ON A COLLECTION OF FRESHWATER CRUSTACEA FROM THE TRANSVAAL.

By PAUL A. METHUEN, New College, Oxford.

[*From the* Proceedings of the Zoological Society of London, 1910.]

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On a Collection of Freshwater Crustacea from the Transvaal.

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(Plates VIII.–XVIII.†; Text-figures 11 & 12.)

Introduction.

In the beginning of August 1908, I had the opportunity of visiting the lake district of the Transvaal while out in that country during the Oxford summer vacation. The lakes or pans visited lie in the Carolina district due east of Pretoria near the borders of Swaziland. My object was to study and make as complete a collection of the Crustacean fauna as I could in the time at my disposal. I made Chrissie my headquarters.

Though not the highest point of the veldt, Lake Chrissie is some 6000 feet above the sea-level, and is situated in a slight hollow in the hills; in fact the word "pan" applied to these pieces of water ideally expresses their chief feature, in that they resemble shallow basins to be found in certain parts of the undulating stretches of the veldt. The Ecca sandstone of the Karroo formation characterises the geology of this district. At the time I was there all the pans were very empty, some of them had completely dried up.

It was cold most of the time, especially during the nights.

Lake Chrissie is about twelve miles in circumference; on the north side the lake is shallow and tends to deepen very gradually towards the centre, where it was found to be five or six feet deep; approaching the southern margin, the tendency is to deepen another foot or two and then to shallow rather rapidly. Though there are no reeds, various weeds grow plentifully in the shallows, especially in the northern parts. Many species of wild-fowl frequent the western end of the lake where it has of late years considerably receded, leaving mud flats behind. Most conspicuous among the birds was the flamingo, whose contrasting colours of black and crimson when on the wing were most striking towards sunset. The bottom of the lake is composed of fine mud. The water was very discoloured, owing to a great extent, I presume, to the activity of the large number of birds on it, and savoured strongly of wild-fowl.

It was in the shallow littoral water that I found the Entomostraca described in this paper, the Ostracoda on the muddy bottoms, the Cladocera and Copepoda a little farther out among the weeds. A small species of Barbel (*Barbus anoplus* Max

* Communicated by Prof. G. C. BOURNE, D.Sc., F.Z.S.

† For explanation of the Plates see pp. 165 & 166.

Weber)* used to come into my tow-net, when dredging through the weeds; this was the only fish I came across, and I was told that no other existed there. I might also add, that an effort had been made to introduce a large species of Barbel but without success.

Besides Lake Chrissie there are about a dozen other pans, none however approaching that lake in size. The larger pans are as a rule without reeds; the smaller ones may be completely overgrown. In the case of the former, the bottom may be composed of sandstone with little or no mud present; in the latter case, fine mud is always present, very often of some depth. Very few pans were at the time dry, but all of them, during certain seasons after droughts, dry up completely; most of them depend for their supply of water on rain-fall; others like Lake Chrissie are furthermore fed by small spruits. Generally speaking the water is somewhat brackish.

As to local distribution, I found most species of Entomostraca in Lake Chrissie; but this result may be merely due to the fact that since I had not the time to dredge all the pans very thoroughly, I thought it best to pay most attention to Lake Chrissie and to visit others but once or twice.

A feature of interest among this entomostracan fauna is, that out of the six species of Cypridæ here described, in five males and females were found in about the same proportion. No doubt this interesting fact is correlated with the frequent drying up of the pans, thus agreeing with the Cypridæ of South-West Africa as noticed by Vávra (11), and differing from their European freshwater representatives in which males occur so rarely that some species are known only by descriptions of females †.

The species collected throw some not altogether uninteresting light on recent theories of distribution, and tend to confirm these theories. This paper will, I think, have added some evidence in favour of those who contend that South Australian, Tasmanian, New Zealand, and South American forms have been independently derived, perhaps through some Antarctic continent, from those now found inhabiting South Africa; I refer especially to a paper recently read by Mr. G. W. Smith (10). In this paper it is suggested that such forms as the freshwater Gammarids and Isopods or the genus *Lepidurus*, being essentially Crustacea preferring a temperate or cold climate, found their way to South America, and the Bassian subregion of Australia (Prof. Baldwin Spencer), by spreading along the Andes and thence to Australia by some lost Antarctic continental connection. Now no forms, typical of these said regions, have as yet been described from South Africa; no freshwater Gammarids or Isopods are known to

* I am indebted to Mr. G. A. Boulenger, F.R.S., for the identification of this fish.

† R. Moniez (5) first alluded to male Ostracods in Algeria appearing regularly amongst those forms which in Europe propagate their species parthenogenetically.

occur; in the family Apodidæ, *Apus* alone is represented; among the Copepods we find rather a striking fauna: *Boeckella* is absent, and we find instead several genera some of which appear to be peculiar to South Africa; Crayfishes are absent from the spruits and rivers, the chief occupants appearing to be the river crabs and prawns. Of further interest is the great resemblance some of the forms found in the Transvaal bear to their European representatives; in all cases where possible, their points of resemblance to particular European forms have been mentioned; it is also interesting that *Daphnia pulex*, which was found in a dam near Pretoria, is in nearly every detail similar to the *Daphnia pulex* of European waters (*vide* Pl. XV. fig. 40).

But to return for a moment to the Copepods. Including the *Metadiaptomus* of this paper, in all, four genera peculiar to South Africa have been determined. Of these the dominant genus *Broteas* (=*Lovénula*) appears to be the most widely distributed. Moreover, several species of *Diaptomus* have been described from South Africa, notably by Mrázek (6) from German West Africa. The genus *Metadiaptomus* resembles *Adiaptomus*, described by A. W. Cooper (2), in that the antennule possesses twenty-six segments instead of twenty-five as in *Diaptomus*; but a glance at Pl. XVI. fig. 46 *a*, and Pl. XVIII. fig. 55, will show two further peculiarities: (1) in that the antennal region of the thorax appears to be distinctly divided from the rest of the body; and (2) in the marked difference in the structure of the modified sixth pair of thoracic appendages from that of *Diaptomus*, especially in the male (*vide* text-fig. 11 *b*, p. 162).

Summing up the question of distribution here discussed, it might be said briefly: (1) that the Entomostraca here described show no relation whatever to Crustacea from the Bassian Region of Australia: (2) that they do show a certain approach, in some cases a marked resemblance, to European forms; (3) that, further, they have been evolved to a certain extent along lines of their own, showing considerable modifications which are not paralleled elsewhere.

In conclusion I take this as an opportunity of expressing my gratitude to Dr. Gunning, of the Transvaal Museum, for his kind assistance and advice; and to Mr. G. W. Smith, who just before I left England suggested Lake Chrissie as likely to yield some interesting results, for the help and encouragement he has given me in preparing the following descriptions; and I feel, if there is anything in this paper of interest or value, it is due to his suggestions.

Order OSTRACODA.

Family CYPRIDÆ.

The classification of G. W. Müller (7) has been adopted for assigning to the Ostracods here described their systematic position. They are all five undoubtedly Cyprids having eight-segmented antennules which are provided with long and slender

hairs. However, it has not been without some hesitation that they have all been placed in the genus *Cypris*. Müller gives as characteristic for this genus, that the third biting process of the maxillula has two claw-like bristles distinct from the others which may or may not be toothed (p. 51). This is so in the cases of *Cypris gunningi*, *C. chrissiensis*, and *C. mastigophora* and possibly of *C. tuberculata*; but although the maxillula of *C. spinosa* possesses these toothed bristles, it has, in addition, two small ones of similar character. It was not considered expedient to create another genus for this species on that character and others mentioned below, nor yet a new sub-genus, so it has been placed temporarily in the genus *Cypris*.

As to the common relationship of these five species, it will be seen that whereas *C. gunningi* and *C. chrissiensis* are closely connected one with the other, *C. spinosa* and *C. tuberculata* are aberrant, chiefly in the characters of the shell and of the maxillula. *C. mastigophora* undoubtedly conforms in many particulars to the subgenus *Cypridopsis*.

Besides the new species, *Cypris venusta* (Vávra, *loc. cit.*) was found fairly plentifully in Lake Chrissie; the most notable feature of this Cyprid is the presence of peculiar marginal denticulations on the shell.

Genus Cypris O. F. Müller.

Cypris spinosa, sp. n. (Plates VIII., IX. & X. figs. 9–12.)

Length 3·3 mm.; breadth 2·52 mm.; height 2·05 mm.

External appearance: from the dorsal aspect, the shape of the body is roughly quadrilateral, the ventral margins of the shell being expanded horizontally into wings. From the dorsal posterior region of each shell spring two long stout spines directed backwards. The anterior dorsal border of each valve is furnished with eight small spines; between the fourth and last spines are regular groups of bristles. The lateral expanded wings of the valves are much flattened and are produced along their posterior border into four or five spine-like processes; on the rounded surface of each shell there are two small prominences present.

The general colour is mottled umber; specimens found in Lake Chrissie were greenish.

Appendages.—The eight-jointed antennule resembles that of a typical *Cypris*.

The antenna consists of four joints: the second joint is furnished with five long swimming-hairs which reach to the end of the claws; the claws are longer than the terminal segments; just behind the claws are found three fine bristles. The second joint is provided dorsally and ventrally with rows of small fine hairs which vary somewhat in size and arrangement.

The mandible resembles very closely that of *Eurycypris pubera* as described by Claus (1).

The maxillula consists of a branchial appendage, a palp, and three biting processes. The branchial plate is provided with twenty-eight plumose rays. The palp is two-jointed; the distal joint bears five smooth bristles, and the proximal joint one short and six long bristles, also smooth. The third biting process carries terminally two simple bristles and two large and two smaller foliaceous setæ; subterminally there are three plumose bristles and a short smooth one. The second biting process carries terminally nine bristles, some simple, some plumose, and two foliaceous setæ. The first biting process is provided with seven bristles, some of which are simple, the others plumose, and in addition three foliaceous setæ.

The maxilla is precisely similar to that of *Eurycypris pubera* figured by Claus except for the presence of an inconspicuous group of hairs midway between the endopodite and the biting process. The clasping organ attached to this appendage in the male consists of a straight proximal and a curved terminal segment; on the inner side and situated at the distal base of the former piece are two spines, one considerably larger than the other, and the terminal segment ends in a sharp spine. The structure of this clasping organ is different on each side; on one side the proximal joint is shorter, and the distal joint which is sharply recurved is slenderer than is the case in the opposed portion. On the other side the distal joint is stout and sharply recurved.

The fourth post-oral limb resembles that of the subgenus *Eurycypris* in having the second and third segments fused, the internal border of the first joint bearing groups of short bristles which appear to spring from peculiar chitinous thickenings. The terminal serrated claw is somewhat longer than the fused second and third joints, and at its base springs a short serrated spine with a V-shaped base.

