

ON SOME AUSTRALIAN FRESHWATER COPEPODA
AND OSTRACODA.

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With Plates I and II.

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Introduction.

The present paper is a continuation of the work on Freshwater Crustacea begun in the paper "On Some Australian Cladocera," published in the Proceedings of the Royal Society of N.S.W., Vol. LII.

The work has been done under the ægis of the Commonwealth Advisory Council of Science and Industry as work arising out of an investigation of the transmission of worm-nodes in cattle by a Special Committee appointed for that purpose. The work was begun at Kendall on the North Coast and continued at the Zoological Laboratory of Sydney University.

Material Investigated.

The material was mainly obtained from freshwater ponds and creeks in the vicinity of Kendall, and from a pond in the University grounds. Collections were also made at Waterfall, on the Lett River, Blue Mountains, Botany and Dorrigo. One or more tubes of preserved material were received from each of the following places: Byron Bay, Casino, Bangalow, Orange, Cumbalum, and Corowa. Two of the new species here described were found at Kendall, one at Cumbalum and one at Botany.

Methods Employed.

In the case of Crustacea obtained at Kendall, Botany and the University, the specimens were examined alive

BOECKELLA MINUTA, Sars.

This species was first described by Sars in "Freshwater Entomostraca from the neighbourhood of Sydney."⁽²⁰⁾ He again gave a description of it in "Freshwater Copepoda from Victoria."⁽²⁷⁾

This form was found in abundance in a pond in the University grounds in June and July. It was also found at Kendall in June and at Corowa in March.

Sars recorded it from Botany Bay, the Waterloo Swamps and from Heidelberg near Melbourne.

Genus GLADIOFERENS n. g.

Cephalothorax consisting of six segments, last segment rather short with the lateral parts only slightly expanded, rounded. Abdomen *consisting of four segments in the female*, five in the male. Caudal rami long and slender. Antennules in the female consisting of twenty-five segments; right antennule in the male geniculate. Antennæ, with the outer ramus about the same length as the inner, composed of six segments. Oral parts of normal structure. Natatory legs biramus, each ramus consisting of three segments; basal segment of each leg of the fourth pair in the female *bearing a long curved sword-like spine on the inner edge*. Fifth legs in the female similar, each with a curved process on the inner edge of the middle segment of the outer ramus. Fifth legs in the male dissimilar, outer ramus usually three segmented, terminal segment of the outer ramus of the right leg armed with one long spine, that of the left leg armed with several short spines. Ovisac present, situated on the ventral surface.

This genus is nearly allied to *Boeckella*, De Guerne and Richard, with which it agrees in the structure of the oral parts, the natatory legs and the fifth pair of legs in the female. It differs, however, in the number of abdominal

segments in the female; the length of the caudal rami; the presence of a long spine on the basal segment of the fourth leg in the female and the structure of the last pair of legs in the male.

GLADIOFERENS SPINOSUS, sp. n.

(Plate I, figs. 1-7.)

The average length of the female, not including the caudal rami, is 1.3 mm.

The general form of the body is moderately robust, with the two chief divisions sharply marked off from each other. Seen dorsally, the cephalothorax is of oval form, with the greatest width a little behind the middle; it tapers more anteriorly than posteriorly. The head is narrowly rounded in front, and projects below in a fairly well marked rostral prominence. The last thoracic segment is rather short and has the lateral parts slightly expanded into two rounded lobes; each lobe bears a spine and sometimes one or two smaller spines in addition.

The abdomen is long and slender, composed of four segments. The genital segment widens posteriorly and is expanded into two small rounded lobes; there is also a slight rounded projection on each side at about the middle; a group of bristles is present on each of these four projections. The prominence on the ventral surface of this segment is not very protuberant. The second segment is short and somewhat rounded; the third is longer than the second and is rectangular; the fourth is about the same length as the second. The caudal rami are very long and slender, equalling the length of the last two segments combined. They are divergent and bear hairs on their inner and outer edges; those on the inner edges being the longer. The outer edge on each side has a ledge to which one of the caudal setæ is attached; the remaining four setæ issue close together from the truncated end of each ramus. They are all about the same length.

