NOTES ON THE INDIAN SPECIES OF THE GENUS *ARGULUS* MÜLLER (CRUSTACEA COPEPODA) PARASITIC ON FISHES.

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INTRODUCTION.

This short note deals with a small collection of Argulids preserved in the Zoological Survey of India.

The only species of *Argulus* so far recorded from India was the one which was referred by Southwell and Hora (*Vide infra*), to the European *A. foliaceous* (Linn.). I have, however, examined Southwell's and Hora's collections and I am of the opinion that these specimens belong to *A. siamensis* Wilson. *Argulus foliaceous* is known to occur in European waters, while *A. siamensis* is recorded from Siam, and now its occurrence in India is reported for the first time.

[1]Khan has made a reference to some specimens of *Argulus* collected from *Cirrhina mrigala* Ham. in a tank at Lyallpur (Punjab). Unfortunately, the specific identity of these specimens has not been established.

Besides typical *A. siamensis*, this note also deals with the description of a new sub-species of the same, and two new species, *viz. A. giganteus* and *A. bengalensis*. In addition *A. indicus* Web. is also reported from Indian region for the first time.

I wish to acknowledge my thanks to Dr. B. S. Chauhan, Zoological Survey of India, for suggestions and general help, and to Shri K. K. Tiwari, Officer in charge, Crustacea section, for his keen interest and guidance.

SYSTEMATIC ACCOUNT.

Argulus siamensis Wilson, 1926.

1915. *Argulus foliaceous*, Southwell, *Rec. Ind. Mus.* XI, pp. 323-325, pl. xxviii, figs. 16-19.

1943. *Argulus foliaceous*, Hora, *Proc. Ind., Sci. Congr.*, XXX, III, pp. 66-67.

After careful examination of specimens named as *A. foliaceous* by Southwell and Hora, I find that they actually belong to *A. siamensis*, since they differ from *A. foliaceous* and agree with *A. siamensis* in the following characters.

The respiratory areas are placed side by side, parallel with the edge of the carapace. The anterior respiratory area, being club-shaped, is curved round the posterior one, and both of them are quite narrow. In *A. foliaceous*, which is excellently figured by Wagler[2], the anterior respiratory area is placed in front of the posterior one, and it is very minute in size compared with the large posterior area. The former is oval in shape and situated just by the side of the second maxilla, while the latter extends as far as the third pair of swimming legs.

[1] Khan, H., *Proc. Indian Acad. Sci.*, XIX B, V, pp. 171-175 (1944).
[2] *Wagler, E.*, Zool. AMZ., CX, pp. 7-10, pl. 3, figs. (*a-i*) (1935).

Carapace is ovate in all these specimens, and it is longer than wide. Males are slightly longer and narrower in size than females. The ribs of sucking cups are provided with 4 to 5 imbricate plates of which the basal one is the longest. The first antenna is comparatively stouter and shorter than the second. The lateral hook of the first antenna is quite long. The spine at the base of the second antenna is small and transparent. The post antennal spines are long and blunt. The basal plate of second maxilla is quite broad, and is provided with three teeth which are blunt and short. The first two pairs of swimming legs are provided with flagellum in both sexes. On the ventral surface of each of the third swimming leg of males there are three adhesive discs, while there is peg like structure on the anterior margin of the fourth leg. The boot-shaped lobe is present in the case of females, but they are totally absent in males. The toe of the lobe is drawn out into a long conical structure.

Due to long preservation the colour of these specimens are completely lost. But fresh specimens which are at my disposal are green in colour.

Wilson[1] described *A. siamensis* from the material that was placed at his disposal by Dr. H. M. Smith, who collected the same from a Cyprinid fish (*Cirrhina*) from Bangkok (Thailand). Meehan[2] redescribed this species in 1940. As far as I am aware this is the first record of this species from India.

