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TERRESTRIAL OSTRACODS IN AUSTRALIA

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SUMMARY

Two new species of terrestrial ostracods are described from Australia: *Mesocypris australiensis* n.sp., mainly recorded from near the east and south coast of eastern Australia, and *M. tasmaniensis* from south-west Tasmania. An additional species *Scottia audax* is also recorded from Queensland and New South Wales.

Ecological notes on *M. australiensis* are given and the distribution of the terrestrial ostracods found only in the southern hemisphere is discussed.

INTRODUCTION

Ostracods occur in most aquatic environments ranging from typically marine to freshwater. They are present in interstitial and non-marine saline waters and are also found outside the typical aquatic habitats, living among moss and leaf litter characterised by a high moisture content. The term 'terrestrial' used here refers to that particular environment. Such cases of terrestrial adaptation for ostracods have been recorded from African forests by Klie (1939) with *Mesocypris pubescens* Daday, 1908 and by Lawrence (1953) and Harding (1953) with *Mesocypris terrestris* Harding, 1953, from New Zealand native forests by Chapman (1960, 1961) with *Scottia audax* (Chapman, 1961), and from a variety of terrestrial environments in Madagascar by Danielopol and Betsch (1980) who described *Mesocypris madagascariensis* and *M. pauliani* and also *Terrestricandona minuta*. Additionally, Schornikov (1969) described a highly adapted terrestrial ostracod *Terrestricythere ivanovae* Schornikov, 1969 living in vegetal debris of marine origin on a beach of the Kuril Archipelago. It is only recently that ostracods have also been recorded from litter and soil in wet sclerophyll forests in Victoria (as *Mesocypris* sp. by Ahern and Yen, 1977) and Queensland (no identification given by Plowman, 1979) and New South Wales (De Deckker, 1980).

All the ostracods found in terrestrial environments, including the Australian species here, belong to the family Cyprididae Baird, 1845, which groups non-marine ostracods with the exception of *Terrestricythere ivanovae* and *Terrestricandona minuta*. The former belongs to the superfamily Terrestricytheracea, which has marine affinity, and the latter belongs to the Candonidae, which groups mainly freshwater and some marine forms. Danielopol and Betsch (1980) claim that *T. minuta* originates from a typical interstitial freshwater candonid ancestor.

In Australia there are three species of terrestrial ostracods known: *Mesocypris tasmaniensis* n.sp from SW Tasmania, *M. australiensis* n.sp from northern Queensland to New South Wales and Victoria (see Table 1, Fig. 6) and *Scottia audax* (Chapman, 1961) from Queensland and New South Wales. The latter species has recently been re-examined by De Deckker (1980).

