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THE EXTERNAL ANATOMY OF *METOPONORTHUS PRUINOSUS* (BRANDT, 1833) (ISOPODA : CRUSTACEA)

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In the present work, the external anatomy of the isopod, *Metoponorthus pruinosus* has been described and many details in its external morphology have been added. The general characters of this isopod are similar to other related species of Oniscoidea. It ranges from 10 mm to 12 mm in length and 4 mm to 4.5 mm in width. The youngones resemble the adults but are smaller in size.

The body is oval, dorso-ventrally compressed and is covered with series of hard, articulated plates. It is divisible into three regions viz. head, thorax and abdomen. Besides the mouthparts, the head carries a pair of eyes, a pair of small uniramous antennules and a pair of long antennae, each with two segmented flagellum; thorax is without a carapace with first segment indistinctly fused with the head. Thoracic appendages are paired, uniramous and all alike except the first pair i.e. the maxillipedes. Abdomen narrows abruptly from the thorax and bears biramous plate like pleopods and terminal uropod. Body colour of living individuals is handsomely variegated with purplish brown pigment on a light background. This coloration is due to chromatophores which are densely spread all over the body except its legs and underparts where it is virtually absent. The pigmentation is prominently conspicuous along the mid-dorsal line of the body as well as on the lateral margins where it forms a continuous chain extending antero-posteriorly. The antennae, telson and uropods are similar in colour to the body. The young ones are lighter in colour.

INTRODUCTION AND REVIEW OF LITERATURE

The isopod, *M. pruinosus* (Fig. I) is commonly found in humid and semi-humid places usually underneath flower pots, loose bricks in gardens, organic debris around fields and even on the roots of certain vegetables of the family Cucurbitaceae. It belongs to the family Porcellionidae of the sub-order Oniscoidea. The distribution of most of the described species in

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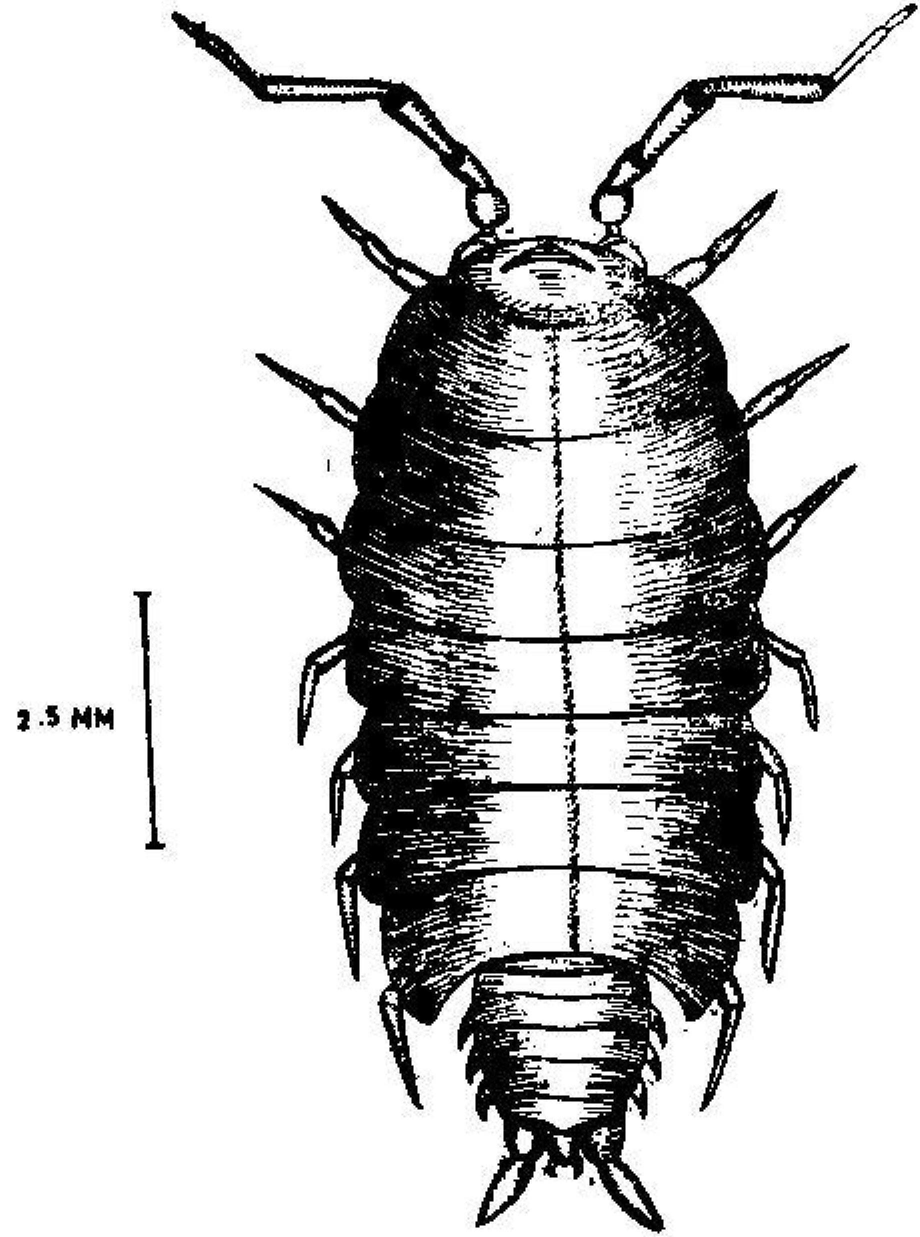


FIG.1 METOPONORTHUS PRUINOSUS
(DORSAL VIEW)

Oniscoidea is wide, if not cosmopolitan. *M. pruinosus* although originated in the Mediterranean region and has now acquired a world-wide distribution (Vandel, 1966–personal communication).

Attems (1928) and Barnard (1932) have shown that some species of isopods are of very wide distribution in South Africa and may be regarded even of cosmopolitan occurrence. Muchmore (1957) has reported the occurrence of terrestrial isopods in situations where the substratum is very loose. He has further reported that a great majority of terrestrial isopods found in Northeastern United States have undoubtedly been introduced from Europe. Some of the immigrants have been more successful and have become more widely distributed than others and are among the commonest sowbugs and pillbugs in that part. In New York state, for instance, apart from the local species, certian European species such as *Oniscus asellus* Linn. *Porcellio scaber* Latr., *Porcellio spinicornis* Say., *Metoponorthus pruinosus* (Brandt.), *Cylisticus convexus* (DeGeer), *Tracheoniscus rathkei* (Brandt) *Armadillidium vulgare* (Latr.) are reported to be very common.

An intensive search in literature has revealed that most of the previous work on Oniscoidea and many related crustacea is restricted in the from of notes, scattered in smaller or larger monographs, on the distribution and taxonomy of this group (Richardson, 1905 : Attems, loc. cit; Barnard, loc. cit; Vandel, 1943 and Hely, 1958). The information on the biology of Oniscoidea is particularly scanty and virtually no references are available on the detailed external and internal anatomical features of this otherwise very familiar group.

This apparent neglect of the study of morphology and anatomy of Isopoda may be attributed to the greater attention given by Zoologists to the insects than other groups of Arthropods. This is however, not justified in view of the great economic importance of isopods. Recent work is bringing us the realisation that the isopods, which apparently seem to us harmless are not so in reality. These small crustaceans frequently become pests in the vegetable and flower gardens as also in glasshouses. Damage to plants by these creatures has been reported by Anderson (1946), Cloudsley-Thompson (1958), Hely (*loc. cit*) and Anonymous (1935). Theron (1961) has invited attention to another important aspect of this problem. He has shown that the habitat favouring woodlice and other arthropods will consequently also be suitable for terrestrial molluscs. According to him plants damaged by millipedes and woodlice, also invariably suffer damage from slugs and snails.

It is clear from the foregoing account that the woodlice are not so harmless as they appear to be and therefore, require much greater attention than has hitherto been given to them. The study of these arthropods require much further work before all the aspects of the biology and control of this important and so far neglected group could be covered. The only available reference of any consequence in the context of the present problem is that of Snodgrass (1956) but he deals only with the external morphology of a marine isopod, *Lygida*. Brusle (1960) and Gupta (1961) have published brief notes on the structure of anal sphincter in *Ligia* and rectal glands of woodlice, respectively. In the present work the external anatomy of *M. pruinosus* has been described and may new details in the external morphology of the isopod have been added.

