PARAPETALUS CAUDATUS N. SP., A COPEPOD PARASITIC ON *DUSSUMIERIA ACUTA*, FROM MADRAS

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Parapetalus orientalis Steenstrup and Lutken, *P. occidentalis* Wilson, *P. hirsutus* Bassett-Smith are the only known species of the genus. The present new species parasitic on the clupeid *Dussumieria acuta* differs so markedly from the species of *Parapetalus* described so far that a full description of the parasite and a comparison of all the known species are given in this paper.

Host and Record

Six specimens of the parasite, all female, were found attached to the posterior region of the mouth floor of six different rainbow sardines (*Dussumieria acuta*) caught on the Madras Coast. Nearly 120 fishes of all sizes were examined, hence the percentage of infection appears to be about 5%. Though the six hosts were of different age groups yet the location of the parasite was remarkably uniform. The cephalothorax of the parasite was fixed near the posterior angles of the triangular mouth floor, with the rest of the large flat body extending over the gill arches. The peculiar site of attachment of the parasite probably accounts for its frequently being alive, nearly eight hours after the host fish was landed and is probably also responsible for its large size and flat form.

Definition of the Species.—The carapace is elliptical, less than a fifth of the body in length. The genital segment is more than twice the length of the carapace and widens posteriorly where it ends in two lateral flattened lobes which, however, do not hide the abdomen ventrally. There are no median lobes. Abdomen is only a little longer than the genital segment and has two wide latero-dorsal wings, very nearly the entire length. The fourth or free segment, almost hidden, bears no plates, processes or appendages other than legs which are uniramous and bear a slender seta on the protopod and five spines on the three-jointed exopod. The first leg has a protopod bearing groups of stiff short hooked hairs, and a terminal joint bearing a small spine on its anterior aspect, three aborted setæ on the posterior aspect and five terminal spines,

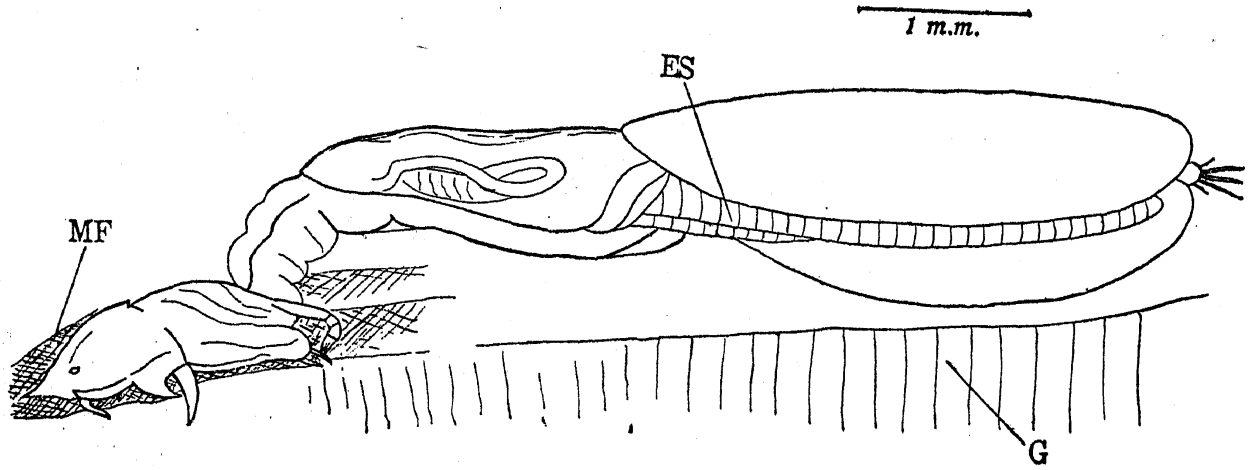

FIG. 1. Lateral view of Parasite attached to mouth floor of fish host. *E. S.*—egg strings of parasite. *G.*—Gills of fish. *M. F.*—mouth floor of fish.