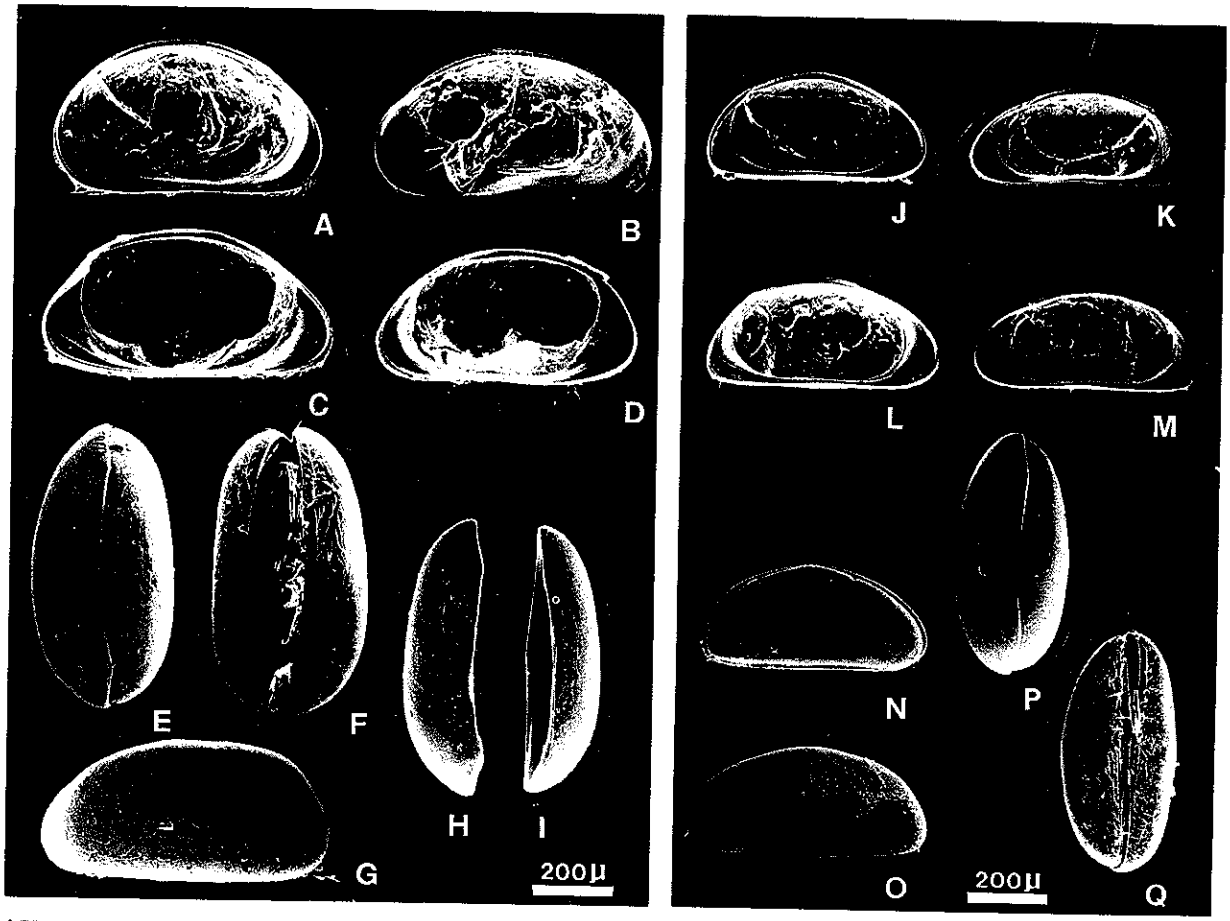
SYSTEMATICS

Superfamily Cypridacea Baird, 1845

Family Cyprididae Baird, 1845

Subfamily Scottinae Bronstein, 1947

Remarks: This subfamily is characterised by: smooth oviform shell, dorsally arched and ventrally flat and often densely pilose, especially in the ventral area. Central muscle field consisting of an almost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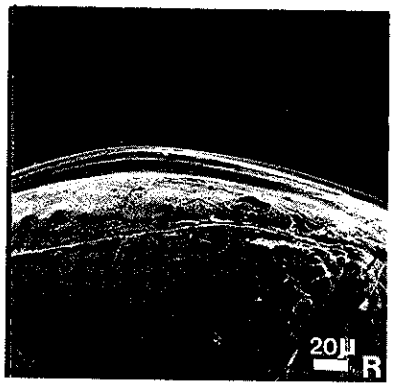
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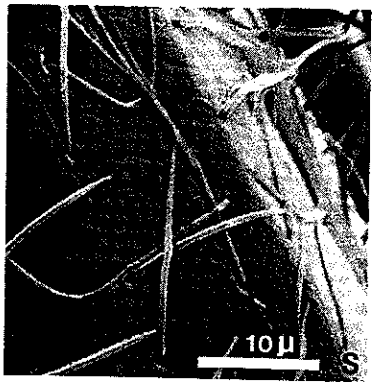
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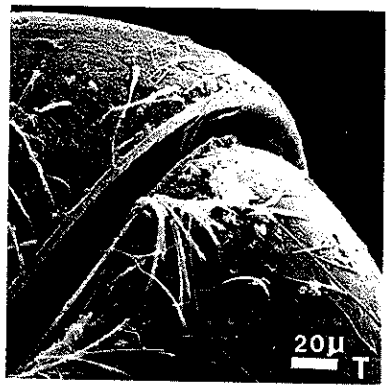
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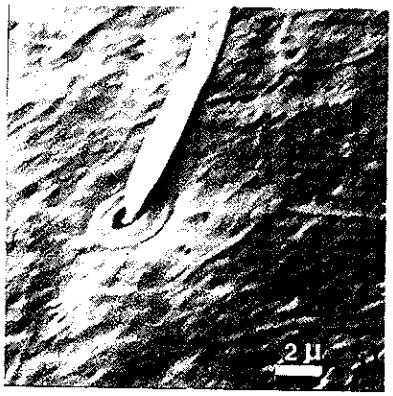
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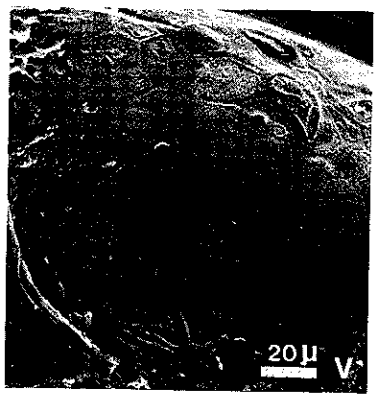
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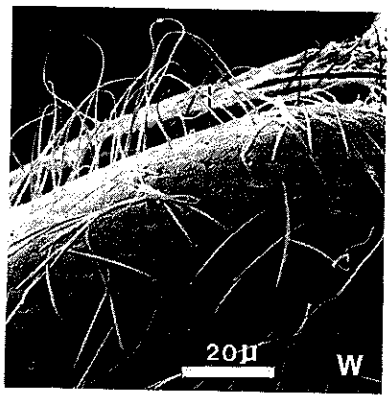
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vertical row of 3 large rectangular scars with a smaller one below plus 2 others behind, the top one often being the largest. Natatory bristles of the antenna strongly reduced. Furca strongly chitinised and with 2 thick and strong denticulated claws. Zenker organ with one rounded, globular end. (Modified from Hartmann and Puri, 1974.) *Scottia* Brady and Norman, 1889 and *Mesocypris* Daday, 1908 are grouped in this subfamily as discussed by De Deckker (1979a).

Mesocypris Daday, 1908

Remarks: Shell smooth or pseudopunctate and often strongly pilose, especially in the ventral area; left valve larger than right one especially at both anterior and posterior ends. Thoracopod I with segments 2 and 3 fused and a small seta on the outside of the 4th segment; furcae asymmetrical: right one with strongly denticulated shaft, left one finely pectinated.

Mesocypris australiensis n.sp

Figs 1, 2, 5A-G

Types. *Holotype:* ♂ adult, Beauchamp Falls, Otway Ranges, Victoria—collected on moss. South Australian Museum, C3922.

Paratype: ♀ adult, same data, C3923.

Diagnosis: *Mesocypris* with furcae consisting each of 2 short, stout and strong and almost equal denticulated claws plus a long plumose anterior seta which is often much longer than the claws. The posterior setae are dissimilar: a thin (at least twice thinner and shorter than the claws) and pectinate one on the left furca which has a shaft with fine hairs; a short (almost half the length of the claws) stout and thick one on the right furca which possesses a coarse and irregular denticulation along its shaft.

