atrium on the left side of the body. Cirrus long, muscular and curved.



TEXT-FIG. 1.—Ventral view of *Kaurma longicirra*, gen. *et* sp. nov.

c. s., cirrus sac; *i. c.*, intestinal caeca; *m.*, metraterm; *os.*, oral sucker; *ov.*, ovary; *p. g.*, prostatic gland; *ph.*, pharynx; *rs.*, receptaculum seminis; *s. v.*, vesicula seminalis; *t.*, testes; *vs.*, ventral sucker; *vit.*, vitelline glands.

Ovary median, just behind ventral sucker, partly overlapping it dorsally, 0·16—0·35 in diameter: in some specimens it was broader than long, a condition probably brought about by unequal contraction at the time of fixation. Oviduct arises from the posterior margin of the ovary and running for a short distance joins the receptaculum seminis. Immediately afterwards it receives the common vitelline duct and forms the ootype. Receptaculum seminis sacular, 0·135—0·532 in length, lying almost transversely behind ovary just in front of anterior testis. Vitellaria consists of large follicles lying across the entire length



TEXT-FIG. 2.—Cirrus sac, cirrus and metraterm of *Kaurma longicira*, gen. *et* sp. nov.

c., cirrus; *c. s.*, cirrus sac; *g. o.*, genital opening; *m.*, metraterm; *s. v.*, vesicula seminalis.

of the body posterior to pharynx, posterior to testes they meet from both sides and reach posterior end of body. Uterus moderately long and very much coiled, the coils mostly lying on both sides of body in between ventral sucker and anterior testis. Metraterm muscular, joining uterus a little anterior to ventral sucker. Eggs thin-shelled, oval, 0·058—0·072 × 0·038—0·05.

The present form resembles the members of the subfamily Allocreadiinae of the family Allocreadiidae in the nature and size of the suckers ; the distribution of the vitellaria ; the position of the genital pore ; the structure and composition of the cirrus sac ; the relative position of the testes and ovary ; the extent and situation of the uterus ; and the condition, size and number of ova. All the genera included in this subfamily have simple ova except *Helicometra*, *Helicometrina*, *Helicometroides*, *Diplobulbus* and *Stenopara* in which they are filamented. In the absence of such filamented ova the present form differs from the above genera and shows resemblance with the rest. The extent of the cirrus sac shows all varying conditions in the different genera of *Allo*creadiinae, but in most of them it either reaches the centre of the ventral sucker or extends further backwards reaching in some cases as far back as the ovary. In the present form it just touches the anterior border of the ventral sucker and is well separated from the caecal bifurcation, being deflected laterally. A long cirrus is present. The metraterm is very distinct and its wall shows undulations. The genital pore is lateral, intercaecal and much behind the intestinal bifurcation. Oesophagus which is so characteristic of other Allocreadiinae is also absent in the present form. This last difference with the other above mentioned differences makes it necessary to create the new genus *Kaurma* for this parasite with the following diagnosis :—

Allocreadiinae ; Body oval and elongated. Integument smooth except on the ventral sucker. Suckers well developed ; oral smaller than ventral. Prepharynx and oesophagus absent. Pharynx well developed. Intestinal caeca nearly reaching posterior end of body. Genital pore much behind intestinal bifurcation, on left side of body. Cirrus sac well developed, anterior to ventral sucker, enclosing coiled vesicula seminalis, undifferentiated pars prostatica and a ductus ejaculatorius. Cirrus long and muscular. Testes large and lobed, in posterior half of body. Ovary spherical, anterior to testes and close to ventral sucker. Receptaculum seminis present. Metraterm well developed, muscular. Vitelline glands between pharynx and hinder end of body, marginal anterior to testes but confluent behind them. Post-testicular vitellaria much shorter than lateral. Uterus pre-testicular, moderately long. Ova numerous, oval, with thin shells.

Genotype.—Kaurma longicira, sp. nov.

Key to the genera of Allocreadiinae.

