

<sup>ECL</sup>  
*Prof. E. A. Birge*  
*with the author's kind regard*

ON SOME  
WEST-AUSTRALIAN  
ENTOMOSTRACA

RAISED FROM DRIED SAND

BY  
G. O. SARS

WITH 4 AUTOGRAPHIC PLATES

ARCHIV F. MATHEM. OG NATURVIDENSKAB



*Sars 96*

KRISTIANIA  
ALB. CAMMERMEYERS FORLAG  
LARS SWANSTRØM

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ADAMSONS



### Introduction.

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Mr. Knut Dahl, who has been travelling for 2 years in the northern and western parts of Australia, and who also made some excursions into the interior of the continent, brought with him, on returning home this year, a sample of dried material taken by him from shallow depressions in the sandy desert, at a distance of about 40 miles east of Roebuck Bay. When he first visited these inner tracts, immediately after the rainy season, all the greater depressions were filled with rain-water, and swarmed with Entomostraca, among which an *Apus* was observed in great numbers. Unfortunately he did not preserve any of the specimens, apparently owing to the want of a suitable preserving fluid. Later in the season he again visited the interior of the country, but now nearly all the depressions were completely dried up, and the whole country had the character of a barren desert. Having, however, learned that at times some parts of this desert were peopled by multitudes of small crustaceans, and knowing of the good results of my earlier hatching experiments, he kindly collected for my use some dried material from places where it was supposed that, at an earlier time of the season, rain-water accumulated. The material, when received (on the 4th May of the present year), had the character of a very fine, reddish



brown sand, without any mud intermingled, and at first I therefore had some doubts as to the suitability of such a material for hatching operations. On a preliminary microscopical examination of the sand, however, some scattered pieces of the carapace of an *Apus*, and of the shell of a bivalve *Phyllopod* were easily detected, as also a few detached valves of 2 different *Cypridids*, and this induced me immediately to start upon my hatching experiments. For this purpose I prepared a series of aquaria, to receive each a small portion of the sample, the date of preparation being in each case noted. The aquaria were placed in my laboratory in such a manner, that they were exposed to the direct rays of the sun during the first part of the forenoon, and in clear weather the temperature of the water was often found during this time to rise to a very considerable height. After the lapse of some days a few small Entomostraca made their appearance in a number of my aquaria, whereas in others no trace of life could be detected, either at that time or subsequently. The latter were of course discarded, while the former were kept for further observation during the whole summer. Of the results of my experiments, which I believe may be of some interest, I propose to treat in the present paper. The number of species hatched and examined in detail, is rather limited, amounting to only 5 in all, viz., 2 Phyllopoda, 1 Cladoceran, and 2 Ostracoda; but of these only one of the Phyllopoda seems to have been noticed at an earlier date, whereas I regard the 4 other species as new to science.

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## Phyllopoda

Trib. Notostraca. Fam. Apodidæ.

Gen. *Apus*, Schæffer.

1. *Apus australiensis*, Spencer & Hall.

(Pl. 1).

*Apus australiensis*, Spencer & Hall, Report on the Horn Expedition to Central Australia. Part II. Zoology. Crustacea, p. 235, Pl. 20, figs. 1—3.

A single specimen of an *Apus*, which in all probability is referable to the above-named species described by Messrs. Spencer & Hall, developed in one of my aquaria, and was watched for nearly a month. On Plate 1 is given a figure (dorsal aspect) of the specimen in its most advanced state, drawn from life, and accompanied by some detail drawings. On comparing this figure, which has been carefully verified by a renewed examination of the preserved specimen, with that given by Messrs. Spencer & Hall, several rather striking differences may be found to exist, both as regards the form of the carapace, and the several proportions given by the above-named authors; and, indeed, these differences might lead one to suppose, that in reality it belonged to a different species. Considering, however, the great variations in these respects found in different specimens of the same species, especially when examined in a preserved state, I am unwilling to lay any stress on such characters as specific marks. The specimen was of rather small size, as compared with those



examined by the above-named gentlemen, and had probably not nearly reached to its full size; yet it was so far developed as to admit of the assumption that it exhibited all the essential characteristics of the species.

The dimensions of the specimen are as follows:

Total length, measured from the frontal margin to the end of the terminal caudal segment: 13 mm.

Length of carapace: 8.5 mm.

Median length of same (to the bottom of the posterior sinus): 6.8 mm.

Greatest width of same: 5.8 mm.

Median length of cephalic part of carapace (to the posterior edge of the mandibular segment): 2.5 mm.

Width of posterior sinus: 2.9 mm.

Depth of same: 1.6 mm.

Length of exposed part of body: 6.4 mm.

Length of terminal caudal segment: 0.7 mm.

Width of same: 1.2 mm.

Length of caudal filaments: 7.4 mm.