The fifth post-oral limb, the cleaning-foot, closely resembles that of *Eurycypris pubera*.

The caudal rami are a pair of slender, slightly curved rods, each carrying terminally a serrated seta which is twice as long as the outer seta inserted just proximal to its base; this latter is also serrated. They resemble closely those of *Eurycypris pubera*.

The copulatory organ of the male resembles in general shape that of *Cyprinotus incongruens* described by Müller. The outer branch of the outer process is foot-shaped, the inner branch being in the form of a curved spine; the outer border has a large projection to receive the coils of the vas deferens.

Locality. I obtained a great number of specimens in the littoral water of a small reed-pan near Chrissie and found two or three specimens in Lake Chrissie itself.

Remarks.—This species is remarkable in the peculiar shape of the shell and especially in the presence of the remarkable spinous processes which have been described.

The large size of this species is also to be noted. The

appendages agree closely with the genus *Cypris* and especially with the subgenus *Eurycypris*; from this subgenus it differs in certain characters, the most important of which is the presence of a greater number of foliaceous setæ on the biting processes of the maxilla. *C. puberoides* as described by Vávra (*loc. cit.*) from German South-West Africa, is not unlike this species, chiefly in the character of the flattened shell, the penis and copulatory styles of the maxilla, and in the character of the antenna, which carries five claws.

CYPRIS GUNNINGI, sp. n. (Pl. X. fig. 13; Pl. XI. figs. 14 *a*, *b*, 15 *a–c*, 17; Pl. XII.; Pl. XIII. figs. 23 *a*, *b*; Pl. XV. fig. 36.)

Length 1·30 mm.; height, greatest ·74 mm., at centre ·68 mm.

External appearance: a lateral view of this animal shows it to be considerably longer than deep, the ratio of the length to the depth being as 2 : 1. The whole surface of the bivalve shell is covered with hairs of moderate length; they are longest on the ventral marginal edge, becoming shorter near and disappearing on the hinge-line; on the ventral inner margin of the shell, denticulations are present, which become very minute as they approach the dorsal hinge-line; these denticulations do not project beyond the outer margin of the shell.

Appendages.—The antennule is typical of the genus *Cypris*.

The antenna has the terminal segment considerably thinner than in the foregoing species and the number and length of the setæ and hairs differ slightly; but two important distinctions are found on the second segment: (1) the swimming-hairs project considerably beyond the claws, a characteristic of the subgenus *Cypridopsis*; (2) a row of movable (?) denticulations is developed on that part of the distal marginal edge of the second segment which is opposed to the proximal portion of the third joint (Pl. XI. fig. 14 *b*). The exact function of these tooth-like processes is not perhaps at once clear; but it may be, that being so placed in conjunction with the distal segment they serve the purpose of locking the second and third segments together in a straight line, thus strengthening the whole appendage for swimming. It is to be noticed that when the appendage is flexed at this point, the denticulations are flexed also. When, however, the third joint is flexed back into a straight line with the second, these processes would be brought up into the same straight line and so form a strong support to the two segments or actually lock them together.

The mandible is stouter than in *C. spinosa*; the two stout hairs on the inner part of the gnathobase are much shorter. The palp differs slightly in that the setæ on the terminal segment are not serrated, the stout plumose setæ on the fourth segment are much shorter, and the palp futhermore differs from that of *C. spinosa* in the number and character of the setæ on the inner margin of the first and second segments.

The maxillula: the forward-directed palp bears six fairly long bristles, two of which are plumose and one short. The distal joint bears three large and three small bristles, besides a number of hairs set close behind the base of the bristles, and one stout hair on the inner margin. The third biting process is peculiar. Besides the normal foliaceous setæ and bristles characteristic of the genus, the process is provided with a short seta which is armed with a number of hairs springing from its distal extremity and set at right angles to this seta: close but external to this structure is another seta considerably larger and thicker whence spring several short bristles. The other two biting processes, which are without the foliaceous structures found in *C. spinosa*, bear a number of stout smooth bristles.

The maxilla: the exopodite has fourteen plumose hairs as against thirteen present in *C. spinosa*; the plumose median seta of the endopodite is very long. The male accessory copulatory processes are, on the whole, stout; the distal joint of each differs considerably, one being slender, the other pear-shaped.

The fourth post-oral appendage: the third segment distinctly consists of two pieces; two rows of minute bristles border the distal margin of the fourth and fifth segments; the arrangement of the terminal setæ of the fourth segment differs from that found in *C. spinosa*.

The fifth post-oral appendage: the median seta of the third segment is longer than in *C. spinosa*; otherwise similar.

The caudal furca: the rami are generally stouter than in *C. spinosa*; distally a double row of serrations are borne along half their lengths; the two large distal processes on each ramus are relatively stout and short.

Locality. Found abundantly in littoral water of Lake Chrissie.

Cypris chrissiensis, sp. n. (Pl. XI. fig. 16; Pl. XIV. figs. 34, 35; Pl. XV. fig. 37.)

Length ·73 mm.; height ·44 mm. External appearance: in proportion to its depth this species is not so long as *C. gunningi*, the ratio of length to depth being as 1·7 : 1; correlated with this comparative decrease in length or increase in depth are two factors, namely, that the convexity of the dorsal surface of the body and a concavity in the ventral margins of the shell are more evident. In nearly all other respects this species resembles *C. gunningi*. It also bears a great resemblance to *Cyprinotus congener* (Vávra, *loc. cit.*), especially in the character of the accessory copulatory processes of the maxillæ. The general shape of the body and of the gnathobase of the mandible, and the structure of the accessory maxillary copulatory organs, are sufficient evidence that this is not a young form of *C. gunningi*; further, more than one female was found with ripe ova and introduced spermatophores, which leaves no doubt on the subject.

Appendages.—All the appendages are similar to those of *C. chrissiensis* except the following:—

The mandible, which is somewhat slimmer.

The fifth post-oral appendage: the terminal bristle is as long as the third segment. The median seta of the third segment and terminal seta of the second segment are short as in *C. mastigophora.*

The maxillary accessory copulatory structures are longer and thinner than in *C. gunningi.* The basal joint of one is very thick and stout, but of the other thin and long.

CYPRIS MASTIGOPHORA, sp. n. (Pl. XI. fig. 18; Pl. XIV. figs. 31, 32; Pl. XV. fig. 38.)

Length ·52 mm.; height ·25 mm. External appearance: viewed from the side the ratio of the length to the depth is roughly as 2 : 1. The hind-end tapers considerably; the fore-part ends bluntly. Fairly long hairs cover the surface and margins of the shell; denticulations are absent.

Appendages.—The antennule is typical of the genus *Cypris.*

The antenna: the swimming hairs extend beyond the claws.

The mandible: the disposition and number of setæ and bristles on the palp are different from such as are found in the foregoing species. The terminal joint bears two large stout bristles and one small seta; the third segment is furnished with one large plumose bristle, and four setæ, three plumose, on the inner margin; on the external surface one short and three long setæ, and a group of hairs just behind these structures. The third segment of the palp bears on the external margin two long smooth setæ, and on the internal margin five stout pectinose bristles. The second segment is provided on the internal surface with three thick bristles, two of which are pectinose.

The maxillula: the terminal bristles of the palp are stouter than in *C. gunningi.* On the third biting process, in addition to the two foliaceous bristles, a number of fine setæ are developed below the extremity. Foliaceous bristles on the other biting processes are absent.

The maxilla does not differ from *C. gunningi.*

The fourth post-oral appendage: the third segment consists of two pieces; the appendage is practically similar to that of *C. gunningi*, except for the presence of additional setæ at the terminal end of the fifth segment and in the arrangement of some minute hairs about the second segment.

The fifth post-oral appendage: the median seta on the third and the end seta on the second segment are much shorter than in *C. spinosa*; otherwise similar in structure.

The caudal furca differs from that of any of the other Cypridæ described here in that the rami consist of long thin whip-like processes with one short seta at the base, a character peculiar to the subgenus *Cypridopsis.*

Remarks.—This species was comparatively rare; unfortunately

no males were taken. It was found with the other Cypridæ in Lake Chrissie in the shallow marginal parts of the lake.

CYPRIS TUBERCULATA, sp. n. (Pl. XIII. figs. 24–28, & Pl. XIV. figs. 29, 30, 33.)

Length 1·9 mm. Height, anterior portion 1·65 mm., central 1·50 mm., and posterior 1·53 mm. External appearance: the shell has rather an exceptional appearance. It is covered with tubercles and short spines; the arrangement of these processes in no way resembles that found in *C. spinosa*; moreover, those parts not bearing tubercles or spines have everywhere small indentations, giving the appearance of beaten copper. The fore-part of the shell bears a few hairs irregularly arranged. The marginal edge is provided with hairs along most of its length. From the side, the outline of the shell is seen to have a slight anterior prolongation.

Appendages.—The antennule is typical of the family Cypridæ.

The antenna: the swimming-hairs do not extend beyond the bristles of the distal segment. The arrangement of the minute hairs on the second and third joints resembles that found in *C. spinosa*, but differs chiefly in the absence of hairs just behind the basal attachment of the swimming process on the second joint. Denticulations, as in *C. gunningi*, found on third joint. Distally only three curved serrated setæ are present.

The mandibles: an external serrated seta is present on the gnathobase; a comb-like structure is found on one of the external biting lobes of the same. The palp is provided with a very strong plumose bristle which is conspicuously larger than any of the other bristles and seta which it has in addition; the structure as a whole bears most resemblance to that of *C. gunningi*.

The maxillula from the point of view of classification is of most importance, in that no foliaceous hairs are present on the biting processes, although the two large bristles characteristic of the genus are present. The first biting process is provided roughly with a dozen and a half bristles, all smooth save two which are longer than the rest and serrated; at the basal extremity on the inner surface of this process arise two hairy bristles. The second biting process does not differ much from the first; but the long serrated bristles of the first are in this case absent. The third biting process is remarkable in possessing no foliaceous setæ. The two stout bristles shown in fig. 27 represent the foliaceous setæ found in the genus *Cypris*, the small grooves noticeable on these structures possibly indicating the remains of the reduced "pinnæ." This same character is also found in *C. virens* described and figured by Claus (1), but in this case the bristles are smooth. The palp resembles that of *C. gunningi*, the only difference between the two being that the short hair on the first segment is replaced by a longish one.

The maxilla: the exopodite is furnished with fifteen stout

bristles; the first two bristles, which are short and thick, bear distally a number of small setæ; the third is large and hairy; the fourth and fifth are smooth; the sixth is short and serrated. Small hairs are found to cover the ventral surface and other parts of the appendage (Pl. XIII. fig. 28).

The fourth post-oral appendage: the third and fourth segments are distinct: the arrangement of bristles and hairs resembles that of *C. gunningi*.

The fifth post-oral appendage: the bristle and curved seta of the distal segment are comparatively long.