Ova filamented	. . .	1
Ova not filamented		5
1. Ova with bipolar filaments	.	*Diplobulbus* Yamaguti 1934.
Ova with unipolar filament	.	2
2. With more than two testes		*Helicometrina* Linton 1910.
With two testes	. .	3

3.	Post-testicular vitellaria absent : testes posterior-most in body	*Helicometroides* Yamaguti 1934.
	Post-testicular vitellaria present	4
4.	Cirrus sac reaching up to centre of ventral sucker	*Helicometra* Odhner 1902.
	Cirrus sac extending much beyond ventral sucker	*Stenopara* Manter 1933.
5.	Oesophagus absent	*Kaurma*, gen. nov.
	Oesophagus present	6
6.	Yolk glands extending in the neck	7
	Yolk glands not extending in the neck	13
7.	With more than two testes	*Decemtestis* Yamaguti 1934.
	With two testes	8
8.	Testes in the posterior extremity of the body	*Caudotestis* Yamaguti 1934.
	Testes not in the posterior extremity of the body	9
9.	Cirrus sac not reaching centre of ventral sucker	10
	Cirrus sac extending to centre of ventral sucker or beyond	11
10.	Ovary with entire margin	*Maculifer* Nicoll 1909.
	Ovary trilobed	*Cainocreadium* Nicoll 1909.
	Ovary multilobate	*Hemacreadium* Linton 1910.
11.	Oral sucker funnel-shaped	*Choanostoma* Yamaguti 1934.
	Oral sucker not funnel-shaped	12
12.	Intestinal caeca not extending behind testes	*Eurycreadium* Manter 1934.
	Intestinal caeca extending behind testes	*Lebouria* Nicoll 1910.
13.	Ventral sucker pedunculated	14
	Ventral sucker sessile	15
14.	Cirrus petaloid .	*Podocotyloides* Yamaguti 1934.
	Cirrus simple . .	*Pedunculacetabulum* Yamaguti 1934.
15.	Vitellaria not coalescent posterior to testes	*Astacotrema* Warren 1903.
	Vitellaria coalescent posterior to testes	16
16.	Oesophagus short .	*Podocotyle* Dujardin 1845.
	Oesophagus long	17
17.	Intestinal caeca broad	*Megasolena* Linton 1910.
	Intestinal caeca narrow	18
18.	Cirrus sac well developed	*Allocreadium* Looss 1900.
	Cirrus sac reduced . .	*Cymbephellus* Linton 1934.

Family CEPHALOGONIMIDAE Nicoll 1915.

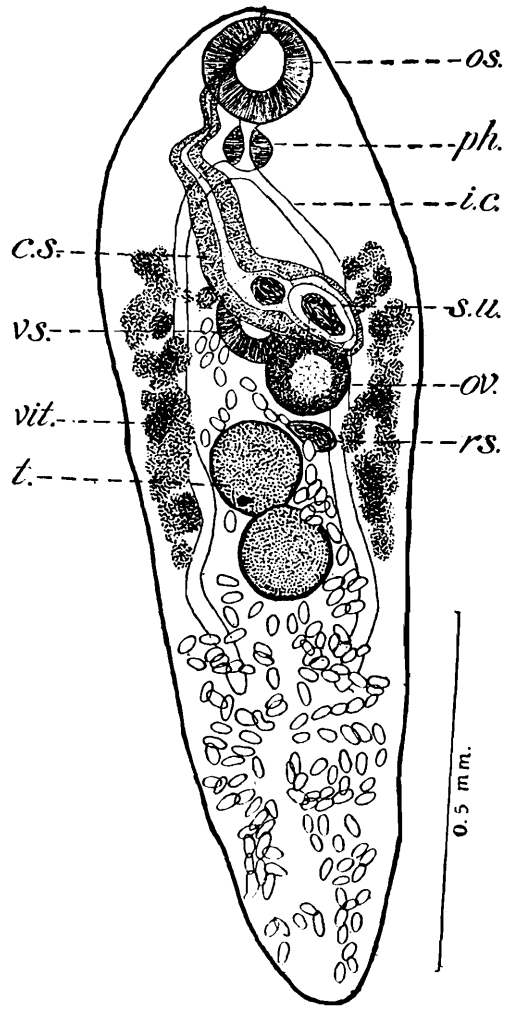
Cephalogonimus Poirier 1886.

Cephalogonimus burmanica, sp. nov.