From the above-given dimensions, it will appear, that in the specimen examined by me, the carapace is comparatively larger in proportion to the exposed part of the body, the proportion in length between the two being as 4 to 3, whereas, according to Messrs. Spencer & Hall, these parts are of about equal length. Moreover, the width of the carapace in the specimen examined by me, is far from attaining the median length, whereas, according to Messrs. Spencer & Hall, it exceeds it considerably. On the whole, the form of the carapace, when seen from above (fig. 1), looks rather different. Messrs. Spencer & Hall describe it as a short oval, and in the figure its greatest width occurs considerably behind the middle. In the specimen examined by me, it has an oblong



oval form, being broadest somewhat in front of the middle, and slightly narrowed posteriorly, with the edges quite evenly arched in front and laterally. The posterior sinus is broadly rounded at the bottom, and is edged with from 24 to 30 small denticles. On the lower edge of the carapace there are only 3 or 4 very small serrations close to the posterior corners, whereas, according to Messrs. Spencer & Hall, they extend to about half the length of the carapace. The dorsal carina is quite smooth in the specimen examined by me, and gradually vanishes anteriorly, for which reason its exact length cannot be stated; it terminates at the bottom of the posterior sinus in a slightly projecting prominence. The cephalic part of the carapace, defined by the strongly-marked cervical furrow containing the transversely convex mandibular segment, but little exceeds half the median length of the remaining part of the carapace, whereas in the figure given by Messrs. Spencer & Hall, it almost equals this part in length. The exposed part of the body is subcylindric in form, though gradually tapering somewhat distally, and exhibits about 28 segments, of which the 12 posterior are without legs. They are, as usual, provided dorsally with a transversal row of short stout spines, which, on the non-limb-bearing (caudal) segments, extend also around the ventral side. The terminal caudal segment, to which the name of telson can scarcely be applied here, is about twice as broad as it is long, and somewhat flattened, expanding a little distally, with the hind edge slightly emarginated (see fig. 5). It carries dorsally a single, stout median spine near the hind edge, and has moreover on each side, in its anterior part, a small circular area carrying a delicate sensory bristle, and flanked in front by 3 denticles (see fig. 6). Outside the bases of the caudal filaments, a

few strong spines are seen to project, and the hind concave edge of the segment is armed dorsally with about 6 small denticles, beyond which the soft skin, flanking the anal orifice, projects in the form of 2 short rounded lobes. In the specimen described by Messrs. Spencer & Hall, the terminal caudal segment is much more spinous, but it is most probable, that the number of spines increases with age.

The eyes (see fig. 1) are rather large and of the usual reniform shape, slightly converging anteriorly, and having here between them the ocellus, which shines distinctly through the integuments as a small dark spot. Immediately behind the eyes, the post-ocular tubercle is seen in the form of a nearly semicircular prominence.

The shell-glands are easily observable as 2 narrow, sabre-like areas extending obliquely along the sides of the carapace from the cervical furrow to some distance from the posterior corners.

The 1st pair of legs (fig. 2) exhibit the structure characteristic of the genus, the endites (excepting the rudimentary, scale-like 5th one) being much elongated and thread-like, and projecting laterally far beyond the edges of the carapace. The 4th endite, as usual, is much the longest, being fully twice as long as the stem, and, like the other 3, has the edges divided into small, spinulose ledges, exhibiting also in certain places a distinct segmentation. The outer appendages (exopodite and epipodite) are very small.

The 2nd pair of legs (fig. 3) are much more strongly built than the 1st, and are, as usual, more or less incurved, and prehensile in character, exhibiting a rather distinct segmentation. Of the endites, the 5th is well developed, though not quite attaining the length of the 4th, and has the form of a lanceolate claw, finely denticulated inside, and



fringed outside with a row of delicate bristles. The 4th endite is scarcely more than half as long as the stem, the others still shorter and not exhibiting any trace of segmentation, though provided on the inner edge with minutely spinulose ledges. Of the outer appendages, the exopodite in particular is considerably larger than in the 1st pair, and is of a triangular form, the upper corner being exerted to an acute lappet.

In the next succeeding pairs of legs, the stem becomes gradually shorter, and its segmentation is at last wholly lost. Of the endites, the 5th somewhat increases in size, and assumes a lamellar character, whereas the other endites are much shortened and densely crowded together. Both the outer appendages, on the other hand, are rather fully developed.

The 11th pair of legs (fig. 4) do not exhibit, in the specimen examined, the slightest trace of the ovisac characteristic of the female, both the outer appendages being quite normally developed, and although the specimen had not, in all probability attained its full size, I am much inclined to believe that it was in reality of the male sex.

The total number of legs I have not been able to make out exactly, because the posterior pairs are so extremely small, and lie so close together as scarcely to admit of being counted without dissection.

The caudal filaments somewhat exceed half the length of the body, and exhibit the usual structure. In the living animal they were kept more or less strongly divergent, though they may also admit of being extended straight posteriorly, as indicated in the figure given by Messrs. Spencer & Hall.

The colour, in the living state of the animal, was light yellowish, semipellucid, with a very slight greenish tinge on



the exposed part of the body. The edges of the carapace, and the several spines occurring on the body were of a fine chestnut colour. The eyes were dark brown. Within the exposed part of the body, the capacious intestinal tube was plainly seen, owing to its dark contents.

Remarks.—From the European species, *A. cancriformis*, Schäffer, of which I have had specimens for examination, the Australian form is chiefly distinguished by the greater number of caudal (non-limb-bearing) segments. In *A. cancriformis* I have never found more than 6 such segments, whereas their number in the Australian species is twice as large. It is also for this reason that the exposed part of the body in the latter species appears longer in proportion to the carapace. Otherwise the 2 species seem to be very closely allied.