The antennules are composed of twenty-five segments, some of the proximal ones being very small. When reflexed they extend about as far as the middle of the genital segment.

The antennæ (fig. 4) are biramus, the outer branch, composed of six segments, is about the same length as the inner.

The mandibles are strongly built; the masticatory part is expanded and bears eight somewhat rounded denticles; the outermost of these is the largest, and is separated from the others by a sinus.

The maxillæ and anterior maxillipedes are of normal structure.

The posterior maxillipedes (fig. 5) are long and slender, the four distal segments are small and bear numerous setæ.

The first four pairs of natatory legs are long and slender, each ramus consisting of three segments; the inner rami are shorter than the outer. In addition to the setæ, the outer ramus of each leg bears a denticulated spine on the outer edge of each segment, the third segment also bears two terminal spines, one of which is very long and coarsely denticulated. The basal segment of each leg of the fourth pair (fig. 2), bears a long curved spine on the inner edge, which reaches as far as the end of the middle segment of the inner ramus. The fifth pair of legs (fig. 3) is slightly shorter; the outer ramus is armed like the preceding ones, but bears in addition a long curved spine on the inner edge of the middle segment.

The ovisac is rounded, and is situated on the ventral surface.

The male is smaller than the female, the abdomen is very slender, and consists of five segments. The right antennule (fig. 6) is modified, being swollen and hinged. It may be divided into three sections; the first consists of

nine segments, some of which are very small, the last three bear sensory appendages; the second section is swollen and consists of six segments; the terminal part is curved and consists of two long segments.

The natatory legs are armed as in the female, but the spine on the basal segment of the fourth pair is not present.

The fifth pair of legs (fig. 7) are strongly built, the right being the longer. In both legs the inner and outer rami are composed of three segments. In the right leg, the terminal segment of the outer ramus is small and bears one long spine; the second and third segments each bear a denticulated spine on the outer edge; the inner edge of the third segment is produced into a short pointed projection. The inner ramus is smaller, it bears only setæ on the terminal segment. The left leg is shorter, its outer ramus is very stout. Each segment of the outer ramus bears a denticulated spine on the outer edge, while the third segment bears two terminal spines as well; the inner ramus is smaller; its third segment bears a short spine.

Specific Characters.—Female. Body moderately robust with the anterior division oval in form, narrower in front than behind. Lateral parts of the last thoracic segment slightly expanded, rounded, each bearing one or more small spines; abdomen consisting of four segments. Genital segment widening posteriorly. Caudal rami very long, with hairs on the inner and outer edges. Caudal setæ of equal length. Antennules reaching as far as the middle of the genital segment, consisting of twenty-five segments. Natatory legs with both rami composed of three segments; outer rami with long coarsely denticulate terminal spines; fourth pair, each with a long curved spine on the basal segment. Last pair of legs smaller, outer ramus armed in the same manner as in the other legs, but also possessing a curved spine on the inner edge of the middle segment. Ovisac present, ventral in position. Length 1.3 mm.

Male smaller than the female. Right antennule bearing three sensory processes, middle section moderately swollen. Last pair of legs powerful; both rami three segmented. Right leg with a curved terminal spine on the outer ramus; second and third segments with denticulated spines; third segment produced into a projection on the inner edge; inner ramus bearing setæ. Left leg short and stout; outer ramus with three short spines on the third segment, and one on each of the other two; inner ramus armed with one short spine. Length 1.0 mm.

Collected at Kendall and Waterfall in May and June. Type specimen in the Australian Museum, No. ♀ P 4336, ♂ P 4337.

GLADIOFERENS BREVICORNIS, sp. n.

(Plate II, figs. 10–12.)

The average length of the adult female is about 1 mm. The general form of the body is rather slender with the anterior division oval in shape, tapering in front and behind. The greatest width occurs about the middle. The head is narrowly rounded and has a very small rostral prominence. The last pedigerous segment is small, hardly expanded at all, the lateral parts being rounded off and tipped with a bristle.

The abdomen is slender and composed of four segments. The genital segment is rounded, widening posteriorly; the second segment is short and somewhat rounded; the third is longer and narrower; the fourth is about as long as the second.