Host :—*Emyda scutata.*

Over five hundred specimens obtained from the small intestine of one host. Body elongated with anterior end much broader than posterior. Length 0·83—1·52, maximum thickness 0·32—0·42 at the region of oral sucker. Cuticle posteriorly to anterior testis covered with sharp backwardly directed spines, the spines being progressively denser from the posterior to the anterior end. Oral sucker subventral, more powerful than ventral and slightly broader transversely than antero-posteriorly measuring 0·11—0·14 × 0·12—0·154. Ventral sucker

0·1—0·13 in diameter lying a little anterior to middle of body. Prepharynx very small. Pharynx muscular, approximately spherical, 0·042—0·07 in diameter. Oesophagus absent. Intestinal bifurcation away from ventral sucker and closer to oral sucker. Intestinal caeca fairly uniform in width extending behind testes, ending a little anterior to posterior end of body. Genital pore at median anterior tip of body anterior to oral sucker.



TEXT-FIG. 3.—Dorsal view of *Cephalogonimus burmanica*, sp. nov.

c. s., cirrus sac; *i. c.*, intestinal caeca; *os.*, oral sucker; *ov.*, ovary; *ph.*, pharynx; *rs.*, receptaculum seminis; *s. u.*, vesicula seminalis; *t.*, testes; *vs.*, ventral sucker; *vit.*, vitelline glands.

Testes large, slightly oblique, almost equal, contiguous, approximately 0·09—0·14 in diameter, situated between the caeca a little anterior to their blind ends. Cirrus sac large, 0·32—0·52 long, club-shaped, oblique, extending from near posterior margin of ventral sucker to almost the anterior margin of oral sucker. Near the pharynx it coils on itself and narrows into an elongated region that contains the pars prostatica and the ejaculatory duct. The basal sacular part contains the large convoluted vesicula seminalis, divisible into two portions —a large proximal and a small distal one which, by a narrow constriction, passes into the long pars prostatica.

Ovary on right side of median line, approximately spherical 0·08—0·12 in diameter, anterior to testes and partly overlapped anteriorly

by the ventral sucker. Oviduct arises from the posterior margin and, running obliquely for a short distance, joins the receptaculum seminis. Immediately afterwards it receives the common vitelline duct and forms the ootype. Receptaculum seminis ovoid, 0·038—0·065 in length, on left side of body, between anterior testis and ovary. Vitellaria consists of large follicles, lateral, extra and over caecal, from immediate anterior of ventral sucker to a little behind anterior margin of posterior testis. Uterus arises from the left side of the ootype. Each lateral half of the post-testicular region of the body contains a descending and an ascending loop of the uterus. Beginning on the right side the uterus descends backwards and reaching the posterior end it turns forwards. On approaching near the posterior testis the coils turn to the left and there again it descends and ascends. The ascending uterus passes forwards taking a course parallel and dorsal to the cirrus sac on its way to the genital atrium. Eggs thin shelled, oval, 0·03—0·035 × 0·015—0·02. Excretory pore at the posterior end. Excretory bladder Y-shaped, occupying a median position and extending as far forward as the posterior testis.

The presence of oblique testes separates the present form from all other species except *C. americanus* Stafford 1902, *C. europoeus* Blazoit 1910, *C. vesicaudus* Nickerson 1912, *C. compactus* Stunkard 1924 and *C. mehri* Pande 1932. The situation of the genital pore at the anterior tip of the body brings the present species closer to the last three of the aforesaid forms. Of these it is closely allied to *C. mehri* Pande 1932 on account of the shape of the body, a higher ratio in size of oral sucker to ventral, absence of oesophagus, left sided position of anterior testis and the median position of posterior testis. It differs from *C. mehri* in the distribution of vitellaria and the position of ovary and testes. The former extend from immediate anterior of the ventral sucker to a little behind anterior margin of posterior testis. Of the latter the ovary is partially overlapped by the ventral sucker and the testes are contiguous with one another. These differences necessitate the creation of a new species for the reception of the present forms.

Family PRONOCEPHALIDAE Looss 1902.

Subfamily *NEOPRONOCEPHALINAE* Mehra 1932.