Each ramus of the caudal furca bears along nearly the whole of its inner edge a row of setæ and distally the four characteristic bristles.

Remarks.—This species was found not uncommonly, together with the other Ostracods described, in the shallow littoral water of Lake Chrissie.

Order CLADOCERA.

Family LYNCEIDÆ.

Genus LEYDIGIA Kurz.

LEYDIGIA TRISPINOSA, sp. n. (Pl. XVI. fig. 43.)

Length 1·27 mm.; height ·735 mm. This species resembles, in the general shape of the body and character of the telson, *Leydigia acanthocercoides* described by Lilljeborg (3) and figured on pl. lxxi. fig. 4. The head is small.

The posterior part of the carapace has the appearance of having been "pulled out" in a ventro-posterior direction; its ventral margin is provided with a row of stout hairs. The two large terminal spines of the telson are serrated; each bears at its base one small spine and a group of small hairs; anterior to these are eight pairs of fairly large stout spines; at the base of each arise two small ones of which the most internal is the smaller; the arrangement is therefore characteristically triple; in front of these spines, again, lie eight pairs of small spurs each with its group of setæ placed in an anterior position; slightly external to these, a row of fine setæ, which runs nearly the whole length of the body, is noticeable.

Locality. Shallow littoral water of Lake Chrissie.

Genus CHYDORUS Leach.

CHYDORUS CAROLINÆ, sp. n. (Pl. XVI. figs. 44 *a*, *b*.)

Length ·47 mm.; height ·37 mm. Body rotund; posterior angle distinct, without spine or process; the ventral margin of the shell has a fringe of spines; the rostrum, which is long and pointed, projects considerably beyond the end of both pairs of antennæ; no striations visible on the carapace; the arrangement of bristles on the telson is somewhat unusual.

Found in same locality as preceding species.

Family DAPHNIIDÆ.

Genus SIMOCEPHALUS Schœdler.

SIMOCEPHALUS CORNIGER, sp. n. (Pl. XV. fig. 41 & Pl. XVI. fig. 42.)

Length 2·34 mm.; height 1·76 mm. Body sub-ovate; head region defined from thorax by a dorsal notch; the shape of the body resembles that of *S. vetulus* described by Lilljeborg (*loc. cit.*) and figured on pl. xxiv. fig. 8; the ventral margin of the carapace is provided with a row of minute spines reaching backwards from near the head along a considerable portion of its length; through three quarters of this length but slightly internal to the row of spines, lies a line of closely-set stiff hairs; posterior to these structures, the carapace is furnished with a single row of short stout spines which reach almost as far as the posterior limit of the ventral margin of the body; they are smallest at the posterior region of the carapace. Nearly the whole surface of the body is covered with minute prickles. The carapace is striated (only a portion is shown striated in fig. 41).

The two large claws of the telson are serrated, and at the base of each lies a group of small setæ. Of the other spines the largest are curiously bent; each carries a group of setæ; further, groups of minute hairs, generally five or six to each group, are produced on the inner part of the telson; their limits are best realized on reference to fig. 42.

Locality. This species was found in Lake Chrissie, but occurs more abundantly in a little reed-pan three miles east of Chrissie.

Genus DAPHNIA O. F. Müller.

DAPHNIA PULEX. (Pl. XV. figs. 40 *a–c*.)

A few adult forms were found in Lake Chrissie, and a quantity of young in a dam near Erasmus' Farm, Pretoria. As already mentioned this *Daphnia* appears to be similar to the European form. There is one point in which it differs from *D. pulex*, but it is so insignificant, that it was not thought desirable to give this species specific distinction from *D. pulex*. The point is, that caudal styles and dorsal processes just in front, which project into the brood-chamber, are quite smooth. This South African form was not found to differ from the European representative in any other detail.

DAPHNIA GIBBA, sp. n. (Pl. XV. figs. 39 *a*, *b*.)

Length with tail 6 mm. Body rotund, but dorsal part of head and neck region enlarged to form a hump. Carapace striated. Tail, which is fairly long, covered with small spines which run a short way up the carapace and also ventrally extend along the margins of the carapace as far as the head.

The distal claws of the telson are pectinate, and are provided with small setæ. The pectinate processes are divided into three lots, each arranged in a semi-lunar form (*vide* fig. 39 *b*). Anterior to these claws, the telson is fringed by a number of stout bristles; internal to this fringe, along half its length, groups of minute setæ are found. On following the course of this fringe of bristles, it is found that they end gradually, passing internally into three or four rows. Still further, a number of minute setæ are found arranged in parallel tiers which run at right angles to the sagittal plane of the telson.

The caudal styles are partly plumose; the dorsal part of the telson extending from these styles, so as to include the finger-like processes which project into the brood-pouch, is hairy.

Locality. This striking and beautiful *Daphnia* was found fairly abundantly in Lake Chrissie and in some of the other larger pans.

Order COPEPODA.

In all, four species of Copepoda were taken. But it is an interesting fact that although the two species described below were found in great quantities, only one specimen of *Cyclops* and one specimen of Harpactid were taken. The latter may have easily been overlooked on account of its small size, but the scarcity of *Cyclops* is not a little remarkable. Unfortunately the *Cyclops* was not well enough preserved to allow identification.

Family CENTROPAGIDÆ.

Genus BROTEAS Lovén = *Lovénula* Schmeil.

BROTEAS FALCIFER Lovén = *Lovénula falcifera* Schmeil. (Pl. XVI. figs. 45 *a*, *b*.)

Length of male 4 mm.; of female 3·6 mm. In nearly every detail this species is identical with *Broteas falcifer* described by G. O. Sars (8) from the Cape Peninsula; a few points of structural difference are found: (1) in the length of the antennules, which when flexed back in line with the body reach as far as the proximal part of the caudal rami; (2) in the fact that the three outer bristles on the right furcal ramus in the male, instead of being smooth, as in the case of the species described and figured by G. O. Sars, are serrated on the inner side only in the case of the two internal and on each side in the case of the third bristle internal to these two; (3) in that the small fine bristle on each ramus, which occupies an internal position, slightly removed from the fringe of stout bristles, is somewhat longer than in *B. falcifer*. The caudal rami are asymmetrical.

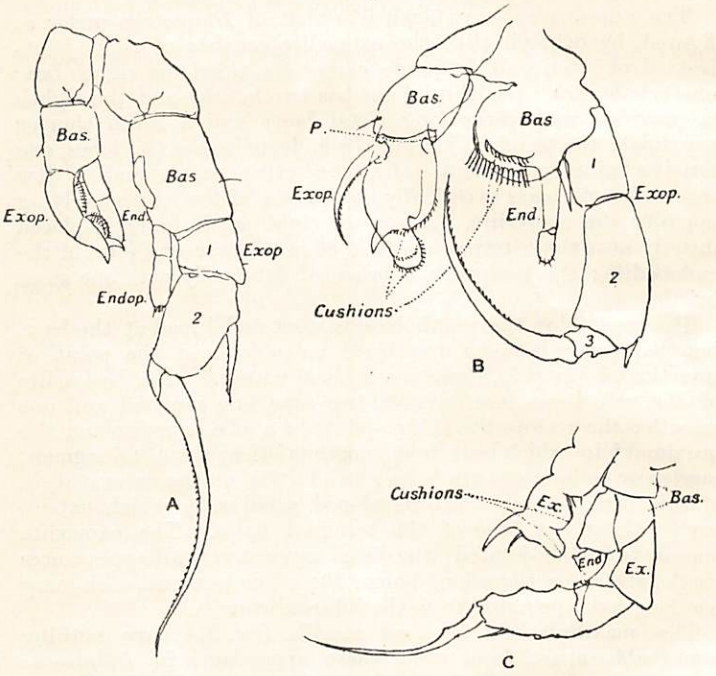
It is considered that this Centropagid is no more than a local variety of the Cape form and has not therefore been given specific distinction.

Abundant in the larger pans.

inner margin three bristles are found, of which the proximal is setaceous; between this bristle and the joint of the first and second segments there is a close-set row of fine stiff bristles, in the form of a long comb, placed just internal to the inner margin of the joint which is itself partly fringed with fine hairs; occupying the centre of the surface of this same segment is a mass of fine long hairs set in the long axis of the same and occupying about a third of its length.

The thoracic limbs (figs. 53 & 54) used for swimming are like those of a typical *Diaptomus*; but the modified sixth pair is sufficient to show the marked aberrancy of this species from *Diaptomus* or

Text-fig. 11.



Sixth Thoracic Appendages of (A) *Diaptomus castor* (after Schmeil); (B) *Metadiaptomus*; (C) *Adiaptomus natalensis* (after Cooper). P. possibly indicates remains of endopodite.

any other Centropagid genus described. For convenience sake, the sixth pair of thoracic appendages of the male of *Diaptomus castor*, of *Adiaptomus natalensis*, and of the new species now under discussion are here figured side by side for comparison, since it is thought that the character of these limbs is of the greatest importance for classification (*vide* text-fig. 11 *A*, *B*, *C*). The whole organ is seen to consist of a pair of asymmetrical limbs,

The distal claws of the telson are pectinate, and are provided with small setæ. The pectinate processes are divided into three lots, each arranged in a semi-lunar form (*vide* fig. 39 *b*). Anterior to these claws, the telson is fringed by a number of stout bristles; internal to this fringe, along half its length, groups of minute setæ are found. On following the course of this fringe of bristles, it is found that they end gradually, passing internally into three or four rows. Still further, a number of minute setæ are found arranged in parallel tiers which run at right angles to the sagittal plane of the telson.

The caudal styles are partly plumose; the dorsal part of the telson extending from these styles, so as to include the finger-like processes which project into the brood-pouch, is hairy.

Locality. This striking and beautiful *Daphnia* was found fairly abundantly in Lake Chrissie and in some of the other larger pans.

Order COPEPODA.

In all, four species of Copepoda were taken. But it is an interesting fact that although the two species described below were found in great quantities, only one specimen of *Cyclops* and one specimen of Harpactid were taken. The latter may have easily been overlooked on account of its small size, but the scarcity of *Cyclops* is not a little remarkable. Unfortunately the *Cyclops* was not well enough preserved to allow identification.

Family CENTROPAGIDÆ.

Genus BROTEAS Lovén = *Lovénula* Schmeil.

BROTEAS FALCIFER Lovén = *Lovénula falcifera* Schmeil. (Pl. XVI. figs. 45 *a*, *b*.)

Length of male 4 mm.; of female 3·6 mm. In nearly every detail this species is identical with *Broteas falcifer* described by G. O. Sars (8) from the Cape Peninsula; a few points of structural difference are found: (1) in the length of the antennules, which when flexed back in line with the body reach as far as the proximal part of the caudal rami; (2) in the fact that the three outer bristles on the right furcal ramus in the male, instead of being smooth, as in the case of the species described and figured by G. O. Sars, are serrated on the inner side only in the case of the two internal and on each side in the case of the third bristle internal to these two; (3) in that the small fine bristle on each ramus, which occupies an internal position, slightly removed from the fringe of stout bristles, is somewhat longer than in *B. falcifer*. The caudal rami are asymmetrical.