The specimens at my disposal are from the following localities :—

Reg. No.	Locality.	Collector and date of collection.	Host.
C2975/1	Harischandrapur, Malda Dist., W. Bengal.	Civil Surgeon, Malda. 22-2-1922.	Not known.
C2967/1	Champahati, 15 miles south of Sealdah station, Calcutta, W. Bengal.	Mr. S. C. Baugh, Zool. Surv. of India. 11-12-1949.	*Ophicephalus punctatus* Bloch.
9054/10	Siripur, Bihar	Dr. T. Southwell (det. as *A. foliaceous*).	*Labeo rohita.*
9055/10	Mahananda river, Siliguri, Base of Himalayas.	Dr. N. Annandale 17-4-1911. (det. as *A. foliaceous.*)	Not known.
C2968/1	Dharangadhara State (Saurashtra).	Dr. S. L. Hora. (det. as *A. foliaceous*).	Murrel.

Argulus indicus Weber, 1892.

1892. *Argulus indicus*, Weber, *Zool. Ergeb.* II, p. 544, fig. 1.
1909. *Argulus indicus*, Van Kampen, *Zool. Anz.* XXXIV, p. 447, figs. 5 and 6.
1940. *Argulus indicus*, Meehan, *Proc. U. S. Nat. Mus.* XXCVIII, p. 483, fig. 25.
1944. *Argulus indicus*, Wilson, *Proc. U. S. Nat. Mus.* XCIV, pp. 552-553, pl. 22, figs. 34-39 and 48.

[1]Wilson, C. B., *Journ. Siam. Soc. Nat. Hist. Suppl.* VI, pp. 361-363, pl. xxii, figs. 1-7 (1926).

[2]Meeham, O. L., *Proc. U. S. Nat. Mus.* xxcviii, pp. 482-83, fig. 24 (1940).

Max Weber (*loc. cit.*) established this species to accommodate some female specimens from east coast of Java. The male was described by Wilson (*loc. cit.*) from Bangkok (Thailand.)

In the material at my disposal, I am hardly able to notice any difference between males and females, with regard to posterior lobe on the proximal segment of the fourth basipod, and also the posterior respiratory area as mentioned by Wilson.

Except for one, all other specimens are dark green in colour with characteristic dot like markings on the dorsal surface of the carapace.

Out of six specimens whose measurements are given below, only two are adult males.

Measurements in millimeters.

	1	2	3	4	5	6
Sex.	♀	♀	♀	♀	♂	♂
Total length	7·3	7·7	6·7	6·2	6·5	6·9
Maximum breadth	6·7	6·8	6·0	5·0	5·7	5·9
Length of carapace	6·4	6·3	5·5	4·9	5·3	5·8
Cephalic region—Length	3·3	3·2	3·0	3·1	3·0	3·1
,, —Breadth ..	3·3	3·0	3·1	3·0	3·0	3·0
Abdomen—Length	1·0	1·4	1·2	1·2	1·2	1·1
,, —Breadth	2·2	2·2	2·0	1·9	2·1	2·0

It is obvious from the above table of measurements that the length and greatest breadth of the cephalic region is almost equal in all the specimens. The extent of cephalic area is nearly 50 per cent. of the carapace in adult females and less than 50 per cent. in case of young females and adult males.

The specimens were collected by Mr. S. C. Baugh, formerly Research Scholar of the Zoological Survey of India, from the skin of *Ophicephalus punctatus* Bloch, a freshwater food fish, at Champahati, a village about 15 miles south of Sealdah Station, W Bengal, bearing the Register No. C. 2969/1.

The occurrence of this species, hitherto reported from Java (Max Weber), and Bangkok, Thailand (Wilson) only, in India is of great interest, especially with reference to its zoogeographical distribution, as it affords another example of the so called Malayan element in the Indian fauna.