MATERIALS AND METHODS

The material viz., grown up specimen of *M. pruinosus* which have been utilized in the present study were collected from a number of ecologically varied niches. The adults due to their delicate structures and danger of desiccation avoid exposures to direct sun-light aud remain sheltered underneath decaying plant debris, clods and in crevices during the day and come out to feed at night. The sowbugs breathe by means of gills which must be kept moist and on this account they frequent damp situations. The places of collection mainly included roots of cucurbitaceous and other vegetables grown at the farms of University of Agriculture, heaps of loose bricks and organic debris near the water taps and around tanks and soil patches covered by flower pots. The specimen were carefully swept with the help of a camel hair brush into small glass tubes, measuring 3 x 1 inches and were brought to the laboratory where they were introduced into a large (1 ft. diameter) glass trough. Soil taken from flower pots and containing roots of grasses and plants was put at the base of the trough. Some dried and decaying leaves taken from under the mango tree, *Mangifera indica* were svread over the soil to serve as cover for the living specimen. Several such troughs were maintained in the laboratory and water was frequently sprinkled in the troughs with the help of a wash bottle to provide proper moisture and humidity conditions for the sowbugs. These troughs were covered with a piece of muslin cloth to prevent the escape of living animals and to provide sufficient aeration. In this way, the supply of fresh specimen required for studying the external morphology was regularly available at hand.

The specimen preserved in alcohol, were sent to Prof. A. Vandel in France who identified them as *M. pruinosus* (Brandt, 1833). For the preparation of permanent slides, the living specimen were killed with chloroform and boiled in 10 per cent KOH for about five minutes to do away with excessive chitin. These were washed in distilled water and treated with 10 per cent glacial acetic acid for about five minutes to remove traces of KOH, washed again in distilled water to remove the acid and dehydrated in the ascending grades of alcohol starting from 30 per cent and reaching up to absolute alcohol. The specimen were stained with 70 per cent carbol fuschin after 70 per cent alcohol's treatment. After dehydration the material was kept in clove oil for at least four hours, the body parts and appendages were dissected under a binocular microscope and were given a dip in xylol before mounting in canada balsam.

THE HEAD AND ITS APPENDAGES

The Head

The head of *M. pruinosus* like other isopods is small unified cephalic structure and sunk into the first thoracic segment. It carries a pair of sessile eyes, a pair of attenuated three-segmented antennules, a pair of multi-segmented antennae with two flagellar segments, a pair of mandibles, the first and second maxillae and one pair of maxillipeds. It, therefore includes the protocephalon, the three gnathal segments and the first thoracic (maxilliped) segment, all these structures have consolidated in a cranium-like capsule in which the traces of the original head segmentation have become obsolete.

Anterior View: (Fig. 2)

The head when viewed from anterior or frontal side appears triangular; the apex of this triangle being represented by the point where the distal ends of the mandibles meet. The anterior sclerotization of the head may be said to be accomplished by four plates culminating on the lowermost part by an approximately triangular (but with an oval distal margin) labrum joined above by a sub-rectangular piece referred to as epistome. The epistome of the isopods is usually regarded analogous to the clypeus of insects. Like insects it provides anterior articulations of the mandibles on its basal angles. The epistome is further followed by a similar but a larger plate. This latter plate bears a well-marked but incomplete transverse supra-antennal suture which separates a narrow profrons posteriorly and a large postfrons anteriorly. The postfrons has carved in it antennary fossae and fossae

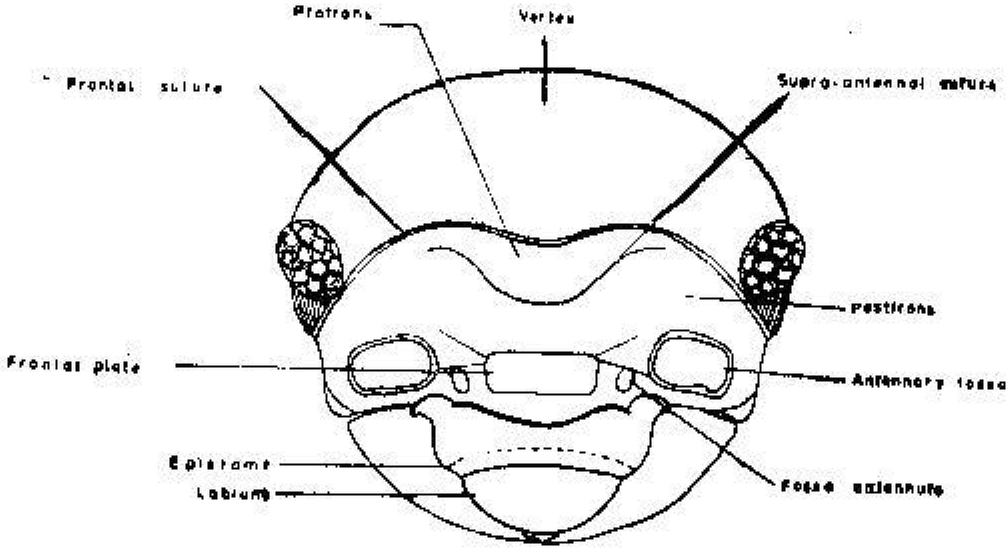


FIG. 2 HEAD ANTERIOR VIEW

antennule which accommodate the bases of the antennae and the antenlnues, respectively. A rectangular frontal plate is conspicuously discernible above the base of clypeus and in between the fossae antennule. Immediately above the profrons there is a large plate which is separated from the former by a well-marked frontal suture. The eyes are lodged bulging on the lateral corners of this plate. This plate because of its position appears directly analogous to the vertex of some higher arthropods like insects.

Posterior View: (Fig. 3)

On the back of the head is the large rectangular neck foramen below which are suspended the maxillipeds. The neck foramen, is laterally margined by narrow rims which are confluent dorsally in a wider flange distinctly separated by a wider groove from the dorsal wall of the cranium. Ventrally the foramen is closed by a neck membrane which contains a cross-bar from the posterior end of the maxilliped sternum. Since the dorsal flange over the foramen, the marginal rims on the sides, and the sternal bar below appear to be parts of a circle on the posterior part of the head carrying the maxillipeds the inference can hardly be avoided that they together represent the reduced annulus of the maxilliped's segment united dorsally and laterally with the maxillary part of the cranium. On each side of the neck

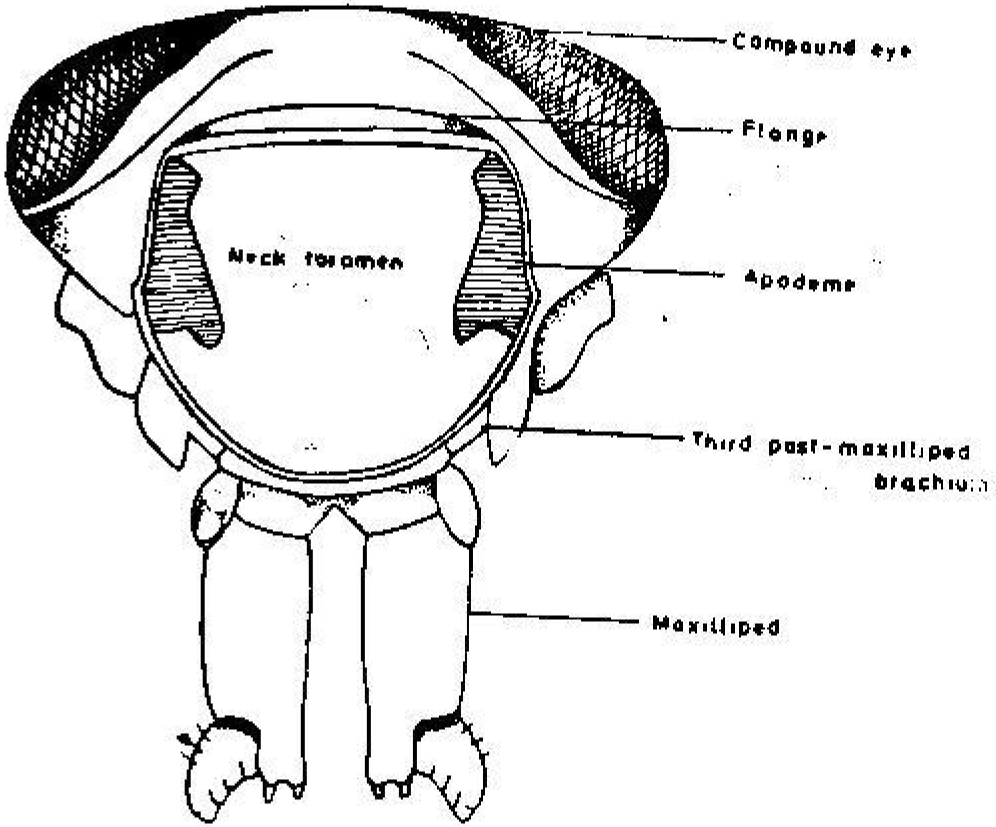


FIG. 3 HEAD POSTERIOR VIEW

foramen an apodeme is inflected from groove in front of the marginal rim which evidently is an ingrowth between the tergal region of the maxillary and the maxilliped segments.