It is considered that this Centropagid is no more than a local variety of the Cape form and has not therefore been given specific distinction.

Abundant in the larger pans.

Genus METADIAPTOMUS (gen. n.).

Diagnosis. Both antennules of female and left of male consist of twenty-six segments. Proliferation to form this *extra* joint has not apparently taken place in the same manner as in *Adiaptomus* judging from the explanation and figure given by A. W. Cooper (*loc. cit.*). In the sixth pair of thoracic limbs in the male, the exopodite of the right appendage is three-jointed; the basipodite is much enlarged on the internal surface to form a double cushion. The first joint of the two-jointed exopodite of the left leg carries a large curved claw, and distally two cushion-like processes are present. An endopodite to this left appendage appears to be wanting, but it may be present in a very reduced condition.

In other respects like the genus *Diaptomus*.

METADIAPTOMUS TRANSVAALENSIS, sp. n. (Pl. XVI. figs. 46 *a–c*, & Pls. XVII. & XVIII.)

Description of female.—Length of cephalothorax 1·25 mm.; of abdomen including furcal bristles ·7 mm.: of antennule 1·27 mm. Body subcylindrical, the greatest breadth at the junction of the third and fourth segments; the anterior portion of the body shaped like the nose of a bullet; the posterior part tapers slightly. The cephalothorax is composed of six distinct segments, the antennal region being distinctly divided from the rest of the body; the sixth segment bears projecting angular corners on its marginal lobes; these corners do not seem to represent another segment. The antennules when flexed back in line with the body do not extend beyond the limits of the cephalothorax. The abdomen consists of three distinct segments and the caudal rami.

Description of male.—Length of cephalothorax ·8 mm.; of abdomen, as for female, ·45 mm.; of left antennule ·86 mm. The great difference of size between the male and female is to be remarked upon. In general shape however and in its appendages it resembles the female. The abdomen consists of five segments and the caudal rami. The right antennule is geniculated.

Appendages.—The descriptions and drawings of the appendages have been taken in nearly all cases from females.

The antennules of the female and the left one of the male are made up of twenty-six distinct segments, a feature of *Adiaptomus* (see introduction p. 150). It is to be noticed, however, that whereas the proximal spine on the antennule of a female *Adiaptomus* occurs on the third segment, in that of *Metadiaptomus* it occurs on the second. From this evidence alone, it is concluded that proliferation to form this additional segment has not taken place in the same area or rather in the same way as in *Adiaptomus* as explained by A. W. Cooper (*loc. cit.* p. 101 and figs. 5, 5 *a*). Now, from the sudden change of length exhibited in segments twelve and thirteen, it is tentatively suggested that proliferation may have taken place from a segment once representing segments eleven and twelve (*vide* Pl. XVII. fig. 47). This explanation

is put forward with all the more hesitation, seeing, first, that it may be merely superficial, and secondly, that the generally accepted view is, that proliferation takes place from the proximal segment, which is in this case together with the second segment admittedly short in comparison with that of the antennule of other Centropagidæ. Ten æsthetes were found on the female antennule (they are coloured blue in the figure). The spines from segment fifteen onwards are finely serrated. On segments three to nine marginal groups of small setæ are borne on the side other than that bearing spines and æsthetes: on the same side, and situated at the distal extremity of each segment from eight to thirteen, is a group of minute setæ. The male geniculated antennule consists of the normal twenty-three joints.

The antenna is very much like that of *Diaptomus castor* as figured by Schmeil (9): the exopodite consists of eight joints instead of seven; all the joints except the third and eighth bear one bristle each; the third joint has two bristles and the eighth is provided with three long distal hairs and a much shorter proximal: the terminal joint of the endopodite has two lobes, one bearing nine prominent setæ, the other seven and a few inconspicuous hairs marginally at the base of the long seta lying opposite the exopodite. A row of eight small hairs is placed distally near the external marginal edge of the second joint of the endopodite: the basipodite is provided internally with one stout bristle.

The mandible: the gnathobase is stout and broad at the base, but half-way between the basal tubercles and the point of insertion of the palp, there is a marked "neck." The basipodite of the palp bears four bristles, two setæ, one serrated and one smooth: the endopodite is two-jointed: a lobe is present on the proximal joint which bears four smooth bristles; the distal segment carries seven long smooth hairs: in addition, on the outer margin of this distal segment are developed small setæ which extend partly along the base of the terminal hairs. The exopodite appears to be four-jointed; the distal segment is to all appearances single, and bears three long hairs; the other segments each carry one long hair springing from the internal margin.

The maxillula (fig. 50) and maxilla (fig. 51) have nothing remarkable apart from what these appendages in *Diaptomus* possess. In the maxillula, the first endite of the first basal joint bears ten stout and three finer bristles; the second endite has four bristles; the third endite has three; the first exite is provided with nine large bristles and the second exite with one; the second basal joint and its endite together carry fourteen bristles.

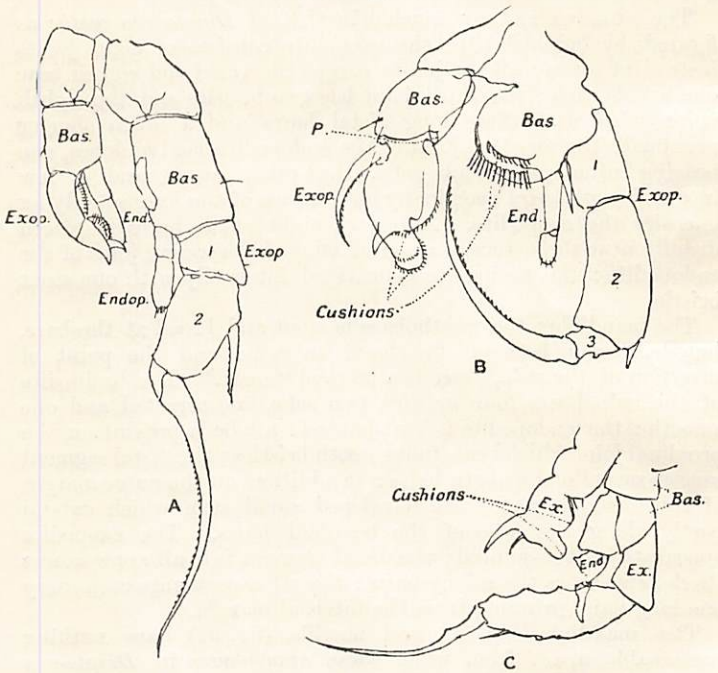
The maxilla is very like that of *Diaptomus castor*, but the third and fourth exites have two bristles each instead of three, and the fifth exite has four bristles instead of three.

The first thoracic appendage or maxilliped is in the main like that of *D. castor* but is quite different from that of *Adiaptomus*. The second segment calls for special description. Distally, on the

inner margin three bristles are found, of which the proximal is setaceous; between this bristle and the joint of the first and second segments there is a close-set row of fine stiff bristles, in the form of a long comb, placed just internal to the inner margin of the joint which is itself partly fringed with fine hairs; occupying the centre of the surface of this same segment is a mass of fine long hairs set in the long axis of the same and occupying about a third of its length.

The thoracic limbs (figs. 53 & 54) used for swimming are like those of a typical *Diaptomus*; but the modified sixth pair is sufficient to show the marked aberrancy of this species from *Diaptomus* or

Text-fig. 11.



Sixth Thoracic Appendages of (A) *Diaptomus castor* (after Schmeil); (B) *Metadiaptomus*; (C) *Adiaptomus natalensis* (after Cooper). P. possibly indicates remains of endopodite.

any other Centropagid genus described. For convenience sake, the sixth pair of thoracic appendages of the male of *Diaptomus castor*, of *Adiaptomus natalensis*, and of the new species now under discussion are here figured side by side for comparison, since it is thought that the character of these limbs is of the greatest importance for classification (*vide* text-fig. 11 *A*, *B*, *C*). The whole organ is seen to consist of a pair of asymmetrical limbs,

the right considerably larger than the left and armed with a long terminal claw serrated on the inner side. This claw is borne by the exopodite, which consists of three segments; the distal one is small, bearing, besides the long claw, a small protuberance or knob on its outer margin; the second segment, which has a short spine terminally, is large; the endopodite is two-jointed; the distal joint is much shorter than the proximal and is armed with about four fine setæ terminally; between the endopodite and exopodite arises, apparently from the basipodite, a conspicuous thorn. The basipodite itself is somewhat peculiar; it has a rounded inner face bearing a double cushion, an inner part furnished with a row of short curved spines, and an outer part with a row of digitiform processes. Left limb: the distal basal joint bears a bristle on its external surface and in addition an exopodite, but no signs of a endopodite, unless a small knob on its inner edge be taken as the remains of such. The structure of the exopodite is not very clear; but the following points have been made out, namely: a long proximal curved claw serrated along its inner margin, a cushion with serrated margin which is produced externally and distally into a short curved spine, a second distal cushion smaller than the proximal one, bearing two rows of prickles.

In the female this pair of limbs is in the main like that of *Diaptomus*; however, the first basal joint has no spines; the second basal joint is as thick as it is long; both endopodite and exopodite are present: the endopodite consists of one joint only; internally it bears two very small spines some distance apart, and terminally two bristles: the exopodite is two-jointed; the distal segment carries two spines, and is produced into a serrated claw; the middle spine has further a small bristle and two or three minute hairs on its inner margin.

The caudal furca are asymmetrical in both sexes, the left one being longer in each case. Five stout plumose bristles are present, and one small slender one which is smooth.

Locality. Very abundant in Lake Chrissie and in the pans generally.

Family HARPACTICIDÆ.

Genus CANTHOCAMPTUS.

CANTHOCAMPTUS?

The one specimen obtained, which was very small, was unfortunately lost in attempting to macerate it. However, before this happened, it had been determined that it belonged undoubtedly to the genus *Canthocamptus* and closely resembled *Canthocamptus finni*, as described and figured by Prof. G. C. Bourne (2*a*) from the neighbourhood of Zanzibar. This specimen from Chrissie was a female and was remarkable in having asymmetrical caudal styles; a text-figure of these is inserted, and it will be seen that the right style is peculiarly bent and fashioned. This may be merely an abnormality, but the process was certainly intact. In the general

shape, the animal was seen to be comparatively broad and short. The left caudal style was rather more than two-thirds as long as the body.

Text-fig. 12.

Posterior region of the body of *Canthocamptus*? seen from the right side, showing the two asymmetrical caudal styles.