The caudal rami are fairly long, and only slightly divergent. The outer edge of each ramus has a little ledge from which the outermost seta springs; the two middle setæ of the terminal four are longer than the inner and outer ones.

The antennules are not very long, only extending, when reflexed, to the end of the cephalothorax. They are com-

posed of about twenty-five segments, some of the proximal ones being very small. The oral parts are similar to those of the preceding species.

The first four pairs of legs have both rami composed of three segments. The spines on the terminal segments of the outer rami are long and coarsely denticulated. The fourth pair of legs bears a curved denticulated spine on the inner edge of the basal segment as well as the usual bristle. The fifth pair of legs is armed as in the preceding species; the curved process of the middle segment of the outer ramus is large and coarsely denticulated. The inner ramus reaches beyond the middle segment of the outer. The rounded ovisac is situated on the ventral surface.

The male is slightly smaller than the female and has a slender abdomen composed of five segments.

The right antennule bears three or four sensory processes and several short spiny projections; it is more swollen than that of the preceding species.

The fifth pair of legs are short and very stout. The right leg (fig. 11) is longer, and bears a curved spine on the terminal segment of the outer ramus, the two other segments each bear a spine on the outer edge; the inner ramus consists of two segments, the terminal one bears a spine. The outer ramus of the left leg (fig. 12) is composed of two large segments; the broad expanded terminal one bears four short spines and a longer denticulated spine on the outer edge; the second segment bears a denticulated spine; the inner ramus consists of a single segment bearing four short spines.

This species is smaller than the preceding one; the main points of difference are as follows. The antennules, although consisting of the same number of segments are comparatively shorter; the right one in the male is more swollen.

The caudal setæ are of different lengths instead of being equal.

The spine on the basal segment of the fourth leg in the female bears a row of denticles instead of being smooth. The fifth pair of legs in the male differs in the number of segments in the rami and in the armature.

Specific Characters.—Female. Body slender with the cephalothorax oval in shape, narrowed in front and behind; lateral parts of the last pedigerous segment rounded. Abdomen composed of four segments, of which the genital segment is the largest. Antennule composed of twenty-five segments, only reaching as far as the base of the cephalothorax. Fourth pair of legs each with a long denticulated spine on the basal segment. Last pair of legs with the curved process of the outer ramus large and coarsely denticulated, inner ramus reaching beyond the middle segment of the outer ramus.

Male smaller than the female, abdomen slender, composed of five segments. Right antennule bearing three or four sensory processes, swollen. Last pair of legs short and stout; right leg with a terminal spine on the tri-articulate outer ramus, one lateral spine on each of the other segments, inner ramus small, composed of one segment bearing a terminal spine; outer ramus of the left leg with two broad segments, terminal segment bearing four short spines and a longer lateral spine; inner ramus small, one segmented, bearing four short spines.

Collected at Cumbalum in January. Type specimen in the Australian Museum, No. P 4338.

Family DIAPTOMIDÆ.

Genus DIATOMUS, Westwood.

DIATOMUS ORIENTALIS, Brady.

This species was first described by Brady in "Notes on Entomostraca collected in Ceylon," Linn. Soc. Jour. Zool.,

Vol. XIX. A more detailed description with good figures was given by Sars in "On some Freshwater Ostracoda and Copepoda raised from Dried Australian Mud."⁽¹⁷⁾

Both males and females of this species were collected at Casino in January.

Brady recorded this form from Ceylon, and Sars from Rockhampton, Queensland.

Division CYCLOPOIDA.

Family CYCLOPIDÆ.

Genus CYCLOPS, Muller.

CYCLOPS AUSTRALIS, King.

This form was first described by King in his paper "On Australian Entomostracans."⁽¹⁴⁾ It was later described by Sars in "Freshwater Entomostraca from the neighbourhood of Sydney"⁽²⁰⁾ and figured in "Freshwater Copepoda from Victoria."⁽²⁷⁾

This large species was collected at Kendall and at Corowa in March, and at Byron Bay in January.

Sars recorded it from the Waterloo Swamps, Centennial Park and Bourke Street, Sydney.

Genus MESOCYCLOPS, Sars.

MESOCYCLOPS OBSOLETUS, Koch.