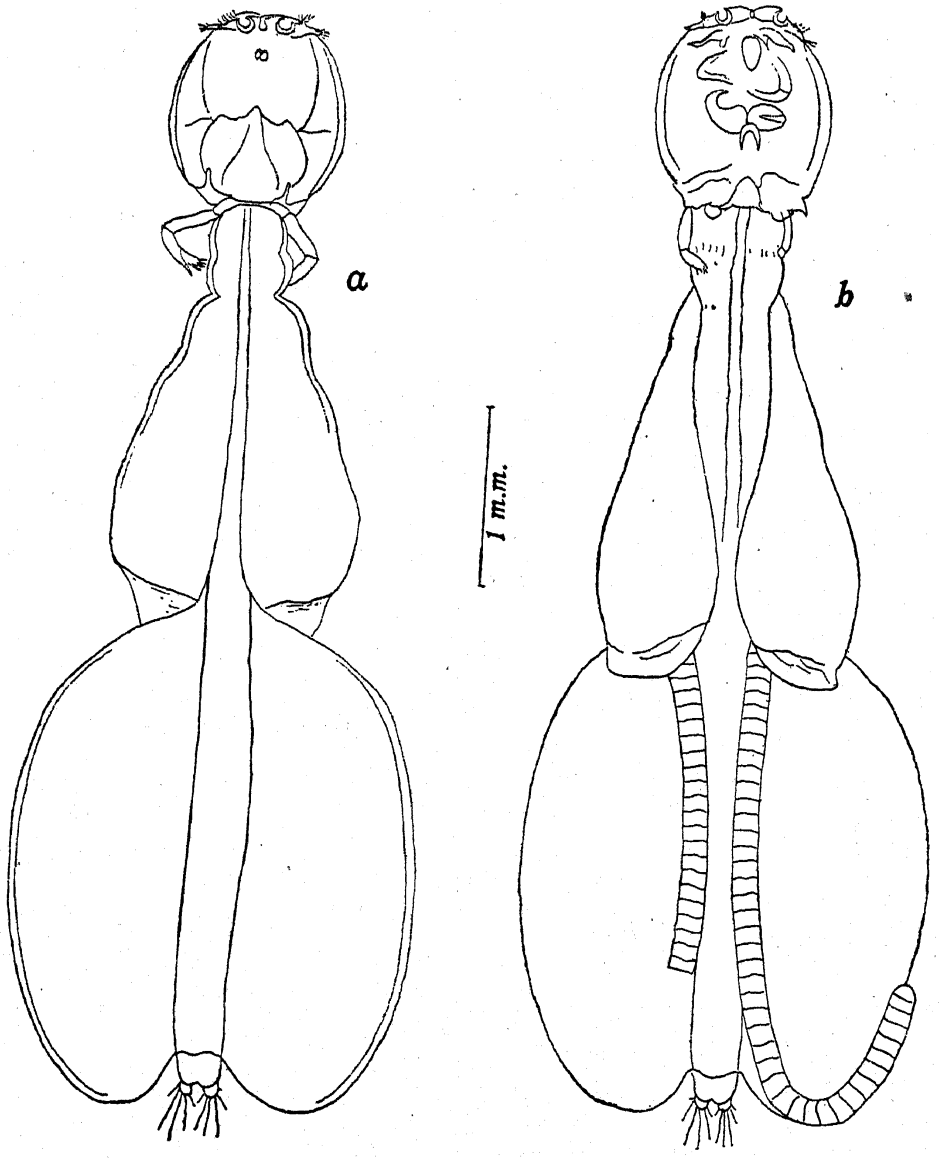

FIG. 2. Dorsal (*a*) and ventral (*b*) views of female *Parapetalus caudatus* n. sp.

Size and Colour.—The parasite with the longest egg-string is 7·4 mm. long and 2·8 mm. across the abdomen where the body is broadest. When alive, the body was pale yellow, the median eyes red, the abdominal extensions whitish and the egg-strings bright yellow.

Body.—The cephalothorax is almost circular being 1·32 mm. long and 1·2 mm. across. Though only about a sixth of the whole body in size, it is the only part attached to the host. The frontal area as well as the lateral margins have a narrow transparent flexible fringe which facilitates adhesion. The lunules on either side of the medially notched frontal plate, are shallow being 0·18 mm. across and 0·4 mm. deep. They are directed ventrally and with their dentate margin, probably, act more by friction than by cupping adhesion characteristic of the lunules of *Caligus*. The disposition of chitin ridges within the lunules, as well as round the edge of the cephalothorax shield, is peculiar and prevents slipping. The cephalothorax being less concave ventrally than in *Caligus*, the appendages seem to be mainly responsible for the tenaceous hold of the parasites. The first three segments of the thorax proper appear united with the cephalon as in all Caliginæ. The fourth (free) segment is small being 0·34 mm. broad and 0·18 mm. long and is invisible ventrally owing to the backward extension of the protopodite of the third leg, and is very nearly hidden dorsally by the backward extension of the dorsal shield and the forward extension of the genital segment behind.