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(2 *a*) Bourne, G. C.—"On two new species of Copepoda from Zanzibar." Proc. Zool. Soc. 1893, pp. 164–166, pl. vi.

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GIESBRECHT, W., & O. SCHMEIL.—Das Tierreich, 6 Lief. Berlin, 1898 (especially p. 67).

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WELTNER, W.—"Die Cladoceren." Deutsch-Ost-Afrika, 4. 1898, Berlin.

For histology of soft parts, and especially of the spermatozoa of Ostracods, see G. O. Sars, "On some Freshwater Ostracoda and Copepoda, raised from dried Australian mud." Christiania Vid.-Selsk. Forhandl. 1889, No. 8.

EXPLANATION OF THE PLATES.

The appendages have been drawn with the aid of a Camera lucida, and in most cases the nature of the lenses used has been inserted in this explanation together with such reduction or magnification found to have been necessary for the reproduction of the same from the original drawings.

PLATE VIII.

All figures of *Cypris spinosa*, sp. n.

Fig. 1. Dorsal view of animal. × 20.
2. Lateral view of shell.
3. Antennule. aa. AD. 4. Zeiss, 3 eyepiece. × ¾.
4. Antenna. Ditto. × ¾.

PLATE IX.

All figures of *Cypris spinosa*, sp. n.

Fig. 5 *a*. Mandible. aa. AD. 4. Zeiss, 3 eyepiece. × ¾. 5 *b*. Terminal part of gnathobase. ⅟₁₂ Zeiss, 2 eyepiece. × ¾.
6 *a*. Maxillula. 6 *b*. Part of typical seta of branchial appendage. 6 *c*. Palp. 6 *d*. Third biting process.
7. Maxilla.
8 *a* & 8 *b*. Accessory copulatory processes of maxilla. aa. Zeis, 4 eyepiece. × ¾.

PLATE X.

Fig. 9. Fourth post-oral appendage of *C. spinosa*. aa. AD. 4 Zeiss, 4 eyepiece. × ¾.
10. Penis of male of same.
11. Fifth post-oral appendage of same. aa. AD. 4 Zeiss, 4 eyepiece. × ¾.
12. Caudal furca of same. aa. AD. 4 Zeiss, 3 eyepiece. × ¾.
13. Antennule of *C. gunningi*, sp. n.

PLATE XI.

Fig. 14 *a*. Antenna of *C. gunningi*. B. Zeiss, 2 eyepiece. × ¾.
14 *b*. Denticulations on second joint (*vide* p. 153).
15 *a*. Mandible of same. 15 *b*. Terminal part of gnathobase. 15 *c*. Palp.
16. *C. chrissiensis* in lateral view. AA. Zeiss, 2 eyepiece. × ½.
17. *C. gunningi* in lateral view.
18. *C. mastigophora* in lateral view.

PLATE XII.

Fig. 19 *a*. Maxillula of *C. gunningi*. 19 *b*. Palp. 19 *c*. Third biting process.
20 *a*. Maxilla of same. 20 *b* & *c*. Accessory copulatory process of male.
21 *a*. Fourth post-oral appendage of same. 21 *b*. Internal terminal bristles of distal part of third joint.
22 *a* & 22 *b*. Fifth post-oral appendage of same.

Plate XIII.

Fig. 23 *a* & 23 *b*. Two views of a furcal ramus of *C. gunningi*.
24. Lateral view of *C. tuberculata*, sp. n. AD. aa. 6 Zeiss, 4 eyepiece. × ½.
25. Antenna of same. AD. aa. 6 Zeiss, 4 eyepiece. × ¾.
26 *a*. Gnathobase of mandible of same. AD. 6 D. Zeiss, 2 eyepiece. × ½.
26 *b*. Palp. AD. 6. Zeiss, 2 eyepiece.
27. Third biting process of maxillula of same. AD. 6. Zeiss, 4 eyepiece.
28. Maxilla of same.

Plate XIV.

Fig. 29. Fourth post-oral appendage of *C. tuberculata*. AD. aa. 6. Zeiss, 4 eyepiece. × ¾.
30. Terminal part of fifth post-oral appendage of same. AD. 6 D. Zeiss, 2 eyepiece. × ½.
31. Palp of mandible of *C. mastigophora*.
32. Third biting process of maxillula of same.
33. Furcal ramus of *C. tuberculata*. AD. aa. 6. Zeiss, 2 eyepiece. × ¾.
34 & 35. Accessory copulatory process of maxilla of *C. chrissiensis*. AD. 6 D. Zeiss, 2 eyepiece. × ¾.

Plate XV.

Fig. 36. Penis of male *C. gunningi*. DD. Zeiss, 2 eyepeice. × ½.
37. Penis of male *C. chrissiensis*. AD. 6 D. Zeiss, 2 eyepiece. ½.
38. Furcal ramus of *C. mastigophora*.
39 *a*. Lateral view of *Daphnia gibba*, sp. n. × 16.
39 *b*. Telson of same.
40 *a*. Lateral view of *Daphnia pulex*.
40 *b*. Lateral view of terminal part of head of same.
40 *c*. Telson of same.
41. Lateral view of *Simocephalus corniger*, sp. n.

Plate XVI.

Fig. 42 *a*. Telson of *S. corniger*. 42 *b*. Enlarged drawing of a spine.
43. Lateral view of *Leydigia trispinosa*, sp. n. × 60.
44 *a*. Lateral view of *Chydorus carolinæ*, sp. n. × about 100.
44 *b*. Telson of same.
45 *a*. Terminal portion of abdomen of male *Broteas falcifer* Sars.
45 *b*. Abdomen of female of same.
46 *a*. Lateral view of female *Metadiaptomus transvaalensis*, sp. n. × 46.
46 *b*. Abdomen of female. 46 *c*. Abdomen of male.

Plate XVII.

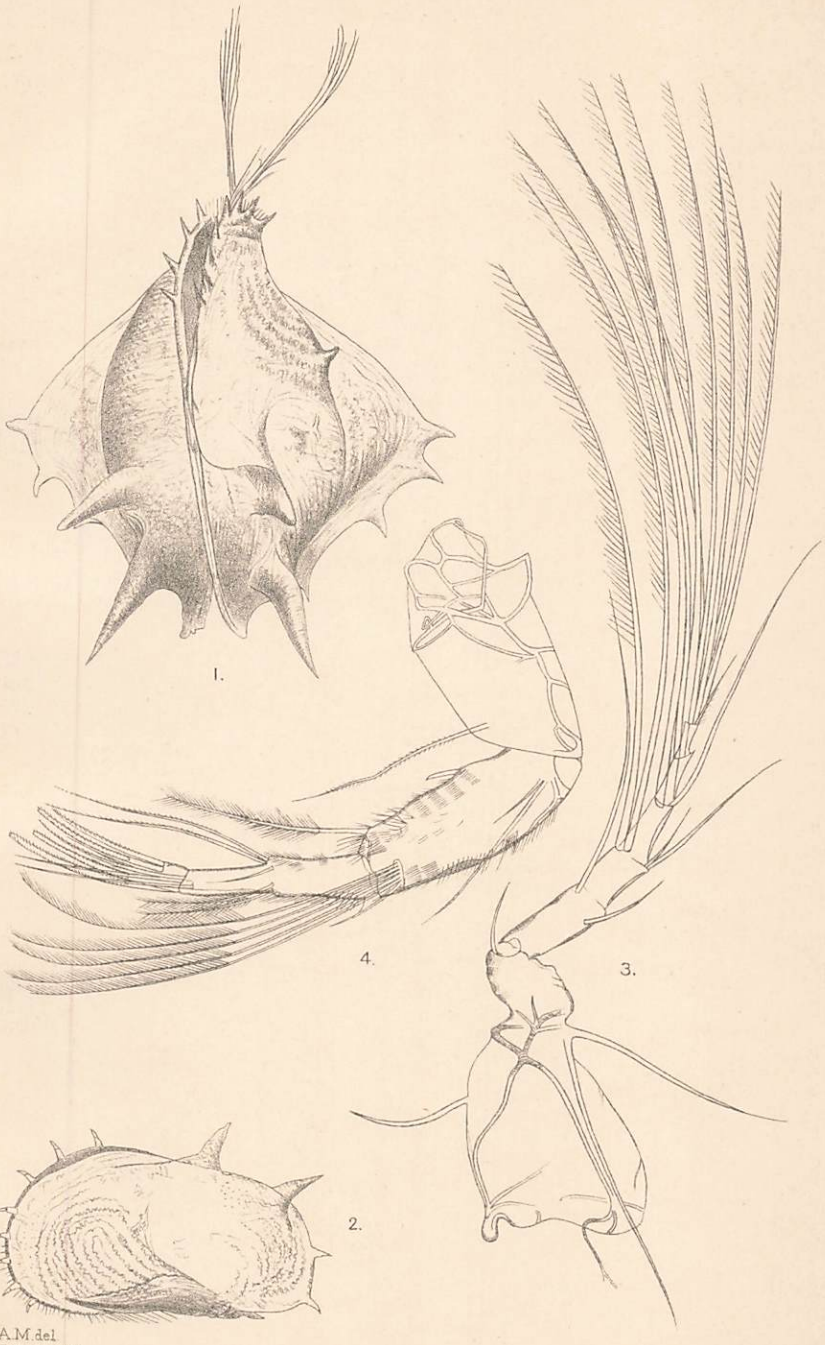
All figures of *Metadiaptomus transvaalensis*, sp. n.

Fig. 47. Antennule of female. AA. Zeiss, 4 eyepiece. × ¾. Æsthetes in blue.
48. Antenna. AA. Zeiss, 2 eyepiece.
49. Mandible. DD. Zeiss, 2 eyepiece. × ¾.
50. Maxillula. DD. Zeiss, 2 eyepiece. × ¾.

Plate XVIII.

All figures of *Metadiaptomus transvaalensis*, sp. n.

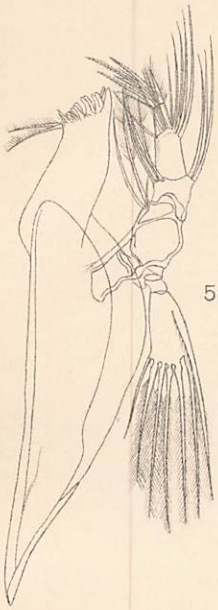
Fig. 51. Maxilla. DD. Zeiss, 2 eyepiece. × ¾.
52. Maxilliped. DD. Zeiss, 2 eyepiece. × ¾.
53. Second thoracic appendage. AA. Zeiss, 4 eyepiece.
54. Fifth thoracic appendage. AA. Zeiss, 4 eyepiece.
55 *a*. Sixth thoracic appendage of male. DD. Zeiss, 2 eyepiece. × ¾.
55 *b*. Sixth thoracic appendage of female. DD. Zeiss, 2 eyepiece. × ¾.