Syn. *Cyclops leuckarti*, Claus, *C. simplex*, Poggenpol, *C. scourfieldi*, Brady.

This form was first described by Koch in "Deutschlands Crustaceen, Myriapoden und Arachniden," Heft 21, Tab. 5.⁽¹⁵⁾

Sars gives a description and good figures in the "Crustacea of Norway."⁽³¹⁾

This species was found in abundance at Kendall in both summer and winter. It was also collected at Waterfall in July.

This form has been recorded from Europe, Asia, Africa and North and South America. Sars gave the following Australian localities, Centennial Park, Bourke Street and the Waterloo Swamps, Sydney, and St. Arnaud, Victoria.

Genus PACHYCYCLOPS, Sars.

PACHYCYCLOPS ANNULICORNIS, Koch.

Syn. *Cyclops quadricornis albidus*, Jurine, *C. tenuicornis* Claus, *C. albidus*, Schmeil, *C. gyrinus*, Forbes.

This species was first described by Koch in "Deutschlands Crustaceen," Heft. 21, Tab. 6.⁽¹⁵⁾

It is described and figured in detail by Sars in the "Crustacea of Norway."⁽³¹⁾

This form was collected at Kendall in both winter and summer months, and at Waterfall in July.

This species has been recorded from Europe, Northern Asia, Central Africa, North and South America and Hawaii. Sars recorded it from the Centennial Park, Sydney, and St. Arnaud, Victoria.

Genus LEPTOCYCLOPS, Sars.

LEPTOCYCLOPS AGILIS, Koch.

Syn. *Cyclops serrulatus*, Fischer, *C. varius* var. *brachyura*, Lilljeborg.

Koch first described this species in Deutschlands Crustaceen, Myriopoden und Arachniden,⁽¹⁵⁾ Heft 21, Tab. 3.

A more detailed description is given by Sars in the "Crustacea of Norway."⁽³¹⁾

This very common form was collected at Kendall and Orange in December, the Lett River in September, at a pond in the University Grounds in July, and at Byron Bay, Bangalow and Dorrigo in January.

This species has been recorded from Europe, Asia, Algeria, The Azores and North America. In Australia it has been

recorded from Centennial Park and the Waterloo Swamps, Sydney.

LEPTOCYCLOPS VIRIDIS, sp. n.

(Plate II, figs. 8, 9).

This is a very small form; the length of the adult female only attains 0.61 mm.

The cephalothorax is moderately slender and oval in outline; the greatest width occurs about the middle. The abdomen is slender and composed of four segments; the genital segment is not dilated and is equal in length to the next two segments combined. The caudal rami are somewhat divergent, slightly longer than the last segment. The inner of the two middle apical setæ is twice as long as the outer; the seta of the inner corner is small, shorter than that of the outer.

The antennules are long and slender, reaching, when reflexed, almost to the end of the cephalothorax. They are composed of twelve segments, the third and sixth of which are very small, the last six are slender and elongated. The rudimentary palp of the mandible bears two long feathered setæ and a bristle.

The anterior maxillipedes have the subdivision of the first basal segment indistinct. The posterior maxillipedes have stout curved setæ on the proximal segment.

The natatory legs are well developed with tri-articulate rami. The first pair is the smallest, and has the second basal joint produced at the inner corner and provided with a spine. The apical spines of the fourth pair are particularly long. The last pair (fig. 9) is very small, it consists of a simple lamella armed inside with a denticulate spine and outside and at the tip with a slender seta. Ovisacs oval in shape and greyish-brown in colour.

The male is smaller than the female and possesses very much swollen and curved antennules.

The colour of males and females is dark green with light orange antennules and antennæ and orange markings on the abdomen.

This species somewhat resembles *Cyclops prasinus*, Fischer. The antennules, however, are straight and lack the hinge of *C. prasinus*; the lateral caudal seta is situated close to the end of the ramus instead of in the middle; the colouring is distinctly green and orange instead of indigo blue.