#### Biological Observations.

I first observed the above-mentioned specimens on the 27th May in one of the smaller of my aquaria, prepared on the 17th of the same month. It was at that time still in the larval condition, though rather advanced, and of a reddish brown colour. It moved about along the bottom of the aquarium chiefly by the aid of the 2nd pair of antennæ, which, as in the larvæ of other Apodidæ, at this period constitute powerful biramose oars. In the course of the succeeding days it grew very rapidly, and before the close of the month it had attained almost double the size, the larval stages having been long before passed through. During the next month it was watched every day, and I had great pleasure in witnessing the rapid growth and the peculiar habits of the animal. It seemed to thrive exceedingly well, and was very voracious, feeding eagerly upon the small

algæ contained in the aquarium. More frequently it was seen to move about along the bottom, with the back always upwards, and burrowing the frontal part more or less deeply into the mud. During its passage, the loose muddy particles were whirled up by the violent swinging movements of the legs, and thereby, apparently, feeding matter brought within reach of the mouth. At times it was seen to ascend the walls of the aquarium or the stems of plants growing in it, clinging with great dexterity to the outmost ramifications in search of food. It also not infrequently swam with great rapidity through the water, twisting about in all directions. The movements, which were extremely graceful, were chiefly effected by the rhythmical swinging of the legs, and generally constituted a rather even dart through the water; but this dart might be suddenly altered in any direction by the bending of the extremely flexible posterior part of the body. The epipodites and exopodites of the exposed legs were seen to be in uninterrupted rapid vibratory motion, apparently not coincident with the movements of the legs themselves; and by this means a constant renewal of the water beneath the carapace might be effected, to assist the respiratory process. The capacious intestinal tube was always filled with dark contents, and at times long coherent portions of the latter were seen to be expelled from the anal orifice. The animal casts its skin several times, and with each exuviation it increased considerably in size. No less than 6 more or less complete exuviae were taken up from the aquarium, and preserved for subsequent examination. On the 29th June the individual showed trace of disease, and I therefore hastened to take it up for examination while still living. It was found that a sharp splinter of some weedy matter had penetrated the mouth, and probably



injured the intestine, without the animal having been able to rid itself of it. The accompanying drawing was immediately executed, and subsequently the individual was carefully preserved, so as to retain its form, and partly also its colour, quite unaltered.

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Trib. Concostraca. Fam. Limnadiidæ.

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Gen. *Estheria*, Rüppel.

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2. *Estheria elliptica*, G. O. Sars, n. sp.

(Pl. 2).

Specific Characters.—♀ Shell, seen laterally, of a rather regularly elliptical form, anything but equilateral, the umbones being placed far in front, dorsal margin behind the umbones nearly straight, and not angular behind, free edges of valves evenly curved throughout, both extremities being rounded and nearly equal, though the anterior one appears a little more obtuse than the posterior:—seen from above, rather tumid, greatest width in front of the middle, posterior extremity more pointed than the anterior. Valves of rather firm consistency, with 14 very strongly marked and elevated, ridge-like concentric lines of growth, each provided in their posterior part with short and stout bristles, surface between the lines finely and irregularly reticulate, marginal area rather broad, and furnished with numerous densely crowded concentric striæ, which are not at all raised. Upper surface of head bent at nearly a right angle close to the cervical impression, rostrum somewhat blunted at the tip. Number of legs 22—23 pairs. Tail of usual shape, with a



single pair of dentiform projections at the base dorsally, caudal plates produced beneath into strong unguiform processes, and each having along the dorsal edge numerous (from 20 to 30) denticles of unequal size, caudal claws slender, without any setæ at the base, but having their outer part distinctly denticulated along the concave edge. Colour dark reddish brown. Length of adult female scarcely exceeding 5 mm.

Remarks.—At first I believed this form to be the *Estheria lutraria* of Brady, described by that author from a badly-preserved empty shell. Having however subsequently consulted Messrs. Spencer & Hall's paper, I have been induced to abandon this opinion. Brady's species is much larger, and, according to the statement of Messrs. Spencer & Hall, the armature of the tail is very different, each of the caudal plates having dorsally only 3 or 4 short denticles, whereas in the present species there is a very great number of such denticles. From *Estheria dictyon* of the above-named authors, it would also seem to differ both in the shape and sculpture of the shell, as also in the armature of the tail. From both these species it is, moreover, distinguished by the smaller number of legs. It is also very distinct from *Estheria Packardii* Brady, described in detail by the present author in another paper<sup>1)</sup>.

#### Description of the female.

The length of the shell of a fully adult specimen measures only 4.9 mm., the greatest height 3.2 mm., and the greatest width 2.2. This form is accordingly far inferior in size to the previously described Australian species.

1) G. O. Sars, Description of some Australian Phyllopoda.

Seen laterally (fig. 1), the shell exhibits a rather regular, oblong elliptic form, the height scarcely exceeding  $\frac{1}{3}$  of the length. It is anything but equilateral, the umbones occurring far in front, at about the end of the first 5th part of the length of the shell. As usual, the umbones are somewhat prominent, and the edges of the valves in front of them appear suddenly deflexed. The dorsal margin behind the umbones is nearly straight and slightly declining, and joins the hind edge without any intervening angle. The ventral margin is gently curved, and quite continuous with the anterior and posterior edges, which both appear evenly rounded.

Seen from above (fig. 2) the shell is found to be rather tumid, the greatest width almost attaining half the length, and occurring rather in front of the middle. Both extremities appear pointed, but the posterior one is much narrower than the anterior.