Dimensions:

		Length (μm)	Height (μm)
Holotype ♂	LV	710	400
	RV	690	380
Paratype ♀	LV	690	370
	RV	670	340

Description

Carapace: *external:* oval in shape with almost flat ventral area; length about twice the height and the width; greatest height usually in middle. Shell smooth or finely pseudopunctate. Pilosity of shell variable but hairs always more prominent ventrally; hairs thin at their base. Left valve (LV) overlapping right valve (RV) all around its periphery except in the hinge area where both valves join at the same level. In dorsal view, strong overlap of LV over RV anterior and posterior to hinge and more extensive posteriorly. Normal pores commonly rimmed and often arranged in rows parallel to the long axis of the shell ventrally. Colour of shell white with pale yellow colouring occasionally noticed on live specimens from Mt Wilson, N.S.W. in the vestibulum areas both anteriorly and posteriorly.

internal: hinge adont; central muscle field consisting in front of an almost vertical row of 3 large rectangular scars plus a narrower one below and two more rounded placed behind. Mandibular scars elongated and almost as long as the rectangular scars above. Calcareous part of the inner lamella broad, especially in the postero-ventral area. Selvage faint in right valve and more evident in left valve where

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Fig. 1 (facing). *Mesocypris australiensis* n.sp **A-I, U**—Beauchamp Falls, Otway Ranges, Vic. **A-B**—Holotype male, internal lateral view of LV and RV; **C-D**—Paratype female, same data; **E**—Female, dorsal view of carapace; **F**—Female, ventral view of carapace; **G**—External lateral view of carapace (note slight deformation of the shell in posterodorsal area); **H-I**—Male, dorsal view of LV and RV separated; **U**—Detail of E to show rimmed normal pore and pseudopunctation of shell. **J-T, V-W**—Gold Hill, McDonald Range (16° 05'S 145° 17'E), Qld. **J-K**—Male, internal lateral view of LV and RV; **L-M**—Female, same data; **N**—Male? external lateral view of carapace showing RV; **O**—Female? external lateral view of carapace showing LV; **P**—Female, dorsal view of carapace; **Q**—Female, ventral view of carapace; **R**—Detail of J to show fine groove in hinge area and below it a sperm thread; **S**—Detail of N to show rimmed normal pores and ? sensory hairs; **T**—Detail of Q to show normal pore canals with and without protruding hairs (note pores aligned parallel to long axis of the shell); **U**—Detail of E to show rimmed normal pore with hair and pseudopunctation of shell; **V**—Detail of K to show central and part of dorsal muscle field and internal pores; **W**—Detail of N to show hairs in dorsal area of shell. LV-left valve, RV-right valve.

Fig. 2. *Mesocypris australiensis* n.sp Holotype male: **A**—Antennula, outline of segments; **B**—Antenna; **D**—Mandibular endopod; **E**—Maxillular palp with lobes; **H**—Thoracopod II; **I**—Thoracopod I; **J**—Rake-like organ; **K-L**—Hemipenis outline; **N-M**—Maxilla, detail of palp; **O**—Right furca; **P**—Left furca; **Q**—Furcal attachment; **R**—Zenker organ. Paratype female: **C**—Antenna; **F**—Maxilla; **G**—Rake-like organ.
Scales: small one (25 μm) for Figs 2G, J; large one (100 μm) for others.

it is narrow anteriorly and broader posteriorly. Width between inner margin and selvage often twice that of distance between selvage and outer margin. Edge of outer margin slightly curved outwards especially in LV.

Appendages. Only the characteristic features will be described here. For details see Fig. 2 and Fig. 5A-G.

Antennula: 7-segmented; segments 4–7 strongly chitinized; segment 4 longer than 5 and 6 together. The distal setae are as long as all the segments together.

Antenna: sexual dimorphism present: 4 short strong claws in both sexes plus an additional smaller one in male which has a broad comb-like denticulation (this claw is thought to help during copulation for the male to trap hairs protruding on the outside of the female carapace in order to remain in a stationary position). 'Natatory' setae very small.

Mandible: coxa with 7 molars; distal molar longer than previous 3 and next to it there is a slightly longer pectinate seta. Mandibular palp 4-segmented with last segment narrow and twice as long as 2nd one; α seta very long and smooth, β seta short and pectinate, γ seta thin and shorter than 4th segment and with brush-like hairs. Respiratory plate normally developed.

Rake-like organ: in holotype only 7 teeth present whereas in females 7–8 teeth seen with outside one bifid.

Maxillula: second segment of palp narrow and small: 2 smooth *Zahnborsten* on 3rd endite and on external side of 1st endite and 2 thick pilose setae, one about the length of the endite and the other about double in length. Respiratory plate normally developed.

Maxilla: strong sexual dimorphism: in male, end segment of prehensile palps slightly asymmetrical: one broader than the other; in female, endopodite with 3 plumose bristles of different lengths, the smallest one being 4 times shorter than the longest one. Long seta at the base of the endopodite in both sexes. Near the tip of the protopodite there are 11 bristles and 2 smaller ones near its base.

Thoracopod I: segments 2 and 3 fused; posterior seta on 4th segment very small (about length of that segment).

Thoracopod II: segments 2 and 3 fused; terminal segment with one pincer and 2 unequal setae.

Hemipenis: for outlines see Fig. 2K-L.

Zenker organ: 16 rosettes in holotype but the number can vary between 9 and 16. Central tube finely ribbed transversally. One end globular.

Furca: see diagnosis. The length of the anterior setae is very variable and occasionally they can be different on a single specimen (Fig. 5H).

Furcal attachment: strongly chitinized; long and straight median branch; ventral branch with broad apex; dorsal branch long and strongly curved.

Eye: dark brown in colour.

Remarks. Variation in hemipenis outline is noticeable especially in the protrusion of the lateral lobe and on the external edge of the median lobe (see Fig. 5A-B). Because of such variations, no constant diagnostic feature could be selected for differentiating *M. australiensis* from *M. tasmaniensis.* This phenomenon is rather unusual as the outline of the hemipenis is normally an excellent taxonomic feature and is used for species differentiation for many cypridid ostracods (see discussions in De Deckker, 1978, 1979). In general, the lateral lobe of *M. australiensis* does not protrude as much as for *M. tasmaniensis.*

Specimens of *M. australiensis* from Gold Hill, Queensland (see Fig. 1J-Q) are much smaller than those from the type locality and others in southern Australia. This is also reflected in the size of the furca (compare Figs 2O-P and 5H); similarly, reduction in size of the animal appears to be associated with a reduction in rosette number in the Zenker organ (9 and 10 rosettes found in specimens from Gold Hill).

Distribution. See Table 1.