Specific Characters.—Female with a moderately slender body, cephalothorax oval. Genital segment equal in length to the next two segments combined. Caudal rami divergent, slightly longer than the last segment. Inner middle apical seta twice as long as the outer. Antennules composed of twelve segments, reaching when reflexed, to the base of the cephalothorax. Natatory legs all tri-articulate. Fifth pair of legs consisting of a lamella with a spine and two setæ. Ovisacs oval, slightly divergent.

Collected at Kendall during both winter and summer months. Type specimen in the Australian Museum No. P 4339.

Genus PLATYCYCLOPS, Sars.

PLATYCYCLOPS PHALERATUS, Koch.

Syn. *Cyclops canthocarpoides*, Fischer, *C. lascivus*, Poggenpol.

This form was first described by Koch in "Deutschlands Crustaceen, Myriapoden und Arachniden"⁽¹⁵⁾ in Heft 21, tab 9. It is described and figured by Sars in the "Crustacea of Norway,"⁽³¹⁾ and by Marsh in "North American Species of Cyclops."⁽¹⁶⁾

This species was found in abundance at Kendall during the winter and summer months; it was also collected from a pond in the University grounds in July.

This form has been recorded from Europe, Turkestan, North America, Egypt and Java. Sars found this species in a collection made at the Centennial Park, Sydney.

PLATYCYCLOPS FIMBRIATUS, Fischer.

Syn. *Cyclops crassicornis*, Sars.

Fischer first described this species in his "Beiträge zur Kenntniss der Cyclopiden," Bull. Soc. Imp. Moscou, 1853.

It is described and figured by Sars in the "Crustacea of Norway,"⁽³¹⁾

A few specimens of this small species were collected at Kendall in December.

Platycyclops fimbriatus has been recorded from various parts of Europe and from North America.

OSTRACODA.

Division PODOCOPA.

Family CYPRIDIDÆ.

Genus CYPRETTA, Vavra.

CYPRETTA GLOBULUS, Sars.

Sars first described this form in his paper "On some Freshwater Ostracoda and Copepoda raised from Dried Australian Mud,"⁽¹⁷⁾ under the name of *Cypridopsis globulus*. This species, however, does not belong to the genus *Cypridopsis* for the caudal rami are normally developed. Sars in his paper on the "Ostracoda from Tanganyika"⁽²⁸⁾ refers this and the allied Australian species to the genus *Cypretta*, Vavra.

This form was fairly numerous at Kendall in both summer and winter months.

Sars recorded it from Rockhampton, Queensland.

CYPRETTA VIRIDIS, Thomson.

This form was first described by Thomson in "On the New Zealand Entomostraca" as *Cypris viridis*.⁽³⁵⁾ It was later more fully described by Sars in "Freshwater Entomostraca of New Zealand"⁽¹⁸⁾ as *Cypridopsis viridis*.

A few specimens of this species were collected at Botany in July.

Thomson recorded this form from Dunedin, and Sars from Kaitaia, New Zealand, and Bourke Street, Sydney.

Genus STENOCPYPRIS, Sars.

STENOCPYPRIS MALCOLMSONII, Brady.

This form was first described by Brady in "Notes on Entomostraca collected by Mr. Haly in Ceylon," Linn. Soc. Jour. Zool., Vol. XIX, as *Cypris malcolmsonii*. A more detailed description with good figures was given by Sars in his paper "On Some Freshwater Ostracoda and Copepoda raised from Dried Australian Mud."⁽¹⁷⁾ Two well preserved specimens of this species were obtained at Casino in January. Brady recorded this species from Nagpur in India, and from Ceylon.

Sars found it in collections made at Gracemere and Crescent Lagoons near Rockhampton, Queensland.

Genus CYPRINOTUS, Brady.

CYPRINOTUS DENTATO-MARGINATUS, Baird.

This form was first described by Baird as *Cypris dentato-marginatus* in "Description of some new recent Entomostraca from Nagpur collected by the Rev. S. Hislope," Proc. Zool. Soc., London 1859. Sars gave a very full description with good figures in "On some Freshwater Ostracoda and Copepoda raised from Dried Australian Mud."⁽¹⁷⁾

This form was present in abundance in a collection made at Botany in July.

This species was collected at Nagpur in India, and in Australia from the Gracemere and Crescent Lagoons near Rockhampton.

CYPRINOTUS FUSCUS, sp. n.

