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Comparative morphology and review of Australian Notodromadinae KAUFMANN 1900

(Crustacea: Ostracoda).

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With 7 text-figures, 8 plates, 1 map and 1 table.

Abstract: All Australian species of the subfamily Notodromadinae are reviewed and their carapace morphology and soft parts are compared. The following characteristics were found to be important in taxonomy at the genus level: size of eye tubercle; fine details of shell, details shown by cross sections (longitudinal and transverse) of shell; type of inner lamella, selvage and flange; and these at the species level: fine details of shell, details shown by cross sections (longitudinal and transverse) of shell; shape of prehensile palps of maxilla in males; shape of hemipenis.

Two new species of *Newnhamia* (*N. petiola, N. insolita*) and one new genus, new species *Kennethia cristata* are erected.

Finally, on morphological grounds, the discussion leads to the separation of notodromadinid ostracods from the family Cyprididae BAIRD 1845 into a separate family, Notodromadidae KAUFMANN 1900.

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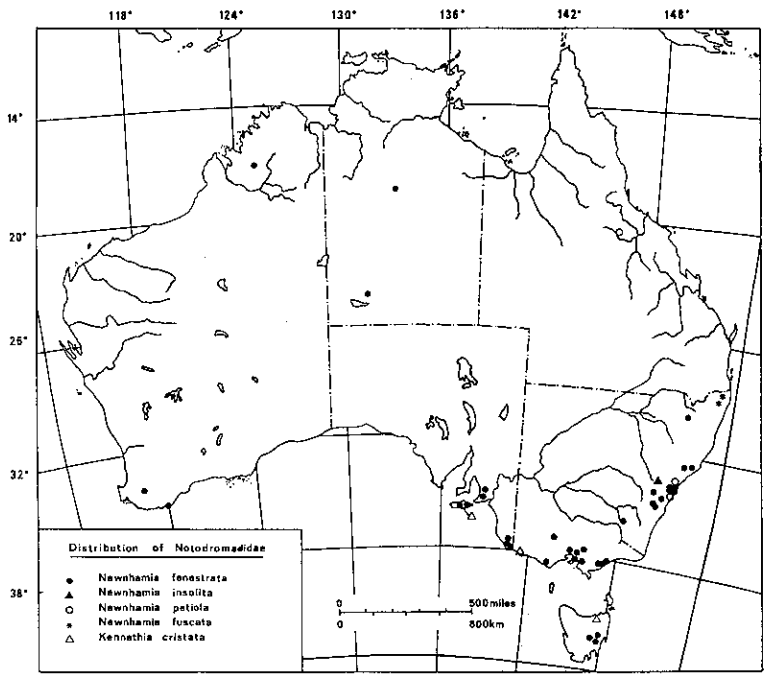
Introduction.

In 1855, Reverend KING described the first freshwater ostracods from Australia; among these he named *Newnhamia fenestrata* for which he said: "it is living almost wholly near the surface of the water ..... walking along the under surface, while its eyes are directed downwards and give the immediate notice of the approach of an enemy". Since then many records of *N. fenestrata* have been registered in the literature but specimens were never compared with KING's original ones as they have been lost. On the other hand *N. gulielmi* KING 1855, characterized by its pointed tubercles on the shell, has never been recorded since its original description.

After assembling a large collection of notodromadinid ostracods from Australia, it was decided to revise this group. No topotype material could be collected as KING gave no locality for his two *Newnhamia* species. Rapidly it was found that there was a great variety in external shell morphology: some shells had rounded tubercles only, whereas others had pointed ones but most often the shells had transitional forms. It was then concluded that KING's diagnosis of *N. fenestrata* and *N. gulielmi* had to be revised. In comparing KING's illustrations of *N. fenestrata* with those of the same species done by VÁVRA (1901) from the Bismarck Archipelago and those by BRADY (1906)



Map 1. Localities from which notodromadinid species have so far been recorded in Australia.

from New Zealand, it could be seen that the three authors have drawn the lateral lobe of the hemipenes in the form of a sickle. This was found in most of the specimens I possessed despite the fact that they had either a smooth or a spinose carapace. The sickle-shaped hemipenis appeared then to be an important characteristic for differentiating this species from others. Another ostracod, with similar carapace feature, but characterized by a T-shaped lateral lobe of the hemipenis was then separated from *N. fenestrata,* and is here called *N. petiola* n. sp.

Dr. K. G. McKenzie sent me specimens of *Newnhamia* sp. which he illustrated in 1971 from Bridport, Tasmania. These specimens are thought to belong to a new genus *Kennethia* and new species *K. cristata.*

I also have a number of specimens which correspond to King's description of *N. gulielmi,* in possessing pointed tubercles over the entire carapace. The soft anatomy of those specimens, however, conforms to either *N. fenestrata* or *N. petiola* depending on the shape of the lateral lobe of the hemipenis. This illustrates the variable sculpture of the shell in notodromadinid ostracods, at least in Australia. The ornamentation of the shell of *K. cristata* is also variable.

I also examined the type specimens of *Notodromas fuscata* Brady 1886 (stored at the Hancock Museum in Newcastle upon Tyne). Those specimens are very fragile and, for that reason, have not been used for SEM photography but are described here.

Dr. B. V. Timms has tried to collect specimens of *N. fuscata* in the Condong area (type locality) but none were found. The entire area has been drained for agricultural purposes and it would seem that, as a consequence, natural aquatic environments have been destroyed.

In the process of revising and describing all notodromadinid species collected in Australia (see distribution in text; map 1), it was also decided to compare the carapace morphology and anatomy of the soft parts of all species studied in order to find out the features important in taxonomy at the species and genus levels as already done by De Deckker (1978) for the Australian mytilocypridinid ostracods. The following Australian species: *Newnhamia fenestrata* King 1855, *Newnhamia fuscata* (Brady 1886), *Newnhamia petiola* n. sp., *Newnhamia insolita* n. sp. and *Kennethia cristata* n. gen. n. sp., will be compared also with *Notodromas monacha* (O. F. Müller 1776) collected from Belgium, as the latter species belongs to a genus not recorded in Australia but belonging to the Notodromadinae.

Abbreviation used for Australian States: ACT = Australian Capital Territory, NSW = New South Wales, Qld = Queensland, Vic = Victoria.

Comparative Morphology.

Carapace Morphology.

It was rather difficult to separate all the specimens studied only on the basis of the carapace morphology, as the carapaces showed considerable diversity. The following details are investigated:

External: carapace outline; eye tubercle; fine details of the shell; muscle scars; normal pore canals.

Internal: longitudinal and transverse sections; inner lamellae, selvage and flange; marginal pore canals.

External features.

Carapace outline: For every species investigated, there was a marked difference in carapace morphology between males and females. — For *Newnhamia* and *Kennethia* species, the female is always larger in size and also much broader in the posterior area; this larger size is probably for the storage of eggs within the female carapace. — For *Notodromas monacha*, the opposite occurs: the male is larger than the female. The outline is different for each sex and the female bears a very noticeable flat protuberance on the posteroventral area of the left valve which takes the curvature of the shell in that area. As mating is in a venter-to-venter position for this species (KLIE 1938), it is thought that the protuberance helps to keep the male valves open during copulation. — On the carapace of the three genera, the posterodorsal side in males forms a less steep angle with the ventral side than in females.

The carapace of notodromadinids is a distinctive one: the ventral area is flattened and surrounded by a rim. This flattened area is ornamented with three or four ridges on each valve, with connecting branches in *Newnhamia* and *Kennethia* whereas no such ridges are found in *Notodromas*. In the anteroventral area, there is a broadening of the flange present for all genera (pl. 1 fig. 5, pl. 4 fig. 38, pl. 5 fig. 51).

Eye tubercle: It is prominent in *Newnhamia* and *Kennethia* whereas in *Notodromas monacha* it is faint on each valve. It is also possible to distinguish some *Newnhamia* species from others according to the size and position of the eye tubercle:

1) Tubercle large and globular in shape; in males it appears to be larger: *N. fenestrata, N. petiola.*

2) Tubercle small and flattened: *N. insolita, N. fuscata, Kennethia cristata.*

Fine details of the shell (pl. 6 figs. 53-65): It is possible to distinguish immediately *Notodromas* from the other two genera studied on the basis of shell ornamentation:

Notodromas has a mostly smooth pseudopunctate shell which is faintly reticulated anteriorly.

Newnhamia and *Kennethia* hava a distinctive, highly variable shell surface; the ornamentation of the shell is colliculate with additional features added to the polygonal elevations.

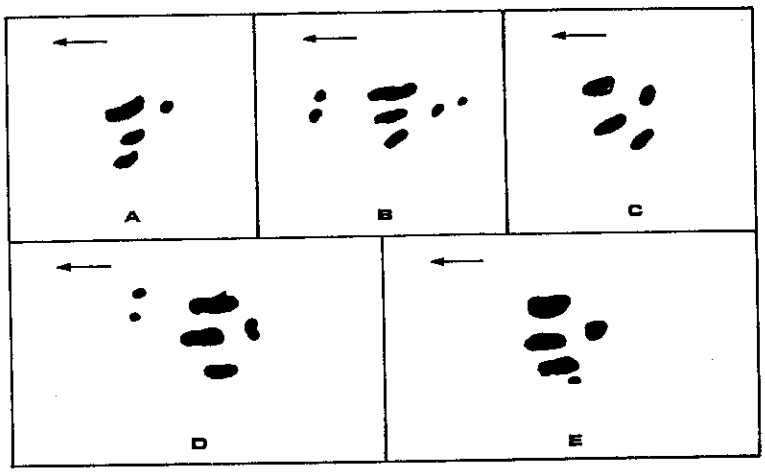
In *N. petiola* (pl. 6 figs. 56, 57), the polygons are slightly swollen and are outlined by narrow grooves. These outlines of polygons are very faint in *N. fuscata* and *N. insolita* making the shell look almost smooth, the reason for which BRADY originally placed *N. fuscata* in the genus *Notodromas*.

The elevations are rounded in *Kennethia cristata* (pl. 6 fig. 62) and tuberculate at their edges. On *N. fenestrata* (pl. 6 figs. 54, 59, 60, 65) the elevations are of varied shapes and the space between them can be either broad or almost absent. The peculiar terminal ending of some of the elevations in *N. fenestrata* from the pond on Monash University campus (pl. 6 fig. 60) showing different

layering in the spine, is also common for the same species collected near Pine Hut, Victoria. In males spiny elevations are always more abundant in the posterodorsal area. A few spines are occasionally visible in specimens of *N. petiola*. Many anterior and posterior spines are also visible on specimens of *Kennethia cristata*.

It is also possible to distinguish some species from the others on the basis of unique characteristics of the shell, but characteristics which cannot be tabulated, e. g. in *Kennethia cristata*, the presence of long hairs all over the carapace, as well as the contouring keel as a prolongation of the flange and around the flattened ventral area, are typical of that species. The faint reticulation of the same ventral area in *N. fuscata* is again typical of that species. The flange of *Newnhamia* species is ornamented with regularly spaced transverse ridges. These ridges are absent in *Notodromas monacha*.

Muscle scars: These are not easily detectable on the carapace of *Newnhamia* because of its ornamentation. However, it was possible to see quite a number of scars in the lateral area of the shell, but some could also be seen in the dorsal area. From the examination of different specimens it was noticed that the shape, size and even number of scars was highly variable. Various scars are illustrated in text-fig. 1. The general pattern is similar for all notodromadinids: a set of three large scars, parallel to the ventral area is preceded by two small ones at about the level of the highest scar and followed



Text-fig. 1a-e. Diagram showing the variation in pattern of the central muscle scar for the notodromadinid ostracod studied. — a) *Newnhamia insolita* n. sp. from a pond in Dog Rocks State Forest, near Rockley, NSW; holotype Xe 10835; b) *Newnhamia fenestrata* KING 1855 from a pond at Pine Hut, Vic.; Xe 10867; c) *Kennethia cristata* n. gen. n. sp., from Sheepwash Lagoon, Vic.; holotype Xe 10806; d) *Newnhamia fenestrata* KING 1855 from an unnamed swamp 2 km e. of Princetown, near Port Campbell, Vic.; neotype Xe 10841; e) *Notodromas monacha* (O. F. MÜLLER 1776) from a pond at Rouge Cloître, near Brussels, Belgium; Xe 10804.

by an almost round scar posteriorly at the level of the middle scar. As to the importance of the arrangement of the scars which are thought to be a distinguishing feature above the genus level, see p. 444.

Normal pore canals: These are very commonly seen on the carapaces of any of the notodromadinid species (pl. 6 figs. 53-65). They are funnel-shaped and rimmed (this type of pore corresponds to type A″ of PURI 1974) and a hair protrudes from them. In a few instances, it was noticed that some funnel-shaped pores, which are not rimmed, possess a sieve plate inside, with about six holes surrounding the hair. This type of pore corresponds to type C of PURI (1974). As to the importance of this type of pore, unusual for a cypridiid member, see p. 444.

Internal features.

Longitudinal sections: From pl. 7 figs. 66-70 showing sections through the shell (and also from the various plates showing the dorsal view) of every species, it is possible to distinguish the various species from one another according to the way both valves meet anteriorly and posteriorly.

Anteriorly, each species is characterized by unique features, *N. petiola* has unequal flanges both bent towards the left side. The curvature of the right flange is greater and gives the appearance of covering the left flange which is flatter and smaller.

In *N. fenestrata* the flanges are similar to the ones of *N. petiola* with the exception that the left flange is less curved. — In *Kennethia cristata*, both flanges are nearly straight and almost parallel to the anterodorsal axis. The right flange is, however, much longer than the left. — In *N. insolita* the right flange is also longer and is curved over the almost straight left one. — *Notodromas monacha* has two flanges of equal size which are almost parallel to the anterodorsal axis of the shell.

Posteriorly, the flanges are very small for specimens of *N. petiola* and almost equal in size. They are lower than the posterior part of the carapace, thus forming in that area of the shell a small, but deep space. — Both flanges of *K. cristata* are unequal in size with the left one being the longer. They are straight as in the anterior area. — For *N. insolita*, both flanges are equal in size and extend slightly further than the carapace. — However, in *N. fenestrata* the numerous spines in the posterodorsal area always extend past the flanges. — In *Notodromas monacha*, both flanges are straight and almost equal in size.