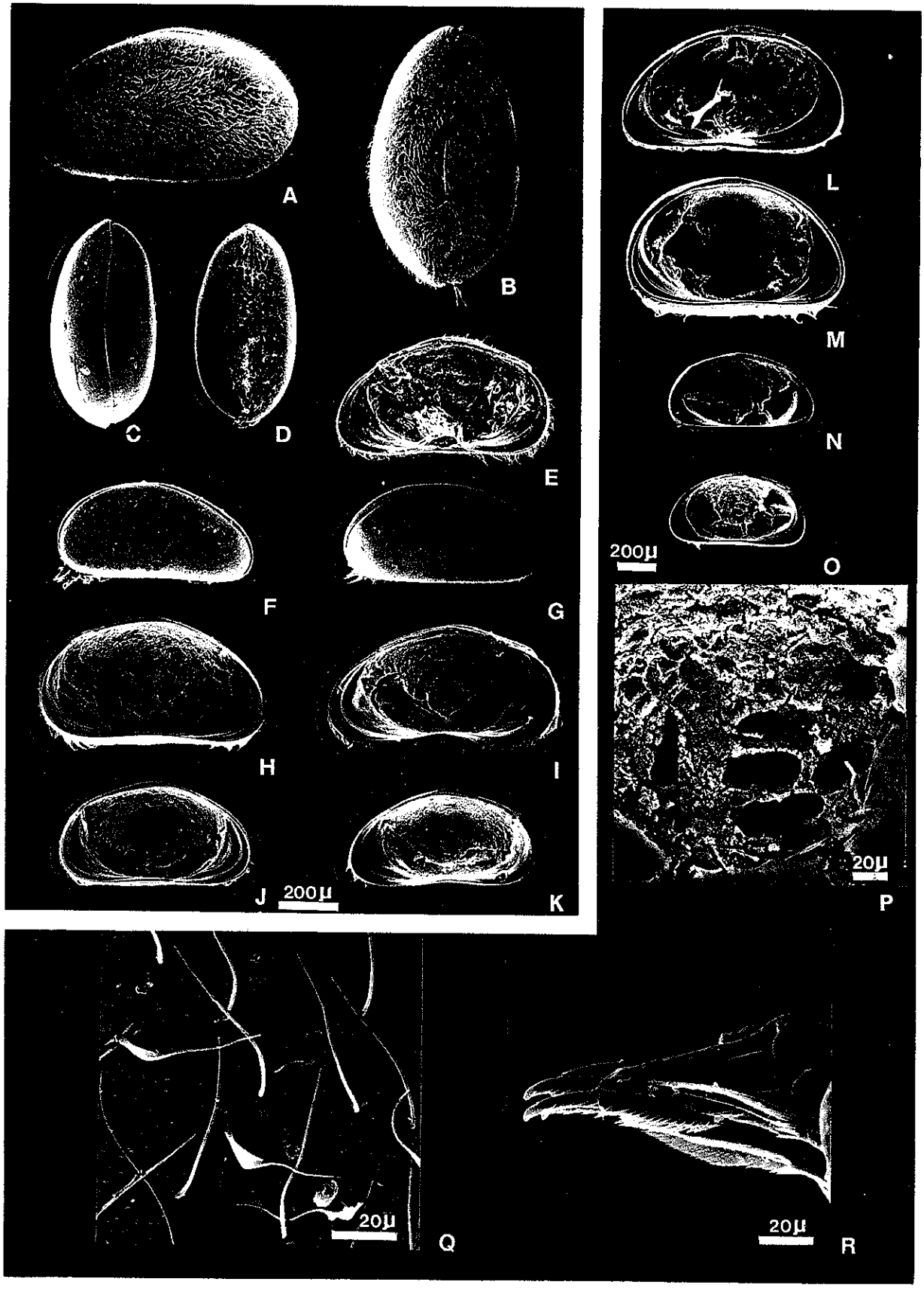
Mesocypris tasmaniensis n.sp.

Figs 3A-K, 4, 5I-N

Types. *Holotype:* ♂ adult, broken valves, wet sclerophyll litter, lower Gordon River area in SW Tasmania (42° 51′S, 145° 50′E). Tasmanian Museum, G2237.

Paratype: ♀ adult, same data, G2238.

Diagnosis. *Mesocypris* with furca with similar claws and setae: 2 almost equal, short, stout and strong claws and a thin anterior seta often longer than the claws and a pectinate posterior seta, coarser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than the anterior one and about half to ¾ the length of the claws. Right furcal shaft with coarse irregular denticulation and left shaft with fine hairs.

Dimensions:	Length (μm)	Height (μm)
Paratype ♀: carapace	600	300
Paratype ♂: carapace	580	300
Paratype ♀(unusually large): carapace	840	440

Description

Only the features of the carapace and the anatomy which are different from those of *M. australiensis* are presented.

Carapace: *externally:* the height and width of the carapace are slightly less than half the length; the greatest height is usually at 3/5 from the anterior.
internally: the selvage is broader and more prominent in both valves.

Appendages. The main anatomical feature distinguishing *M. tasmaniensis* from *M. australiensis* is the morphology of the posterior setae of the furcae. For description see diagnosis. The minor differences seen in the Tasmanian species are:
— on the antennae, the natatory setae are very short in the male;
— on thoracopod I, the posterior seta on segment 4 is slightly longer;
— in the male maxilla, the broadening of both palps is almost identical;
— the lateral lobe on the hemipenis is usually longer;
— the furcal attachment has a ventral protrusion at mid-length on the median branch and the apex of the ventral branch is knob-shaped;
— the main tube of the Zenker organ is transversely ribbed.

Remarks. Occasionally unusually large specimens of *M. tasmaniensis* have been found in the Tasmanian collections. The carapaces of these are more hairy (see Fig. 3A-B). No difference in morphology has been noticed for these specimens. It is thought that they represent animals which could have undergone an additional moult but there is no evidence to substantiate this.

Distribution. Lower Gordon River and tributaries area in SW Tasmania. Found in 122 samples taken in that area by members of the Zoology Department, University of Tasmania. Fossil specimens, which have been recovered in many samples from Mowbray and Pulbeena Swamps from NW Tasmania (formed during the Late Quaternary—De Deckker, 1982), are tentatively included in this species even though it is necessary to have soft parts to distinguish species of *Mesocypris* in Australia, as quite a few fossil specimens have large valves as seen in some of the living samples taken in the lower Gordon area (see remarks above).