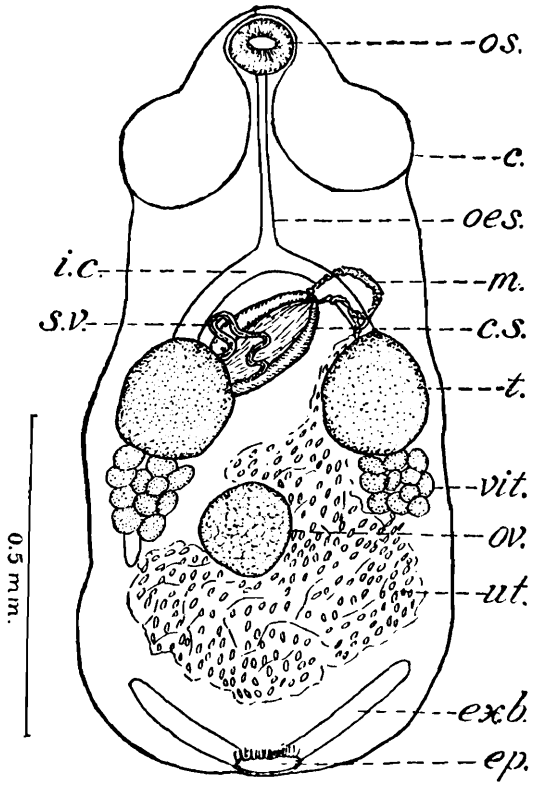
Neopronocephalus Mehra 1932.

Neopronocephalus mehri, sp. nov.

Host :—Morenia ocellata.

Both the turtles dissected harboured parasites of this new species numbering 140 and 52 respectively. Body small and thick, with thin cuticle and well developed musculature. Length 1—1·5, maximum thickness just posterior to ovary 0·5—0·6. Cephalic region distinct and is separated from the body by prominent constrictions. It is encircled by the characteristic " collar " which is complete dorsally and

laterally but incomplete ventrally. In the anterior region the body is strongly convex dorsally and deeply concave ventrally, the depth decreasing posteriorly until the body shows an evenly rounded oval structure near the posterior end. Sucker longer transversally than antero-posteriorly, measuring 0·1—0·11 × 0·11—0·12. Pharynx absent. Oesophagus narrow, 0·2—0·3 long. Intestinal bifurcation 0·3—0·38 from the anterior extremity of the body. Intestinal caeca first curve outwards and then inwards in the region of testes running dorsal to them. Behind testes they again curve a little outward ending a little posterior to the vitelline glands. Genital pores separate, situated on the left side of the median line, intercaecal and close to the intestinal bifurcation.



TEXT-FIG. 4.—Ventral view of *Neopronocephalus mehri*, sp. nov.

c., cirrus; *c. s.*, cirrus sac; *ep.*, excretory pore; *ex b.*, excretory bladder; *i. c.*, intestinal coeca; *m.*, metraterm; *oes.*, oesophagus; *os.*, oral sucker; *ov.*, ovary; *s. v.*, vesicula seminalis; *t.*, testes; *ut.*, uterus; *vit.*, vitelline glands.

Testes oval, almost equal, measuring 0·18—0·3 × 0·17—0·2 and lying at the same level almost near the middle of the body. Cirrus sac oval, 0·25—0·27 long and 0·1—0·12 in maximum breadth. Vesicula seminalis external lying coiled external to the cirrrus sac.

Ovary almost on the median line, nearly spherical, 0·13—0·15 in diameter. Receptaculum seminis absent. Vitelline glands immediately behind testes, composed of 11—13 closely packed follicles, lying on either side of the body. Metraterm present. Uterus much coiled extending both anterior and posterior to ovary. Ova with thin transparent shells measuring 0·023—0·027 × 0·0134—0·0154. Excretory pore very prominent, subterminal, lying on the ventral surface of the body. Excretory bladder V-shaped, the two limbs of which extend

upto a little more than half the distance between ovary and the posterior extremity of the body.

From the two other known species of the genus *Neopronocehalus triangularis* Mehra 1932 and *N. gangeticus* Mehra 1932 the present form is separated owing to great disparity in size, difference in the structure of the cephalic region and the collar, the number of the vitelline glands and the shape and the position of the excretory pore.

The following table gives the chief differences between the present form and those described by Mehra (1932, pp. 236-244).

——	*N. triangularis* Mehra 1932.	*N. gangeticus* Mehra 1932.	*N. mehri* sp. nov.
Length . .	2·9—4	2—2·4	1—1·5
Cephalic region . .	Triangular	Not entirely separated.	Triangular and entirely separated.
Int. bifurcation from ant. end	0·6—0·8	0·46—0·5	0·3—0·38
Size of cirrus sac	0·53—0·62 × 0·23—0·3	0·4—0·52 × 0·25—0·28	0·25—0·27 × 0·1—0·12
Follicles in vitelline gland .	11—17	13—15	11—13
Excretory pore . .	Dorsal, subterminal.	..	Ventral, subterminal.