Transverse sections: The general outline seen from these sections indicates that each species possesses a characteristic unique shape of its own except for the flattened area which is typical of all notodromadinids.

K. cristata possesses an obviously different shape with a pointed dorsum ending with a keel (pl. 7 fig. 69b). The ventral area is flat and is bordered with a long carina on each side. The position of the three longitudinal ridges on each valve in that area can also be detected easily. Such features made necessary the separation of a new genus, *Kennethia*, from other *Newnhamia* species having a similar outline consisting of an ellipse with one of the extremities being flattened. There are, however, different features unique to each species. For example, the placement and size of the carina bordering the

flattened ventral area and the exaggeration of both sets of the three ridges vary from one species to another. *Notodromas monacha* is quite different in possessing a smooth surface in its ventral area.

Inner lamella, selvage, flange (see pl. 7 figs. 66-70): The inner lamella is very similar for all notodromadinid species: it is broad anteriorly and very narrow posteriorly and ventrally and is broadest anteriorly in the right valve. The selvage is also very pronounced and is further away from the flange in the right valve for all species. The duplicature is, however, much larger for *Notodromas monacha* than for *Newnhamia* and *Kennethia* species (pl. 7 fig. 70). *Kennethia cristata* can be distinguished from the *Newnhamia* species because it has in the anterior part of the right valve both a much broader flange and a much more pronounced selvage. The presence of a broad and ribbed flange in the dorsal area of the left valve of *Kennethia cristata* easily distinguishes it from the *Newnhamia* species. *Notodromas monacha* differs from the other two genera by possessing a part of the duplicature entirely closed by a prolongation of the inner lamella into a slight fold of the outer lamella or flange (pl. 7 fig. 70b).

Marginal pore canals: In notodromadinids these are only visible in the anterior and posterior regions. They are also present in the ventral region as it is possible to see the regularly aligned openings of the pores at the inside edge of the flange. The canals of these pores are difficult to see in transmitted light because the shell is rather thick in that area, but also because the outside ornamentation obscures the vision. The pore canals are common, but not arranged closely together.

A major difference distinguishes *Notodromas monacha* from *Kennethia* and the *Newnhamia* species in that the radial pore canals are branched towards their end in the former species. — For *Newnhamia* and *Kennethia*, these pores can be of varying lengths on a single specimen and also sometimes funnel-shaped towards their end. These pores do not extend into the flange at all.

Normal pore canals are also visible on the inside of the shell, at least in *Newnhamia* and *Kennethia cristata*. As in some of the outside ones, they are not rimmed and possess a sieve plate inside them.

Anatomy of the Soft Parts.

The following features will be studied in detail in order to establish distinguishing features which occur both at the generic and specific levels: eye, antennula, antenna, mandible, rake-like process, maxillula, maxilla, first and second thoracic legs, hemipenis, ejaculatory tube, furca and furcal attachment.

For the measurements taken on the various appendages see an appendix which has been deposited within the Xe collection of the SMF. A copy of it can be obtained by writing to Dr. H. MALZ.

Eye: For all notodromadinids, optic cups are separated and there are two eyes connected to one another by a "thread" of similar colour to the eyes (black or dark brown). This "thread" is easily extensible when the valves are open. It is interesting to note that the hinge area starts well behind the eye tubercles causing the eyes to cover a different field of vision when both valves are open

or closed. — The taxonomical importance of the presence of two distinctly separated eyes in notodromadinid ostracods, above the generic level, will be discussed in a later part of this paper.

Antennula (= first antenna): The length-width ratios of the 3rd to 7th segments were measured in order to see if such measurements were distinctive for the various species. These ratios are tabulated in Appendix 1.

The term in brackets is the one used by the author in previous publications. The other term is the one now used, as suggested by HARTMANN in order to conform to the terminology used for equivalent appendages in other crustacean groups.

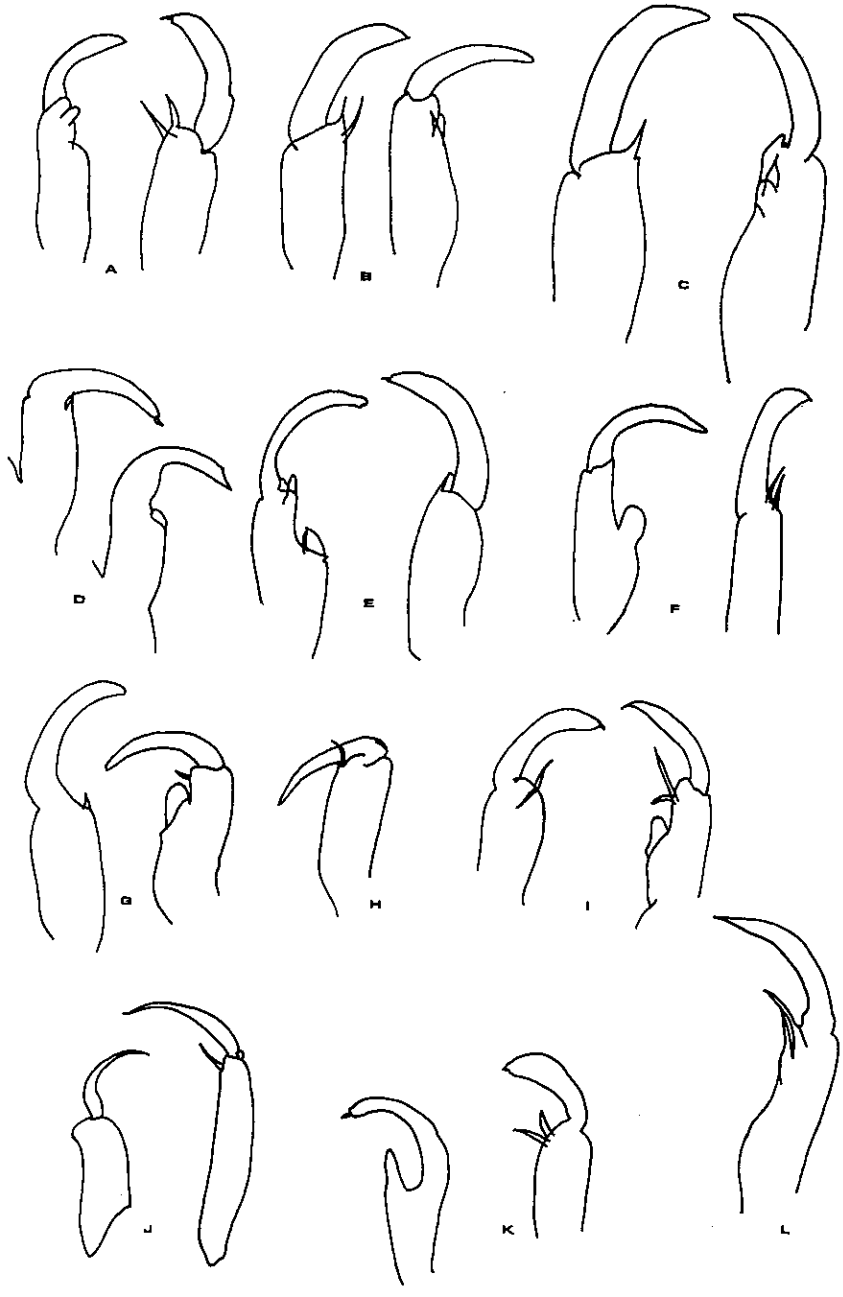
Firstly, the length-width ratio of the 3rd segment for *Notodromas monacha* is of a greater value (3·29) than for all the *Newnhamia* and *Kennethia* species (approx. 2·20). There are, on the other hand, no values which are unique to a species. Ratios measured on specimens from different populations show a large range. For example, the values calculated for *N. petiola* from Windsor and Pine Tree Creek Lagoon are similar except for the length-width ratio of the 7th segment. Similar results can be seen for other species. Consequently, more than one ratio at a time has to be used in order to distinguish one species from another.

Antenna (= second antenna): The length-width ratios of the 1st to 4th segments of the endopodite were measured, as well as the ratio of the length of the anterodistal seta (or bristle) of the 1st segment of the endopodite over the total length of the last three segments of the endopodite. This seta is unusual because its base is swollen and resembles a small sphere.

Neither the length-width ratio of the 2nd segment of the protopodite nor the position of the "sense club" were measured because the length of the protopodite changes with bending of the whole appendage. For all species studied, the base of the natatory setae is in the most distal part of the 1st segment of the endopodite. There are five long setae and a small one, the former reaching at least the tip of the end claw.

▶

Text-fig. 2a-l. Palps of male maxilla of all notodromadinid species studied. — a-i, k-l: × 15, j: × 6. — a) *Newnhamia fenestrata* KING 1855 from an unnamed swamp 2 km e. of Princetown, near Port Campbell, Vic.; neotype Xe 10841; b) *Newnhamia fenestrata* KING 1855 from a pond on Oakdale Farm, near Sutton, ACT; Xe 10870; c) *Newnhamia fenestrata* KING 1855 from a pond on Monash University Campus, Clayton, Vic.; Xe 10860; d) *Newnhamia fenestrata* KING 1855 from a pond near Goulburn, NSW; Xe 10854; e) *Newnhamia fenestrata* KING 1855 from a pond at Christchurch, New Zealand; Xe 10877; f) *Newnhamia fenestrata* KING 1855 from a pond 2 km s. of Cobar, NSW; Xe 10874; g) *Newnhamia petiola* n. sp. from a pond near Windsor, NSW; paratype Xe 10833; h) *Newnhamia petiola* n. sp. from Pine Tree Creek Lagoon via Hughenden, Qld.; holotype Xe 10817; i) *Newnhamia insolita* n. sp. from a pond in Dog Rocks State Forest, near Rockley, NSW; holotype Xe 10835; j) *Notodromas monacha* (O. F. MÜLLER 1776) from a pond at Rouge Cloître, near Brussels, Belgium; Xe 10804; k) *Kennethia cristata* n. gen. n. sp. from Sheepwash Lagoon, Vic.; holotype Xe 10806; l) *Newnhamia fenestrata* KING 1855 from a pond at Pine Hut, Vic.; Xe 10867.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As for the measurements taken on the 1st antenna, there are no unique ratios which can be used to distinguish one species from another. The length ratio of the 3rd over the 4th segments can easily differentiate *Notodromas monacha* from the *Kennethia* and *Newnhamia* species. For the latter, the same ratios measured on specimens of different populations within a species vary greatly (e. g. *N. petiola*, see Appendix 1). This shows the poor taxonomical value of this measurement.

A close study of the structure of the "sense club" by scanning electron microscopy, could show differences at the generic level, or even above. It is unlikely that this structure would vary between species as it is a rather primitive (stable) organ occurring on all cypridacid ostracods.

The antenna is sexually dimorphic, in particular for the larger claw attached to the end segment. It bears one or two rows of about ten to twenty small teeth in males and is barren in females. There is also a small, thinner claw which is barren of teeth and which can vary in length in males.

Mandible: The morphology of the mandible appears to be the same for all notodromadinids, and consequently no measurements were made of this appendage. — The mandibular coxale bears six molars. The 2nd to the 5th ones are all bifid and the 6th one is smaller and thinner. Between the 1st and 2nd molars there are 2 long spines slightly longer than the 1st molar. There is also a spine next to the 6th molar which is slightly longer. A smaller seta is visible above the teeth on the external side of the coxale. — The 2nd segment of the protopodite is rather broad and flexible. It bears an exopodite plate with about five pilose setae. The three segments of the endopodite cannot be easily distinguished from one another because they can partly overlap one another in dissections. The 3rd segment, however, appears to be longer in the *Newnhamia* and *Kennethia* species. — There are also four pilose setae attached to the interior side of the 1st segment and two and three setae on the exterior side of the 1st and 2nd segment respectively.

Rake-like process: The general morphology of this process is similar for all notodromadinid ostracods. The end of the process is asymmetrical: the internal side is broader; it bears about 15 teeth in *Newnhamia* and *Kennethia* species and from 10 to 15 in *Notodromas* species. These teeth are very small and very sharp. There are, therefore, no distinguishing features at the generic and specific level, especially as some of the very fine details are difficult to see because of their very small size, and are hidden by other parts of the chitinous framework in the mouth region. — The significance of this organ above the generic level will be discussed later. — The main curved arm of this process can bear some small tubercles (about seven) on the outside (their number varies in all three genera). For *Newnhamia*, tubercles are also present on the inside of the arm.

Maxillula (= maxilla): The length-width ratio of the palp and distal palp of the basal podomere (= segment) were measured as well as the length-length and width-width ratios of both palps. The last two ratios were to be almost constant for all notodromadinid species. It was also noticed that for most species the length-width ratio of the palp was identical to the ratio of the length of the palp over the length of the distal palp. Similarly, the length-

width ratio of the distal palp was identical to the ratio of the width of the palp over the width of the distal palp. This feature might prove to be an important feature above the generic level in taxonomy. — The outer masticatory process always bears six Zahnborsten which occasionally are denticulated. There are also two very elongated bristles attached to the base of the inner masticatory process in all notodromadinids. The maxilla bears a respiratory plate on which there are about 22 Strahlen.

Maxilla (= first leg): Only the male's maxillae will be studied as they are sufficient for distinguishing species from one another, but also because all the collections of notodromadinid ostracods yielded equal numbers of males and females. The endopodites of the maxilla are transformed as a grasping apparatus. They are weakly chitinized in contrast to other cyprididid ostracods and therefore can be partly deformed when fixed on microslides! However, it is still possible to distinguish most species from one another according to the morphology of this appendage (text-fig. 2).

It is, however, very hard to tabulate any information about this appendage as no parts can easily be measured. The only useful way is to compare the shapes of the various palps and from this, the following generalizations can be made:

Newnhamia fenestrata: the maxillae show a great range of variability: the grasping organ on each palp is long and narrow and can be bifid at the end. The curvature of the grasping organ is variable. Two small setae are always present.

N. petiola: the maxillae are difficult to distinguish from those of *N. fenestrata* as they show the same degree of variability.

N. insolita: the two small setae are present on each palp near the base of each grasping organ and both grasping organs have a small hook at their end.

Kennethia cristata: possesses two very unequal maxillae. One has a very long and broad seta on the palp and a narrow grasping organ whereas the other has two thin setae on the palp and a grasping organ narrow at its base but twice as broad near its tip. Both grasping organs end with a hook.