General remarks about *M. australiensis* and *M. tasmaniensis*

Anatomically both species are very similar except for the morphology of the posterior setae of the furcae. The general shape of the shell varies from one locality to another but there does not seem to be any distinctive taxonomic difference except that the selvage is much broader in both valves of *M. tasmaniensis*. The difference in size between specimens from different populations is likely to be caused by varying ecological parameters.

The two Australian species differ from *M. terrestris* mainly in that the latter has no eye and a much higher number of rosettes on the Zenker organ. The outline of the hemipenis is also different. The shell and the anatomy of *M. terrestris* are generally more pilose.

For discussion of other *Mesocypris* species see Danielopol and Betsch (1980).

Fig. 3. (facing) **A-K**—*Mesocypris tasmaniensis* n.sp, from various localities in the lower Gordon River area, SW Tas. **A-B**—(loc. 42° 41′S 145° 39′33″E) Female: lateral and dorsal view of carapace; **C-G**—(Type locality: 42° 51′S 145° 50′E): **C-D**—Male?, dorsal and ventral view of carapace; **E**—Males, internal lateral view of RV; **F**—Female?, external lateral view of RV; **G**—Male, same data; **H-K**—(loc. 42° 43′S 145° 50′E): **H-I**—Large female, internal lateral view of LV and RV; **J-K**—Small female, same data.
L-R—*Scottia audax* (Chapman, 1961). **L-P**—Joalah National Park, rainforest (loc. 27° 55′S 153° 12′E), Qld: **L-M**—Female, internal lateral view of RV and LV; **N-O**—Juvenile, same data; **P**—Detail of O to show central muscle field; **Q-R**—Dorrigo National Park, N.S.W.: **Q**—Detail of shell to show normal pores and different types of hairs; **R**—Detail of claws and setae of furcae.

Fig. 4. *Mesocypris tasmaniensis* n.sp. Paratype female: **A**—Antennula, outline of segments; **C**—Antenna; **D**—Mandibular endopod; **E**—Maxilla; **I**—Thoracopod I; **M**—Right furca; **N**—Left furca; **O**—Furcal attachment. Holotype male: **B**—Antenna; **F**—Hemipenis outline; **G**—Maxillular palp with lobes; **H**—Part of rake-like organ; **J-K**—Maxilla, detail of palp; **L**—Thoracopod II; **P**—Zenker organ. **Scales:** small one (25 μm) for Fig. 4H; large one (100 μm) for others.

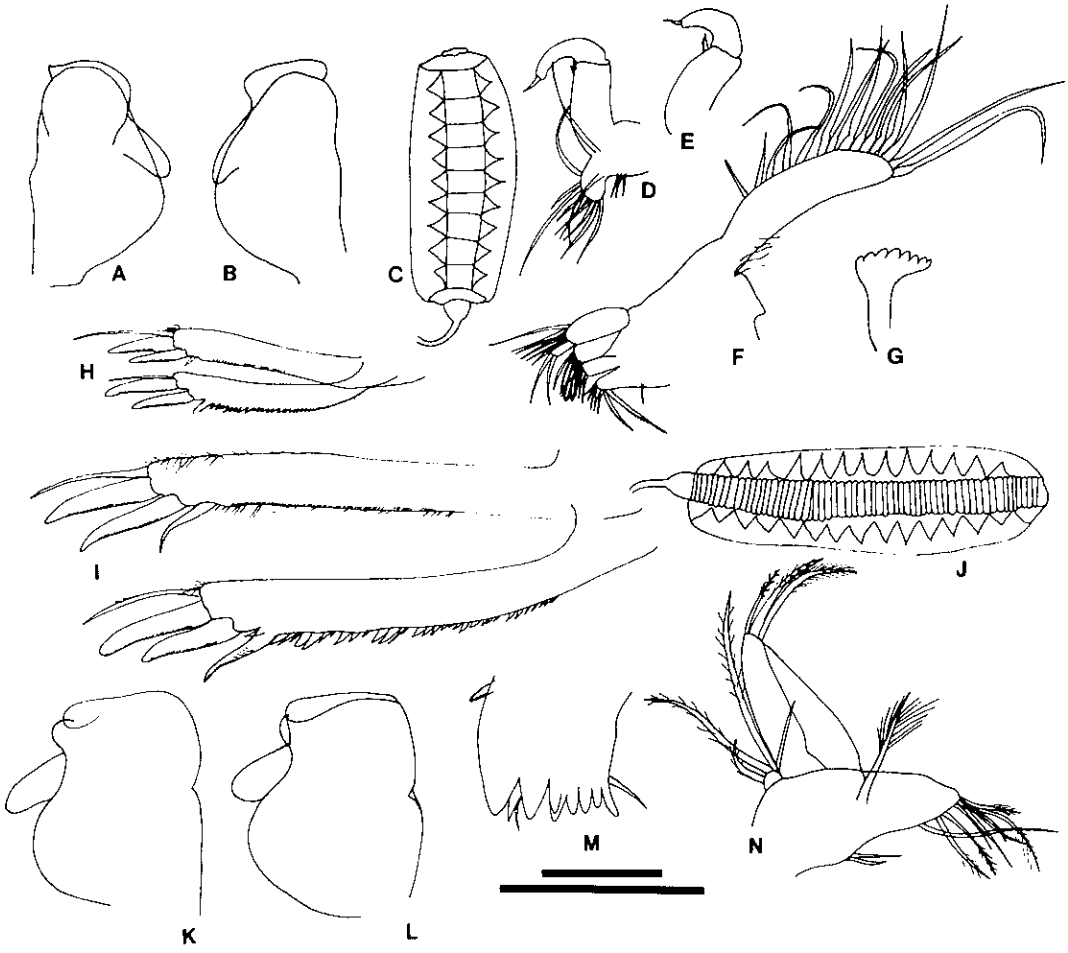

Fig. 5. *Mesoscypris australiensis* n.sp. Gold Hill, McDonald Ranges (loc. 16° 05'S 145° 17'E). Male: **A-B**—Hemipenis outline; **C**—Zenker organ; **D**—Maxilla; **E**—Maxilla, detail of palp; **H**—Furcae. Female: **F**—Maxillula; **G**—Rake-like organ.
Mesocypris tasmaniensis n.sp. Type locality (42° 51'S 145° 50'E), Lower Gordon River area, SW Tas.: Female: **I**—Furcae. Male: **J**—Zenker organ: **M**—Mandibular coxale, detail. (Loc. 42° 37'S 145° 45'E) Lower Gordon River area, SW Tas.: Male **K-L**—Hemipenis outline (Loc. 42° 41' 30"S 145° 54'E) SW Tas.: Female **N**—Maxilla.
Scales: small one (25 μm) for Figs 6 J-M; large ones: (100 μm) for others.