The valves are of rather firm consistency, with the outer layer strongly chitinous, and are each provided with 14 very conspicuous concentric lines, which form distinctly elevated ridges placed at rather regular distances from one another, the uppermost encircling the umbo. These ridges represent the primary lines of growth, and are in all probability present in the same number in all fully adult specimens. On a closer inspection, they each exhibit in their posterior part a row of short and stout bristles (see fig. 3). The interspaces between the lines are closely and irregularly reticulated. On the other hand, the rather broad marginal area is quite devoid of such reticulation, but is marked by a great number of closely-set concentric striae, which are not at all raised (see fig. 3). These striae represent the secondary lines of growth, and their number is



probably very variable in different specimens, increasing with the age of the individual.

The enclosed animal (see fig. 4) appears on the whole of quite normal structure. In the shape of the head it agrees more closely with *E. dictyon*, the upper part of its dorsal face forming an almost rectangular bend at the cervical impression, whereas in *E. Packardi* this part is produced to a narrowly rounded lobe. The eyes are confluent, and placed within a well-marked bulging of the dorsal surface of the head about in the middle between the cervical sulcus and the tip of the rostrum. The latter appears somewhat blunted at the end, and from it ascends on each side the strongly marked fornix, which, at some distance beneath the ocular bulging, forms an almost angular bend. The ocellus can be only faintly traced at the base of the rostrum. The antennulæ are of moderate length and exhibit about 10 papilligerous lobes. The antennæ, or oars, are of the usual structure, both rami being composed of about 12 lamellar articulations carrying anteriorly short spines, posteriorly slender natatory setæ. The legs do not seem to exhibit any peculiarity in their structure; their number is only 22 or 23 pairs, the last 2 being extremely small. The tail (see fig. 5) resembles in shape that of *E. Packardi*, as described by the present author in the above-quoted paper. It has at the base dorsally 2 juxtaposed dentiform projections, from which extends on each side a row of 4 or 5 small denticles, the last occurring somewhat below the insertion of the caudal setæ. The caudal lamellæ are, as usual, produced into strong unguiform projections, which are not perfectly juxtaposed, and each of them has the slightly concaved dorsal edge armed with numerous (from 20 to 30) denticles of somewhat unequal size, small den-



ticles being interposed between somewhat larger ones. The caudal claws are rather slender, and without any setæ at the base, whereas their outer part is distinctly denticulated along the concave edge.

The colour, in the living state of the animal, was a dark reddish brown, the concentric ridges of the shell being considerably lighter. From the umbones, moreover, an opaque whitish stripe was seen extending obliquely in front, and just behind it, between the 8th and 10th ridge an oval area was faintly traced, indicating the insertion of the adductor muscle of the shell.

#### Biological Observations.

Of this beautiful species some few specimens developed in my aquaria; but of these only a solitary individual attained full maturity. When first observed (on the 31st May), this individual had long since passed through the larval period, the shell showing already 2 or 3 lines of growth. It rapidly increased in size during the next month, the shell gradually acquiring at the same time a greater number of lines of growth, until 14 such lines, all very strongly marked, were counted. After that time apparently no more such lines were formed; but the marginal area was seen slowly to increase in size, so as at last considerably to exceed in width the interspaces between the lines of growth. On the 30th June the individual was taken up and subjected to a closer examination under the microscope. It showed itself at once to be a fully grown female carrying a very dense cluster of eggs inside the shell. After a coloured drawing had been made from the specimen, while still alive, it was carefully preserved for subsequent examination.

In habits it exactly agreed with *E. Packardi*, likewise observed by the present author in the living state. More frequently it was found lying quietly on the bottom of the aquarium, where it had burrowed more or less deeply into the loose mud; but at times it was seen to make some rapid excursions through the water, moving about rather violently in different directions, the back generally upwards. It casts its skin several times, and a rather large number of exuviae were found in the aquarium, consisting of the skin of the whole body with its several appendages, as also the inner coating of the shell.

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## Cladocera.

Trib. Anomopoda. Fam. Daphnidæ.

Gen. *Moina*, Baird.

3. *Moina flexuosa*, G. O. Sars, n. sp.

(Pl. 3.)

Specific Characters.—Carapace with the dorsal part, in gravid female specimens, often very much, almost globularly expanded, ventral edges of valves highly flexuous, bulging in the middle to an obtuse prominence, behind which is a distinct, though rather shallow sinus. Head in female not very large, but remarkably erect, seen laterally triangular in form, with the ventral margin nearly straight and continuous with the labrum, frontal part narrowly rounded and somewhat prominent, supra-ocular sinus very slight, cervical impression strongly marked. Eye of moderate size. Antennulæ of female about half the length of the head, subfusiform, sensory bristle of the anterior edge situated nearly in the middle. Caudal claws perfectly smooth, antennal denticles about 8 on each side, the outmost placed at some distance from the others, and, as usual, bidentate. Ephippium with only a single egg-ampulla placed longitudinally. Male resembling that of the other species, but having the ventral edges of the valves flexuous in a similar manner to that in female. Body in both sexes highly pellucid, having sometimes, in larger female specimens, a slight rosy tinge. Maximum length of female 0.9 mm, of male 0.5 mm.