The ventral wall of the head has a continuous median sclerotization from which three pairs of lateral arms are given off. The first arms are intermaxillary brachia since they go between the bases of the first and second maxillae, the second are post-maxillary brachia between the second maxillae and the maxilliped, the third are post-maxilliped brachia extending transversely behind the bases of maxillipeds. The ventral skeleton of the head, therefore, includes the united sternal region of the first maxillary segments, the second maxillary segment and the maxilliped segment. The slender intermaxillary brachia extend laterally and posteriorly, and each ends with a loop in a pocket of the head wall above the outer end of the much thicker post-maxillary brachium of the same side. From the angle of the loop is given off a large apodeme that extends forward in the head cavity.

The appendages of head

(*A*) *The Antennae* (*Fig. 4*: *A & B*)

Like other Crustacea the antennae of *M. pruinosus* are uniramous and consist of two pairs. The first pair of antennae which are commonly known as antennules (Fig. 4 B) are very small and inconspicuous and consist of three segments. The basal segment is the largest and annular while the remaining two segments are of almost equal size. The second segment is annular whereas the third one is tapering towards the apex. The antennule are lodged in small cavities internal to the bases of the anntenae.

The second pair of antennae arise from the larger fossae below the compound eyes. These are long pointed and seven-segmented, the flagellum consisting of two segments (articles). The first three segments are small and the fourth and fifth are longer, fifth being the longest. All the segments are furnished with innumerable bristles nnd disc shaped sensillae.

(*B*) *The Mouthparts*

Mouthparts consist of labrum, a pair of mandibles, and two pairs of maxillae and a hypopharynx. The mouth is bordered anteriorly by the labrum, and laterally by the mandibles. The two remaining head appendages overlie the bases of mandibles and in turn covered by the maxilliped (of the first fused thoracic segment).

(i) *The Labrum* (*Fig. 2*)

The labrum is a free flap-like structure attached to epistome on the facial surface of the head. It is roughly triangular in shape with an obtuse distal margin.

(ii) *The Mandibles.* (*Fig. 5: A & B*)

The mandibles as in other isopods consist of a single piece. Whatever may be the primitive elements that have entered into its composition, these elements are fused into a solid gnathal organ. There are, hence, no internal muscles within the mandibles. The mandibular musculature consists exclusively of the external abductor and adductor muscles that move the appendage as a whole.