The genital segment is clearly of two parts; an anterior narrow neck-like part, 0·44 mm. long and as broad, constricted in the middle and attached to the cephalothorax at an angle of about 45°, and a hind part which broadens posteriorly and ends in two flattened corners extending backwards ventral to the abdomen. Viewed ventrally these flattened extensions appear to be continuous with the two longitudinal lateral swellings of the genital segment, separated by a groove between. The dorsal side is conspicuously marked by the attachment of the abdomen, a little in front of the lateral corner lobes. The egg-strings are usually straight but when longer than the body they become coiled outwards and forwards.

The abdomen is composed of two segments; the first is greatly elongated and broadened, being (3·4 mm. long and 2·8 mm. broad). Dorsally it is convex and is marked by a median anterior projection and by a posterior notch. In the smaller forms examined the broad lateral wings of the abdomen appear flat, whereas in the mature female forms the wings appear inflated on either side of the median region where the gut runs. These lateral extensions are penetrated by a network of blood channels from two

longitudinal trunks running on either side of the gut. The second segment of the abdomen is much shorter, being one twentieth of the entire length of the abdomen, and occupies the median notch behind. It bears two short rounded anal laminæ; each lamina carries one short slender bristle on either side, and five plumose setæ of which the central three are far longer.

Appendages

The 1*st antenna* is two-jointed. The stout basal joint bears the lunules as well as eleven plumose setæ along the anterior edge and nine spines ventral to them. The distal segment which is club-shaped bears twelve spines.

The 2*nd antenna* is two-jointed and has a single-toothed lobe on its basal joint while the distal segment is long and ends in a powerful hook.

The mouth tube is long, conical and is supported by several rods jointed about the middle of the tube. The labrum and labium are similar semi-circular lobes at the end of the tube. At either corner of the mouth occur two slender processes. The mandible is sickle-shaped, the distal joint bears sixteen teeth, the more proximal ones being smaller than the others.

The 1*st maxilla* is a broad, short, pointed structure bearing two recurved spiny setæ—the vestiges of the palp.

The 2*nd maxilla* is similar but longer and more curved. Its simple spine-like character allies this form to the genus *Caligus*. The seta at its base probably represents the exopod or palp.

The 1*st maxilliped* is three-jointed, the long distal part bearing three sharp curved hooks. The 2nd maxilliped is of a large and powerful build. The basal joint is extremely stout and broad, while the distal segment is a strong sharp curved hook, and is the main organ of attachment to the host. The furca is slightly divergent, straight, and sharp-pronged. The 1*st leg* is uniramous as in *Caligus*. The basal segment is stout, and bears a spine-like seta. The exopod is two-jointed; the proximal joint bears groups of stiff, short, hooked hairs on its hinder edge and is nearly thrice as long as the distal. The distal joint is slender and bears five spiny setæ as well as four short recurved prickles. Of these prickles three on the posterior margin are aborted setæ. The 2*nd leg* is biramous. The protopod is two-jointed, the distal being nearly thrice as large as the basal, which bears a sharp plumose seta. The endopod is three-jointed and bears six plumose setæ on the distal rounded joint and two on the inner aspect of the middle joint. The exopod is also three-jointed and bears on its outer aspect three spines one on each joint, as well as six plumose setæ on the medial side of

the two terminal joints. The 3*rd leg* is much reduced, though it still has the foliaceous biramous form, as in Caligines. The protopodite is large and laminate and extends backward over the short free segment and bears a short slender plumose seta on either side of the median line. The exopod is three-jointed; the basal joint bears a large hook-like spine, the longer middle joint is fringed with hairs along its edges and bears a plumose seta at its inner tip, while the third joint bears three slender spines and three