Family PARAMPHISTOMIDAE Fischoeder 1901.

Subfamily *ZYGOCOTYLINAE* Ward 1917.

Stunkardia Bhalerao 1931.

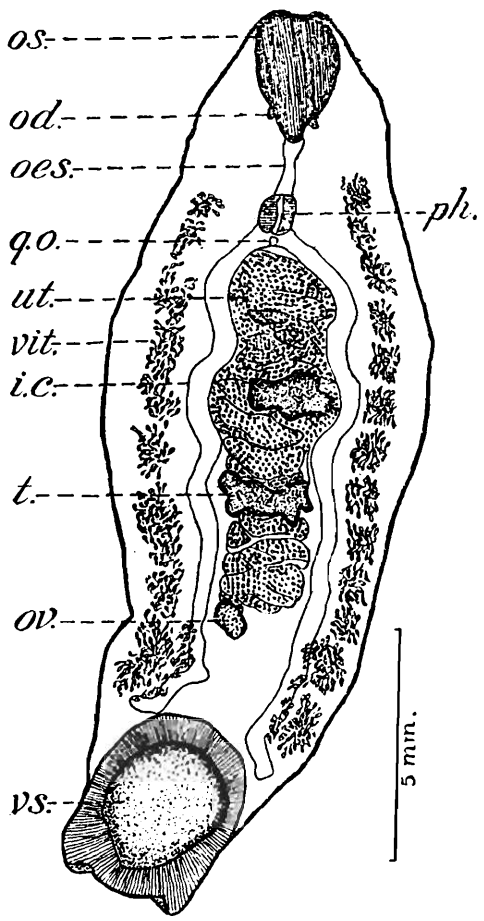
Stunkardia dilymphosa Bhalerao 1931.

Host :—Morenia ocellata.

Both the turtles harboured the parasites in the rectum, the numbers being 2 and 3 respectively. Length 13·5—20, maximum breadth 3·8 —7. Oral sucker 1·8—2·7 × 1·4—1·8. Ventral sucker 2·5—4·1 × 1·7—3·2. Testes lobed and equal in volume. Ovary lobed. Vitellaria not diffused in the parenchyma, as described by Bhalerao (1931, p. 104), but arranged in distinct follicles along the lateral margin of the body, extending from the level of the oesophageal bulb almost to anterior border of ventral sucker, running mostly alongside intestinal caeca but slightly overlapping them behind ovary. Uterus pre-ovarian, very much convoluted, and filled with a large number of eggs.

The present form is identical with *Stunkardia dilymphosa* Bhalerao 1931, except in the size of the various organs and in the nature of the vitellaria and uterus. The differences of size are all within the limits of individual variation and are of no importance. The comparatively

large size of the gonads suggests that the present form is more mature than Bhalerao's specimens and this fact is further supported by his

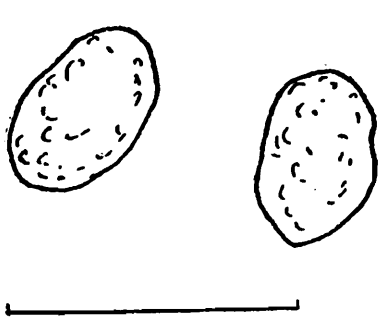


TEXT-FIG. 5.—Ventral view of *Stunkardia dilymphosa* Bhalerao.

g. o., genital opening ; *i. c.*, intestinal coeca ; *od.*, oral diverticulum ; *oes.*, oesophagus ; *os.*, oral sucker ; *ov.*, ovary ; *ph.*, pharynx ; *t.*, testes ; *ut.*, uterus ; *vs.*, ventral sucker ; *vit.*, vitelline glands..

description of vitellaria and uterus. The former are said to be diffused in the parenchyma, but the mature specimens showed distinct lateral follicles which were absent in the partly immature specimen obtained from the same host. The uterus has been described as devoid of eggs but in the present forms contained a large number. All these variations appear to be due to the different degree of maturity of the specimens, a hypothesis further corroborated by observations of one of my colleagues. It thus appears that the description of Bhalerao is based on immature specimens, and that what were considered as vitellaria may be simply the minute excretory granules that are so well developed and scattered in the parenchyma. In the light of the present work the following amendment in the generic character is necessary—

"Vitellaria follicular, lateral, extending from the level of oesophageal bulb to near posterior sucker"



TEXT-FIG. 6.—Ova of *Stunkardia dilymphosa* Bhalerao.