Remarks.—This new species may be easily distinguished from any of the other known *Moinæ* by the peculiar, flexuous bend of the ventral edges of the valves, as also by the form of the head in the female.

#### Description of the female.

The average length of fully adult, ovigerous specimens is from 0.7 mm. to 0.8 mm. The largest specimen found in my aquaria measured 0.9 mm., and it is therefore most probable, that this form never exceeds a length of 1 mm. It is accordingly by far the smallest of the 4 as yet known Australian species.

The general form of the body (see figs. 1 & 2) agrees on the whole with that of the other species of the genus, being rather short and stout, with the head and carapace very sharply marked off from each other.

The shell or carapace, which is defined dorsally from the head by a deep depression, has the dorsal part often enormously expanded, in order to make room for the numerous developing young ones. When these are ready to escape from the matrix, that part is sometimes found to project as a large, almost globular pouch sharply defined from the true valvular part, which in all specimens preserves its form quite unaltered. At the junction between the two, the carapace projects posteriorly to a short obtuse prominence, immediately below which there is a slight notch in the hind edges. The ventral edges of the valves, which in all other known species appear almost straight and horizontal, are in the present form rather irregularly flexuous, projecting in the middle to an obtuse prominence, behind which the edges appear slightly concave, before joining the posterior margin. In



front of the median prominence the edges are clothed with delicate bristles, and just within the margin a cellular stratum occurs similar to that found in other species. I have, however, failed to detect on the valves any trace of the usual irregular striation.

The head is comparatively small and, seen laterally (fig. 1), of a somewhat triangular outline. It is remarkably erect, not, as in the other known species, procumbent, and has the frontal part rather prominent and narrowly rounded at the tip, with only a very slight indication of a sinus above. The ventral margin of the head is nearly straight and horizontal, being continuous with the labrum; the dorsal margin appears slightly vaulted. Seen from above (fig. 2), the head appears rather broad, subpentagonal in form, with the greatest width about equalling the height, and the front obtusely rounded. The fornix is well defined, though not very prominent, and occurs just above the base of the oars.

The eye, occurring just within the frontal part, is not particularly large, exhibiting, however, the usual structure. As in the other species, no trace of an ocellus is to be detected.

The antennulæ (fig. 3) equal about half the length of the head. They are, as in the other species, freely mobile and of a subfusiform shape, with the posterior edge finely ciliated. The sensory bristle of the anterior edge occurs about in the middle. The apical olfactory papillæ are very small.

The antennæ or oars (see figs. 1 & 2) are powerfully developed, and agree in their structure exactly with those in the other species of the genus. At their base exteriorly 2 remarkably large, juxtaposed setæ occur pointing straight outwards.

The tail, which, as usual, does not admit of being wholly withdrawn between the valves, but is constantly seen projecting behind them, exhibits the structure characteristic of the genus. At about the middle, the posterior, or dorsal edge forms a conspicuous bulging, and at this place the anal orifice occurs. The outer part of the tail, beyond the anal orifice (see fig 4), is conically tapered, and carries on each side a series of about 3 denticles, the outermost of which is placed at some distance from the others and terminates in 2 unequal points. The remaining 7 denticles are very delicate, somewhat flattened, and finely ciliated on both edges. The caudal claws are of moderate length and perfectly smooth, without a trace of secondary denticles. The caudal setæ somewhat exceed the tail in length, and are distinctly biarticulate and densely ciliated.

The ephippium, seen laterally (fig. 5), is of an oval triangular form, being broadly rounded in front, and conically produced behind. It is very coarsely sculptured in the centre with raised knob-like prominences, and always contains but a single egg-ampulla placed longitudinally.

The adult male (fig. 6) is scarcely more than half as large as the female, and on the whole resembles the males of the 3 other Australian species, though it may be at once distinguished from them by the peculiar bend of the ventral edges of the valves, which exactly agrees with that found in the female. The head is comparatively much larger than in the female, and appears obtusely truncated in front, forming between the bases of the antennulæ a well-marked obtuse prominence.

The antennulæ, as in the males of the other species, are very powerfully developed, fully equalling half the length of the body. Their basal part is somewhat thickened, and



contains a strong muscular band passing through it diagonally. From the place where this muscle terminates, springs the sensory bristle of the anterior edge, and immediately inside it, a small hook-shaped denticle is seen projecting inwards. The outer part of the antennula is rather narrow and more or less curved, so as to meet, with its tip, the corresponding antennula on the other side, when bent in. Each antennula is armed on the obtusely rounded end with 4 strongly curved hooks, between which the usual fascicle of olfactory papillæ may be discerned (see fig. 7).

The structure of the 1st pair of legs and that of the testes seems to agree with that found in *M. australiensis* and *tenuicornis*.

In both sexes the body is highly pellucid and almost colourless. Only in large female specimens, a more or less distinctly rosy tinge may sometimes be observed. The egg contained in the ephippium is of a brick-red colour.