Notodromas monacha: has two much larger endopodite palps which are weakly chitinized and of very unequal sizes.

The female maxillae are the same for all notodromadinids except that *Notodromas monacha* possesses a very long pointed endopodite with two small hairs at its end. In the other two genera, the endopodite is much smaller and only possesses one hair on its tip, consequently being flexible. Both palps are slightly different in their distal portions. The exopodite plate is absent in all notodromadinids, being therefore a taxonomic feature important at the suprageneric level.

First thoracic leg (= second leg): This appendage is not sexually dimorphic. Various measurements were also made on this appendage to determine if any such measurements could be taxonomically important at the specific and generic level. The length-width ratios of the 1st segment, proximal portion and 2nd segment distal portion of the endopodite were measured, as well as the ratio of the length of the longest over the length of the smallest terminal claws (Appendix 1). No measurements were made on the 3rd segment of the endopodite because of its small size, and because its triangular shape makes it hard to measure. The length ratios measured on the two claws appear to be

the best distinguishing feature of the various species. The values for *N. fenestrata* and *N. petiola*, however, fall within a similar range and this is expected as they share other similar characteristics. This fact could indicate that these ostracods share a common, close ancestor.

Second thoracic leg (= third leg): Like the first thoracic leg it strongly resembles, the second is not sexually dimorphic. — The following measurements were taken: the length-width ratio of the 2nd segment of the endopodite; the ratios of the length of ventrodistal hair of the protopodite over the length of the distal hair of the 1st segment of the endopodite; the ratio of the length of the mediodorsal hair of the 2nd segment over the length of the claw, both of the endopodite (Appendix 1). — The results of these measurements which vary a lot within a species, proved to be useless, as no features proved to be distinctive at the specific or generic level of taxonomy.

Hemipenis: This organ has not been dissected as the lateral lobe and the general shape of the copulatory sheath is sufficient to distinguish one species from another. The outline of the hemipenis for all the species studied (see pl. 8 fig. 71-80).

From these it is possible to see that *N. petiola* has a unique, almost T-shaped, lateral lobe. *N. fenestrata* has a conspicuously different lateral lobe which is long, narrow and sickle-shaped. In this species there are also 2 straight chitinous rods, perpendicular to one another, visible in the median area of the hemipenis.

The lobe of *Kennethia cristata* is bent at a larger angle and is of varying width from the copulatory sheath to its apex.

N. insolita has a lateral lobe which resembles the one of *N. fenestrata* except that the lobe of the former is bent to a lesser extent and only one chitinous rod is visible, and is curved.

Notodromas monacha is also easily distinguished from the *Newnhamia* species by possessing an almost circular copulatory sheath and a very small lateral lobe.

Ejaculatory process: The length-width ratio for the ejaculatory tube for all notodromadinids was measured but it was found to be of no taxonomical value as, when fixed in microslides, the tubes tend to become deformed, and sometimes enlarged to a great extent. — The number of rosettes was not found to be useful either, in taxonomy, as in some species they were not easily seen because they were covered with a thick, almost opaque, sheath. This number was found to vary between 21 and 31. It was, however, found that both extremities of this tube, being funnel-shaped in all notodromadinids (pl. 8 figs. 81-84) are very important in the taxonomy above the genus level as they are so different from those of other ostracod in the Cyprididae.

Furca: The furca is strongly chitinized and pediform. It possesses three claws (two equal long ones plus a small one) at its extremity. In *Kennethia* and most *Newnhamia* species an extremely small, thin and transparent hair is present anteriorly near the base of the first claw. On rare occasions this thin hair was not seen on one furca of some individuals of *Newnhamia fenestrata* and *N. petiola*. The female specimen of *Newnhamia fuscata* dissected by BRADY (1886) does not possess this small hair on either furca. A hair was mentioned

by VÁVRA (1901) for his male specimens which he described from the Bismarck Archipelago. KLIE (1935) also illustrated such a hair for the female of *N. thomseni*.

The three claws are all curved posteriorly and the ratios of the length of the largest one (most anterior one) over the length of the smallest one (most posterior one) were measured as well as the ratio of the length of the furcal shaft over the length of the longest claw (Appendix 1). These ratios do not demonstrate any pattern which could indicate differences between species or genera. It appears that the morphology of this appendage is variable for notodromadinid ostracods, at least when lengths of shaft and claws are measured, and when the presence of the small hair is taken into account.

Furcal attachment: As already shown by ROME (1969), the furcal attachment of *Notodromas monacha* is strongly sexually dimorphic and the dorsal and ventral branches possess a highly complicated architecture. Similar morphology and sexual dimorphism is also valid for *Newnhamia* species and *Kennethia cristata*. However, it was not possible to compare this apparatus for all species as it was often broken during dissection or partly hidden by adjacent tissues. The important taxonomical value of the furcal attachment above the genus level for the Notodromadidae will be discussed later, see p. 446.

Conclusion.

After comparison of many morphological details of *Notodromas monacha* with *Newnhamia* and *Kennethia* species, it is possible to say that many of these details do show great variations between the various species but unfortunately also between specimens of different populations belonging to a single species. Therefore, for this group of ostracods, often a combination of two or more morphological details will have to be used in order to distinguish species from one another (see Table 1). However, there are still some characteristics which can be used singly for that purpose but their number is much smaller than found for mytilocypridinid ostracods (DE DECKKER 1978). A summary of the investigations carried out can be found in Table 1.

Systematic Descriptions.

Subfamily Notodromadinae KAUFMANN 1900.

Diagnosis: Shell: arched dorsally with both ends broadly rounded, ventrally with a smooth or ridged flattened field which is surrounded on the side by a list; valves overlap ventrally; presence of eye tubercles (faint or prominent); calcified part of inner lamella and fused zone narrow; marginal pore canals straight; surface pseudopunctate or with tubercles (rounded or pointed); type C normal pore canals (PURI 1974).

Anatomy of the soft parts: Cups of eye separated; antenna with four long segments (last three are narrow) on endopodite; rake-like process with many small and sharp teeth (> 10); maxilla without respiratory plate and often dissimilar in males as well as poorly chitinized; furca with three end claws;

Table 1. Summary of morphological features of notodromadinid ostracods important in taxonomy at the species, group of species or genus levels (for further comparison see De Deckker 1978). — x = feature important in taxonomy; – = feature not important in taxonomy.

Features Examined	Taxonomical Importance		
	Species Level	Group of Species	Genus Level
Carapace Morphology			
External — carapace outline	some	–	–
— eye tubercle	some	–	x
— fine details of shell	x	x	x
— muscle scars	–	–	–
— normal pore canals	–	–	–
Internal — cross section . longitudinal	x	x	x
. transverse	x	x	x
— inner lamella, selvage & flange	–	–	x
— marginal pore canals	–	–	–
Anatomy			
antennula: L/W 3rd segment	–	–	some
combination of L/W of some segments	some	some	–
antenna: L/W 3rd & 4th segments	–	–	some
combination of L/W of some segments	some	some	–
L/L anterodistal seta of 1st segment over last 3 segments together	some	some	–
mandible: L/W 3rd segment of endopodite	–	–	some
rake-like process	some	–	–
maxillula	–	–	–
maxilla: male prehensile palps	most	some	some
1st thoracic leg: length of long claw over length of small claw	most	some	–
L/W 1st, 2nd proximal, 2nd endopodite	–	–	–
2nd thoracic leg: L/W 2nd segment	–	–	–
L/L various hairs	–	–	–
hemipenis	x	some	–
ejaculatory tube	–	–	–
furca: L/L long claw over short one	–	–	–
L/L shaft over longest claw	–	–	–
presence of anterior hair	–	–	probably
furcal attachment: morphology	some	–	?

furcal attachment highly elaborated; Zenker organ with both ends funnel-shaped and with a small number of rosettes (around 20).

Remarks: So far three genera are comprised within this subfamily: *Notodromas* Lilljeborg 1843, *Newnhamia* King 1855, *Kennethia* n. gen.

Dr. K. G. McKenzie has informed me of the presence of another new notodromadinid genus from Queensland which he will describe in the near future.

Newnhamia KING 1855.

Type species: *Newnhamia fenestrata* KING 1855.

Diagnosis: Carapace almost covered with polygonal elevations, or partially covered or with spinose elevations; carapace oval in shape in anterior view except for the ventrum which is flat and ridged and surrounded by a small list. Two large or small eye tubercles in anterodorsal area of the shell.

Remarks: So far, five species are grouped within this genus. Among these, four are known in Australia: *Newnhamia fenestrata* KING 1855, *N. fuscata* (BRADY 1866), *N. insolita* n. sp., *N. petiola* n. sp. — *N. fenestrata* is also recorded from New Zealand and the Bismarck Archipelago. The other species, which I was unable to examine and, consequently which is not described here, is *Newnhamia patagonica* (VÁVRA 1898) from Patagonia. (*Newnhamia gulielmi* KING 1855 is considered here as being an invalid species; see remarks on *Newnhamia fenestrata*).

Newnhamia fenestrata KING 1855.

Pl. 1-2, pl. 6 figs. 54-55, 59-61, 63-65, pl. 7 figs. 67-68, pl. 8 figs. 71-75, 81, 84; text-figs. 1b, 1d, 2a-f, 2l, 3.

1855 *Newnhamia fenestrata* KING, Proc. roy. Soc. Tasmania, 3: 67, pl. 9 figs. 1-12.
1855 *Newnhamia gulielmi* KING, Proc. roy. Soc. Tasmania, 3: 67.
1901 *Newnhamia fenestra* [sic!], — VÁVRA, Arch. Naturgesch., 57: 180, pl. 8 figs. 1-15.
1906 *Newnhamia fenestrata*, — BRADY, Proc. zool. Soc. London, 1906: 698, pl. L figs. 1-13.
1923 *Newnhamia fenestrata*, — HENRY, Proc. Linn. Soc. N. S. W., 48: 270, pl. 24 figs. 1-10.
1955 *Newnhamia fenestrata*, — HORNIBROOK, Rec. Canterbury Mus., 6: 273, figs. 6, 17, 20.
v 1966 *Newnhamia fenestrata*, — MCKENZIE, Australian J. mar. Freshwat. Res., 17: 261.

Neotype (des. herewith): ♂ C, pl. 8 fig. 72, text-figs. 1d, 2a, 3; Xe 10841. — Type locality: Unnamed swamp 2 km e. of Princetown, near Port Campbell, Vic. (This new type locality has been chosen because KING gave no locality and no adequate locality was found near Sydney, the supposed area of KING's collection). — Further material in Australian Museum, British Museum, US National Museum, and in SMF (Xe 10842-84).

Diagnosis: *Newnhamia* with lateral lobe of both hemipenes long and sickle-shaped (see pl. 8 figs. 71-75).

Dimensions:	Length (mm)	Height (mm)
Neotype Xe 10841, ♂	RV 0·80, LV 0·78;	RV 0·54, LV 0·54
Xe 10842, ♀	RV 0·85, LV 0·84;	RV 0·62, LV 0·62

Description: Shell: External. The terminology used in MOORE (1961: fig. 15) and TRIEBEL (1968) was chosen here: flange (= Aussenleiste); selvage (= Saum); list (= Innenrand). Carapace subrectangular in shape with dorsum slightly pointed in the middle; surface of shell colliculate (= with small elevations) with polygons varying in shape from flat to pointed. In some specimens, the polygons develop into spines (especially in males) in the postero-

dorsal area. Ventral area flat and ellipsoid in shape with three rows of small squares, all of almost equal size. These rows are slightly curved and parallel to the margin of each valve and are also reticulated. In both valves, the outer margin (= flange), which is prominent and straight across the flat ventrum, is curved outwards and broadening in the anteroventral area (at the edge of the flat ventrum). Anteriorly, it is curved inward to become straight again later. The outer margin on the left valve is straight and small anteriorly and the outer margin of the right valve is broad and incurved in the anterior region. Posteriorly, both outer margins are small and are curved towards one another. The right valve is slightly overlapped by the left one in the ventral region. Anteriorly, both outer margins are ribbed transversally; these ribs are curved downward in the ventral area and straight in the dorsal area. The carapace is egg-shaped in dorsal view and is much broader in adult females. When viewed from the anterior, the shape is almost oval except for the ventral area which is flat. In the anterodorsal area of each valve there is a prominent and large eye tubercle. There are two types of normal pore canals: (1) single rimmed (= type A″ of PURI 1974) and (2) funnel-shaped with a sieve plate consisting of six pores surrounding a central one from which a hair protrudes (= type C of PURI 1974).

Internal. Anteriorly, the flange strip is very broad in the right valve with the selvage and inner lamella being small. The left valve has a flange strip three times narrower plus a small selvage and a very broad inner lamella. Posteriorly, the flange and selvage are small and of equal width. The central muscle scars area consists of a vertical row of three horizontally arranged scars and one or two small ones behind the middle one. Two antennal scars, in front and above the vertical row of three scars, are also visible (text-fig. 1).

Anatomy: The measurements mentioned here and which were taken on the neotypes are often quite different from those taken on specimens from other localities; see Appendix 1.

Antennula (text-fig. 3a). No sexual dimorphism; length-width ratio of 3rd to 7th segments: 3) 2·00; 4) 1·10; 5) 1·30; 6) 1·73; 7) 2·46.