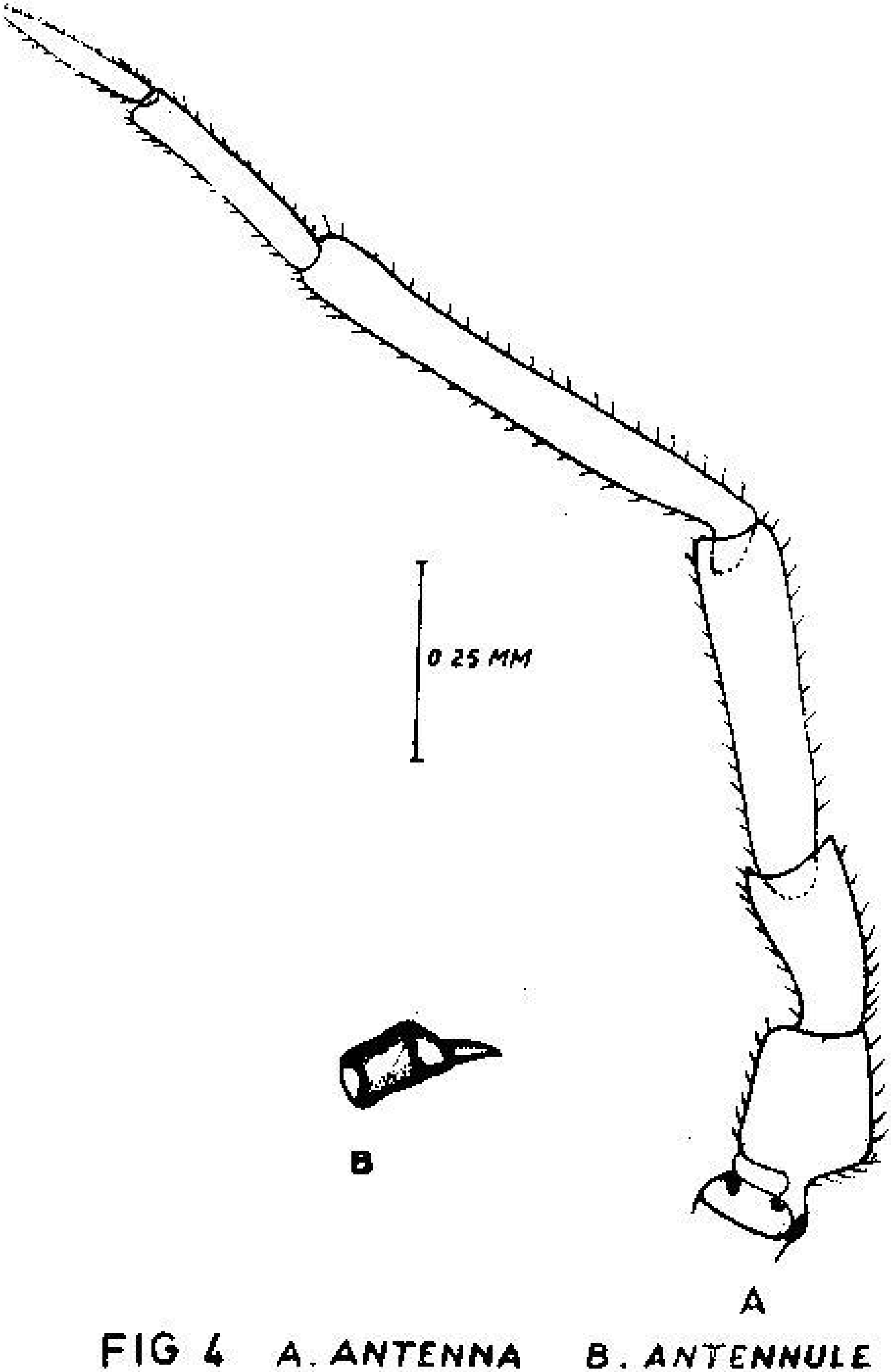


FIG 4 A. ANTENNA B. ANTENNULE

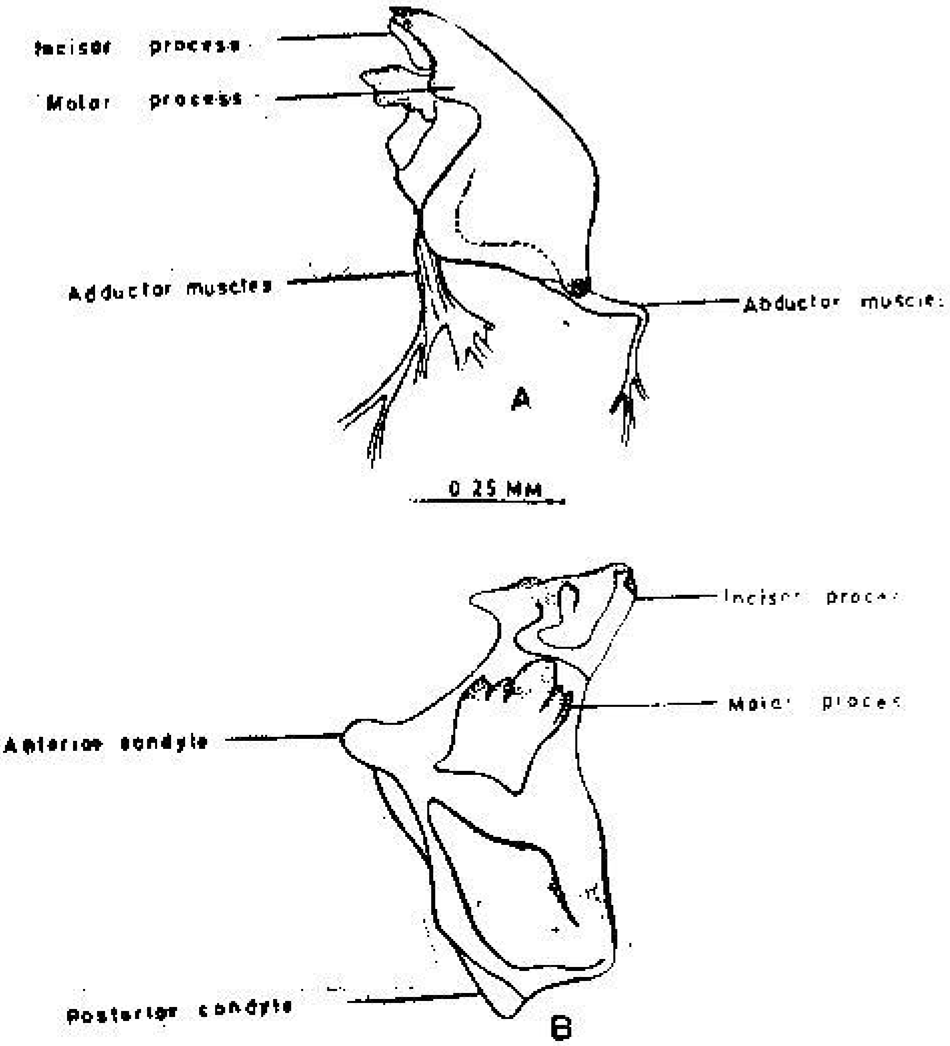


FIG.5 MANDIBLE A DORSAL B VENTRAL

The large mandibles hang vertically from the wall of the mandibular segment. Each is a strongly convex, elongate oval structure attached to the lateral membranous walls of the head by most of its inner margin, leaving only a ventral masticatory part, projecting below as a free lobe. This gnathal lobe is larger and differentiated into a toothed incisor process and a molar process with a flat, oval, mesal surface. The molar processes of the opposite mandibles are opposed to each other when the mandibles are closed; the incisor processes come together behind the labrum. Each mandible is doubly articulated by an anterior condyle and a posterior condyle at opposite ends of the hinge. The anterior condyle articulates on the basal angle of the epistome whereas the posterior condyle on the subgenal margin of the cranium.

The mandibles are moved by a pair of muscles ; one is a large dorsal adductor attached by a wide, thick tendon on the mesal margin of the mandibular base, the other is slender dorsal abductor attached on the lever arm of the lateral margin of the mandible near the posterior articular condyle. The hollow base of the mandible is filled with a great mass of fibres which converges upon a median, transverse ligament that receives likewise the fibres from the opposite mandible.

The mandibles as in other isopods are hanging down-wards from the head and swinging transversely against each other and are clearly more effective as biting organs. The close parallelism in the structure of the head and mandibles between the isopods and pterygote insects with biting and chewing mandibles might suggest that the insects originated from the isopods.

(iii) *The Maxillae (Fig. 6: A & B)*

The maxillae are much simplified appendages. Each first maxillae (A) consists of two elongate lobes, proximally united by a membrane and arising from a basal sclerite that articulates on the inter-maxillary sternal brachium just mesad of the base of the head apodeme. The appendages have wide membranous connections with the head and the mesal lobes are attached by slender rods to the arms of the first maxillary sternum. The second maxillae (B) are still more simplified each consisting of a single broad lobe supported on a basal sclerite that articulates with the post-maxillary brachium.

(iv) *The Hypopharynx. (Fig. 6: C).*

Anterior to the sternal skeleton arise the paragnaths a pair of large

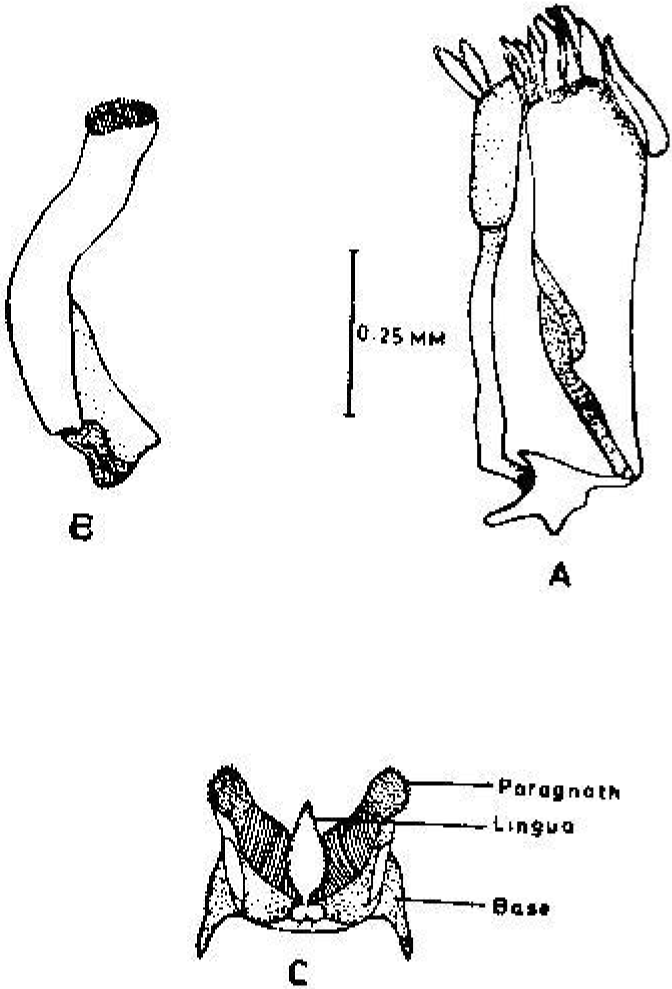


FIG 6

A MAXILLA B. MAXILLULE C. HYPOPHARYNX

flat, soft lobes and between them an elongate, conical median lobe which may be termed as the hypopharynx or the lingua. The three lobes have a common skeletral base which gives off a strengthening arm into each paragnath and is itself supported on the arms of the bifurcate first maxillary sternum. The paragnaths and the hypopharynx together are highly suggestive of the three lobed hypopharynx of certain lower insects; in entomological terminology the lateral lobes (paragnaths) are the superlinguae.

(v) *The Maxillipeds* (*Fig. 7*)

The maxillipeds are a pair of elongate, flattened appendages. They are suspended from the posterior part of the ventral wall of the head behind the post-maxillary brachia. Each maxilliped consists of a small basal segment, the coxa bearing laterally a large epipodite and a distal segment with a movable palp. The maxilliped of either side enclose medially a basal segment the basis above the coxa which bears a sub-apical lobe, the endite.