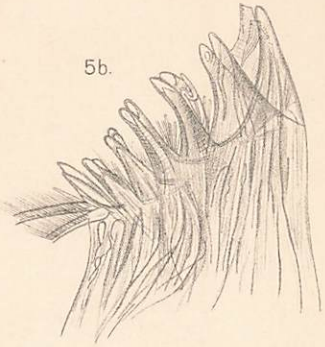


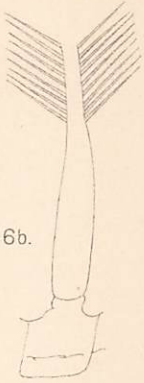
P.A.M. del
M.P. Parker, lith.

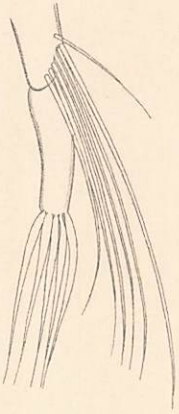
E. Wilson, Cambridge.

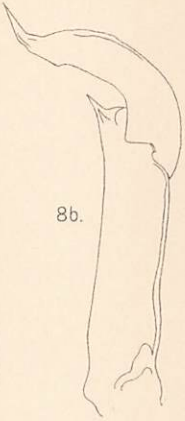
1-4. CYPRIS SPINOSA.

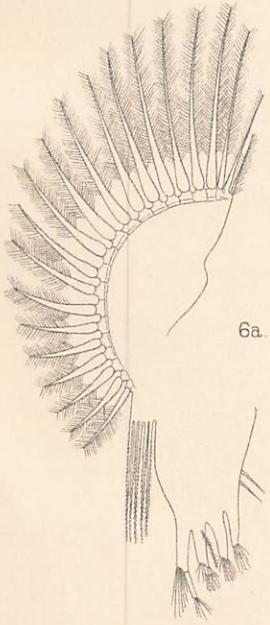








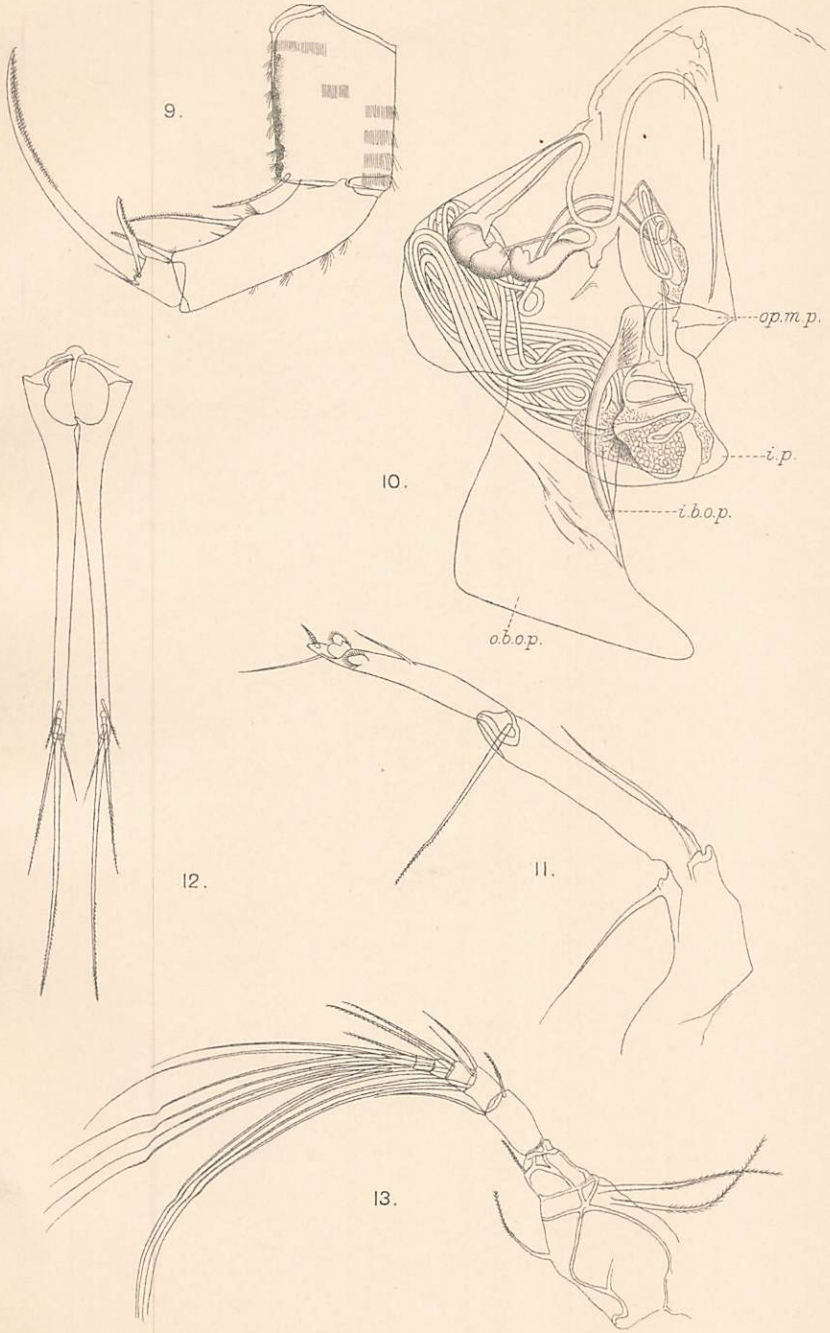




P.A.M. del.
M.P. Parker, lith.

Edwin Wilson, Cambridge.

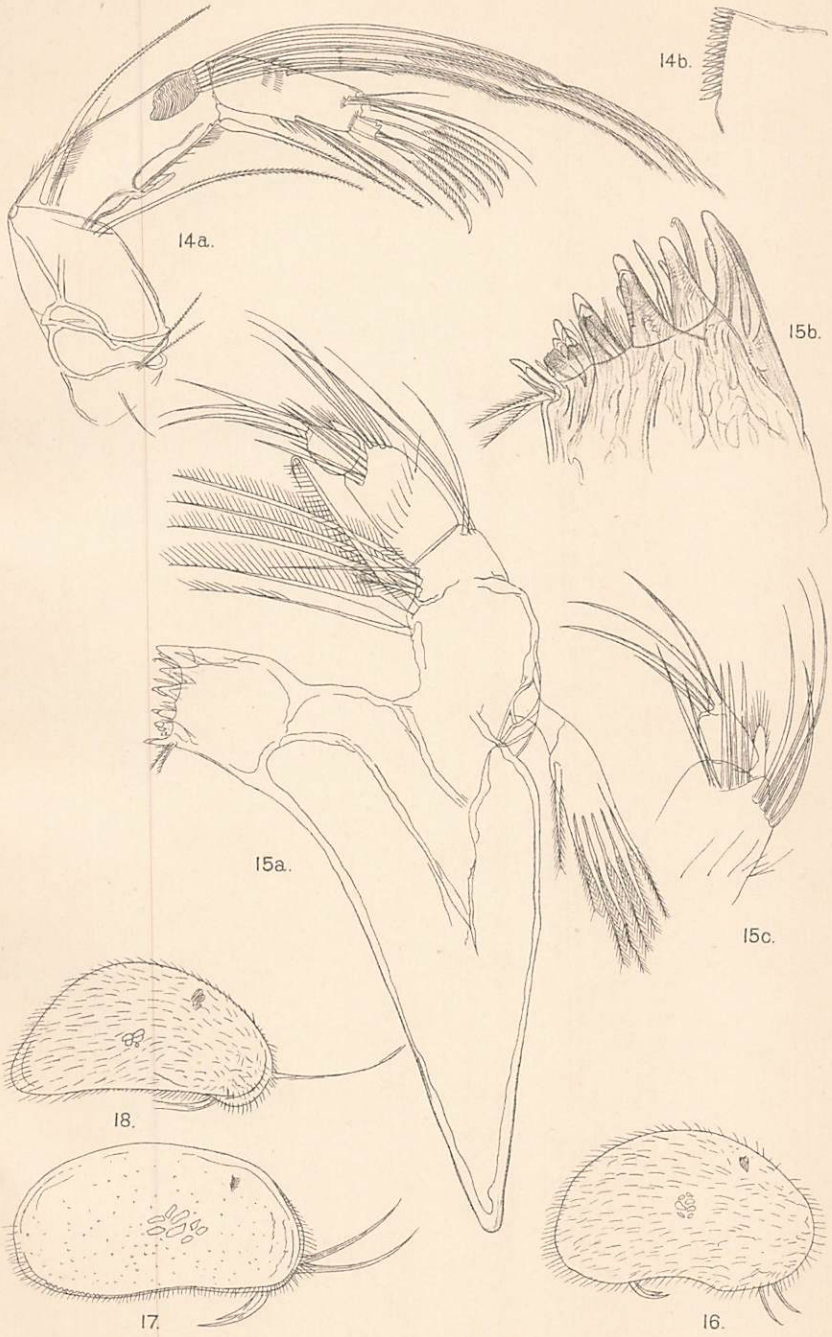
5-8. CYPRIS SPINOSA.



P.A.M del.
M.P. Parker, lith.

Edwin Wilson, Cambridge.

9-12. CYPRIS SPINOSA. 13. C. GUNNINGI.



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M.P. Parker, lith.