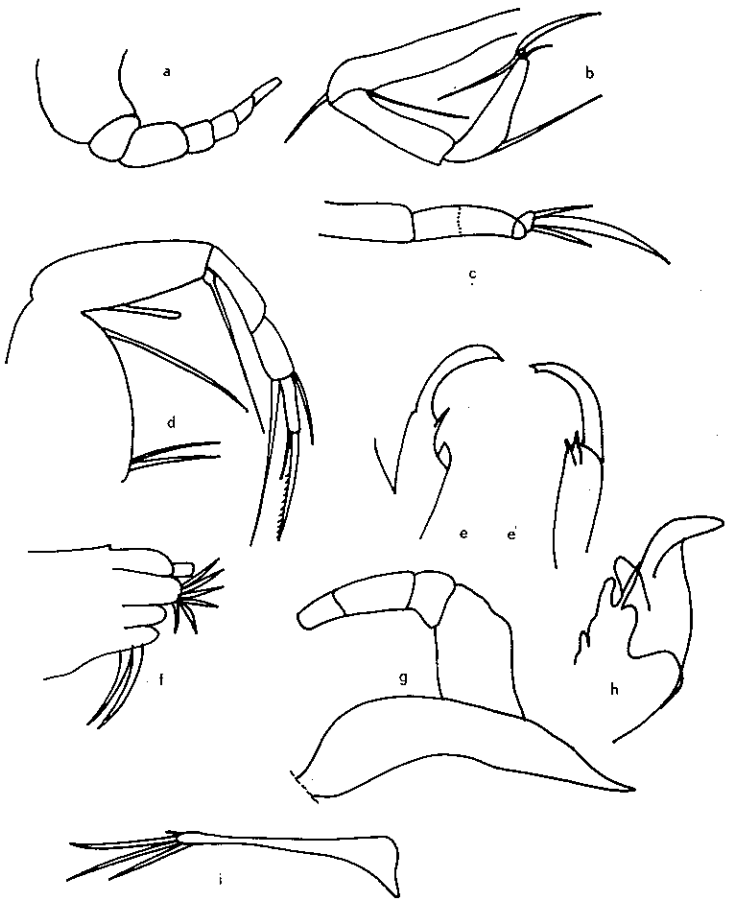
Antenna (text-fig. 3d). Sexual dimorphism of the end claws: male end claw bearing small teeth (about 15) whereas in female it is barren of teeth but there is also another smaller claw present. Length of ventrodistal seta (with globular base) of 1st segment as long as last three segments; length-width ratio of 1st to 4th segments: 1) 2·46; 2) 3·44; 3) 2·60; 4) 6·50.

Mandible (text-fig. 3g). No sexual dimorphism; the endopodite segments are almost as long as mandibular coxale. There are six molar teeth that decrease in size from the anterior on the mandibular coxale. — Rake-like process. Plate asymmetrical and bearing 13 sharp teeth in both sexes; inner side of arm of process bearing seven small nodes irregularly arranged.

Maxillula (text-fig. 3f). No sexual dimorphism; seven Zahnborsten on inner masticatory process; length-width ratio of palp 2·00 (for specimens from other localities it varies between 2·00 and 3·33) and distal palp 1·00; presence of two long bristles (as long as the palp and the distal palp together) near the base of the outer masticatory process.

Maxilla (text-figs. 3e-3e'). Sexual dimorphism of the palps: no exopodite plate present; in female, lobes long and narrow and bearing two bristles distally; in male palps very similar except for the two bristles of their base (= distal end of endopodite) which are unequal in size and shape (sometimes they resemble a knob) or are occasionally absent; palps long and narrow and most often slightly arched.

First thoracic leg (text-fig. 3c). No sexual dimorphism: three distal claws: one in the middle broad and long (as long as last three segments) and two small and thin ones (twice as long as last segment); lengths ratio of long claw over shortest one = 1·93; length-width ratio of last three segments:



Text-fig. 3a-i. *Newnhamia fenestrata* KING 1855 from an unnamed swamp 2 km e. of Princetown, near Port Campbell, Vic.; neotype Xe 10841. — a) antennula; b) 1st thoracic leg; c) 2nd thoracic leg; d) antenna; e-e) palp of male maxilla; f) maxilla; g) mandible; h) hemipenis; i) furca. — All × 140.

1) 2·00; 2) 1·00; 3) 2·17. Presence of one medioventral hair on 1st segment, a ventral one between 2nd and 3rd segment and a posterodorsal one on 3rd segment. — Second thoracic leg (text-fig. 3b). No sexual dimorphism. Length-width ratio of 3rd segment: 4·18. Presence of one posterodorsal and a posteroventral hair on the protopodite segment, the former one being the longest and as long as 1st segment of endopodite; one anterodorsal hair on 2nd segment of endopodite which is as long as 2nd and 3rd segments.

Hemipenis (text-fig. 3h; pl. 8 figs. 71-75). Lateral lobe narrow and arched towards the outside (= sickle-shaped); copulatory sheath bearing an almost vertical chitinous rod in the inner middle side. — Ejaculatory tube (pl. 8 figs. 81, 84). Tube with funnel-shaped ends and bearing 28 to 30 rosettes.

Furca (text-fig. 3i). No sexual dimorphism; three distal claws on shaft; lengths ratio of anterior claw over posterior claw: 1·38 and shaft over anterior claw: 2·32. The presence of a supplementary small bristle above the base of the anterior claw was noticed for the male neotype as well as on specimens from Pine Hut, Victoria. Such a small bristle was also mentioned by VÁVRA (1901) for his specimens of *N. fenestrata* from the Bismarck Archipelago. — Furcal attachment: Rarely well preserved; highly elaborated and poorly chitinized.

Eggs. Brown to yellow in colour.

Eyes. Two large globular ones connected by a black thread (= ? optic nerve).

Remarks: Specimens with carapace completely spinose were collected from two localities (pond on Oakdale Farm, near Sutton, ACT and pond 2 km s. of Cobar, NSW). Originally it was thought that they belonged to *Newnhamia gulielmi* KING 1855 described for the characteristic pointed tubercles all over the carapace. However no other morphological differences could be found between these specimens and others belonging to *Newnhamia fenestrata*; for all these specimens the hemipenes were long and sickle-shaped. (When specimens were to dry for SEM photography they always shrank, preventing therefore proper photography. The carapace seem to be much thinner for these specimens). As other specimens were found later as transitional forms between spinose and spines plus colliculate polygons on the carapace (pl. 2 figs. 11-16: specimens from Pine Hut), it was decided to include the specimens from near Sutton and near Cobar within *Newnhamia fenestrata* and to discard *N. gulielmi*.

Distribution: This is the most common *Newnhamia* species in Australia. It is so far found in all states except in Queensland. It is also recorded from New Zealand and the Bismarck Archipelago.

Newnhamia petiola n. sp.

Pl. 3, pl. 4 fig. 46, pl. 6 figs. 56-57, pl. 7 fig. 66, pl. 8 figs. 77-78, 82; text-figs. 2g-h, 4.

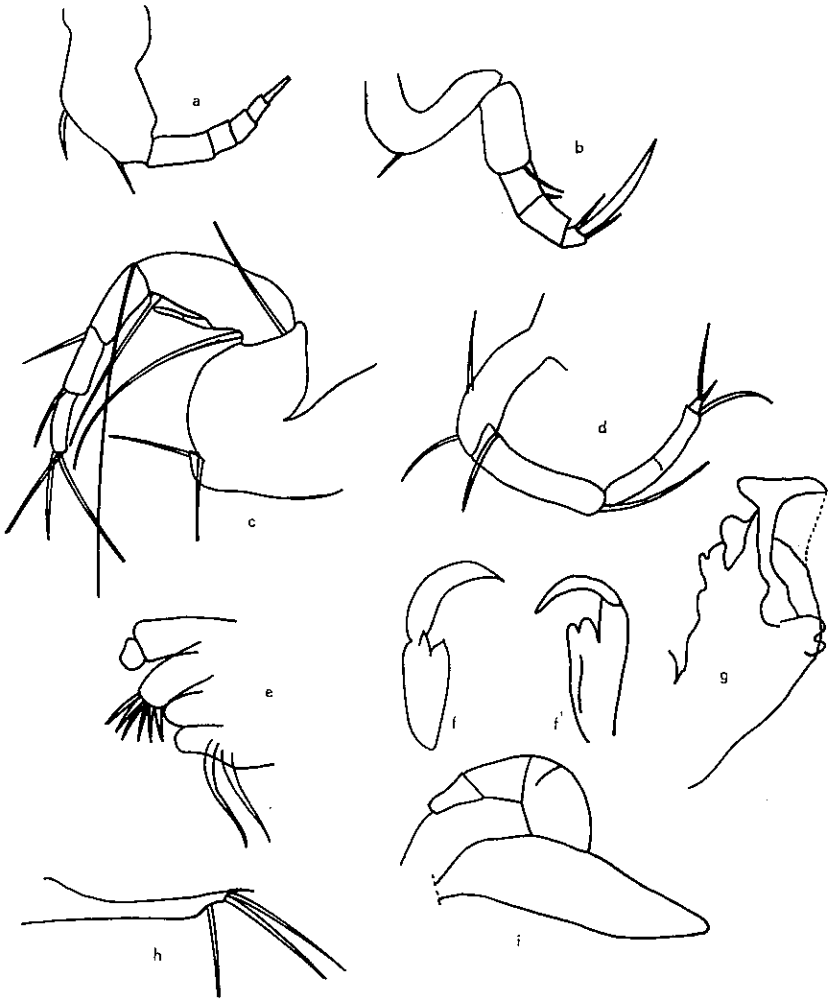
Holotype: ♂ C, pl. 8 fig. 77, text-figs. 2h, 4; Xe 10817. — Type locality: Pine Tree Creek Lagoon, via Hughenden, Qld.

Paratypes: 18♀ + ♂; Xe 10818-34. — Further material in Australian Museum, British Museum, and US National Museum.

Derivation of name: From Latin petiolus = small foot; for the typical foot-shaped lateral lobe of both hemipenes.

Diagnosis: *Newnhamia* with lateral lobe of both hemipenes foot-shaped (see pl. 8 figs. 77-78).

Dimensions:	Lenght (mm)	Height (mm)
Holotype (Xe 10817), ♂	RV 0·78, LV 0·78;	RV 0·58, LV 0·56
Paratype (Xe 10818), ♀	RV 0·81, LV 0·79;	RV 0·59, LV 0·60



Text-fig. 4a-i. *Newnhamia petiola* n. sp. from Pine Tree Creek Lagoon, via Hughenden, Qld.; holotype Xe 10817. — a) antenna; b) 1st thoracic leg; c) antenna; d) 2nd thoracic leg; e) maxillula; f-f) palp of male maxilla; g) hemipenis; h) furca; i) mandible. — All × 140.

Description: Shell: Similar description as for *N. fenestrata*, as for both species, the shell is colliculate but the polygons can vary and be either smooth, ribbed or spinose. In the case of smooth polygons, few spinose ones occur in the posterodorsal area in males on each valve. The only slight and possible difference between the shell of *N. fenestrata* and that of *N. petiola* is that for the latter species, the outer margin in the anterior area of the left valve is curved outwards rather than being straight. However, this feature is not consistent for all specimens. It appears that the selvage is more prominent in left valves in *N. petiola* compared to *N. fenestrata*.

Anatomy: Antennula (text-fig. 4a). No sexual dimorphism; length-width ratio of 3rd to 7th segments: 3) 2·36; 4) 0·91; 5) 1·22; 6) 1·21; 7) 2·75. These ratios vary for specimens from different populations (see Appendix 1).

Antenna (text-fig. 4c). Sexual dimorphism of the end claws as for *N. fenestrata*; length of ventrodistal seta (with globular base) of 1st segment slightly longer than last three segments; length-width ratio of 1st to 4th segments: 1) 2·75; 2) 2·50; 3) 2·70; 4) 3·71.

Mandible (text-fig. 4i). No sexual dimorphism; similar to *N. fenestrata*. — Rake-like process. Similar to *N. fenestrata*.

Maxillula (text-fig. 4e). No sexual dimorphism; six Zahnborsten on inner masticatory process; length-width ratio of palp 2·13 and distal palp 1·00; presence of two long bristles near the base of the outer masticatory process.

Maxilla (text-figs. 4f-f'). Sexual dimorphism of the palps; no exopodite plate present; in females as for *N. fenestrata*; in males, palps dissimilar, one being much narrower than the other and more curved; bristle if present small.

First thoracic leg (text-fig. 4b). No sexual dimorphism; three distal claws as for *N. fenestrata*. Length-width ratio of last three segments: 1) 1·68; 2) 1·55; 3) 1·54. — Ratio of length of long claw over short one: 2·30. — Second thoracic leg (text-fig. 4d). No sexual dimorphism; length-width ratio of 3rd segment: 6·00; hairs in same position as for *N. fenestrata*.

Hemipenis (text-fig. 4g; pl. 8 fig. 77-78). Lateral lobe T-shaped with the external branch longer than the internal one. (This form is reminiscent of a foot). — Ejaculatory process (pl. 8 fig. 82). Tube with funnel-shaped ends and bearing about 20 rosettes.

Furca (text-fig. 4h). No sexual dimorphism; three distal claws on shaft; lengths ratios of anterior claw over posterior claw: 1·67, and of shaft over anterior claw: 2·50. Presence of a small and thin hair anterior to the first claw in the paratype female from Pine Tree Creek Lagoon is noticed. — Furcal attachment: Extremely fragile and it was unfortunately broken during dissection.

Eggs. Brown to yellow in colour.

Eyes. Two large, globular ones connected by a black thread visible through the shell.

Distribution: Pine Tree Creek Lagoon, via Hughenden, Qld.; Xe 10817-25. — From a pond in the vicinity of Windsor, NSW.; Xe 10826-34. — Terpentine Creek, near Minnamurra, s. of Sydney, NSW.

Newnhamia insolita n. sp.

Pl. 4 figs. 42-45, pl. 6 fig. 58, pl. 8 figs. 76, 83; text-figs. 1a, 2i, 5.

Holotype: ♂ C, pl. 8 figs. 76, 83, text-figs. 1a, 2i, 5; Xe 10835. — Type locality: Pond in Dog Rocks State Forest, near Rockley, NSW.

Paratypes: 5♀ + ♂; Xe 10836-40. — Further material in Australian Museum, British Museum, and US National Museum.

Derivation of name: From Latin insolitus = unusual.

Diagnosis: External surface of shell consisting of faint polygons; eye rather small and not protuberant; lateral lobe of hemipenis slightly curved and widest in the middle (the edge is undulated at that spot).

Dimensions:	Lenght (mm)	Height (mm)
Holotype (Xe 10835), ♂	RV 0·68, LV 0·67;	RV 0·48, LV 0·48
Paratype (Xe 10836), ♀	RV 0·75, LV 0·76;	RV 0·54, LV 0·56

Description: Shell: External. Same description as for *N. fenestrata* except that the shell is smaller, the eye tubercles are smaller and not as protuberant. The polygons which form the ornamentation of the shell are flatter and, in places, faintly visible, even under SEM photography. There are no polygons which develop into spines in the posterodorsal area compared to *N. fenestrata* and *N. petiola.* In dorsal view, the carapace of *N. insolita* (even for the female) is ellipsoid in shape with both anterior and posterior ends tapering. — Internal. Same as for *N. fenestrata* except that the inner lamella is broad in the left valve but appears to be absent in the right valve. The central muscle scars area is similar to *N. fenestrata* except for the scar from behind the row of three which is at the same level as the top one.