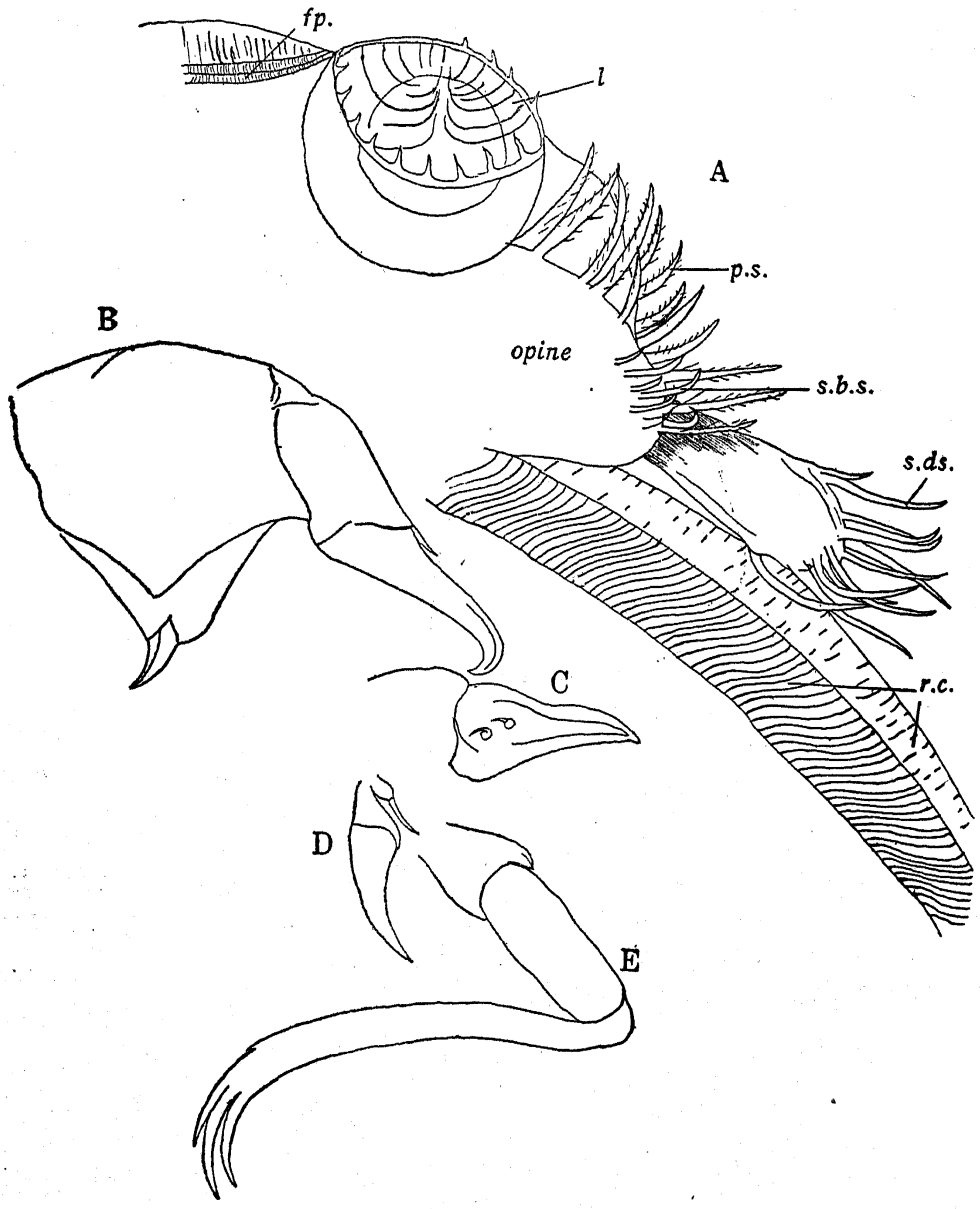

FIG. 3. Antennæ, maxillæ and maxillipede. A. *First Antenna* .*p.f* frontal plate. *l*, lunule. *p. s.* plumose seta. *r. c.* rim of carapace showing flexible fringe and chitinous thickening. *s. b. s.* spines of basal segment. *s.d.s.*- spines of distal segment. B. *Second Antenna* *C.*—First Mexilla. *D.*—Second Maxilla. *E.*—First Maxillipede.