Scottia Brady and Norman, 1889

Remarks. The genus is characterised by a thoracopod I with well defined (not fused) segments 2 and 3 and with a terminal claw and a long thick seta, often longer than half the length of the claw. The furcae are symmetrical and the furcal shafts are much broader than for *Mesocypris* species. So far there are only 3 known living *Scottia* species: *S. pseudobrowniana* Kempf, 1971, *S. audax* (Chapman, 1961) and *S. insularis* Chapman, 1963.

S. audax, recently re-examined by De Deckker (1980), is a terrestrial species; the female anatomy of that species is almost identical to that of *S. pseudobrowniana. S. insularis* could not be examined as the type material is at present missing from the Otago Museum. From Chapman's (1963) description, which is the only one available for that species, De Deckker (1980) has cast doubts on its generic affinity. Eagar's (1969) description of mummified parts of the soft anatomy of *S. insularis* from Pleistocene sediments does not provide additional details as many appendages were partly damaged.

Scottia audax differs from the two Australian *Mesocypris* species on the following characters:
—*shell*—thicker shell which is usually coloured in brown or light grey.
—some hairs protruding from the normal pores are broad at their base.

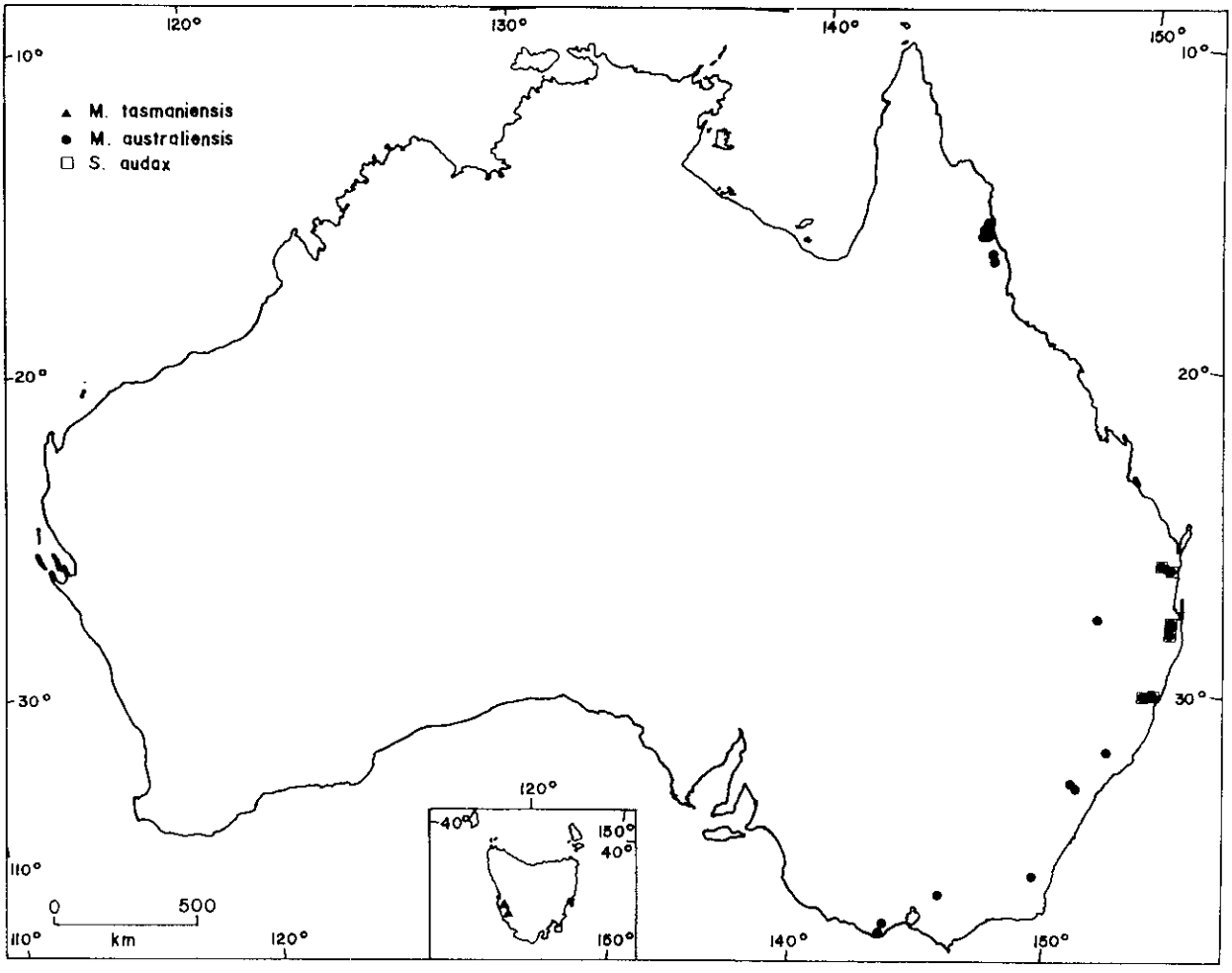

Fig. 6. Distribution of the terrestrial ostracods in Australia. See Table 1 for further details.