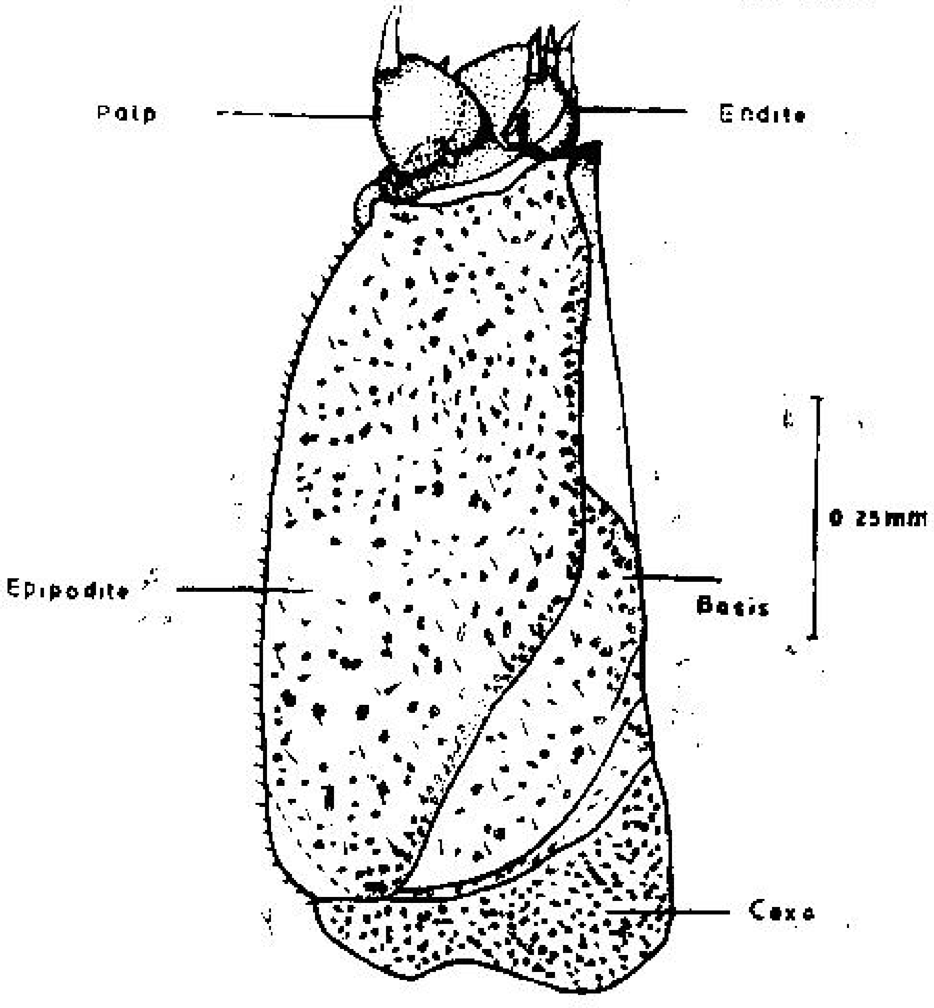


FIG. 7 MAXILLIPED

THE THORAX AND THE LEGS

The Thorax

The thorax consists of 8 segments; first segment being indistinctly fused with the head and carries elongate, flattened appendages, the maxillipeds. The remaining seven free, postcephalic thoracic segments carry each a pair of walking legs. The legs are uniramous and more or less similar to each other.

All the seven thoracic segments are saddle-shaped and similar in their structure. They are free and flexible on each other. The tergal plates are expanded laterally into broad folds (Fig. 8) covering the leg bases. As stated by Calman (1909) in *Idotea* and several other species the coxae expand to form plates that eventually replace the primary folds of the terga.

The ventral surface of the segments between the bases of the legs are soft and membranous and are traversed by weakly developed transverse sternal bars. (Fig. 8).

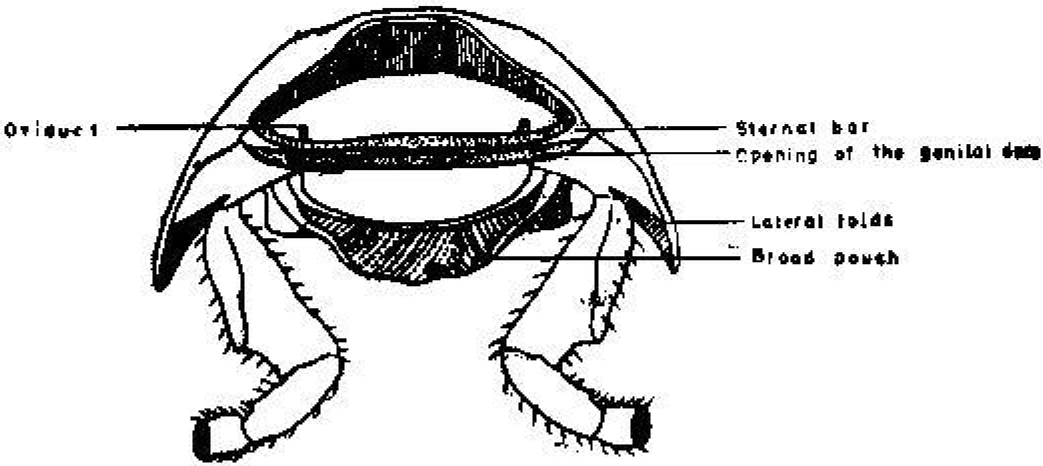


FIG. 8 FIFTH THORACIC SEGMENT OF FEMALE SHOWING GENITAL DUCTS AND OPENING (ANTERIOR)

In the female, the genital ducts open laterally on the sternum of the fifth segment (Fig. 8), In males these ducts open through a pair of penes on the sternum of the seventh segment (Fig. 9). In mature

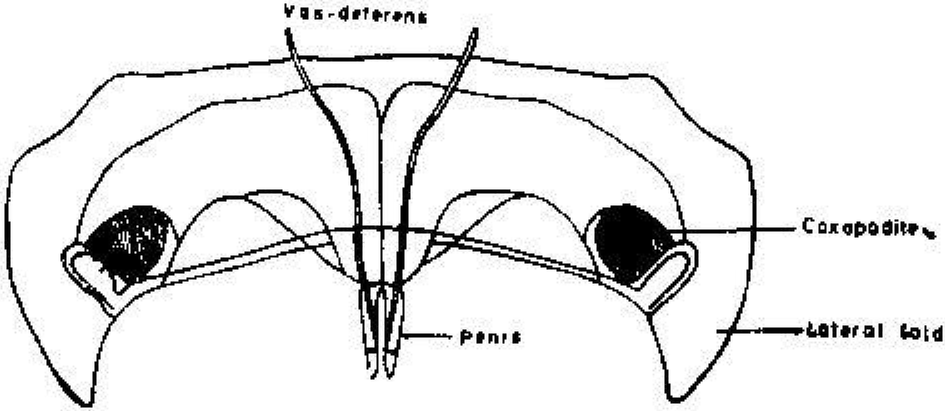


FIG 9 SEVENTH THORACIC SEGMENT OF MALE WITH GENITAL DUCTS AND PENES (VENTRAL)

females the ventral surface of the first five free thoracic segments is covered by strongly convex converings of large, thin, semi-transparent under-lapping lobes arising from the mesal margins of the coxae on each side. These lobes, which are known as oostegites, form deep protective pouches (Fig. 8 & 10)