Anatomy: Antennula (text-fig. 5a). No sexual dimorphism; length-width ratio of 3rd to 7th segments: 3) 1·86; 4) 1·27; 5) 1·81; 6) 1·58; 7) 2·54.

Antenna (text-fig. 5c). Sexual dimorphism of the end claws as for *N. fenestrata*; length of ventrodistal seta (with globular base) of 1st segment smaller than the last three segments; length-width ratio of 1st to 4th segments: 1) 2·54; 2) 4·00; 3) 3·50; 4) 4·67.

Mandible. No sexual dimorphism; similar to *N. fenestrata.* — Rake-like process. In female, 11 visible, pointed and sharp, small teeth on each process with five small nodes on the right hand side of the arm of the process and none on the other side. In males, there are 15 visible teeth on each process and four nodes on each side near the base of the arm of the rake-like process.

Maxillula (text-fig. 5e). No sexual dimorphism; six Zahnborsten on inner masticatory process; length-width ratio of palp: 2·13, and distal palp: 1·00; presence of two long bristles (as long as palp and distal palp together near these base of the outer masticatory process).

Maxilla (text-fig. 5f-f'). Sexual dimorphism of the palps; no exopodite plate present. In female, lobe long and narrow and bearing two bristles distally. In male, palpes are rather similar in being slightly curved; one is of the same width all along and pointed at its tip whereas the other is broader and is ending with a small hook. Two bristles of nearly equal size are present near the base of each palp.

First thoracic leg (text-fig. 5b). No sexual dimorphism; three distal claws as for *N. fenestrata*; lengths ratio of long claw over short one: 3·14; length-width ratio of last three segments: 1) 1·64; 2) 1·42; 3) 1·91. Position of hairs similar to *N. fenestrata*. — Second thoracic leg (text-fig. 5d). No sexual dimorphism; length-width ratio of 3rd segment: 5·60; hairs in same position as for *N. fenestrata*.

Hemipenis (text-fig. 5h; pl. 8 fig. 76). Lateral lobe slightly curved (when compared with specimens of *N. fenestrata*). The curvature of the lateral

Text-fig. 5a-h. *Newnhamia insolita* n. sp. from a pond in Dog Rocks State Forest, near Rockley, NSW; holotype Xe 10835. — a) antennula; b) 1st thoracic leg; c) antenna; d) 2nd thoracic leg; e) maxillula; f-f) palp of male maxilla; g) furca; h) hemipenis. — All × 140.

lobe is smooth on both internal and external sides except in the external middle where an uneven broadening area occurs and where undulations are visible. — Ejaculatory tube (pl. 8 fig. 83). Tube with funnel-shaped ends and bearing 26 rosettes.

Furca (text-fig. 5g). No sexual dimorphism: three distal claws on shaft; lengths ratio of anterior claw over posterior claw: 1·82, and shaft over anterior claw: 2·10. No supplementary small bristle above the anterior claw was noticed. — Furcal attachment: Highly elaborated but fragile (broken during dissection).

Eggs. Brown to yellow in colour.

Eyes. Two black ones connected by a black thread.

Distribution: Only known, so far, from the type locality.

Remarks: I originally thought that this species was *N. fuscata* BRADY 1886. However, after examination of BRADY's original specimens of the *N. fuscata*, important differences were noticed between the two species: *N. fuscata* is much larger (1·02 mm) and its reticulation is extremely faint whereas in *N. insolita* it is present in most areas of the shell. — On the other hand, these two species have in common a small eye tubercle on each valve and this would separate them from the other *Newnhamia* species.

Newnhamia fuscata (BRADY 1886).

Text-fig. 6.

v 1886 *Notodromas fuscatus* BRADY, Proc. zool. Soc. London, **1886**: 92, pl. 10 figs. 4-6.
1912 *Newnhamia fuscata*, — MÜLLER, in: SCHULTZE, F. E.: Das Tierreich, **31**: 159.
1923 *Notodromus fuscatus*, — HENRY, Proc. Linn. Soc. N. S. W., **48**: 269.

Types: Held in the Hancock Museum, Newcastle upon Tyne.

Remarks: I was able to examine the original specimen and a dissection slide from which BRADY described *N. fuscatus*, but was unable to take SEM photographs of the specimen because it was in poor state of preservation. This specimen definitely belongs to *Newnhamia* for the following reasons: The surface of the shell is faintly reticulated into polygons ("surface somewhat rough and furfuraceous", BRADY 1886: 92); the ventrum is flat and bears three longitudinal ridges on each valve; the eye is present but small as in *Newnhamia insolita*.

The dissected appendages found in the dissection slide made by BRADY are described as follows:

Antennula (text-fig. 6a). Length-width ratio of 3rd to 7th segments: 3) 1·65; 4) 1·66; 5) 1·1; 6) 1·1; 7) 3·5.

Antenna (text-fig. 6c). Only female antenna known; end claw barren of teeth; length-width ratio of 1st to 4th segments: 1) 2·8; 2) 4·8; 3) 3·8; 4) 8·5. — Natatory setae attached near the distal end of the 3rd segment. — Bristle attached to ventrodistal end of 1st segment being globular at its base and reaching the middle of the 3rd segment. — Mandible (text-fig. 6b). Similar to *N. fenestrata*.

First thoracic leg (text-fig. 6d). One large end claw and 2 unequal bristles on the end segment. Length-width ratio of 1st to 3rd segments: 1) 1·5;

2) 1·25; 3) 2·0. — Second thoracic leg (text-fig. 6e). Three end claws of different lengths. Not well preserved.

Furca (text-fig. 6f). Three end claws, two of which have the same length. Ratio of furcal shaft to longest claw: 1·3. The smallest claw is hookshaped at its tip.

No living specimens of this species have been found so far in Australia even in the type area (Condong, NSW) nor at Lismore, NSW another potential locality mentioned by HENRY (1923).

Text-fig. 6a-f. *Newnhamia fuscata* (BRADY 1886) from Tweed River, Condong District, NSW. Hancock Museum. — a) antennula; b) mandible; c) antenna; d) 1st thoracic leg; e) 2nd thoracic leg; f) furca. — All × 140.

Kennethia n. gen.

Type species: *Kennethia cristata* n. sp.

Derivation of name: For Dr. KENNETH G. MCKENZIE who was first to illustrate an ostracod belonging to this genus, from Bridport, Tasmania (MCKENZIE 1971).

Diagnosis: Carapace with polygonal elevations: Spines present or absent in posterodorsal area of shell; carapace triangular in shape when viewed from the anterior, and ventrum flat and ridged and surrounded on the side by a broad list. Broad and ribbed outer lamella on left valve in dorsal area. Two small eye tubercles in anterodorsal area of shell. Presence of many hairs on the outside of the shell.

Remarks: *Newnhamia thomseni* KLIE 1935 described from Uruguay could be included within *Kennethia* because the shell is narrow in dorsal view and triangular in shape when viewed from the anterior as in *Kennethia cristata* and contrary to the *Newnhamia* species. Unfortunately I was unable to see KLIE's original material in order to confirm my suggestion.

I have examined specimens of *Notodromas major* MÉHES 1939 from a natural swamp, Lekin, Uvea, Loyalty Islands, which are kept in the British Museum and consider that these belong to *Kennethia* on the following grounds: The shell is triangular in shape when seen from the anterior; the eye tubercles are rather small; the shell is faintly reticulated and bears small hairs all over; broad outer lamella on left valve in dorsal area. These specimens are smaller (0·94-0·975 mm) than those of MÉHES from Lake Canala on New Caledonia (♂ 1·2 mm; ♀ 1·4 mm). I have been unable to examine MÉHES' original specimens but believe from his illustrations of *Notodromas major* that this species is identical to the one kept in the British Museum and which belongs to *Kennethia*.

Kennethia cristata n. sp.

Pl. 4 figs. 35-41, pl. 6 fig. 62, pl. 7 fig. 69, pl. 8 fig. 79; text-figs. 1c, 2k, 7.

1971 *Newnhamia* sp. MCKENZIE, Bull. Centre Rech. Pau SNPA, 5 (Suppl.): 236, pl. 2 figs. 4-5.

Holotype: ♂ C, pl. 8 fig. 79, text-figs. 1c, 2k, 7; Xe 10806. — Type locality: Sheepwash Lagoon, Vic.

Paratypes: 11♀ + ♂; Xe 10807-16. — Further material in Australian Museum, British Museum and US National Museum.

Derivation of name: From Latin cristatus = keel; for the keel-shaped dorsum of the carapace.

Diagnosis: Shell triangular shape in anterior view and with outer lamella very broad on dorsal area of left valve; lateral lobe of hemipenis hook-shaped and bearing six small undulations on the inside near the middle where it is the broadest.

Dimensions:	Lenght (mm)	Height (mm)
Holotype (Xe 10806), ♂	RV 0·78, LV 0·76;	RV 0·53, LV 0·56
Paratype (Xe 10807), ♀	RV 0·82, LV 0·81;	RV 0·56, LV 0·64

Description: Shell: External. Outline of shell subrectangular in lateral view; eye tubercles small and rather flattened; surface of shell colliculate with elevated polygons which are tuberculate at their edges (pl. 6 fig. 62); two types of pores occur as in *N. fenestrata*. Spines occur in the posterodorsal area, more in males than in females which sometimes have no spines (in one case, there were more on the left valve of a male specimen). A large spine is visible in the posteroventral area on each valve (one specimen was seen to have two spines in the posteroventral area of the right valve). On specimens from Eleanor River, Kangaroo Island, these spines are longer than from other localities. — The ribbed outer lamella is very broad and surrounds the right valve anteriorly and posteriorly whereas it is very broad in the left valve dorsally. On both valves, the outer lamella is very small. — In ventral view, the shell is triangular in shape (pl. 7 fig. 69b). In dorsal view, the shell is elliptical in shape with both ends pointed; the greatest width is at about the middle. The valves are light brown in colour and are covered with many hairs. — Internal. The flange strip is twice as broad anteriorly in the right valve as well as the selvage which is even more prominent; in the left valve, the selvage is almost absent. The flange strips and selvage are very narrow ventrally and dorsally in the left valve and are broader and prominent in the right valve. Simple normal pore canals open in the inside of the shell. Central muscle scars pattern similar to *Newnhamia* species consisting of three horizontal scars arranged in an inclined row with a 4th one behind (text-fig. 1c). Marginal pore canals fairly abundant anteriorly and almost all straight but of varying widths.

Anatomy: Antennula (text-fig. 7a). No sexual dimorphism; length-width ratio of 3rd to 7th segments: 3) 2·27; 4) 1·00; 5) 1·43; 6) 2·50; 7) 2·90.

Antenna (text-fig. 7c). Sexual dimorphism of the end claws: male end claw bearing small teeth (about 15) (whereas in female, it is barren of teeth) but also there is a small claw present. Length-width ratio of 1st to 4th segments: 1) 2·90; 2) 5·00; 3) 3·63; 4) 7·25. — Natatory setae (5 large plus 1 small) attached near distal end of 3rd segment. Bristle attached to ventrodistal end of 1st segment being globular at its base and reaching the distal end of 4th segment. — Length ratio of long claw over small one: 3·71.

Mandible (text-fig. 7e). Length of endopodite segments $^2/_3$ of length of mandibular coxale. Six molar teeth decreasing in size from anterior. Other parts similar to *N. fenestrata*. — Rake-like process. Plate asymmetrical and bearing 13 sharp teeth in both sexes; inner side of arm of process bearing seven small nodes irregularly placed.

Maxillula (text-fig. 7g). No sexual dimorphism; inner masticatory process bearing six Zahnborsten; palp and distal palp much smaller than enlarged inner masticatory process; length-width ratios of palp 2·40 and distal palp 1·43; two long bristles attached at the base of the outer masticatory process (as for all notodromadinid species).

Maxilla (text-figs. 7f-f'). Strong sexual dimorphism; female lobe long and bearing two small pilose bristles at its extremity; male palps prehensile and dissimilar: left one being narrower, arched and possessing a very long and broad bristle at its base; right one pointed at its distal end but twice as broad

near its middle than at its base and possessing two small bristles at its base. Both ends have a small hook. No expodite plate present.

First thoracic leg (text-fig. 7b). No sexual dimorphism; two end claws: the largest being at least as long as the last three segments; lengths ratio of long claw over short one: 3·53. Length-width ratio of 1st to 3rd segments

Text-fig. 7a-i. *Kennethia cristata* n. gen. n. sp. from Sheepwash Lagoon, Vic.; holotype Xe 10806. — a) antennula; b) 1st thoracic leg; c) antenna; d) 2nd thoracic leg; e) mandible; f-f) palp of male maxilla; g) maxillula; h) furca; i) hemipenis. — All × 140.

(4th one not measured): 1) 2·38; 2) 1·00; 3) 1·82. Hairs in similar position as in *N. fenestrata* except that the long ventrodistal hair on the 1st segment is missing. — Second thoracic leg (text-fig. 7d). No sexual dimorphism (the size of the end claws plus the proportion of the various segments make this appendage look strongly like the 1st thoracic leg); length-width ratio of the 3rd segment: 7·27; lengths ratio of the two claws: 0·94.

Hemipenis (text-fig. 7i; pl. 8 fig. 79). Lateral lobe narrow and hook-shaped and bearing a row of six small undulations on the inside near the middle where it is the broadest; copulatory sheath with a small chitinous rod on the inside. — Ejaculatory tube. Bearing 21 rosettes and being funnel-shaped at both ends.

Furca (text-fig. 7h). No sexual dimorphism: three claws are present at the distal end of the shaft; lengths ratio of anterior claw over posterior one: 1·44, and of shaft over anterior claw: 1·77. — Furcal attachment: Poorly chitinized.

Eggs. Pale yellow in colour.

Eyes. Similar to *Newnhamia* species.

Distribution: Sheepwash Lagoon, Vic. (38°08'S.-141°11'E.). — Bridport, Tasmania (originally illustrated by McKenzie [1971] as *Newnhamia* sp.). — Eleanor River upstream Kangaroo Island, SA. — Swamp near Cape Leeuwin (far SW corner of Western Australia).

General Remarks.