Class NEMATODA.

Order *ASCAROIDEA.*

Family KATHLANIIDAE Travassos 1918.

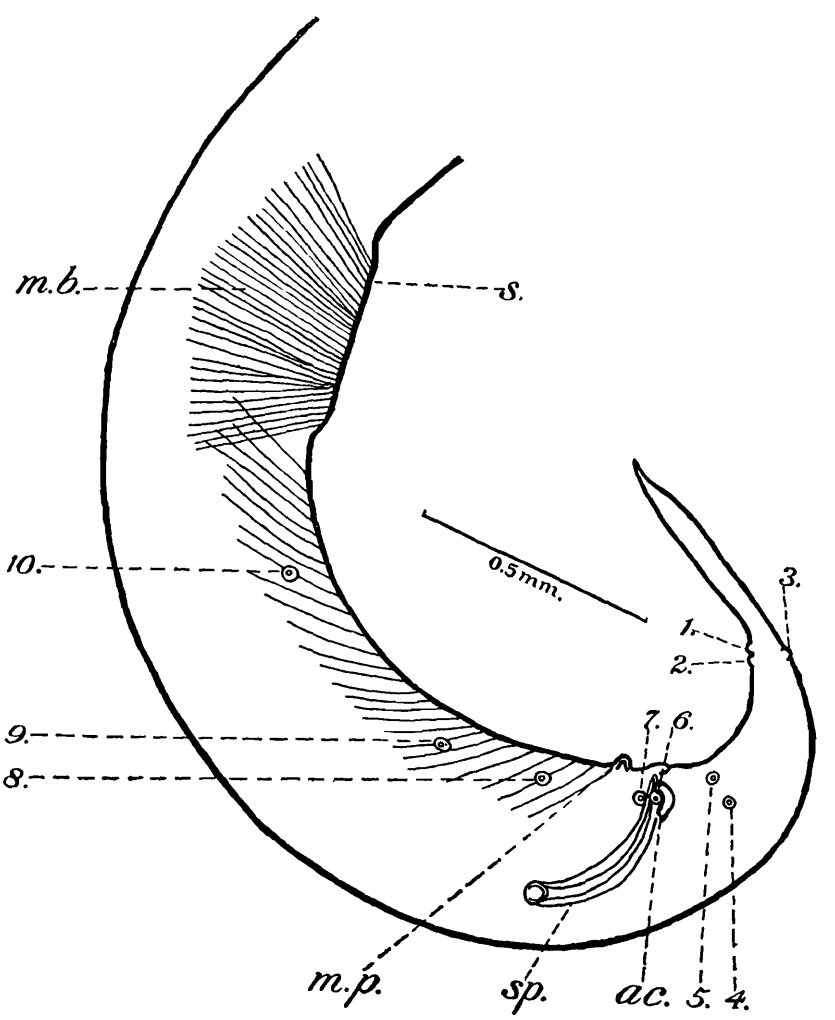
Subfamily *KATHLANIINAE* Lane 1914.

Spironoura Leidy 1856.

Spironoura rangoonica, sp. nov.

Host :—*Morenia ocellata.*

Approximately 181 parasites obtained from the stomach of one host. Worms of moderate size. Body tapering towards the extremeties. Female slightly curved ventrally. Posterior end of male sharply curved ventrally in the form of a hook. The tail in both sexes conical and rapidly tapering in its proximal part; distally it tapers gradually and forms a long stout spike. Head globular and slightly enlarged, separated from the body by a distinct neck. Mouth surrounded by three well developed lips, each being provided with two pairs of papillae



TEXT-FIG. 7.—Posterior end of male *Spironoura ragoonica,* sp. nov.

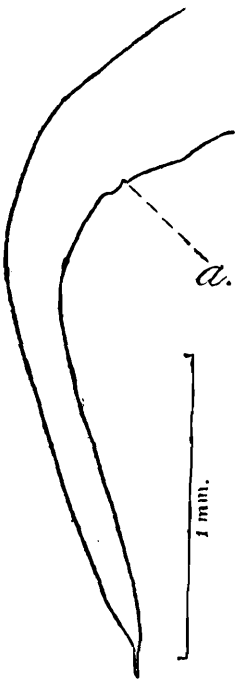
ac., accessory piece; *m. b.*, oblique muscle-bands; *m. p.*, median precloacal papilla; *s.*, sucker-like organ; *sp.*, spicule 1 to 10, ten pairs of caudal papillae.