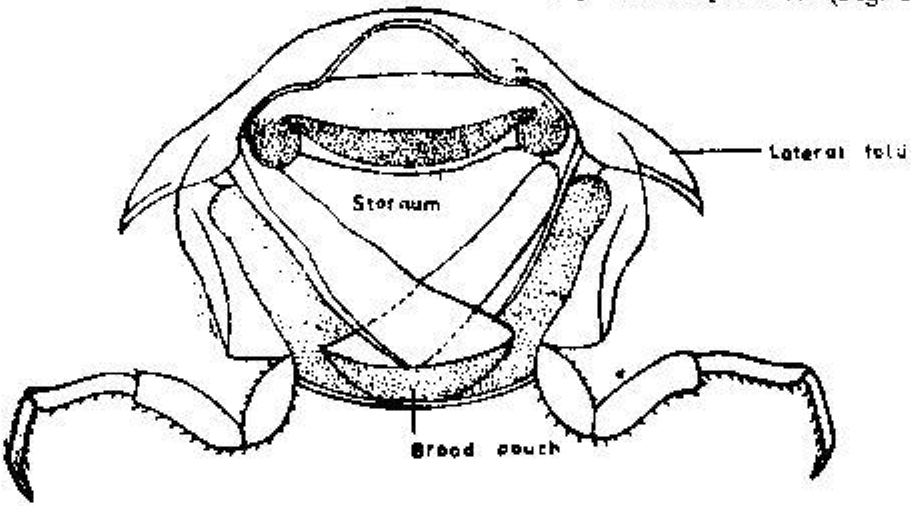
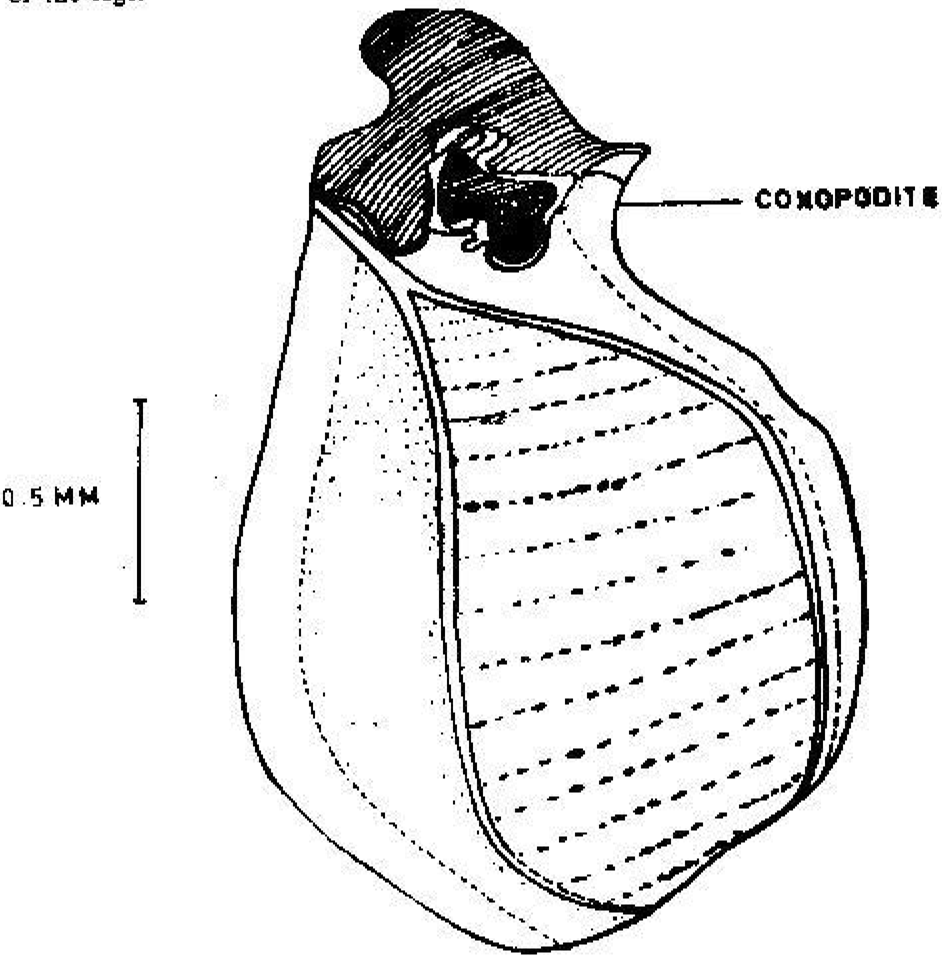


FIG. 10 SECOND THORACIC SEGMENT OF FEMALE (POSTERIOR)

under the body in which the eggs and the young ones are carried. The oostegites underlap each other from behind forward and those on the right underlap those on the left. The first and the last pairs are shorter and narrower then the others and lie more transversely so as to close the two ends of bag-like brood pouch. The second, third and fourth pairs of oostegites (Fig 11) are larger and broader each strengthened by a rib in the anterior part and a thickened posterior margin. They are supported by the long basipodites of the legs.



G. 11 LEFT COXOPODITE AND OOSTEGITE OF FOURTH THORACIC SEGMENT OF FEMALE (VENTRAL)

The Legs: (*Fig.* 12: *A* & *B*).

Each of the first to the seventh free thoracic segments has a pair of walking legs. Each leg consists of a series of six podomeres, which startingfrom the proximal to the distal ends are the basipodite, the ischiopodite, the meropodite the carpopodite, the propodite and the hooked dactylopodite. The pedomeres articulate with one another by means of hinge-joints. The basal segment, the basipodite of each leg is long and is suspended from beneath the tergal fold. The proximal joint (coxopodite) is reduced to a

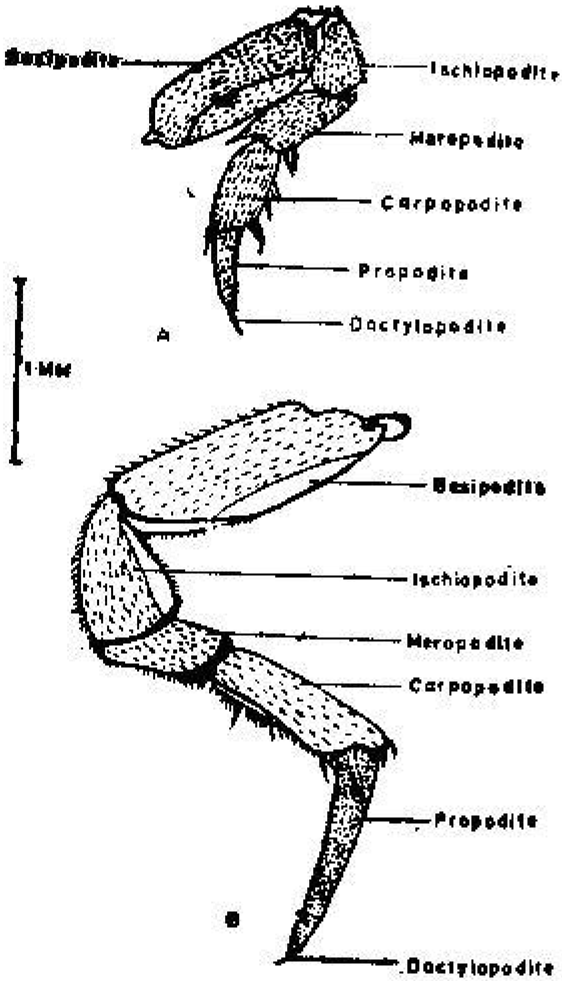


FIG 12 A FIRST LEG B SEVENTH LEG

narrow ring completely fused to the base of the tergal fold. It, however, bears a condyle on which the basipodite is articulated.

The ischiopodite is a small segment roughly triangular in shape and provides articulation with the basipodite proximally and with meropodite distally. The meropodite is a small segment rectangular in shape and distally articulates with the carpopodite. The carpopodite is comparatively longer and bears several well-marked spines on the ventral and posterior aspects. The propodite is a long, slender segment which articulates proximally with carpopodite and distally ends in a terminal hooked podomere, the dactylopodite.

All these segments are richly furnished with setae.

The Abdomen (Figs. 13 & 14).

The abdomen of *M. pruinosus* becomes abruptly narrower than the thorax and like the thorax is convex dorsally and compressed laterally. This region is made up of six segments and a terminal flat conical piece, the telson. The segments are movable upon one another telescopically. The abdomen (Fig. 13) is nearly oval in outline with the larger end towards the anterior side. The first five tergal plates resemble the thoracic terga.

The major portion of the first abdominal segment is covered dorsally by the tergum of the last thoracic segment. The remaining segments except the sixth gradually decrease in size antero-posteriorly. The terga of the third, fourth and fifth segments are produced into conical lateral folds which are more distinct as compared to the lateral folds of the first two preceding segments.

The sixth tergum is a quadrate plate which is produced into an obtuse angle forming the apical piece, the telson between the bases of the uropods.