It is felt, after a detailed study of notodromadinid ostracods, that this group should be completely separated from the family Cyprididae Baird 1845 contrary to Hartmann & Puri's (1974) suggestion, because the following morphological features of the notodromadinid ostracods differ from those of the cypridid ostracods:

1) The shell is characterized by a flattened ventral area which is either ridged (*Newnhamia, Kennethia*) or smooth (*Notodromas*). One exception exists within the Cyprididae for *Pseudocypris* Daday 1910 which is triangular in anterior view and has a smooth ventrum.

2) Eye tubercles are present: they are either faint (*Notodromas*) or distinct (*Newnhamia, Kennethia*). This feature is rarely seen in the Cyprididae (see discussion below). In *Notodromas monacha* however, a thick transparent lens is visible inside the shell in each valve.

3) The basic pattern of the central muscle scars on the shell: a vertical (or almost vertical) row of three elongated scars with one scar or two small ones behind. This pattern differs from the more complicated one found in the Cyprididae (except Scottinae, Cyproidinae, Indiacypridinae and Centrocypridinae. Note that the Cyprideidae and Robsoniellidae have a similar type of central muscle scars pattern).

4) The type of normal pore canals characterized by a sieve surrounding a sensory hair (type C of Puri 1974) is different from most of the Cyprididae. It is thought that this feature is a relict one from an ancestor probably living in a brackish water environment as for the Cyprideidae for example.

5) Anatomical features: two separate cups of the nauplius eye; large number of Zahnborsten on the maxillula (6); rake-like process bearing small, pointed, teeth. This character is also common to the Candonidae (the typical Cyprididae have a small number of wide and less pointed teeth); furca with three end claws (plus most of the times with a thin hair anterior to the claws in *Newnhamia* and *Kennethia*); furcal attachment highly elaborated; ejaculatory tube with both ends funnel-shaped.

Note that these three genera (*Notodromas, Newnhamia* and *Kennethia*) swim upside down as their mode of locomotion.

All these differences suggest a natural separation of the notodromadinid ostracods from the Cyprididae. It is therefore proposed that these ostracods be placed into a different family, the Notodromadidae KAUFMANN 1900. This family, however, could be subdivided into subfamilies because there are other ostracod genera (other than the three mentioned previously) which show important morphological differences from the Cyprididae and which are closely related to the Notodromadidae but somehow differ from the three genera *Notodromas, Newnhamia* and *Kennethia*. The last three genera are grouped within the subfamily Notodromadinae KAUFMANN 1900. The other different subfamilies are:

1) The Centrocypridinae, which includes only one genus *Centrocypris* VÁVRA 1895. This genus shares the following morphological characteristics with the Notodromadinae but which are different from the Cyprididae:
two eye tubercles; flat ventrum which is ridged longitudinally on both valves; central muscle field consisting of a vertical row of three scars plus two others behind; maxilla with a high number of Zahnborsten: 5 (Cyprididae: 2); rake-like process with sharp, pointed teeth; furca with three claws. — It differs from the Notodromadinae by having a maxilla with a small epipod bearing Strahlen.

2) The Cyproidinae, with only one genus *Cyprois* ZENKER 1834, seems to be more closely related to the Notodromadidae than the Cyprididae, in which they were classified by HARTMANN & PURI (1974). The Cyproidinae are characterized by: A central muscle field with a vertical row of three scars plus a fourth one behind; a respiratory plate on the maxilla with six Strahlen; six Zahnborsten on the maxillula; two terminal claws on the 1st thoracic leg; three claws on the end of the furca; a funnel-shaped ejaculatory tube. — It differs from the Notodromadinae by not possessing a flat ventrum on the shell. Note that the maxilla bears a respiratory plate with six Strahlen.

Another genus with many morphological affinities to the Notodromadidae is *Oncocypris* G. W. MÜLLER 1898 but it also has other morphological characteristics typical of the Cypridopsidae. It is surprising to find the following features of *Oncocypris* similar to those of the Notodromadidae, but which are not found within other genera included in the Cypridopsidae: two eye tubercles on shell; flat ventrum; maxillula with four or five Zahnborsten (Cypridopsidae only two); one end of ejaculatory tube at least is funnel-shaped. — As the characteristics mentioned above strongly differentiate *Oncocypris* from the other genera within the Cypridopsidae, *Oncocypris* should form a separate new subfamily, the Oncocypridinae.

The whip-like furca of *Oncocypris* is, at present, a feature that puts this genus into the Cypridopsidae. However further detailed work will decide if transfering the Oncocypridinae within the Notodromadidae is necessary. If one proves that the whip-like furca is not an important feature in taxonomy (for automatically separating the cypridopsidid ostracods from the cyprididids) but only an "atrophy" resulting from different usage of it as cypridopsidid ostracods are good swimmers and do not require an appendage for walking. If so, the whip-like furca will no longer be a feature for separating the Cypridopsidae from the Cyprididae (and grouping these two families together will therefore become necessary) and automatically the Oncocypridinae would be included within the Notodromadidae. More detailed work is also required to investigate shell features (pore canals, muscle scars, position of selvage, inner lamella, presence or absence of eye tubercle or lens) of the Cyprideidae and the Robsoniellidae in order to decide if those families are not in fact closely related to the Notodromadidae.

As a conclusion, it is proposed that the family Notodromadidae should, according to available data, include subfamilies: Notodromadinae (*Newnhamia*, *Notodromas*, *Kennethia*), Centrocypridinae (*Centrocypris*), Cyproidinae (*Cyprois*).

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Note added in proof: *Oncocypris muelleri* (Daday 1910) and *Cyprois marginata* (Strauss 1821) are known to hang upside down at the surface film of a water body (Fryer, G.: Ann. Mag. nat. Hist., (12) 9: 733-736, 1957 [for 1956]) as is *Centrocypris* (McKenzie, K. G.: Philos. Trans. roy. Soc. London, (B) 260: 257-297, 1971). Therefore all the notodromadidid ostracods have a similar mode of locomotion. This ability is also seen in the closely related Oncocypridinae.

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Plate 1-5.

L = left valve, R = right valve; C = carapace.
In brackets the length of the specimen is given in mm.
All are SEM photographs. Note that all photos bear 3 small black marks near the center because the SEM screen was partly scratched. These could not be removed.
Unless otherwise stated, the magnification is approx. × 50.
This is all SMF material, catalogue Xe.

Plate 1.

Figs. 1-10. *Newnhamia fenestrata* KING 1855. 431

Unnamed swamp 2 km east of Princetown, near Port Campbell, Vic. Recent.

1. ♀ C (0·86) right lateral view. — Xe 10845.
2. ♂ C (0·82) right lateral view. — Xe 10846.
3. ♂ C (0·82) dorsal view. — Xe 10847.
4. ♀ C (0·82) dorsal view. — Xe 10848.
5. ♂ C (0·77) ventral view. — Xe 10849.
6. ♀ C (0·80) ventral view. — Xe 10850.

Pond along the road 25 km south of Goulburn, NSW. Recent.

7. ♀ C (0·80) right lateral view. — Xe 10851.

Pond near Goulburn, NSW. Recent.

8. ♀ C (0·90) right lateral view. — Xe 10856.

Pond on Monash University Campus, Clayton, Vic. Recent.

9. ♀ C (1·00) right lateral view. — Xe 10857.
10. ♀ L (1·02) inside lateral view. — Xe 10858.

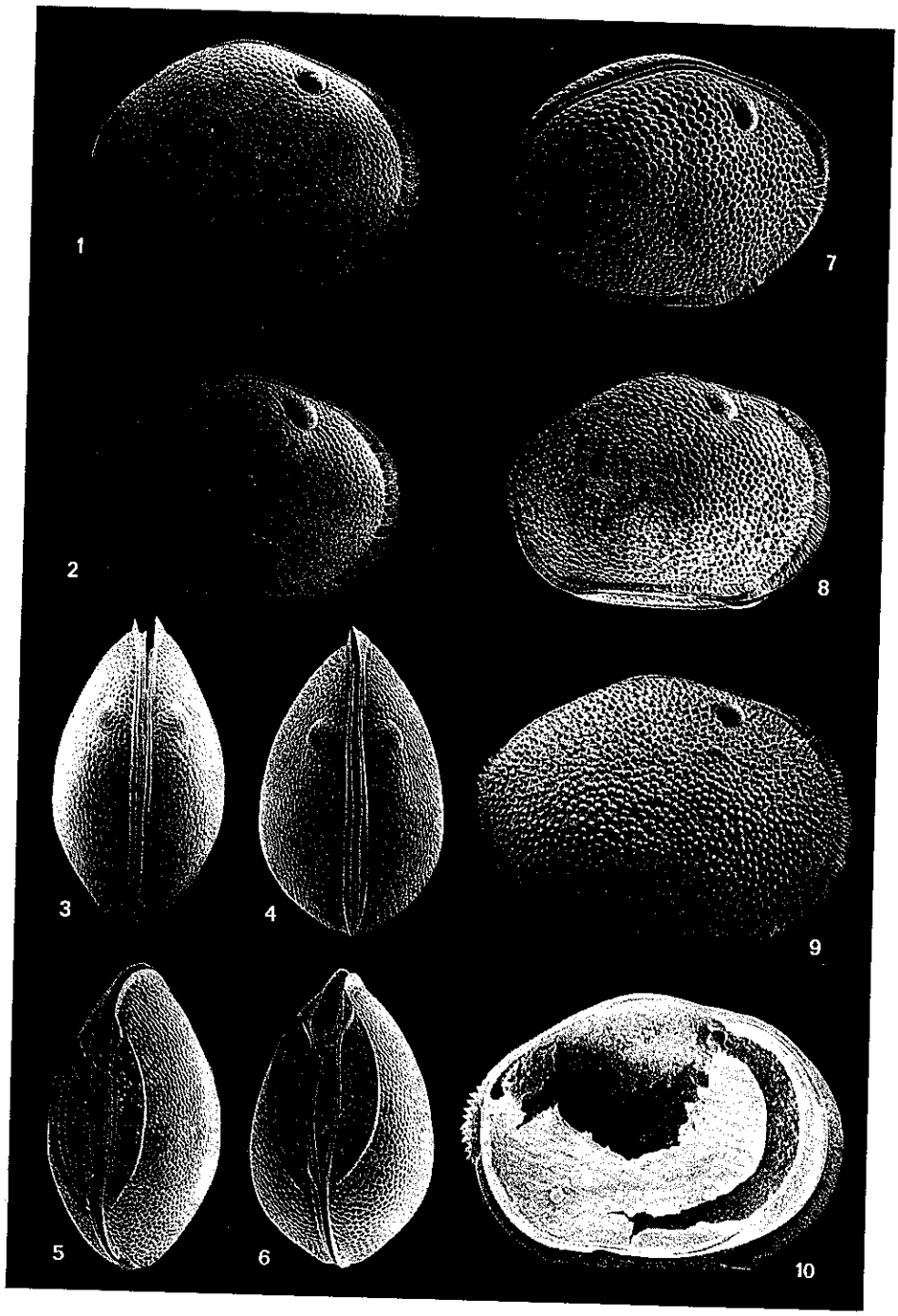

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Plate 2.

Figs. 11-22. *Newnhamia fenestrata* KING 1855. 431

Pond at Pine Hut, Victoria. Recent.

11. ♀ C (0·84) right lateral view. — Xe 10861.
12. ♂ C (0·80) right lateral view. — Xe 10862.
13. ♀ C (0·78) ventral view. — Xe 10863.
14. ♀ C (0·84) dorsal view. — Xe 10864.
15. ♂ C (0·81) ventral view. — Xe 10865.
16. ♂ C (0·82) dorsal view. — Xe 10866.

Pond at Christchurch, New Zealand. Recent.

17. ♀ C (0·90) dorsal view. — Xe 10879.
18. ♀ C (0·91) ventral view. — Xe 10880.
19. ♂ C (0·78) dorsal view. — Xe 10881.
20. ♂ C (0·84) ventral view. — Xe 10882.
21. ♀ C (0·80) right lateral view. — Xe 10883.
22. ♂ C (0·82) right lateral view. — Xe 10884.

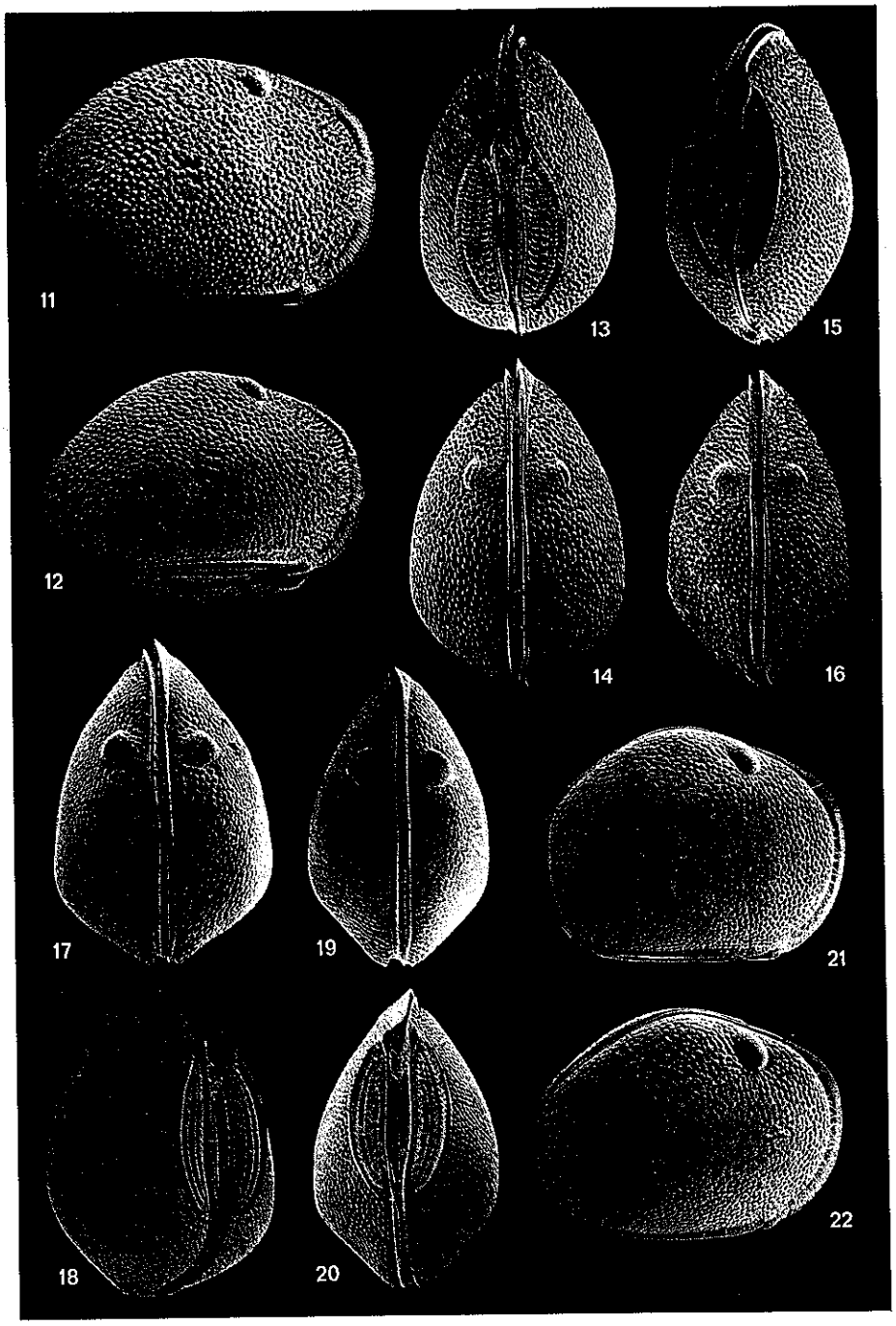

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Plate 3.