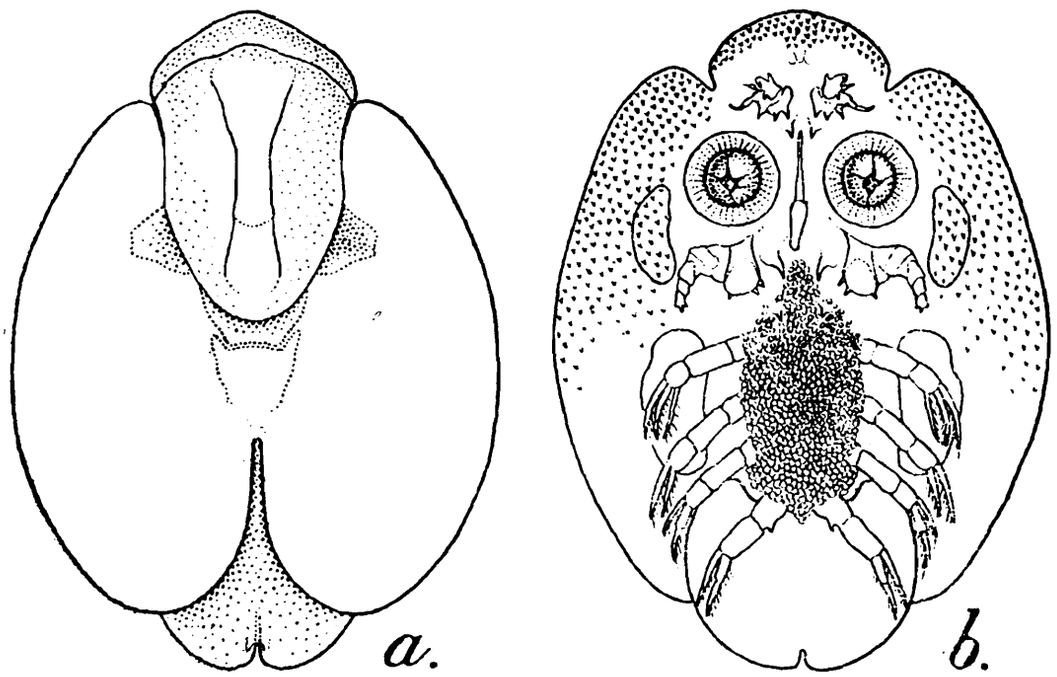
Argulus giganteus sp. nov.

Diagnosis.—A large species. Anterior respiratory area in front of the posterior one, and subequal to it. Ribs of the sucking cups with 25—26 imbricate plates. Eyes absent. First pair of swimming legs with a strong flagellum ; rest of the legs without flagella. Boot shaped lobe on the last pair of swimming legs very small.

Holotype.—Female. Register No. C. 2972/1, Zoological Survey of India.

Type,=Locality and Host.—Not known.

Description.—Carapace (text-fig. 1 *a.*) is ovate, being some what longer than broad. The lateral lobes of carapace are rounded and the latter overlaps two-thirds of the abdomen. The elliptical cephalic area is well separated from the rest of the carapace. The two dorsal ridges are simple and do not extend beyond the transeverse groove, which runs parallel to the anterior edge of the cephalic area, and they deviate at either ends.



TEXT-FIG. 1.—*Argulus giganteus*, sp. nov.

a. Dorsal view of the female holotype : × 3⅕. *b.* Ventral view of the same : × 3⅕.

I can not make out any trace of the paired and median eyes in the specimen at my disposal.

On each sides of the cephalic area towards the anterior end are two lobe like markings.

The anterior respiratory area is situated in front of the posterior one, and is subequal to it (text-fig. 1 *b.*). The former is oval in outline and is situated between the suckers and the second maxillipedes. The elongate, oval, posterior respiratory area extends from the first to the third pair of swimming legs.

The first antenna (text-fig. 2 *a*, *1*) is provided with strong armature. Lateral hook is moderately long, and the anterior spines are provided with a minute hook at the end. The two basal spines of the first antennae are strong and curved. Antennal flagellum consists of a long stout basal segment, bearing a short filament at the tip.