The ventral surface of the abdomen is covered by two rows of large, flat pleopods. The true ventral wall of the abdomen can be seen only after removing the pleopods. Each segment is mostly membranous except for the anteriorly demarcated marginal sternal bar. The outer ends of this bar curve posteriorly and then mesally around the bases of the pleopods and enclose

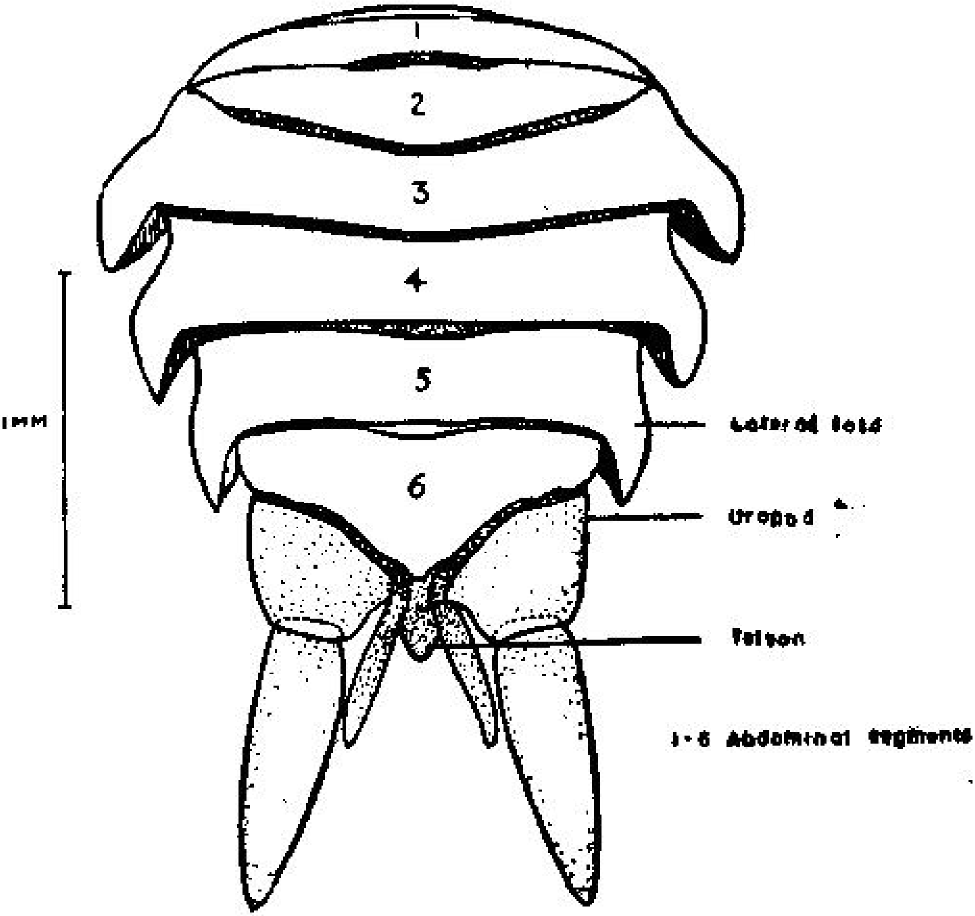


FIG. 13 ABDOMEN DORSAL VIEW

foramina from which the pleopods arise. The sternum of the sixth segment is a broad plate between the lateral lobes of the tergum and the appendages of this segment, the uropods project posteriorly from it.

The telson is represented by a short conical lobe projecting in between the two uropods and encloses the anus on the underside.

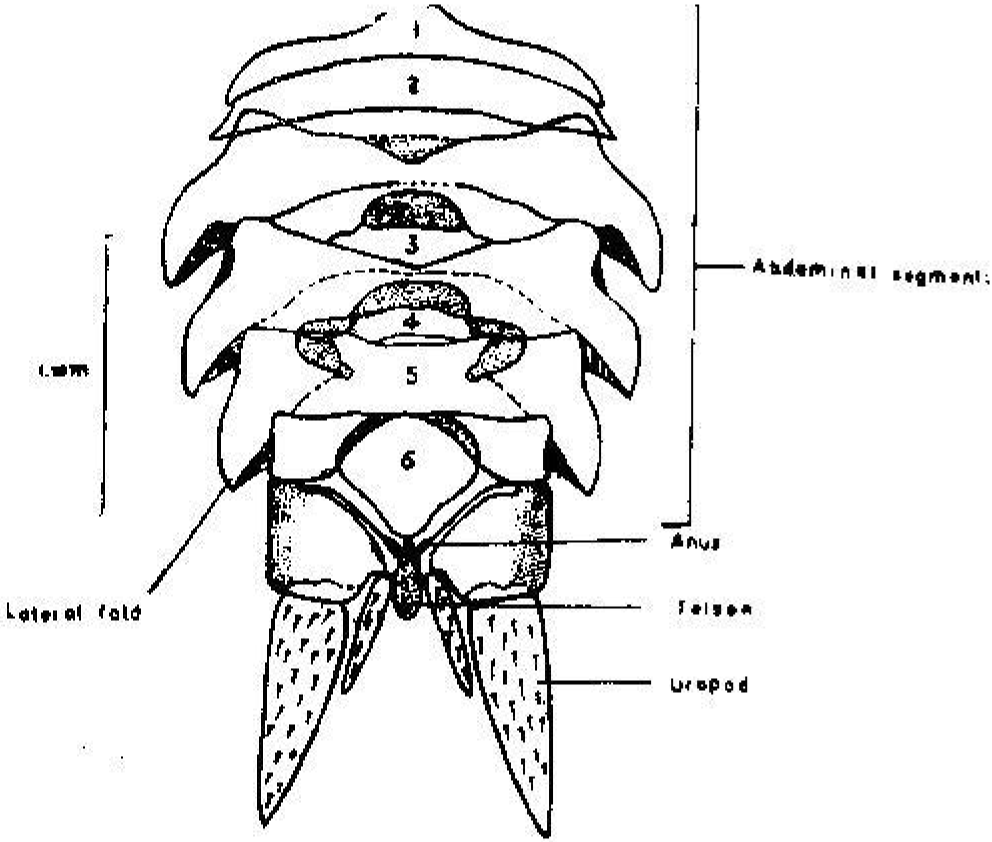


FIG. 14 ABDOMEN VENTRAL VIEW (PLEOPODS REMOVED)

The Appendages

(i) *The Pleopods* (*Figs. 15 and* 16).

The first five abdominal segments bear each a pair of laterally located pleopods, the exopodites of which underlap each other from before backward like a double series of scales. The exopodites are large,, soft, flat lobes which enclose above them a branchial chamber beneath the lower surface of the abdomen. The pleopods arise anteriorly from the ventral surface of their respective segments and all but first have long transverse connections with the body, extending from the median sternal processes to the bases of the lateral tergal lobes.

The first pair of pleopods differ from the following appendages but they are alike in the two sexes. Each has a thick transversely elongate basal part, the protopodite (Fig. 15) which laterally bears a small epipodite (Fig. 16) and a large flat lobe the exopodite (Fig. 15) arising from its ventral surface. The ventral surface and the outer end of the protopodite is traversed by a deep cleft, the inner end of which turns forward within the protopodite. The second pleopods differ in the two sexes. In the male each appendage has a large, flat exopodite like that of the first pleopods and also an epipodite. In addition a long sclerotic two-segmented elbowed endopodite arises from the protopodite which presumably has some copulatory