#### Biological Observations.

Of this form at first only a comparatively small number of female specimens were hatched in some of my aquaria. In the course of a few days they reached maturity, and began to propagate in the usual parthenogenetical manner, several successive generations of this kind being observed, whereby the number of specimens increased considerably. But at the same time the fertility of the individuals diminished conspicuously, and after the lapse of some time, the bisexual or gamogenetic period was seen to have set in, the greater number of the females now having the ovaries filled with a brick-red contents and showing traces of the ephippial formation. At this time, male specimens were observed in great numbers, eagerly pursuing the females, and

at times getting hold of them for copulation. The ephippia were soon formed, and successively dropped to the bottom, where they were subsequently easily detected, on account of the brick-red egg contained in each of them. The individuals now gradually diminished in number, and at last wholly disappeared, no specimens reappearing later in the season. It would therefore seem, that this form, unlike what is the case with the 2 Sydney species previously described by the present author, is «monocyclic» in character.

In habits, this form agrees with the other species, and moves in a similar jerky manner, though it is on the whole less active, especially in the later generations.

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## Ostracoda.

Trib. Podocopa. Fam. Cyprididæ.

Gen. *Cyprinotus*, Brady.

4. *Cyprinotus Dahli*, G. O. Sars, n. sp.

(Pl. 4, figs. 1—5).

Specific Characters.—Shell, seen laterally, ovoid in form, greatest height occurring behind the middle, dorsal margin boldly arched, and declining gradually in front, more steeply behind, ventral margin without any sinus, being on the contrary slightly convex in the middle; anterior extremity somewhat produced and obliquely truncated at the end from the front backwards, posterior extremity obtusely rounded:—seen from above, moderately tumid, greatest width behind the middle and almost attaining half the length, anterior extremity considerably narrower than the posterior. Valves rather unequal, the left one being more convex than the right, and overlapping it at each extremity by a narrow pellucid rim, whereas dorsally it is itself overlapped to some extent by the right one. Anterior and posterior edges of right valve distinctly tuberculated inside. Surface of shell very smooth and shining, clothed with hair only at each extremity. Caudal rami perfectly straight, slightly tapering distally, outer claw exceeding half the length of the ramus. Colour of female light yellowish clouded dorsally with dark sepia, that of male generally

more uniformly light brown. Length of female 1.40 mm., of male 1.20 mm.

Remark.—There cannot be any doubt that this form ought to be referred to the genus *Cyprinotus* of Brady, as defined by the present author in another paper<sup>1</sup>), agreeing as it does, in all essential anatomical details, as also in the structure of the shell, with the other species belonging to this genus. Yet it exhibits well-marked specific differences from any of them. For instance, the form of the shell is more regularly ovoid than in the other known species, and its anterior extremity appears truncated in a most peculiar manner. Moreover, the right valve in adult specimens of both sexes is raised considerably above the level of the left, a circumstance only found in *C. cingalensis*, but here in a still more marked manner. Finally, the colour is different from that in the other species. I am now of opinion, that the *Cypris aurea*, described by the present author from South Africa, should also more properly be referred to the same genus, because the structure of the valves is essentially the same, and because also this species is pronouncedly gamogenetic in character.

#### Description of the female.

The shell in fully grown specimens attains a length of 1.40 mm., a height of 0.90 mm., and a width of 0.70 mm. Accordingly, this form grows to a somewhat larger size than the 2 other Australian species, *C. dentato-marginatus* and *C. cingalensis*.

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<sup>1</sup>) G. O. Sars, On some Australian Fresh-water Ostracoda and Copepoda raised from dried mud.



Seen from the side (fig. 1), the shell exhibits a rather regular ovoid form, with the greatest height about equalling  $\frac{3}{5}$  of the length, and occurring behind the middle. The anterior extremity is somewhat produced and truncated at the end from the front backwards, a circumstance very seldom found in the Cyprididæ. The posterior extremity is much shorter, and obtusely rounded at the tip. The dorsal margin forms a bold and rather regular curve, having its highest point considerably behind the middle. Thence it slopes quite gently towards the front edge, whereas behind it curves more steeply to the posterior extremity. The ventral margin does not exhibit any median sinus, but is, on the contrary slightly convex, in the middle. It joins the anterior and posterior edges without any intervening angle.

Seen from above (fig. 2), the shell appears rather more tumid than in the other 2 Australian species, the greatest width, which occurs considerably behind the middle, almost attaining half the length. Both extremities appear obtusely pointed, but the anterior one is much narrower than the posterior and slightly twisted at the tip.

The valves, as in the other species of the genus, are rather unequal, the right one being conspicuously more convex than the left, and overlapping it at both extremities by a thin hyaline border, which, especially on the anterior extremity, is rather broad. Ventrally also, the left valve is found to overlap the right considerably, and this is the reason why the usual ventral sinus does not appear in the lateral aspect of the shell. On the other hand, the right valve projects dorsally to some extent beyond the left one in a manner similar to that found in *C. cingalensis*. On viewing the shell from the left side (fig. 1), therefore, a part of this valve is seen raised above the hinge, though not form-

ing such a pronounced gibbous prominence as in the last-named species. Whereas the left valve has the edge quite smooth throughout, the right one, as in all other species belonging to this genus, has, inside the anterior and posterior extremities, a series of small tubercles, giving this part of the edge a minutely crenulated appearance.

The surface of the shell is perfectly smooth and polished, with only the usual small scattered pits, and is hairy only at each extremity. In the centre of each valve the impressions of the adductor muscle of the shell are easily observable, exhibiting the usual number and arrangement.

The colour of the shell is light yellowish, sometimes with a slight olivaceous tinge, and clouded dorsally, behind the eye, with dark sepia. The caecal appendages of the intestine shine through the shell with a dark green colour, and just above them the shell generally exhibits a reddish orange tinge caused by the ripe ova accumulated within the body.