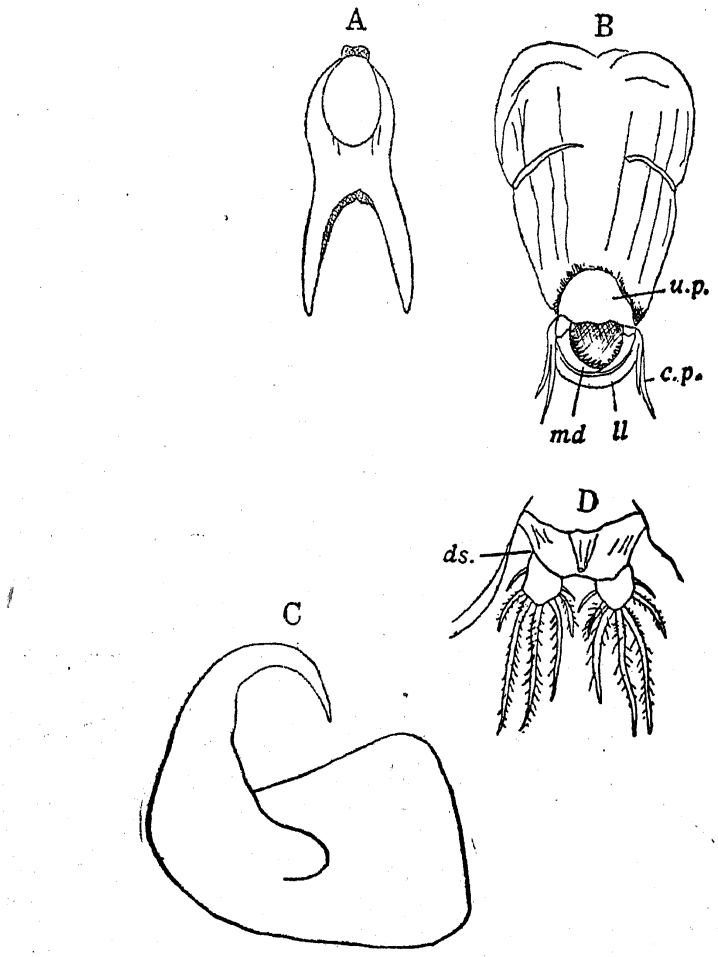

FIG. 4. Furca, mouth tube, II maxillipede and anal laminae. *A.* Furca. *B. Mouth tube, cp.* corner process. *ll.* lower lip. *Md.* mandible. *Up.* upper iip. *C.* Secoud maxillipede. *D.* anal laminæ. *ds.* distal segment of abdomen.

plumose setæ. The endopod is two-jointed; the basal joint which is very short and is sunk into a notch of the protopodite, bears a long plumose seta on the inner edge, while the second joint is nearly circular and bears six plumose setæ of varying lengths.

The *4th leg* is uniramous. To the long basal segment is articulated at its outer end a slender seta, probably representing the vestigial ramus. The distal part of the leg is of two joints; the first, longer joint bears at its outer distal tip a sharped curved spine, the terminal joint bears a shorter spine on its outer margin and three at its free tip. There are no vestiges of the 5th and 6th appendages.

The type will be lodged with the Zoological Survey of India, Calcutta.