—mandibular scars below the central muscle field are very small.
—selvage more prominent in LV and closer to the edge of the shell anteriorly, whereas in the right valves it is thin and far away from the edge of the shell posteriorly.
— *anatomy:* see different generic details mentioned above; in general the appendages are more pilose and many setae are more plumose.

Ecological notes

Terrestrial ostracods in Australia have only been found in wet sclerophyll and rain forests. Live specimens of *Mesocypris australiensis* found in *Sphagnum* moss collected on the side of the road near a small creek (where light penetration was poor) at Mt. Wilson near Lithgow, N.S.W., were examined in the laboratory. The following observations were made:

—when fully immersed in water *M. australiensis* did not swim freely. This is probably due to the atrophy of 'natatory' setae on the antennae and the small number of long setae on the antennulae. When put in an upside-down position at the bottom of a glass petri dish of water, the animal did not return to the normal upright position. At the time, it was possible to see through the white translucent shell the maxillular respiratory plates vibrating between the body and the valves. Rate of beating of the plates increased when the shell was either open or about to open. Immediately after closing of the valves, beating stopped for a short period of time.

—locomotion occurred on any surface by slight opening of the shell and movement of the strongly chitinised antennae and furcae. The use of these two parts of appendages is similar for benthic ostracods. In *M. australiensis* the furcae move together, although they are slightly dissociated from one another, they are welded at their base (for that reason they are hard to separate during dissection).

Table 1. LIST OF OCCURRENCES OF TERRESTRIAL OSTRACODS IN AUSTRALIA

M.a. = *M. australiensis*
M.t. = *M. tasmaniensis*
S.a. = *S. audax*

Queensland

Joalah National Park, altitude c. 380 m, rainforest, 27° 55'S 153° 12'E, **M.a.** + **S.a.**
Dingo Creek, 1 km E of Traverton, c. 80 m, rainforest, 26° 18'S 152° 48'E, **M.a.** + **S.a.**
Cooran Plateau, near Traverton, c. 400 m, rainforest, 26°17'S 152°50'E, **M.a.**
Lamington National Park, c. 920 m, 28° 14'S 153° 09'E, **M.a.** + **S.a.**
Mt Haig, c. 1150 m, 17° 06'S 145° 36'E, **M.a.**
Mt Lewis, 970 m, 16° 33'S 145° 13'E, **M.a.**
Mt Lewis, 960 m, 16° 35'S 145° 17'E, **M.a.**
Mt Lewis Road, near Julatten, 9 km from grid, **M.a.**
Mt Lewis Road, near Julatten, c. 500 m, c. 1000 m, c. 1200 m, c. 1300 m, **M.a.**
Eacham National Park, 760 m, rainforest, 17° 18'S 145° 37'E, **M.a.**
Cammoo Caves near Rockhampton, 28° 10'S 150° 28'E, **M.a.**
Gold Hill, McDonald Range, 550 m, 16 05'S 145° 17'E, **M.a.**

New South Wales

Dorrigo National Park, rainforest, 30° 21'S 152° 45'E, **M.a.** + **S.a.**
Dorrigo National Park, Wonga Walk, rainforest, c. 850 m, **S.a.**
Bruxner Park near Coffs Harbour, rainforest, **M.a.** + **S.a.**
Tuckers Knob, 21 km SW of Coffs Harbour, 760 m, **M.a.**
Upper Allyn Valley, near Eccleston, c. 650 m, rainforest leaf mould, **M.a.**
Brown Mountain, near Nimmitabel, Rutherford Creek, c. 820 m, rainforest, **S.a.**
Clyde Mountain, 600 m, c. 800 m, rainforest, **M.a.**
Mt Tomah, E of Lithgow, from beside a natural spring, wet sclerophyll forest, **M.a.**
Mt Wilson, E of Lithgow, creek along side of road, **M.a.**

Victoria

Beauchamp Falls, Otway Ranges, moss, **M.a.**
8 km SSE of Beech Forest, Otway Ranges, leaf litter and soil sample, **M.a.**
9.5 km SSE of Beech Forest, Otway Ranges, leaf litter and soil sample, **M.a.**
Acheron River, 500 m, trailing vegetation in leafy liverwort, wet sclerophyll forest, **M.a.**

Tasmania

Lower Gordon River and tributaries, 122 samples from moss and leaf litter, **M.t.**

—movement of the animal can be rapid and continuous. When the antennae are moving, the brown eye, with its 2 lateral lenses which can be seen through the carapace, is also moving sideways.

—*M. australiensis* was never seen moving backward or rotating completely.

—when taken out of the water in the petri dish, the ostracod closes its valves immediately and no appendages are seen to move inside the carapace.

—when the ostracod is moving on moss, a film of water surrounds the bottom part of the carapace. The trapping of water is caused by the abundant hairs which are most common ventrally and laterally to mid-height. When the shell is seen from above, hairs are very noticeable at both anterior and posterior ends. Some hairs can reach 100 μm in length (this is often the case in *S. audax*). When *M. australiensis,* surrounded by a bubble of water, is put on a dry petri dish, the animal can be mobile but it cannot retain the whole amount of water which was around it prior to motion. This indicates that hairs can trap water and retain it only when moving on moist ground.

—the position of the animal during motion or at rest is vertical upright at most times. This is achieved by the broadening of the shell near its base (when seen from the anterior, the shell is triangular in shape) and by the abundance of hairs which help in retaining a constant vertical position—other ostracods usually do not retain the vertical position on a hard surface but lie on their side, particularly when feeding.

—the strong pilosity seen on some of the appendages is likely to help in the retention of additional water.