Figs. 23-34. *Newnhamia petiola* n. sp., paratypes. 434

Pine Tree Creek Lagoon, via Hughenden, Qld. Recent.

23. ♀ C (0·78) right lateral view. — Xe 10819.
24. ♂ C (0·74) right lateral view. — Xe 10820.
25. ♀ C (0·80) dorsal view. — Xe 10821.
26. ♀ C (0·78) ventral view. — Xe 10822.
27. ♂ C (0·75) dorsal view. — Xe 10823.
28. ♂ C (0·77) ventral view. — Xe 10824.

Pond near Windsor, NSW. Recent.

29. ♀ C (0·79) dorsal view. — Xe 10826.
30. ♂ C (0·77) dorsal view. — Xe 10827.
31. ♀ C (0.80) ventral view. — Xe 10828.
32. ♂ C (0·76) ventral view. — Specimen lost.
33. ♂ C (0·77) right lateral view. — Xe 10829.
34. ♀ C (0·78) right lateral view. — Xe 10830.

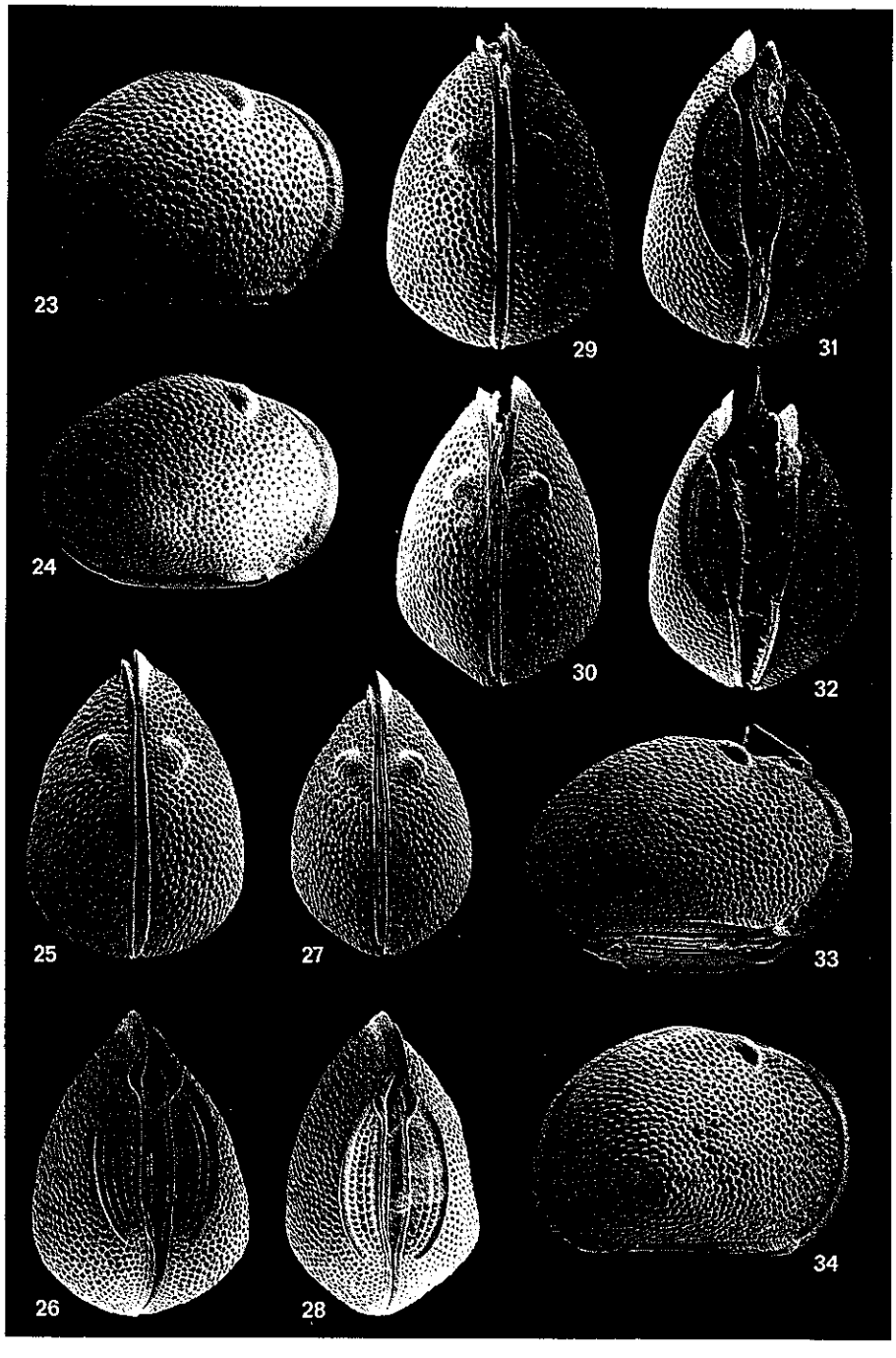

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Plate 4.

Figs. 35-41. *Kennethia cristata* n. gen. n. sp., paratypes. 441
Sheepwash Lagoon, Vic. Recent.
35. ♂ C (0·80) dorsal view. — Xe 10810.
36. ♀ C (0·84) dorsal view. — Xe 10811.
37. ♂ C (0·74) right lateral view. — Xe 10812.
38. ♂ C (0·76) inclined left lateral view to show ventral area. — Xe 10813.
39. ♀ C (0·84) right lateral view. — Xe 10814.
40. ♀ C (0·87) inclined left lateral view to show ventral area. — Xe 10815.
41. ♂ C + ♀ C right lateral view to show ♂ and ♀ in copulation position; both specimens are still attached together. — Xe 10816.

Figs. 42-45. *Newnhamia insolita* n. sp., paratypes. 437
Pond in Dog Rocks State Forest, near Rockley, NSW. Recent.
42. ♀ C (0·70) dorsal view. — Xe 10837.
43. ♀ C (0·70) ventral view. — Xe 10838.
44. ♀ C (0·74) right lateral view. — Xe 10839.
45. ♂ C (0·68) right lateral wiev. — Xe 10840.

Fig. 46. *Newnhamia petiola* n. sp., paratypes. 434
Pine Tree Creek Lagoon, via Hughenden, Qld. Recent.
46. ♂ C + ♀ C right lateral view to show ♂ and ♀ in copulation position; both specimens are still attached together. — Xe 10825.

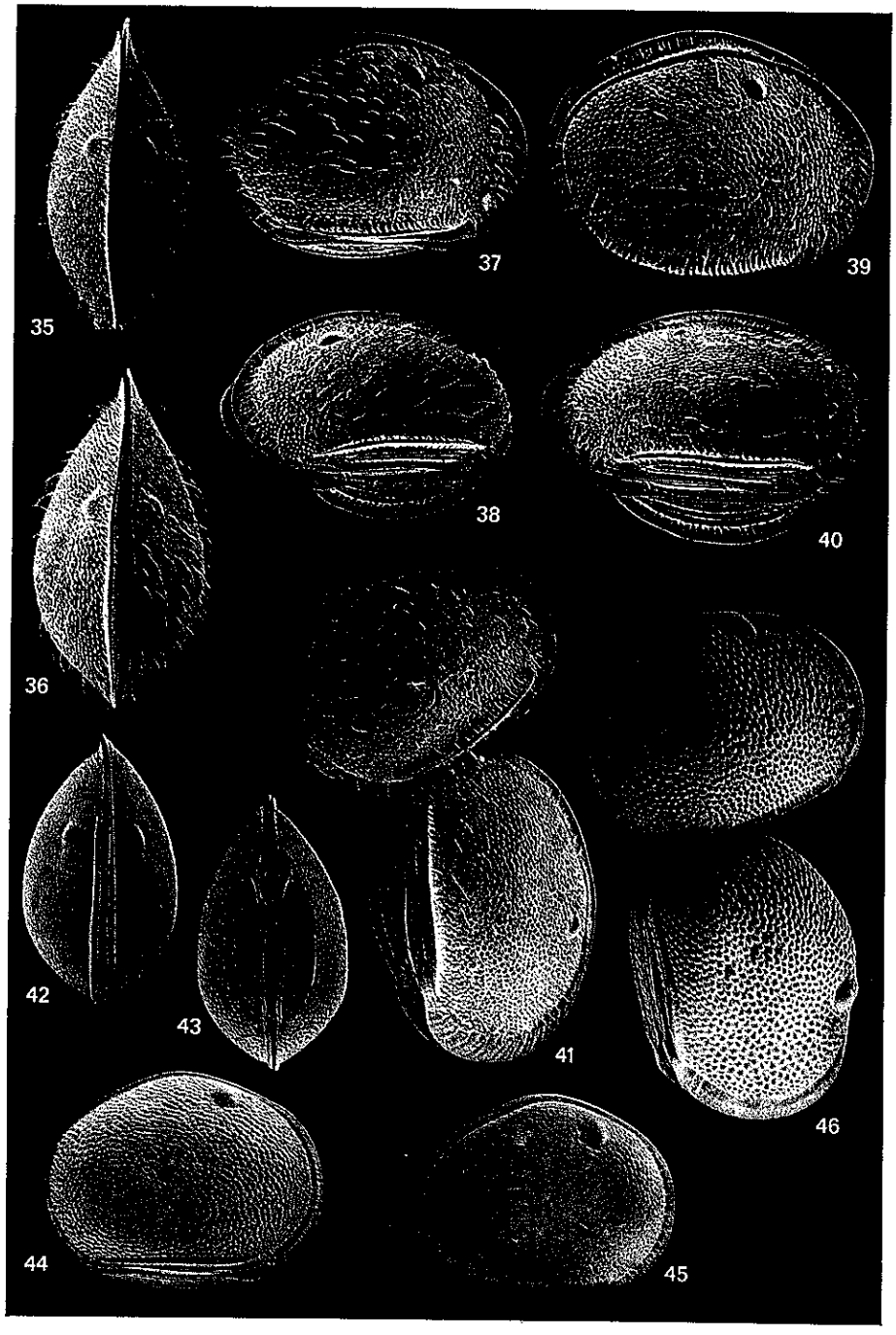

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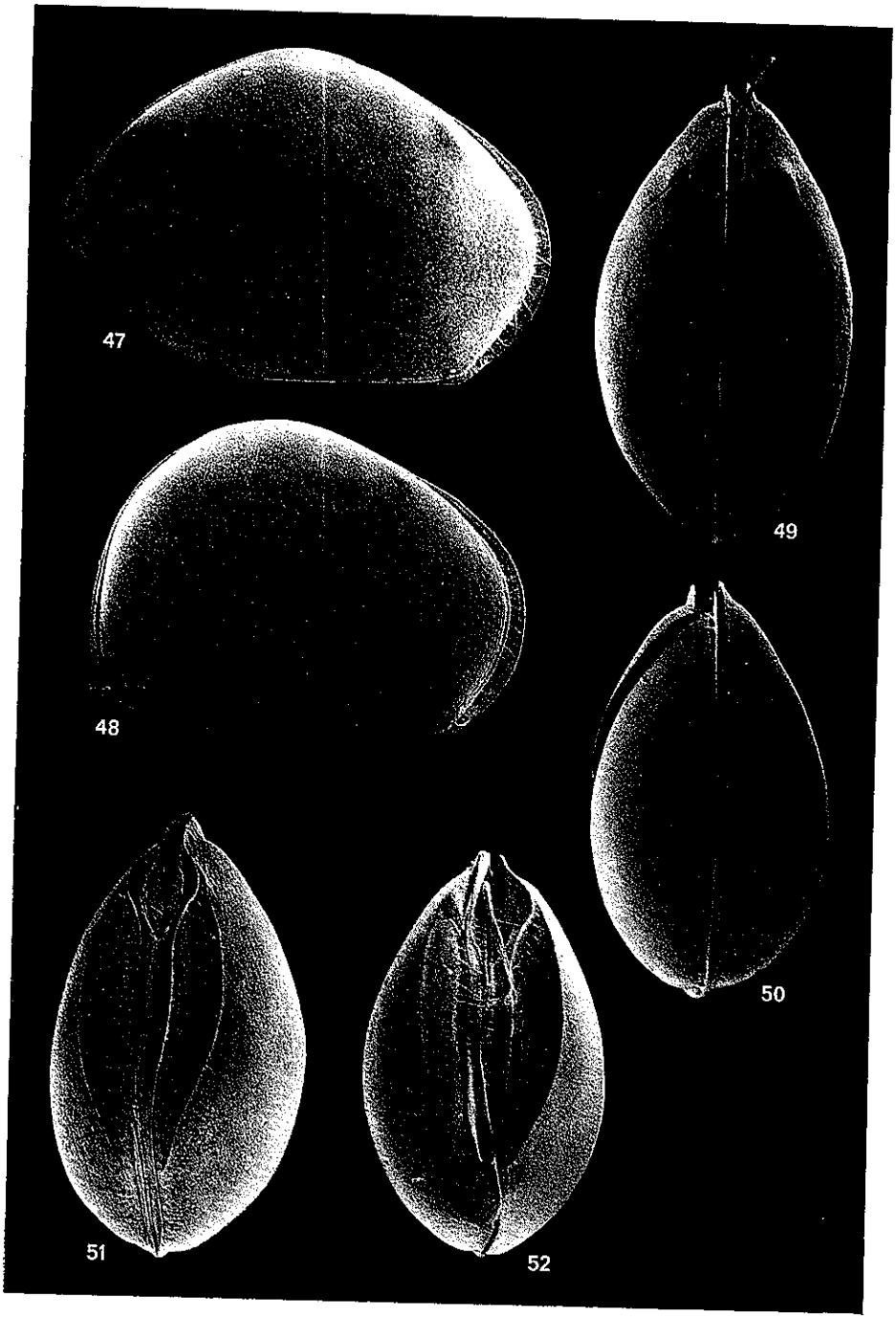
Plate 5.