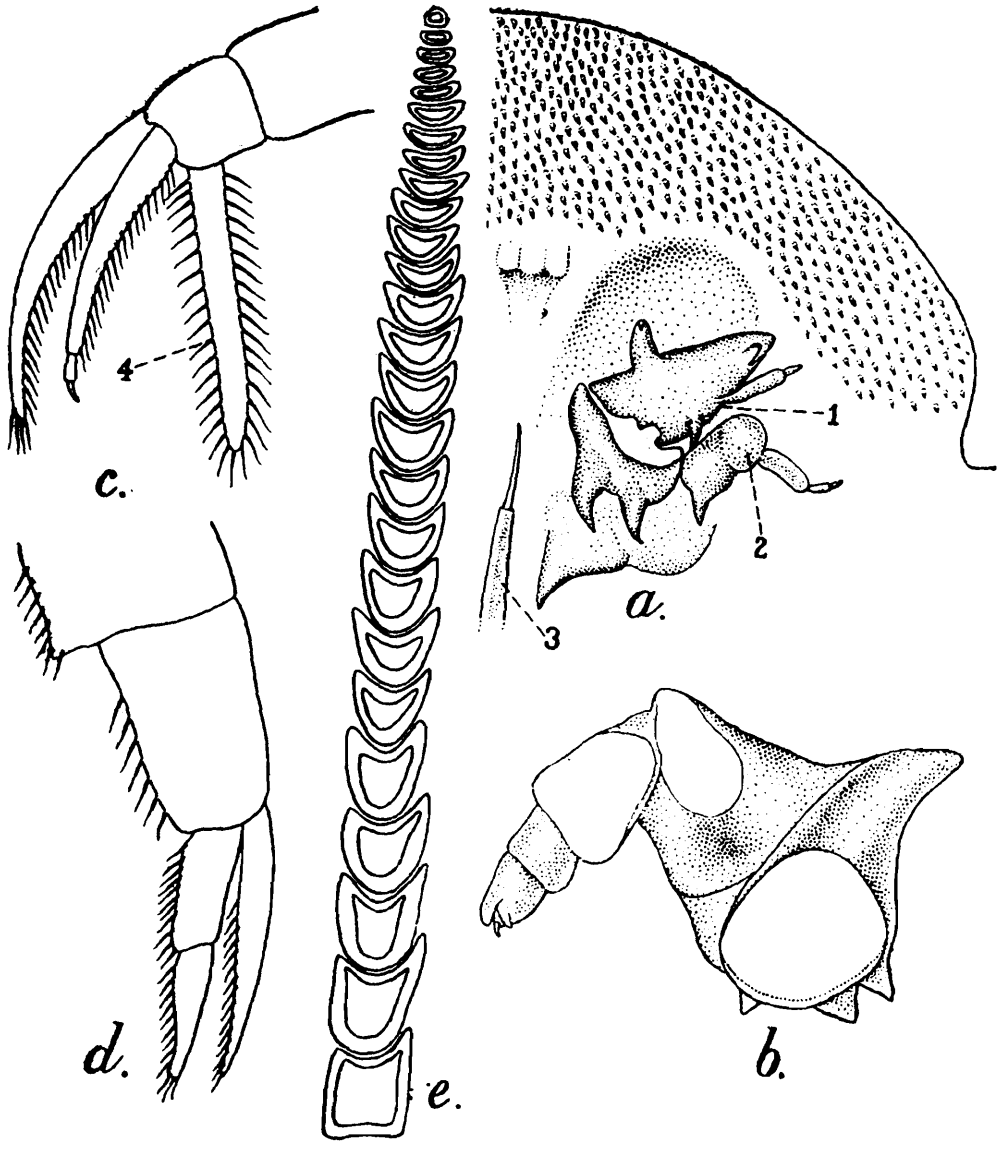
The spines at the base of the second antenna are small and straight and semi-transparent (text-fig. 2 *a*, *2.*). The flagellum consists of four joints the two basal segments being stouter than the two distal ones. The latter are at right angles to the former. Post antennal spines are large and broadly pointed.