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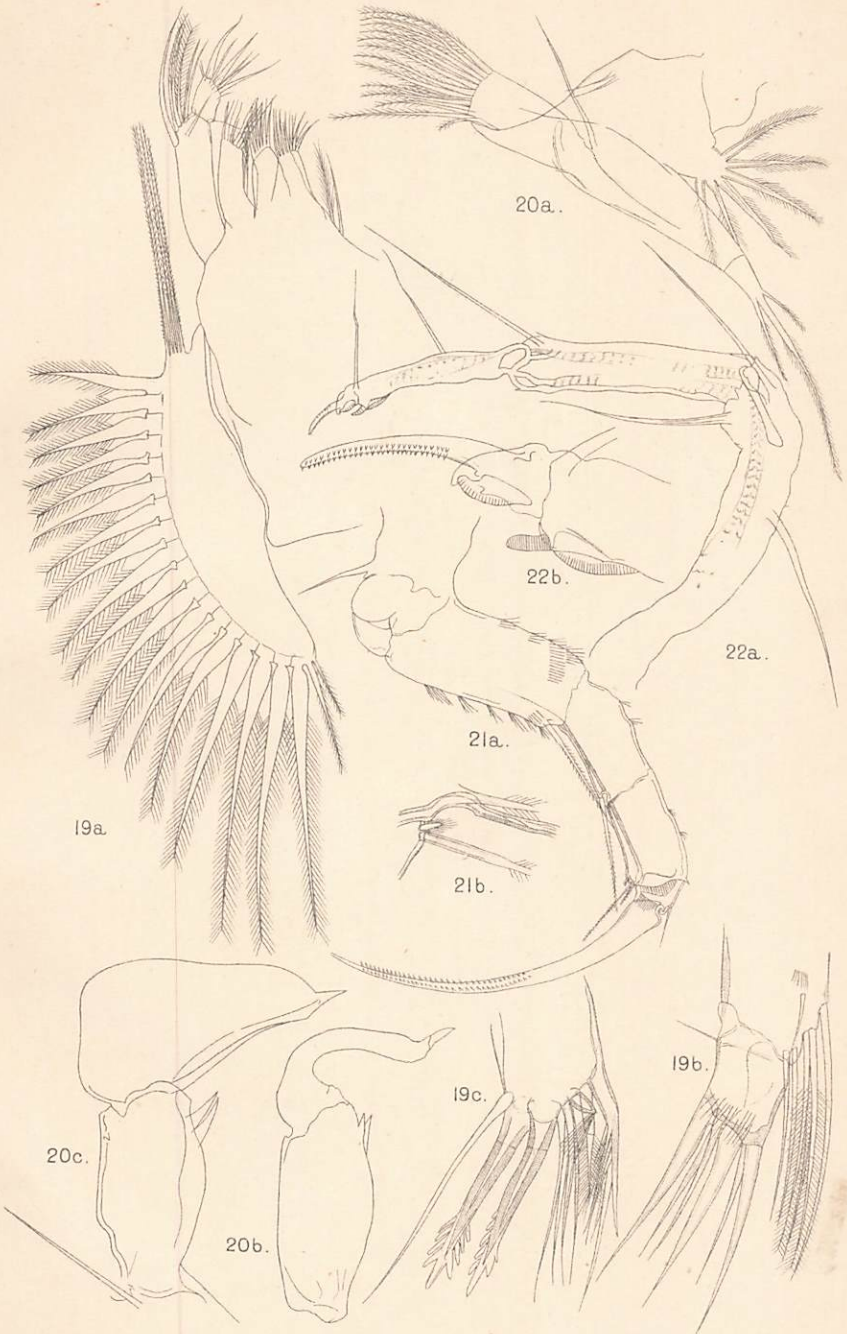
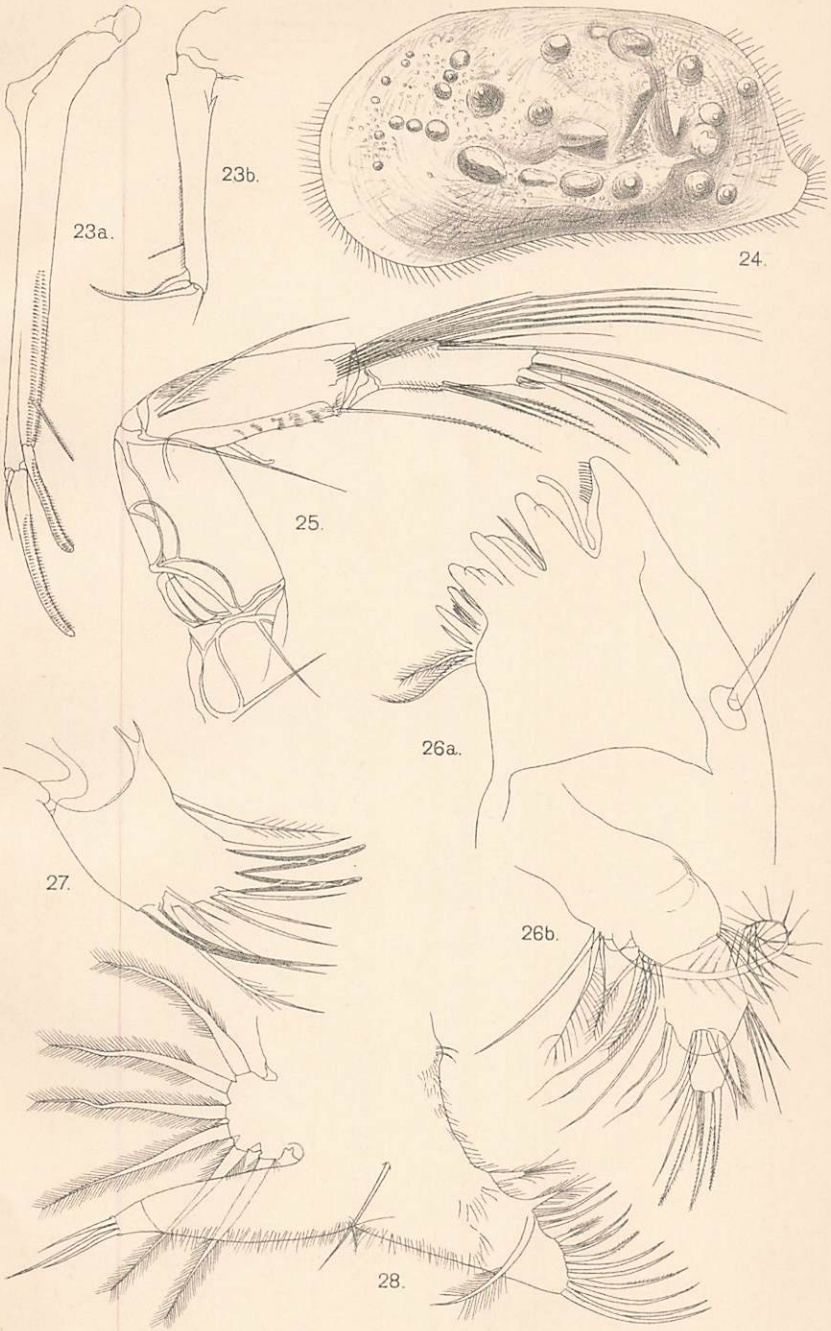
14. 15. 17. C. GUNNINGI. 16. C. CHRISSIENSIS.
18. C. MASTIGOPHORA.



P.A.M.del.
M.P.Parker,lith.

Edwin Wilson, Cambridge.

19–22. C. GUNNINGI.



P.A.M. del.
M.P. Parker, lith.

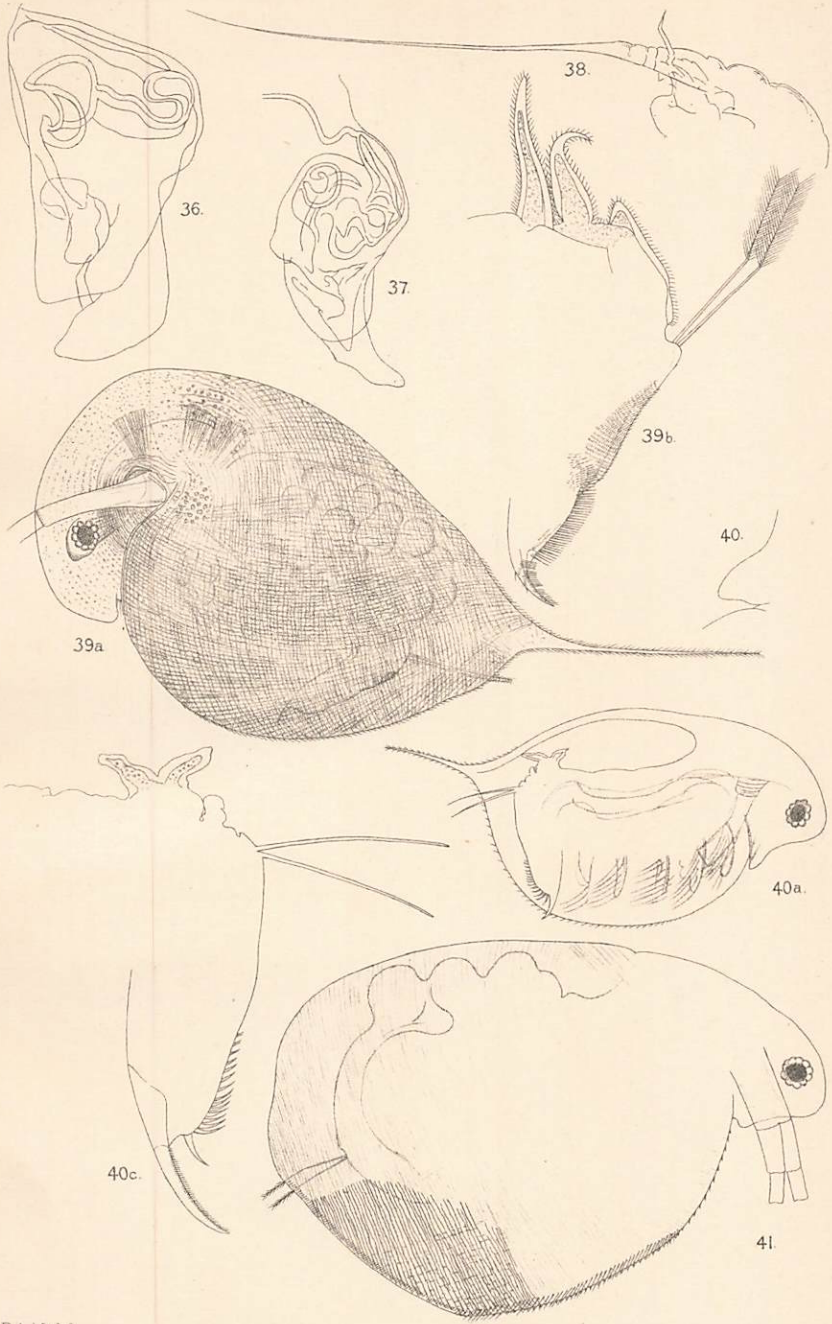
Edwin Wilson, Cambridge.

23. C. GUNNINGI. 24-28. C. TUBERCULATA.

P.A.M. del.
M.P. Parker, lith.

Edwin Wilson, Cambridge.