—one pair small supporting the inner margin of the lip and the other pair lying on its outer margin. Cuticle smooth, with fine transverse striations and less prominent longitudinal striations. Mouth opens

into a buccal cavity, surrounded anteriorly by a ring of thickened cuticle. Oesophagus long and muscular consisting of a short anterior pharynx, a central median shaft, and two oesophageal bulbs, the posterior one of which bears the usual valvular apparatus. Cervical papillae inconspicuous. Nerve ring at a distance of 0·32—0·39 and the excretory pore 1·1—1·34 from the cephalic extremity.

Male :—Length 8·8—10·2, maximum breadth 0·66—0·76. The cylindrical pharynx together with the buccal cavity 0·114—0·115 long. Length of œsophagus from behind pharynx to the end of posterior bulb 1·48—1·65. Oesophageal bulbs broader than long : anterior bulb 0·14—0·16 × 0·133—0·138, posterior bulb 0·26—0·29 × 0·23—0·27. Spicules short and curved, 0·35—0·5 long, broadly expanded dorso-ventrally and containing a central median shaft. Accessory piece small 0·06—0·07 long. Sucker-like organ present on the tail. Preanal musculature well developed with bands of muscles running obliquely from the cloacal aperture to the sucker-like organ. The latter provided with radiating bands of muscle fibres. Ten pairs of caudal papillae present. First two pairs lying ventrally near the junction of the caudal spike and the tail ; third pair lateral lying almost at the same level with the second pair ; fourth and fifth pairs lateral and postanal one lying slightly dorsal to the other ; sixth and seventh pairs near the cloaca ; eighth, ninth and tenth pairs lying lateral and anterior to cloaca. Length of caudal spike 0·4—0·45.

Female :—Length 9·6—12, maximum breadth 0·7—0·76. Pharynx with the buccal cavity 0·114—0·133 long. Length of oesophagus from behind pharynx to end of posterior bulb 1·56—1·58. Oesophageal bulbs broader than long : anterior bulb 0·17—0·18 × 0·13—0·17, posterior bulb 0·82—0·31 × 0·25—0·27. Vulva in posterior half of body dividing the body almost in the ratio of 1·5 : 1. Vagina long with a maximum length of 1·5 in a few specimens, running obliquely anterior to the body across the dorsal side of the body cavity. Length of tail including the spike 1·3—1·62. Eggs oval, with thin shells, measuring 0·114—0·12 × 0·09—0·095.



TEXT-FIG. 8.—Posterior end of female *Spironoura rangoonica*, sp. nov. *a.*, anus.

Out of twenty-five species of *Spironoura* described the present form resembles *S. masculum* (Rudolphi 1819), *S. catesbeianae* (Walton 1929) and *S. brevispiculata* Baylis 1935 in the size of the spicules and number and general arrangement of the caudal papillae. The resemblance with *S. catesbianae* (Walton 1929) is more close on account of the presence of a well developed precloacal sucker-like organ, the condition in the other two cases being quite different. The differences with *S. catesbeianae* (Walton 1929) are obvious in the presence of a much enlarged body, postequatorial position of vulva, simple nature of the median precloacal papillae and much longer tail.

Spironoura onama Karve 1927.

Host :—*Morenia ocellata.*

A large number of these parasites were obtained from the rectum of the same turtle which was infected with the former species. The present form agrees with the description given by Karve (1927, pp. 343-349) except in some minor details. The head of the spicule is not enlarged ' like the head of the handle of a hockey stick ' but is uniformly thick with the shaft and the extremity of the tail beyond the last pairs of caudal papillæ is slightly longer. These differences are not of sufficient importance to justify the creation of a new species.

Order *SPIRUROIDEA.*

Family CAMALLANIDÆ Railliet and Henry 1915.

Camallanus Railliet and Henry 1915.

Camallanus sp.

Host :—*Morenia ocellata.*

A single immature female, measuring 11·2 in length was found in the intestine. The chitinous buccal valves are broader than long. There were ten longitudinal ridges on each valve. Vulva in front of the middle of the body, provided with an anterior prominent lip. Vagina narrow, running obliquely backward in a straight line. In absence of male specimens and sexually mature females the specific determination remains uncertain.

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