The ribs of sucking cups are provided with 25 to 26 imbricate plates (text-fig. 2 *e*) placed one above other. They gradually diminish in size towards the periphery.

Second maxilla (text-fig. 2 *b*) which is composed of six segments, has a broad basal plate. There are three teeth on the basal plate, the inner two widely separated from the third, and relatively longer and broadly pointed. The third spine is very small and blunt. Tips of second maxillae are provided with two curved accuminate spines. Out of two pairs of maxillary spines situated in the middle line of the body, the anterior pair are large and pointed.

Abdomen is broader than long. Posterior sinus is very short and notched. The lateral lobes of the abdomen are rounded.

The first pair of swimming legs (text-fig. 2 *c*) is provided with a well developed and strong flagellum, which is as long as the exopodite (text-fig. 2, *c 4*). The rest of the legs are devoid of flagella.



TEXT-FIG. 2.—*Argulus giganteus*, sp. nov.

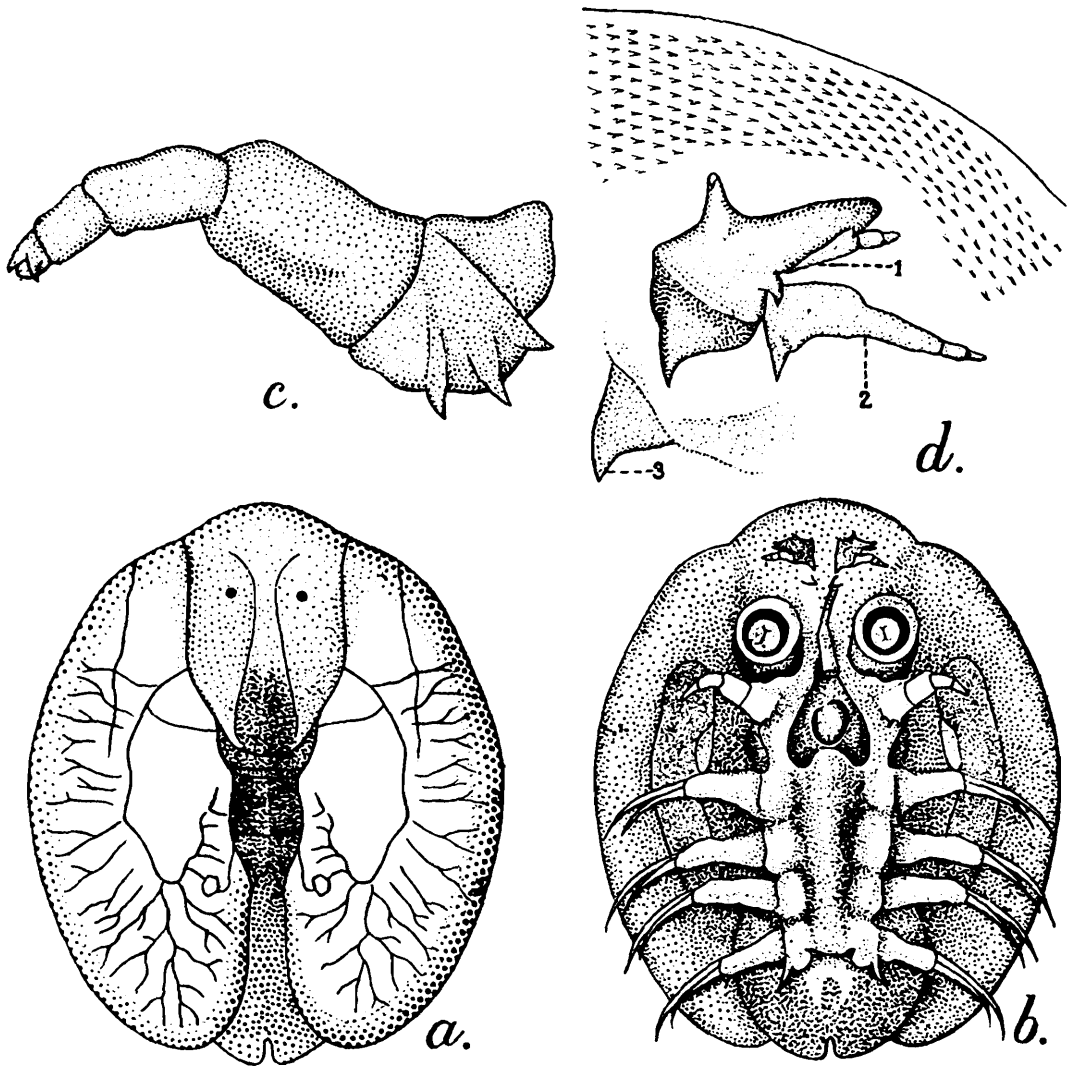
a. Ventral view of the left half of the cephalic region showing antennule and antenna × 16.; *b*. second, maxilla : × 16.; *c*. first swimming leg : × 16 ; *d*. fourth swimming leg : × 16.; *e*. ribs of the sucking cup : × 226⅔.