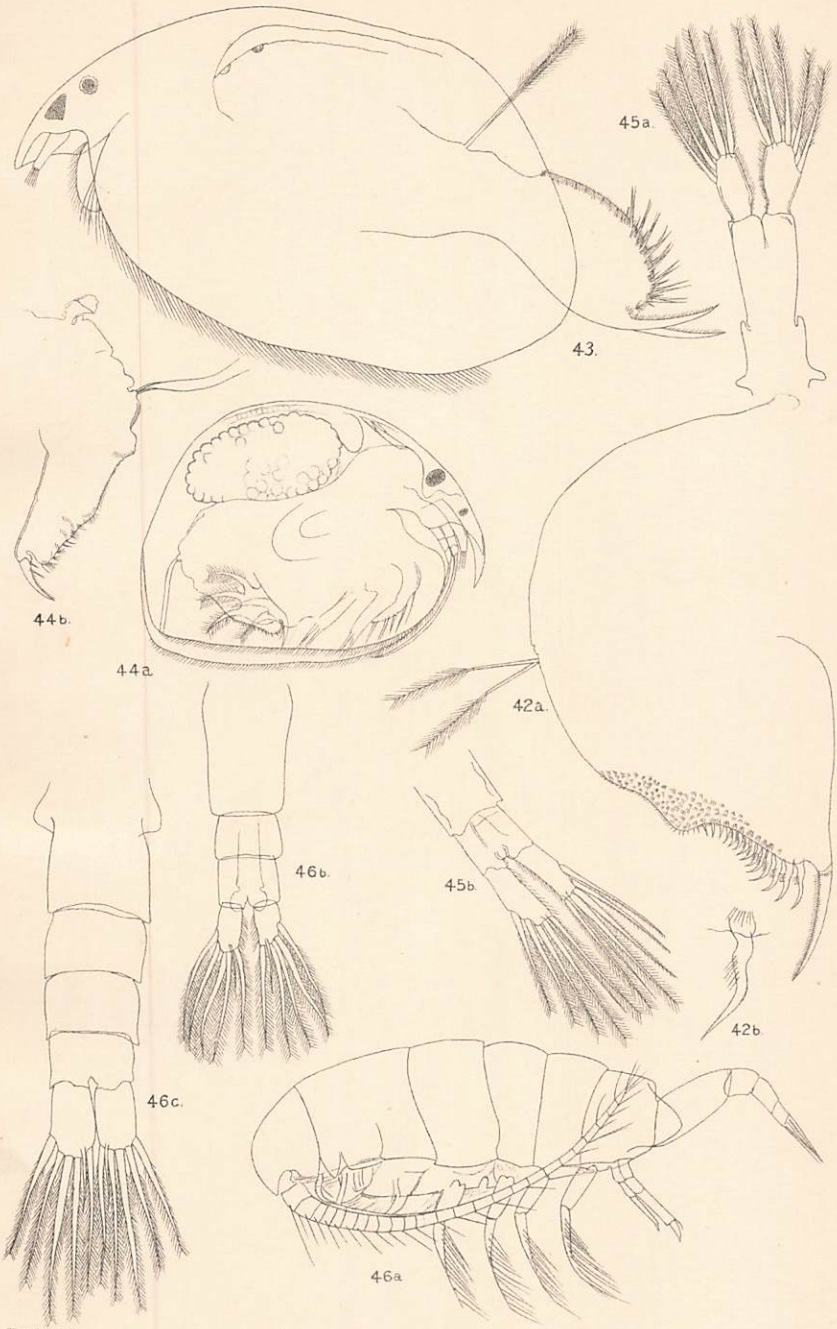
29. 30. 33. C. TUBERCULATA. 31. 32. C. MASTIGOPHORA.
34. 35. C. CHRISSIENSIS.



P.A.M. del.
M.P. Parker, lith.

Edwin Wilson, Cambridge.

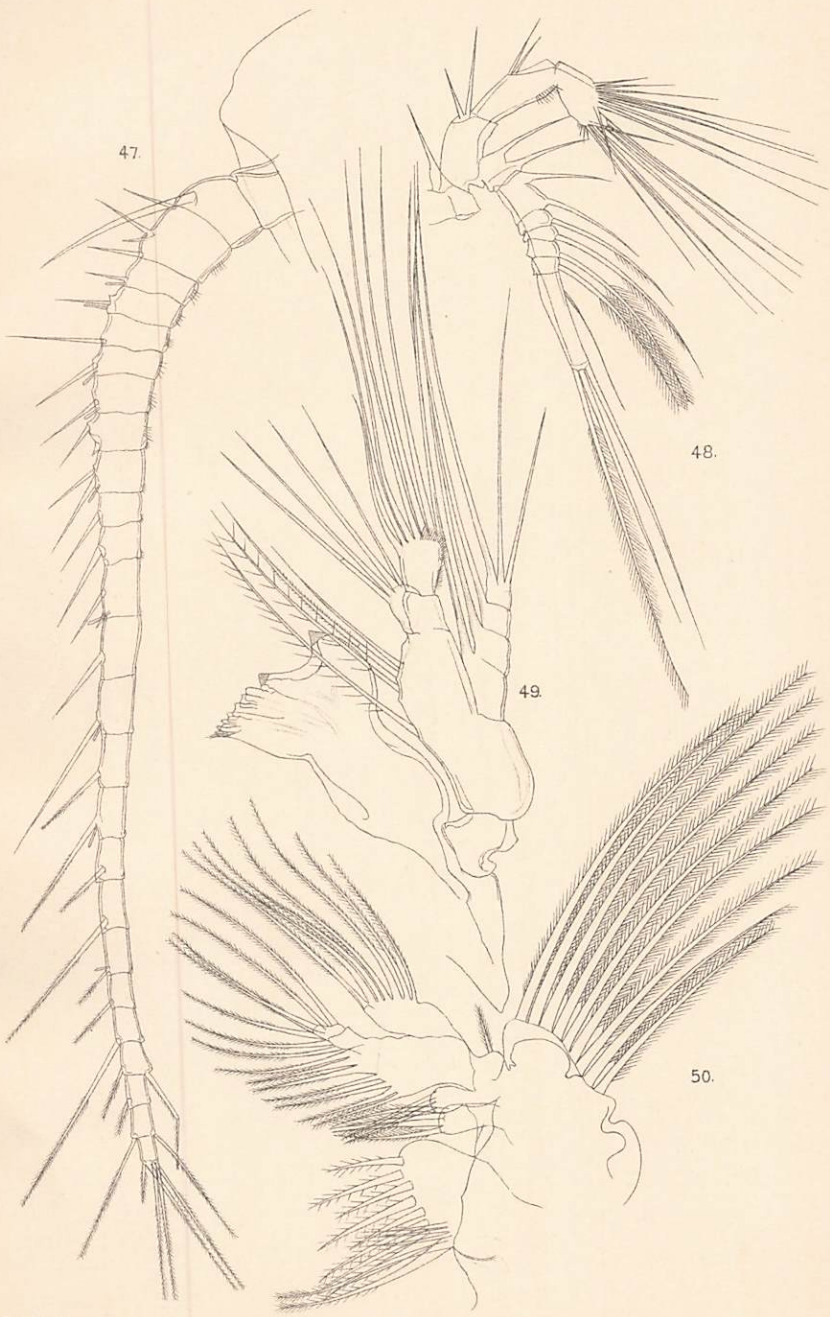
36. C. GUNNINGI. 37. C. CHRISSIENSIS. 38. C. MASTIGOPHORA.
39. DAPHNIA GIBBA. 40. D. PULEX. 41. SIMOCEPHALUS CORNIGER.



P.A.M. del.
M.P.Parker, lith.

Edwin Wilson, Cambridge.

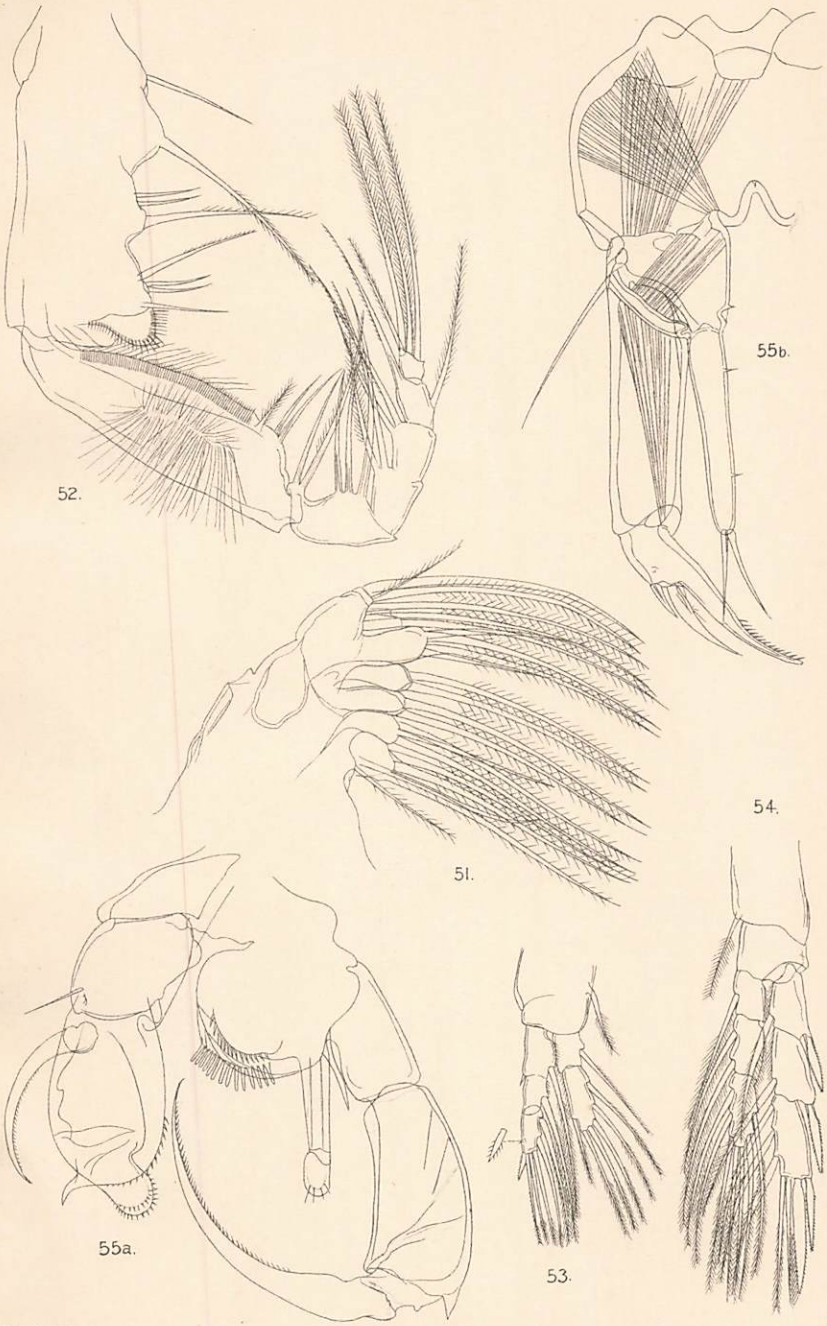
42. S. CORNIGER. 43. LEYDIGIA TRISPINOSA. 44. CHYDORUS CAROLINÆ.
45. BROTEAS FALCIFER. 46. METADIAPTOMUS TRANSVAALENSIS.



P.A.M. del.
M.P. Parker, lith.

Edwin Wilson, Cambridge.

47-50. METADIAPTOMUS TRANSVAALENSIS.



P. A. M. del.
M. P. Parker, lith.

Edwin Wilson, Cambridge

51–55. METADIAPTOMUS TRANSVAALENSIS.