The eye is seen fairly well through the shell; it is of moderate size and normal structure.

The several appendages of the body almost exactly agree in their structure with those in *C. dentato-marginatus*, as described in detail by the present author in his above-quoted paper.

The caudal rami (fig. 4) are of moderate length and quite straight, tapering slightly distally. They are armed in the usual manner, each having at the tip 2 unequal, slender claws, the outer of which is the longer, and somewhat exceeds half the length of the ramus. Just in front of it, there is a rather small bristle, and at a short distance from the proximal claw, the somewhat longer dorsal bristle is seen to originate.



The adult male (fig. 3) is of somewhat smaller size than the female, scarcely exceeding a length of 1.20 mm., and has the shell comparatively shorter, with the dorsal margin still more boldly curved. It may, moreover, at once be recognized by the darker brownish colour, and by the spermatic vessels shining more or less distinctly through the shell. These vessels are arranged in exactly the same manner as in the male of *C. dentato-marginatus*, forming in the posterior part of each valve 4 densely crowded coils, whereas a single vessel is sent off in front, and runs along the anterior extremity.

The palps of the posterior maxillæ are, as is usual in male specimens, transformed into strong grasping organs, and resemble in shape those in the above-named species, being rather dissimilar on the two sides. The outer sexual appendages (fig. 5) have also much the same appearance as in that species.

#### Biological Observations.

This beautiful species, which I have much pleasure in dedicating to Mr. Knut Dahl, to whom I am indebted for its examination, developed in great abundance in some of my aquaria, and has been watched in several successive generations. At first, however, only some few specimens, males and females, appeared in each of the aquaria; but these rapidly multiplied, and at last gave rise to a vast progeny. At the time when this is written (in the beginning of October), the aquaria still swarm with this Ostracod, and it is my intention to keep them for subsequent observation.

As to habits, it is a very active animal, swimming about with great speed by the aid of the long natatory setæ issuing from both pairs of antennæ. Especially during the

warmest part of the summer, when the aquaria were exposed to the direct rays of the sun, did the specimens move with extraordinary rapidity, now and then stopping in order to feed on some nourishing matter. In proportion as the weather became colder, the animals assumed a somewhat more sluggish habit, and were more frequently seen keeping at the bottom, more or less deeply buried in the loose mud, and only at times moving freely through the water. Male and female specimens occurred during the whole season in about equal numbers, and both were very often seen in copulation. This form, indeed, is pronouncedly gamogenetic in character, like the other known species of the genus.

Gen. *Cypris*, Müller.

5. *Cypris oblongata*, G. O. Sars, n. sp.

(Pl. 4, figs. 6—9).

Specific Characters.—Shell, seen laterally, oblong subreniform, greatest height not attaining half the length, and occurring in front of the middle, anterior extremity broadly rounded, posterior considerably narrower, and obtusely produced, dorsal margin in female rather evenly arched, in male nearly straight in the middle, with an indication of angle in front and behind, ventral margin distinctly sinuated:—seen from above, moderately tumid, oblong fusiform in outline, greatest width not attaining the height, and occurring in front of the middle, posterior extremity considerably narrower than the anterior. Valves nearly equal, the left one having a very narrow hyaline border at each extremity, right valve without any marginal tubercles.



Surface of shell perfectly smooth, and but slightly hairy at each extremity; inner duplicatures narrow. Caudal rami of moderate size and somewhat curved, outer claw about half the length of the ramus. Posterior coil of spermatic vessels in male forming in the ventral part of each valve a remarkable bend in front. Colour of female light yellowish, with a dark brown patch above the insertion of the adductor muscle of the shell, generally drawn out behind into 2 narrow bands, the lower one occurring just above the cæca of the intestine, the upper one near the dorsal face; ocular region more or less tinged with light chestnut. Colour of male darker brown. Length of female 1.9 mm., of male 1.6 mm.

Remarks.—I have only provisionally referred this form to the genus *Cypris* (sens. strict.); for in one character, at least, it seems to differ very markedly from the other species. Whereas all these, as far as I know, are parthenogenetic in character, the present species has turned out to be as pronouncedly gamogenetic as the species of the genus *Cyprinotus*. It cannot, however, by any means be referred to the latter genus, because the shell does not exhibit any of the characteristic features peculiar to that genus. In the narrow oblong shape of the shell it somewhat recalls the species of the genus *Stenocypris*; but the caudal rami do not agree in structure with those in the latter genus, the species of which, moreover, are pronouncedly parthenogenetic in character.

#### Description of the female.

The shell of the largest female specimen examined measures in length 1.9 mm., in height 0.8 mm., and in width

0.74 mm. This form accordingly grows to a rather larger size than the species of *Cyprinotus* described above.

Seen from the side (Pl. 4, fig. 6), the shell exhibits a somewhat irregular oblong reniform or slightly clavate shape, with the greatest height not nearly attaining half the length, and occurring considerably in front of the middle. The anterior extremity appears broadly and regularly rounded, whereas the posterior one is considerably narrower and terminates in a slightly deflexed, obtuse prominence. The dorsal margin is gently arched, with its greatest curvature somewhat behind the ocular region, from whence it declines with a nearly straight course to the front edges. In its most posterior part it exhibits an indication of a sinus just above the obtusely produced hind extremity. The ventral margin is evenly concaved a little in front of the middle, and joins the anterior and posterior edges without any intervening angle.