The boot-shaped lobe on the basal segment of the fourth pair of swimming legs is very short.

The holotype measures as follows :—

Total length of the body, 19·5 mm. *Greatest breadth*, 14·6 mm. *Carapace length*, 11·8 mm. *Abdomen length*, 4·6 mm., *breadth*, 7·00 mm. *Cephalic area—length*, 9·00 mm., *breadth*, 5·7 mm. *Diameter of suckers*, 2·8 mm.

Affinities.—In the arrangement of the respiratory areas *Argulus giganteus* sp. nov., resembles *A. scutiformis* Thiele 1900, *A. borealis* Wilson 1912, and *A. floridensis* Meehan 1940. It, however, differs from these in the absence of eyes, prescence of a large number of imbricate plates on the ribs of sucking cups, and in the shape and presence of a boot-shaped lobe on the last pair of swimming legs.



TEXT-FIG. 3.—*Argulus bengalensis*, sp. nov.

a. Dorsal view of the female holotype : × 7; *b.* ventral view of the same: × 7.; *c.* second maxilla × 33⅓.; ventral view of the left half of the cephalic region showing antennule and antenna : × 33⅓. (1. antennule ; 2 antenna ; 3 post antennal spine.)

Argulus bengalensis sp nov.

Diagnosis.—Anterior respiratory areas minute, situated in the central mesial notch of the posterior ones. Lateral sides of the carapace marked with a fine net work of capillaries. Ribs of sucking cups provided with 5 to 6 long imbricate plates, the basal plate being the longest.

With a transparent sac like structure on the third pair of swimming legs ; with a knob like peg on the fourth pair of swimming legs in males.

Holotype.—Female. Register No. C. 2970/1 ; *Androtype*—Male Register No. C. 2971/1 ;

Locality—Harischandrapur, Malda District, W. Bengal ; *Host*—Not known.

Description.—Carapace (text-fig. *3 a*) is ovate and is longer than broad. Posterior sinus is broad and deep. Lateral lobes of the carapace are very broad with rounded margins, overlapping abdomen almost completely in the female, but extending to only two thirds of the abdomen in males (text-fig. *4 a*). Lateral sides of the carapace are clearly marked with a net work of capillaries.

Cephalic region is distinct from the rest of the carapace and is elliptical. It projects slightly anteriorly. The extent of the cephalic area is slightly less than 50 per cent. of the total length of the body.

Lateral eyes are quite large and conspicuous, but they are not placed as farward as in *A. siamensis*. Median eye is not traceable. Dorsal ridges of the carapace are simple and they deviate at either ends.

Abdomen obovate and is wider than long, with a narrow anal sinus. The anal sinus is deeper in females.