Figs. 47-52. *Notodromas monacha* (O. F. MÜLLER 1776). 420

Pond at Rouge Cloître, near Brussels, Belgium. Recent.

47. ♂ C (1·22) right lateral view. — Xe 10796.
48. ♀ C (1·12) right lateral view. — Xe 10797.
49. ♂ C (1·21) dorsal view. — Xe 10798.
50. ♀ C (1·16) dorsal view; L partially broken. — Xe 10799.
51. ♂ C (1·16) ventral view. — Xe 10800.
52. ♀ C (1·09) ventral view. — Xe 10801.



P. De Deckker: Comparative morphology and review of Australian Notodromadinae Kaufmann 1900 (Crustacea: Ostracoda).

Plate 6.

Enlargements of SEM photographs to show the fine details of the outside of notodromadinid carapaces. All × 350.

Fig. 53. *Notodromas monacha* (O. F. MÜLLER 1776). 420

53. Pond at Rouge Cloître, near Brussels, Belgium. Recent. — Xe 10796.

Figs. 54-55, 59-61, 63-65. *Newnhamia fenestrata* KING 1855. ..... 420, 431

54. Pond near Goulburn, NSW. Recent. — Xe 10856.
55. Pond at Pine Hut, Vic. Recent. — Xe 10861.
59. Unnamed swamp, 2 km east of Princetown, near Port Campbell, Vic. Recent. — Xe 10845.
60. Pond on Monash University Campus, Clayton, Vic. Recent. — Xe 10857.
61. Pond 2 km south of Cobar, NWS. Recent. — Xe 10873.
63. Pond on Oakdale Farm, near Sutton, ACT. Recent. — Xe 10872.
64. Pond 25 km south of Goulburn, NSW. Recent. — Xe 10851.
65. Pond at Christchurch, New Zealand. Recent. — Xe 10879.

Figs. 56-57. *Newnhamia petiola* n. sp., paratypes. 420, 436

56. Pine Tree Creek Lagoon, via Hughenden, Qld. Recent. — Xe 10819.
57. Pond near Windsor, NSW. Recent. — Xe 10826.

Fig. 58. *Newnhamia insolita* n. sp., paratype. 420, 437

58. Pond in Dog Rocks State Forest, near Rockley, NSW. Recent. — Xe 10837.

Fig. 62. *Kennethia cristata* n. gen. n. sp., paratype. 420, 442

62. Sheepwash Lagoon, Vic. Recent. — Xe 10810.

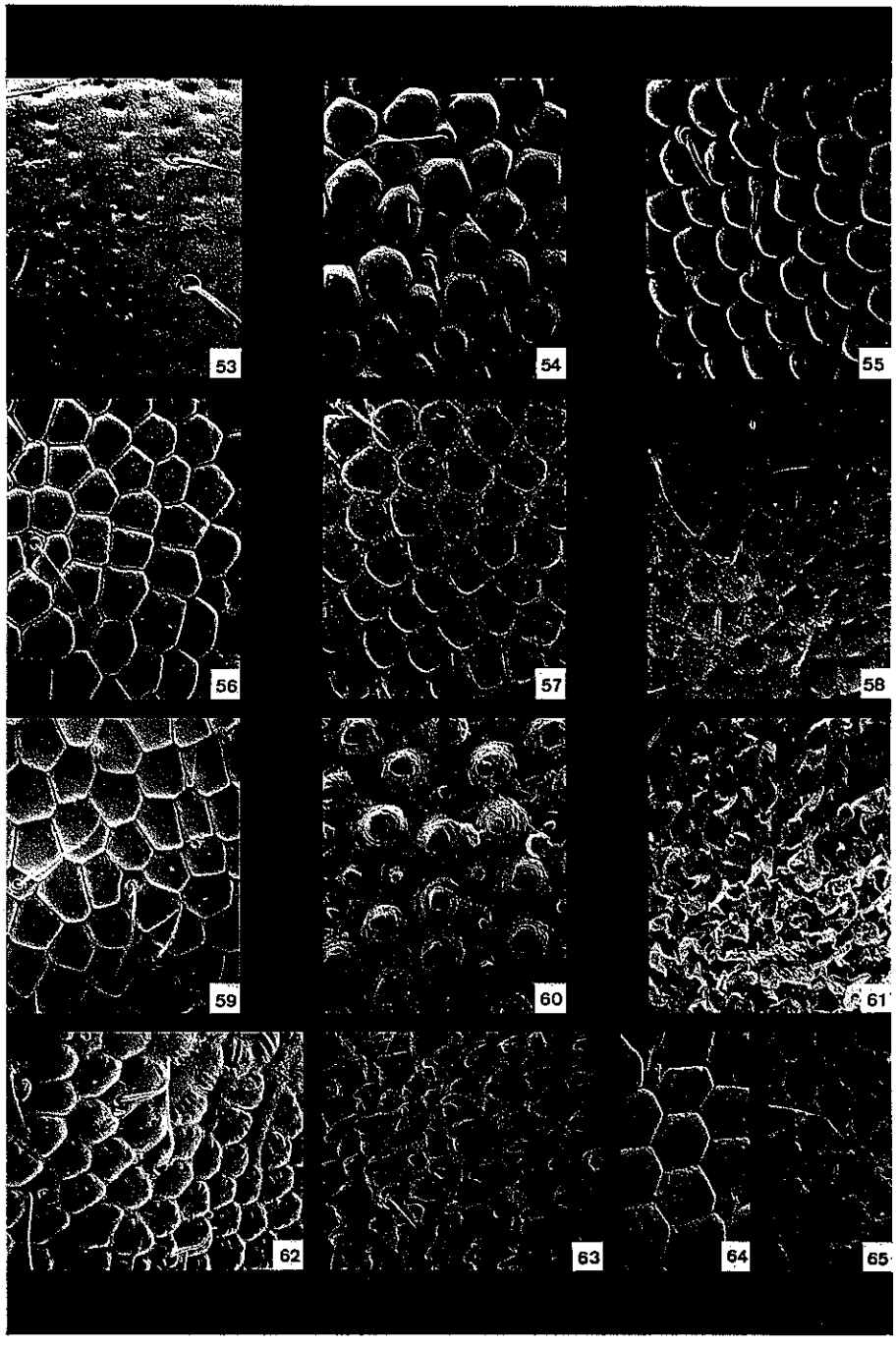


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Plate 7.

Longitudinal and transverse sections through the shell of notodromadinid ostracods by transmitted light photography. All × 52.

a = longitudinal section, b = transverse section.

Fig. 66 (a, b). *Newnhamia petiola* n. sp., paratypes. 422
66 (a, b). Pond near Windsor, NSW. Recent. — Xe 10831, 10832.

Figs. 67-68. *Newnhamia fenestrata* KING 1855. 422
67 (a, b). Unnamed swamp 2 km east of Princetown, near Port Campbell, Vic. Recent. — Xe 10843, 10844.
68 (a, b). Pond 25 km south of Goulburn, NSW. Recent. — Xe 10852, 10853.

Fig. 69 (a, b). *Kennethia cristata* n. gen. n. sp., paratypes. 422
69 (a, b). Sheepwash Lagoon, Vic. Recent. — Xe 10808, 10809.

Fig. 70 (a, b). *Notodromas monacha* (O. F. MÜLLER 1776). 422
70 (a, b). Pond at Rouge Cloître, near Brussels, Belgium. Recent. — Xe 10802, 10803.

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Plate 8.

Hemipenes and ejaculatory tubes of notodromadinid ostracods by transmitted light photography. All × 92, except Fig. 80: × 40.

Hemipenes.

Figs. 71-75. *Newnhamia fenestrata* KING 1855. ..... 428, 434

71. Pond at Pine Hut, Vic. Recent. — Xe 10867.
72. Unnamed swamp 2 km east of Princetown, near Port Campbell, Vic. Recent. — Neotype Xe 10841.
73. Pond 2 km south of Cobar, NSW. Recent. — Xe 10874.
74. Pond at Christchurch, New Zealand. Recent. — Xe 10877.
75. Pond on Oakdale Farm, near Sutton, ACT. Recent. — Xe 10870.

Fig. 76. *Newnhamia insolita* n. sp. 428, 438

76. Pond in Dog Rocks State Forest, near Rockley, NSW. Recent. — Holotype Xe 10835.

Figs. 77-78. *Newnhamia petiola* n. sp. 428, 436

77. Pine Tree Creek Lagoon, via Hughenden, Qld. Recent. — Holotype Xe 10817.
78. Pond near Windsor, NSW. Recent. — Paratype Xe 10833.

Fig. 79. *Kennethia cristata* n. gen. n. sp. 428, 444

79. Sheepwash Lagoon, Vic. Recent. — Holotype Xe 10806.

Fig. 80. *Notodromas monacha* (O. F. MÜLLER 1776). 428

80. Pond at Rouge Cloître, near Brussels, Belgium. Recent. — Xe 10804.

Ejaculatory tubes.

Figs. 81, 84. *Newnhamia fenestrata* KING 1855. ..... 428, 434

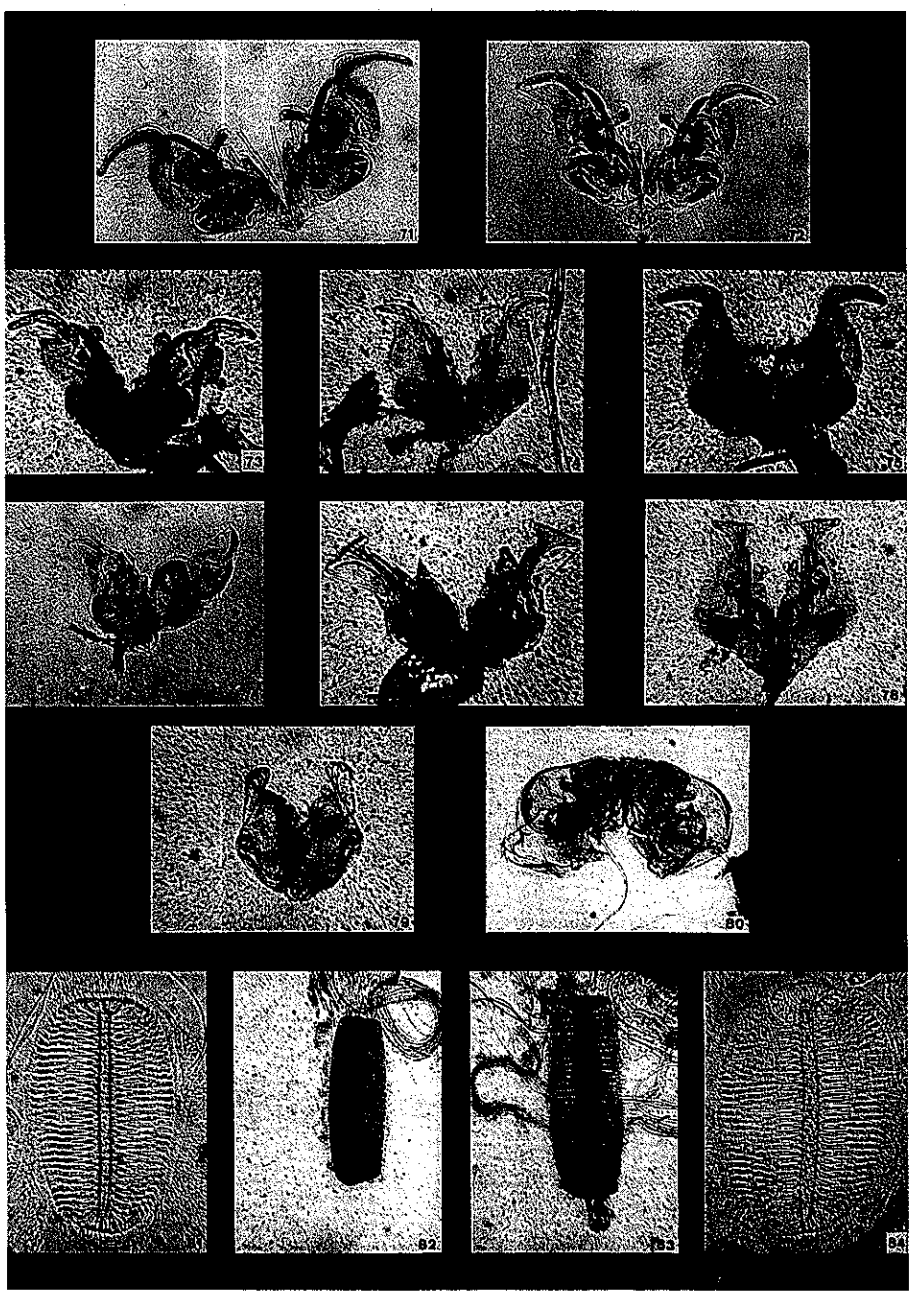
81. Unnamed swamp 2 km east of Princetown, near Port Campbell, Vic. Recent. — Neotype Xe 10841.
84. Pond at Pine Hut, Vic. Recent. — Xe 10867.

Fig. 82. *Newnhamia petiola* n. sp. 428, 436

82. Pond near Windsor, NSW. Recent. — Paratype Xe 10833.

Fig. 83. *Newnhamia insolita* n. sp. 428, 439

83. Pond in Dog Rocks State Forest, near Rockley, NSW. Recent. — Holotype Xe 10835.



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