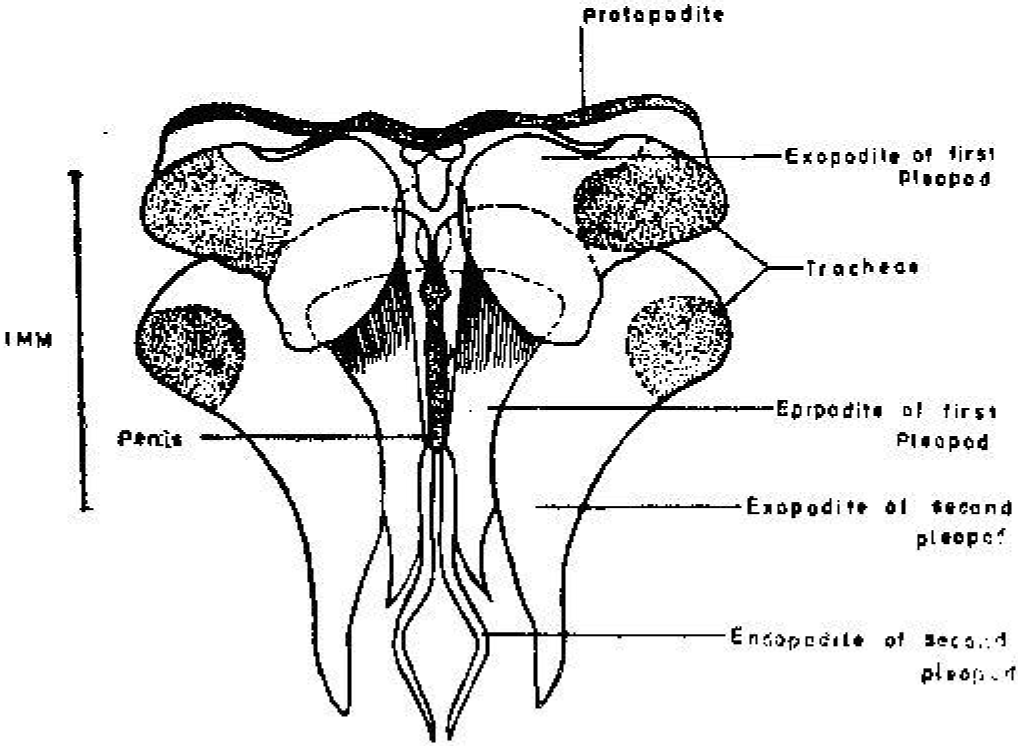


FIG 15 FIRST AND SECOND PLEOPODS AND PENIS OF MALE SHOWING RESPIRATORY ORGANS (TRACHEAE) IN EXOPODITES

function. In female the corresponding pleopod is much simpler and bears in the position of the male endopodite a small dorsal gill lobe which is usually regarded as the endopodite of the appendage. The remaining three pairs of pleopods (Fig. 16) are again alike in both sexes and resemble the second pleopod of the female except that the gill lobe is much larger and there is no epipodite present on the protopodite.

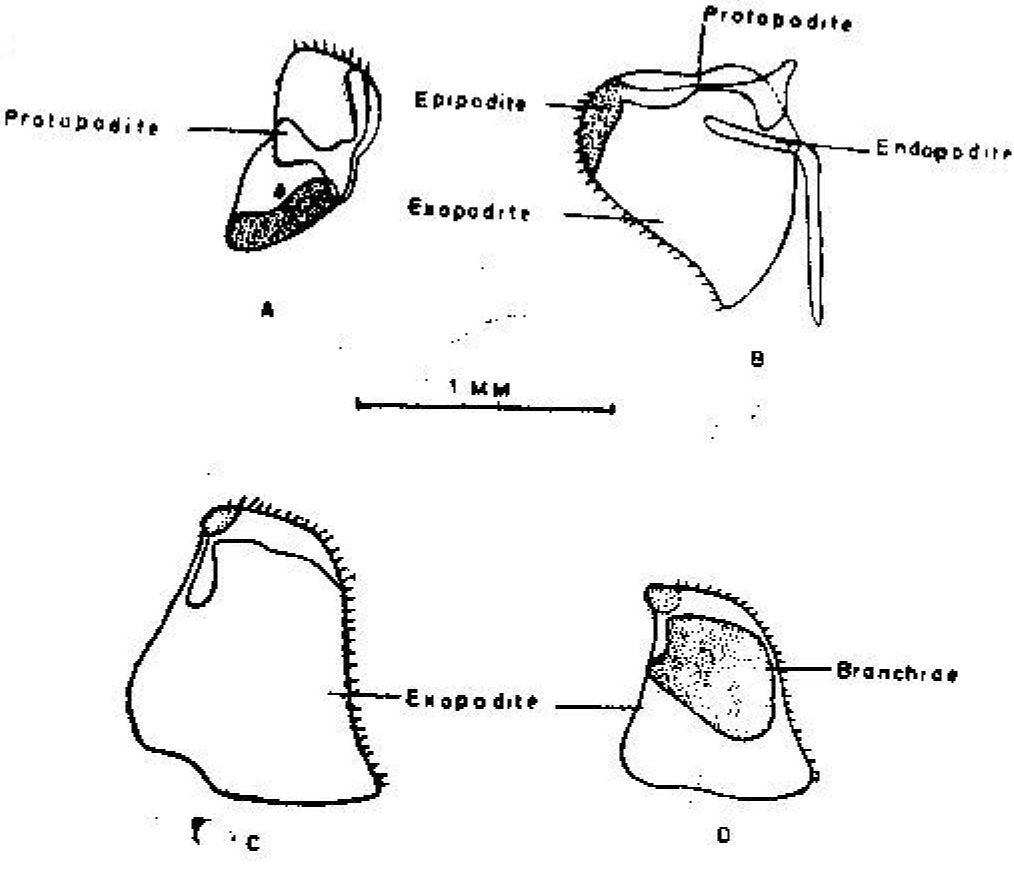


FIG 16 PLEOPODS A FIRST (MALE) B SECOND (MALE) C SECOND (FEMALE) D. FIFTH (MALE)

(2) *The Uropods.* (*Fig 17*).

The uropods of *M. pruinosus* are simple, biramous appendages each consisting of a large basal segment, the protopodite carrying unjointed expodite and endopodite. The expodite is elongate and conical whereas the endopodite is slender and shorter. Both are profusely furnished with setae.

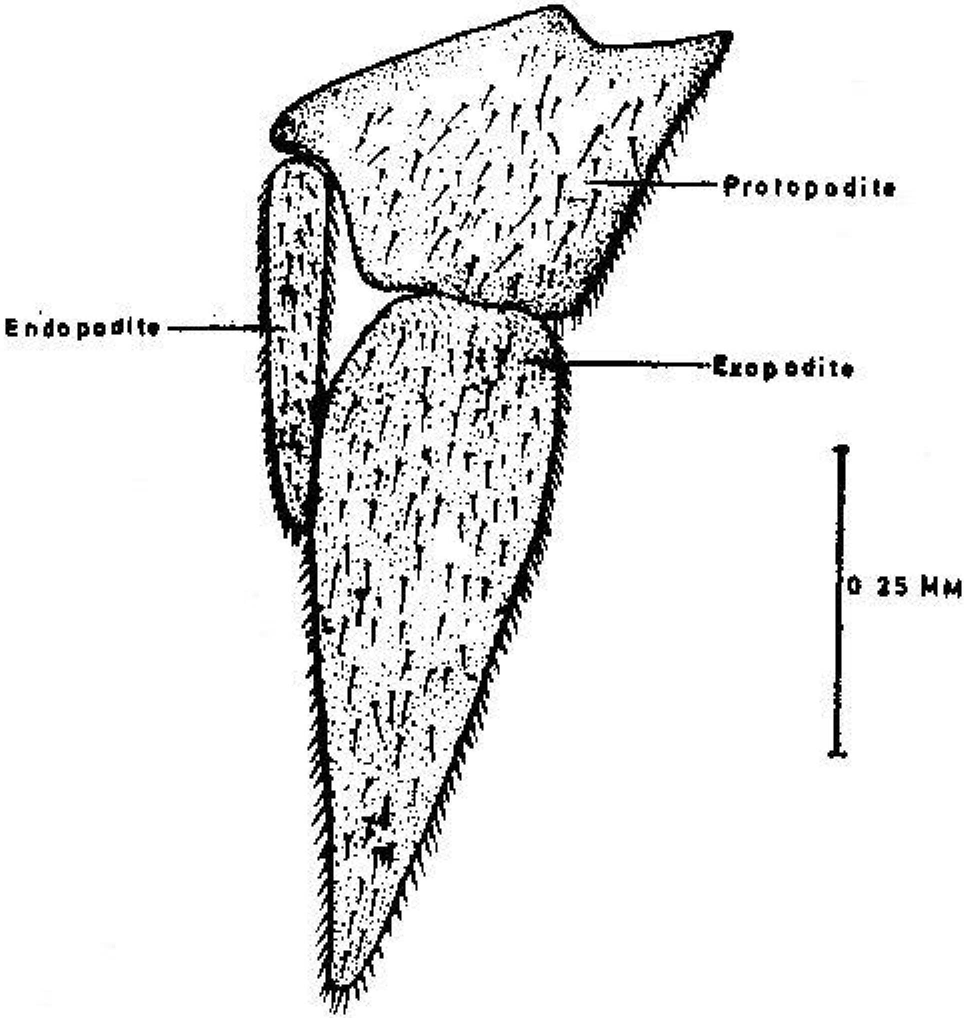


FIG 17 UROPOD (RIGHT)

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