The anterior respiratory areas (test-fig. *3 b*, *4 b*) are situated in the central mesial notch of the posterior ones, both being kidney shaped. Compared with the posterior the anterior one is minute.

Antennule or the first antenna (text-fig. *3d*, *1*) has a fairly long lateral hook, and a small anterior hook. Posterior spines are curved and acute. Basal spine is quite strong, long and pointed. Second antenna (text-fig. *3 d*, *2*) has a large and stout basal spine. Post antennal spines (text-fig. *3 d*, *3*) are large and broadly pointed. They are apposed to each other in the middle line.

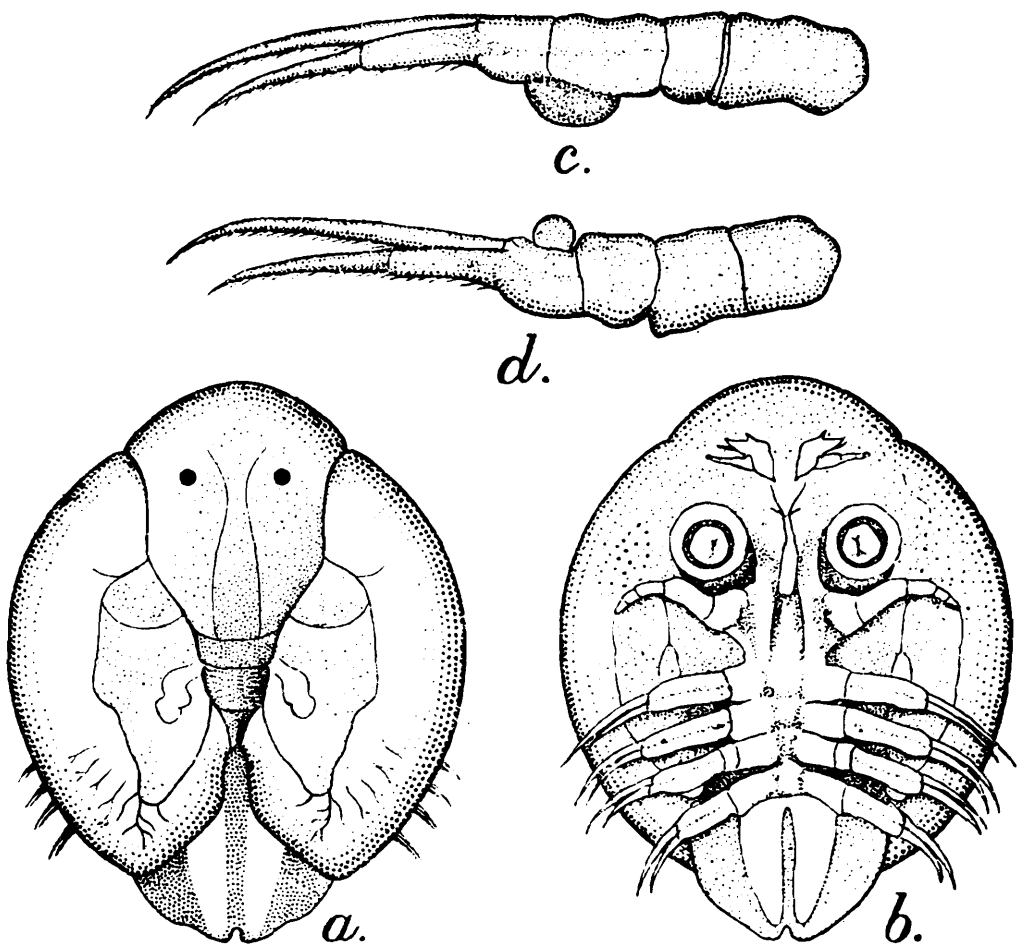
Sucking cups are situated just above the second maxillae, and they are wide apart. Each rib on the sucking cups is provided with 5 to 6 long imbricate plates of which the basal one is the longest.