Seen from above (fig. 7), the shell appears moderately tumid and oblong fusiform in outline, with the greatest width about equalling  $\frac{2}{5}$  of the length, and occurring somewhat in front of the middle. The lateral contours are quite evenly curved, and both extremities pointed, though the posterior one is considerably narrower than the anterior.

The valves are nearly equal, though, on a closer examination, the left one is found to overlap the right at both extremities by a very narrow, hyaline border. The edges of both valves are perfectly smooth, and the inner duplicatures rather narrow.

The surface of the shell is smooth and polished, without any obvious sculpturing, and it is clothed at each extremity with scattered short hairs.



The natatory setæ on the antennæ are very long and finely plumose, those of the inferior antennæ reaching considerably beyond the terminal claws. The oral parts and the legs are of normal structure, nearly agreeing with those parts in the other species of the genus *Cypris* (sens. strict.).

The caudal rami (fig. 9) are not particularly large, and exhibit at the base a very pronounced curve. They have the dorsal edge quite smooth, and carry at the end the 2 usual claws and 2 small bristles, the one apical, the other dorsal. The claws are perfectly smooth, the outer one being, as usual, the larger, though scarcely exceeding half the length of the ramus.

In the living state of the animal, the shell exhibits a light yellowish colour, with a very conspicuous dark brown patch in the dorsal part of each valve, above the insertion for the adductor muscle. This patch is generally drawn out behind into 2 narrow diagonal bands, the lower of which has a somewhat lighter reddish brown colour, and occurs just above the cæcal appendage of the intestine, whereas the upper one lies near the dorsal face. Between the two, a pale orange tinge may be observed, caused by the ripe ova accumulated within the body. In the region of the eye the shell is generally tinged with light chestnut. The cæcal appendages of the intestine shine through the shell with a bluish green colour.

The adult male (fig. 8) is somewhat smaller than the female, scarcely exceeding a length of 1.6 mm., and it slightly differs in the shape of the shell. In a lateral view, the latter appears comparatively shorter in proportion to its height, and less narrowed behind. The dorsal margin is less regularly curved, being almost straight in the middle, and exhibiting a slight indication to an angle in front and

behind. Male specimens may, moreover, be at once recognized by the somewhat darker brown colour of the shell, and by the spermatie vessels shining more or less distinctly through the valves. As usual, the greater number of these vessels is accumulated in the posterior part of each valve, there forming a close, winding coil, which however in the present form exhibits this peculiarity, that its end is bent forward for some distance along the ventral part of the shell (see fig. 8).

#### Biological Observations.

Of this pretty species some few specimens, males and females, developed in 2 of my aquaria, and were watched for some time. They did not, however, multiply to any great extent, and before the end of the summer they had wholly disappeared. A limited number of specimens, however, were previously secured and preserved for closer examination. In habits it agrees with the other species of the genus *Cypris*, being rather agile and admirably well adapted for swimming, though more generally it kept near the bottom of the aquarium. Males and females occurred in about equal numbers, and copulation was very often seen to take place, showing the species to be pronouncedly gamogenetic in character.



## Explanation of the Plates.

### Pl. I.

*Apus australiensis*, Spencer & Hall.

- Fig. 1. Young (male?) specimen, drawn from life, and viewed from above; magnified about 9 diameters.
- » 1 a. Same, natural size.
  - » 2. Leg of 1st pair; magnified 19 diameters.
  - » 3. Leg of 2nd pair.
  - » 4. Leg of 11th pair.
  - » 5. Extremity of tail with bases of the caudal filaments; dorsal view.
  - » 6. Left dorsal sensory knob of the terminal segment; highly magnified.

### Pl. 2.

*Estheria elliptica*, G. O. Sars.

- Fig. 1. Shell of adult female, viewed from left side; magnified about 16 diameters.
- » 2. Same, dorsal view.
  - » 3. Part of left valve, more highly magnified, to show the peculiar sculpturing of the shell.
  - » 4. Right valve with enclosed animal (the left valve being removed), lateral aspect; magnified 22 diameters.
  - » 5. Tail with adjoining part of trunk, seen from left side; magnified 52 diameters.

Pl. 3.

*Moina flexuosa*, G. O. Sars.

- Fig. 1. Adult, gravid female, viewed from left side; magnified 80 diameters.
- » 2. Same, dorsal view.
  - » 3. Antennula, more highly magnified.
  - » 4. Outer part of tail, lateral view.
  - » 5. Ephippium from left side.
  - » 6. Adult male, lateral view; magnified 140 diameters.
  - » 7. Extremity of an antennula of same, more highly magnified.

Pl. 4.

*Cyprinotus Dahli*, G. O. Sars.

- Fig. 1. Adult female, from left side; magnified 52 diameters.
- » 2. Same, dorsal view.
  - » 3. Adult male, from left side.
  - » 4. Caudal ramus.
  - » 5. Left half of outer sexual apparatus, lateral view.

*Cypris oblongata*, G. O. Sars.

- » 6. Adult female, from left side; magnified 44 diameters.
- » 7. Same, dorsal view.
- » 8. Adult male, from left side.
- » 9. Caudal ramus.