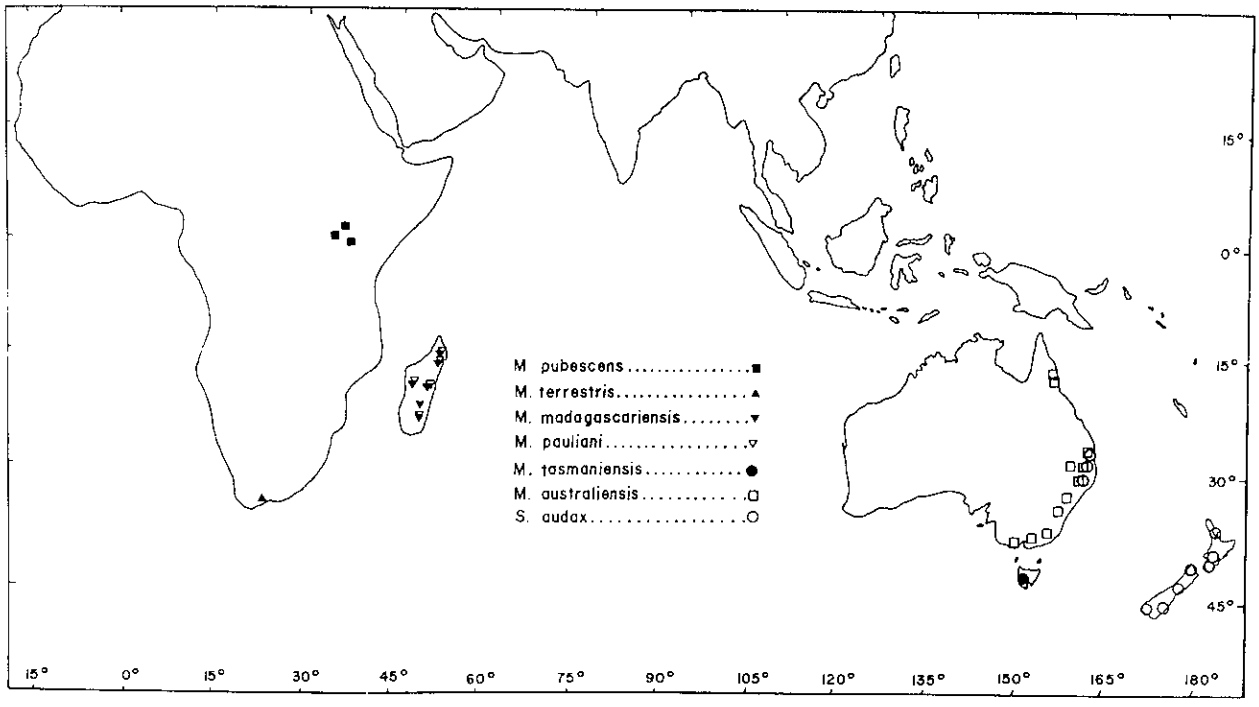

Fig. 7. Distribution of the terrestrial cypridid ostracods for the world. Data from Kile (1939), Harding (1953), Chapman (1961) and Danielopol and Betsch (1980).

Distribution

In Australia (see Fig. 6 and Table 1). In Queensland and some localities in northern New South Wales, *M. australiensis* was collected together with *S. audax* from the same samples of moss. They could usually be easily differentiated because *S. audax* is larger and is coloured light brown or grey. *M. australiensis* has a white shell through which occasionally pale yellow pigmentation is visible. Juveniles of *S. audax* of similar shell length to adults of *M. australiensis* can be distinguished from the latter because of their greater height.

In Tasmania, only *M. tasmaniensis* has been found. In the 122 samples collected, a few unusually large specimens of that species were noticed among others of the normal size. These were always females. No specimens in the Tasmanian collections had furcae similar to those of *M. australiensis* although many specimens had dried up prior to preservation in alcohol and proper dissection therefore was very difficult or impossible.

The presence of a Tasmanian species distinct from the one found on the mainland, and the absence of the latter in Tasmania can be understood as the 2 geographical areas probably always remained separated: during high sea levels marine water covered Bass Strait and during low sea levels, when Bass Strait was dry, arid climatic periods occurred. During the latter period, desert dunes were present even in NE Tasmania at some stage (Bowler, 1976 and Sprigg, 1979) and consequently no birds or transporting agents for ostracods from wet sclerophyll or rain forests were likely to have crossed the natural arid barrier. Recolonisation of the Australian mainland along the entire Great Dividing Range by passive or active migration of *M. australiensis* after arid episodes in the Pleistocene at least could have been achieved more easily than the crossing of Bass Strait, either dry or covered by the sea. A much wider marine barrier, however, separating Australia from New Zealand did not prevent *S. audax* from occurring in both countries (see discussion below).

Outside Australia. The known distribution of terrestrial ostracods is restricted to some of the areas which formed part of Gondwanaland: Africa, Madagascar, Australia and New Zealand. So far there have been no reports of terrestrial ostracods from South America or India. *Mesocypris* groups terrestrial species in Africa, Madagascar and Australia (see Fig. 7). Apparently, *Mesocypris* does not seem to have evolved rapidly since the breakup of the 'super land mass': anatomical specialisation and habitat restriction probably restrained additional specific radiation. The presence of *S. audax* in Australia and New Zealand (female specimens found in both countries possess identical anatomies and features of the shell) cannot

be easily understood unless migrating birds crossing the Tasman Sea or other carrying agents could have existed to transport the animals or their eggs. It is strange, however, that transport only occurred one way, probably from New Zealand to Australia, as *M. australiensis* is absent from New Zealand.

Scottia pseudobrowniana, which is widely distributed in Europe (Löffler and Danielopol, 1978), is closely related to *S. audax* anatomically. It is not surprising therefore to learn of a record of *S. pseudobrowniana* from floating fen in the Danube Delta in Romania by Danielopol and Vespremeanu (1964). The same species is usually recorded from peaty swamps in Europe, as is *S. insularis* in New Zealand.

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Note added in proof

Since the submission of this paper for publication (May 1980) a significant article by Schornikov (1980) on ostracods in terrestrial biotopes has been published. It describes a new species of *Terrestricythere* from among meadow plants on saline soil near Vladivostok. From south-west Pacific islands, 3 ostracod species (*Darwinula malayica* Menzel,

1923, *Callistocypris zlottini* Schornikov, 1980 and *Terrestricypris arborea* Schornikov, 1980 [the latter 2 being new genera]) are also described from a variety of terrestrial habitats (soil, decayed wood and rhizosphere of a fern epiphyte on a tree at a height of 2 m above ground).