Basal plate of second maxilla (text-fig. 3 *c*) is large and it bears three strong pointed spines. All of them are of the same size and they are placed side by side. Tips of maxilla are provided with two minute spines. A pair of maxillary spines are situated in between the second maxillae.

First two pairs of swimming legs are each provided with a flagellum. The basal segment of the fourth pair of swimming legs possesses a boot shaped-lobe in the female (text-fig. 3 *b*), but they are absent in the males (text-fig. 4 *b*.).

In the males the third pair of swimming legs (test-fig. 4 *c*) has a transparent sac like structure, situated on the posterior end of the legs. A knob like peg (text-fig. 4 *d*) is present at the anterior extremity of the fourth pair of swimming legs, towards the posterior end of the transparent sac of the third legs.

The testes in males (text-fig. 4 *b*) descends downwards as far as the anal sinus, and they are massive.



TEXT-FIG. 4.—*Argulus bengalensis*, sp. nov.

a. Dorsal view of the male androtype : ×12.; *b*. ventral view of the same ; ×12 *c*. third swimming leg : ×33⅓ ; *d*. fourth swimming leg : ×33⅓.

Measurements in millimeters.

	♂	♀
Total length of the body	4·4	7·6
Greatest breadth	3·3	6·3
Carapace length	2·9	5·0
Cephalic region—length	2·1	3·6
,, —breadth ..	1·8	2·4
Abdomen—length	1·3	1·8
,, —breadth ..	1·5	2·6
Diameter of the sucker	0·61	0·92

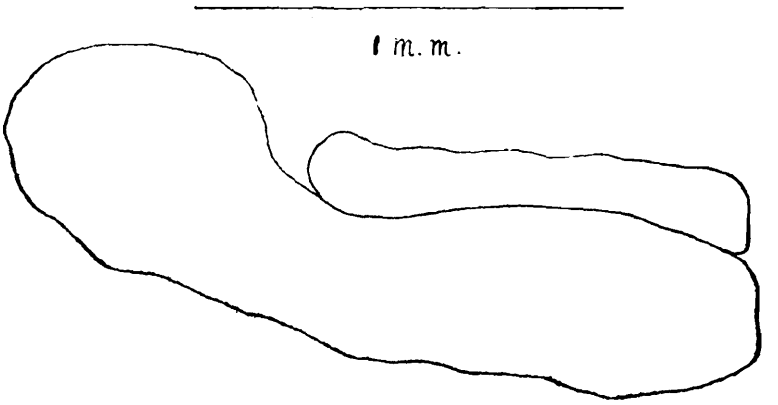
Affinities.—In the disposition of the anterior mesial respiratory area *Argulus bengalensis*, sp nov., resembles *A. catastomi*, but it differs from it with reference to the shape and extent of the respiratory areas, the extent of the cephalic area, shape and number of the sucking cups, and structure of the male accessory organs.

Argulus siamensis subsp. **peninsularis** nov.

This new subspecies differs from *Argulus siamensis* in the following features :—

Carapace overlaps abdomen to a very little extent. Cephalic area is nearly 50 per cent. of the total length of the body. Respiratory areas (text fig. 5) are kidney shaped with the anterior one curved round the posterior area. But the latter ends just by the side of the former and it is never prolonged backwards. It starts just at the bend of the anterior respiratory area, and is comparatively narrow. It is about two-thirds of the anterior in length.

Most of the specimens are adult females, and their total length varies from 4·25 mm. to 4·70 mm. One specimen from Rajahmundry is however 6·25 mm. in length.



TEXT-FIG. 5.—*Argulus siamensis* subsp. *peninsularis* nov. *a.* Respiratory area ×43⅓.

Holotype.—Register No. C. 2973/1, of the Zoological Survey of India, Calcutta ;

Locality.—Rajahmundry ; collector : Fishery Officer, Rajahmundry ; *Host ;* not known.