(Plate II, figs. 13, 14).

The carapace of the adult female attains a length of 2 mm. so that this form grows to a larger size than the other Australian species.

Viewed laterally, the carapace exhibits a wide oval shape, with the greatest height 1.3 mm. occurring about the middle. The anterior extremity is obliquely rounded and somewhat narrower than the posterior. The dorsal margin forms a bold, fairly regular curve; the ventral margin is slightly convex and joins the anterior and posterior extremities without any intervening angle. Seen from above the carapace is rather tumid; the anterior extremity is more pointed than the posterior. The valves are unequal, the left one slightly overlaps the right at both ends, but dorsally and ventrally it is surpassed by fairly large projections of the right valve. The ventral edge of the left valve has a very slight ventral sinus, but the projection of the right gives a convex appearance to the lateral view of the carapace. The left valve has a smooth edge throughout, but the right one, as in all other species belonging to the genus, has a series of small tubercles inside the anterior and posterior extremities. These give the edge a minutely crenulated appearance.

The surface of the carapace is smooth and polished; it is marked with the usual scattered pits. There are only a few hairs, and these are confined to the extremities.

The carapace is an orange-brown colour with darker brown markings. In the living animal the dark greenish intestine and orange coloured ova can be seen through the carapace. The structure of the oral parts is that characteristic of the genus.

The anterior leg (fig. 15) has a long, curved, denticulated terminal spine.

The caudal rami (fig. 14) are of moderate length; they taper slightly distally, and are armed with two unequal claws and two bristles; both the claws are finely denticulated for the outer two-thirds of their length; the larger exceeds half the length of the ramus.

This species most nearly resembles *Cyprinotus dahli*, Sars, described by Sars in his paper "On Some West-Australian Entomostraca."⁽³²⁾ It differs from this smaller form in its general shape, and in having a ventral as well as a dorsal projection of the right valve. It also differs in the fine denticulation of the caudal claws.

Specific Characters.—Carapace, seen laterally, oval in form, greatest height occurring about the middle; dorsal margin boldly arched, ventral slightly convex; anterior extremity obliquely rounded. Seen from above rather tumid, anterior extremity narrower than the posterior. Valves of unequal size, the left one slightly overlapping the right at the extremities, but overlapped by projections of the right valve, both dorsally and ventrally. Surface of the carapace smooth, sparsely hairy at the extremities. Oral parts normal. Caudal rami tapering slightly distally, terminal claws denticulated, outer claw exceeding half the length of the ramus. Colour orange-brown, marked with darker brown. Length 2 mm.

Collected at Botany in July. Type specimen in the Australian Museum, No. P 4341.

Genus ILYODROMUS, Sars.

ILYODROMUS VARROVILLIUS, King.

King first described this species in "On Australian Entomostracans"⁽¹⁴⁾ as *Cypris varrovillia*. Sars gave a description with good figures in "Freshwater Entomostraca of New Zealand."⁽¹⁸⁾ This form was very abundant at Kendall in both summer and winter months.

King found this species at Varroville, near Sydney, and Sars in Lagoons in the neighbourhood of Dunedin, and in ditches at Kaitaia, North Island, New Zealand.

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Explanation of Plates.

The drawings which were made by Mr. F. W. Atkins, of the Technical High School, Sydney, were all done with the help of the camera lucida.

PLATE I, *Gladioferens spinosus*.

- Fig. 1. Whole mount.
 " 2. Leg of the fourth pair, female.
 " 3. Leg of the fifth pair, female.
 " 4. Antenna.
 " 5. Posterior maxillipede.
 " 6. Right antennule, male.
 " 7. Fifth pair of legs, male.

PLATE II.

- Fig. 8. *Leptocyclops viridis*.
 " 9. Fifth leg of *L. viridis*.
 " 10. *Gladioferens brevicornis*.
 " 11. Right leg of the fifth pair, male of *G. brevicornis*.
 " 12. Left leg of the fifth pair, male of *G. brevicornis*.
 " 13. *Cyprinotus fuscus*.
 " 14. Caudal ramus of *C. fuscus*.
 " 15. Anterior leg of *C. fuscus*.



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