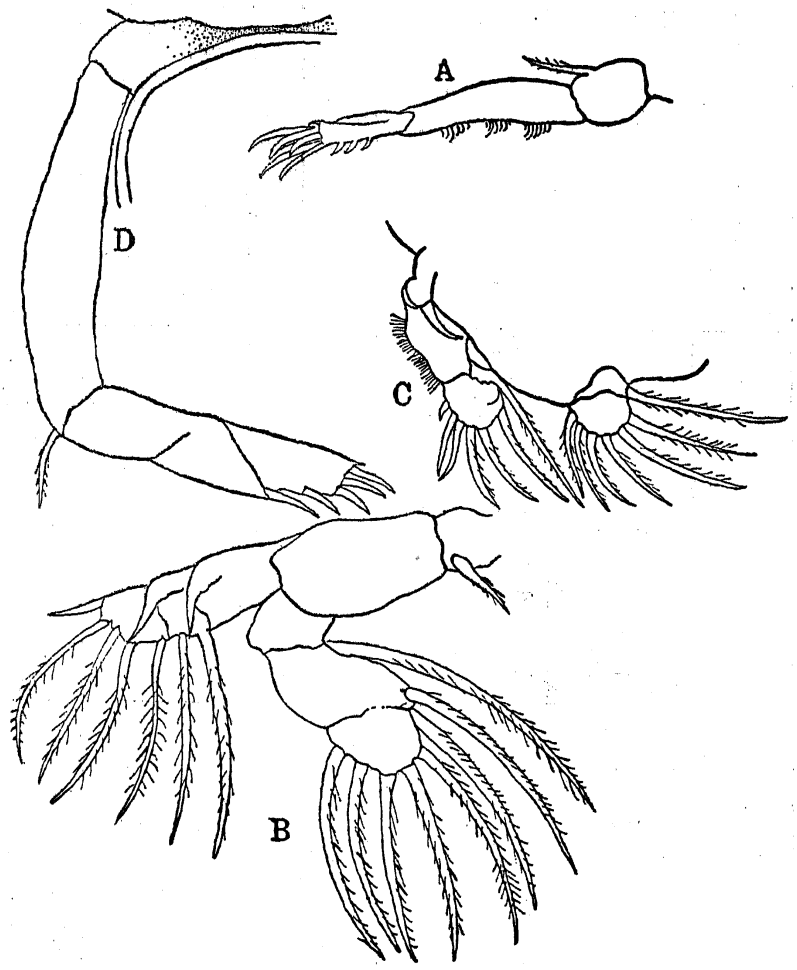

FIG. 5. Posterior appendages. *A* = First leg. *B* = Second leg. *C* = Third leg. *D* = Fourth leg.

TAXONOMIC DISCUSSION

Wilson (1905) in his classification of the Caligidæ places the genus *Parapetalus* of Steenstrup and Lutken, with its type species *P. orientalis*, in the sub-family Caliginæ, which is characterised by the IV segment having no dorsal plates or any appendages other than the IV legs. Within the sub-family, the genus is distinguished from the others by the uniramous character of 1st and 4th legs, the frontal plates being provided with lunules, the 2nd maxillæ being simple and spine-like and both the genital segment and abdomen being winged. A brief comparison of the present form with the other species as given in the following table will show that it belongs to a new species of this genus.

Note on Respiration.—The gill arches of the fish host with the parasite *in situ* were cut out and transferred to fresh sea water and the parasite was observed alive for a few hours. The regular rhythmic movements of the posterior part of the body helping circulation,

	P. caudatus n. sp.	*P. orientalis* Steenstrup and Lutken 1861	*P. hirsutus* Bassett-Smith 1898 redescribed by Wilson 1912	*P. occidentalis* Wilson 1908
Second Maxillæ	Long, curved with a single seta on base		Long, bears two basal setæ	Short and stout, bears two setæ
First leg ..	Protopod bears groups of stiff hooked hairs; distal joint bears a small spine on its anterior aspect, three aborted setæ on its posterior margin and five terminal spines	The second joint bears a spine, the third bears five spines and three plumose setæ	Protopod bears a spur, second joint a spine and the last joint, three spines and three plumose setæ	Protopod bears a spine; distal segment has four spines and three plumose setæ
Fourth leg ..	Protopod long, bears a slender seta and five spines on the two joints of the exopod	Protopod long, three jointed; ramus bears five spines	Protopod long bears a small spine the three joints of ramus bear five spines (Wilson is silent about the clusters of hairs Bassett-Smith noted at the base of spine)	Protopod long, three jointed exopod bears five spines
Carapace ..	Elliptical, less than one-fifth of body length	Orbicular, two-fifths of body length	Elliptical one-third the body length	Ovate, one third the body length
Genital segment	More than twice the length of carapace widens posteriorly and ends in two lateral flattened lobes	Has lateral extensions narrow in front broad behind. Posterior extensions large and hide abdomen ventrally	Three fourths the carpace, widens posteriorly. Posterior lobes not large	As large as carapace, has wide ventrolateral wings curling dorasalwards. Posterior extensions as long as abdomen. There are two median lobes which unite into one after maturity
Abdomen	Longer than genital segment by a fourth. Broadest part of the body. Dorsal surfaee drawn into lateral wings—except for about a twentieth of the length of abdomen	Two thirds the genital segment; produced into wings for about a third of the length	Once and half again as long as genital segment. Wings not up to the end of abdomen	As large has genital segment. Dorsal wings along the entire length

observed in *Caligus savala* Gnanamuthu, were clearly visible. The broad abdomen could be seen swung upwards and downwards through an arc, at intervals of 5 to 15 seconds — the interval being shorter when the host fish was fresher. The large flattened extensions of the abdomen which are traversed by a close network of blood channels, suggest that they have a respiratory function, thus indirectly testifying to the skin being the site of respiratory exchange. The peristaltic movements of the gut were amphidirectional and irregular, as in *Caligus*. Observations of these peristalses, as well as the movements of the rectum, limited as they were to a few hours, however, did not support the possibility of respiration being carried on through the anus.

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