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THE RHAPHIDOPHORIDAE (Orthoptera) OF AUSTRALIA. PART 6. TWO NEW SPECIES FROM NORTHERN TASMANIA

By **Aola M. Richards**

DEPT. OF ZOOLOGY, UNIVERSITY OF NEW SOUTH WALES, SYDNEY

Abstract: A new genus, *Parvotettix*, is erected, and the new species, *P. goedei*, is described. A new species of *Micropathus* Richards, *M. fuscus*, is also described. Both species occur in limestone caves in northern Tasmania. A key is given for the species of *Micropathus*, and the distribution pattern of *Micropathus* is discussed.

Almost all Tasmanian caves occur in the western half of the island where there is a high annual rainfall, and many caves contain active streams which flood periodically. Most caves have developed in the Gordon Limestone of the middle and upper Ordovician, but a few occur in Precambrian dolomites and limestones (Goede, in press). Apart from the Hastings caves which are Precambrian, all Rhaphidophoridae have been found in Ordovician limestone. Twenty-one main limestone areas are known, and rhaphidophorids have been recorded from eight of these areas.

To date only two species of Rhaphidophoridae have been recorded from Tasmanian caves (Richards, 1964), and both belong to the genus *Micropathus* Richards. A third species of *Micropathus*, *M. fuscus* n. sp., is now placed in this genus. It is recorded from an unnamed limestone cave near Gunns Plains in north-western Tasmania. In early May, the population of *M. fuscus* consisted of partly grown nymphs and adult insects.

A new monotypic genus, *Parvotettix*, is recorded from Little Trimmer Cave, Mole Creek. The new species, *P. goedei*, is the smallest rhaphidophorid species so far recorded from Australia, the length of the body not exceeding 10 mm in the adult insect. It lives in association with *Micropathus cavernicola* Richards. The main colony of several hundred *M. cavernicola* occurs within 10 m of the cave entrance, but stragglers extend 180–220 m into the cave, well into the zone of total darkness. *P. goedei* occurs as solitary individuals from about 90 m inwards. It is far more strongly pigmented than *M. cavernicola*. Immature forms were collected in November, but adults were taken in January and April.

At both Mole Creek and Gunns Plains rhaphidophorids were found in association with the Tasmanian cave spider, *Hickmania troglodytes* (Higgins and Petterd). No predation was observed, but in Little Trimmer Cave fairly recent remains of *M. cavernicola* were found in association with the spider.

Although bats occur in Tasmania, there are no bats in Tasmanian caves. Thus the accompanying guanobia found in many mainland Australian caves are also absent. Most of the cave fauna occurs round cave entrances, and extends only a comparatively short distance

inside caves. It is centered around underground streams, and many insect species have aquatic larvae. *Micropathus* spp. and glow-worms, *Arachnocampa* (*Arachnocampa*) *tasmaniensis* Ferguson (Fam. Mycetophilidae), are dominant species in Tasmanian caves, but do not share the same position in caves where they both occur. *Micropathus* occur round the entrance and up to 30 m inside, while *A.* (*A.*) *tasmaniensis* are established further inside. The very large populations of *Micropathus* may be due to the absence of predators such as bats and rats.

Rhaphidophorids are apterous insects, extremely sensitive to temperature changes, and requiring a very high relative humidity. Their normal habitat is in caves or tunnels, or in the bush hidden under stones or bark, or in rotten logs. These requirements would form a barrier to their being carried passively across Bass Strait by strong winds. *Micropathus* and *Parvotettix* may have reached Tasmania via the land bridge which extended from Flinders Island to Wilson's Promontory during the Pleistocene, and until as recently as about 10,000 years ago. However, unlike *Cavernotettix flindersensis* (Chopard) from Flinders Island (Richards, in press), neither *Micropathus* nor *Parvotettix* show any close affinities with south-eastern Australian genera, and it is suggested that they either migrated to Tasmania before the Pleistocene, or that they have evolved independently on the island. The two genera are in no way related to one another.

Genus **Parvotettix** new genus

Body clothed with short setae. Legs long and slender. Antennae very long and tapering, almost touching at their bases; scape about 3× as large as pedicel; from segment 4 onwards segments subequal in length, but steadily decreasing in size, all segments thickly clothed with short setae. Fastigium very poorly developed. Maxillary palps with 3rd and 4th segments subequal in length. Fore coxa armed with a retrolateral spine. All femora sulcate ventrally. Apical spines on legs constant in number. Fore femur unarmed; fore tibia bears 4 apical spines, 1 above and 1 beneath both prolaterally and retrolaterally, ventral spines more strongly developed than dorsal ones; fore tarsus unarmed. Mid femur unarmed; mid tibia bears 4 apical spines, 1 above and 1 beneath both prolaterally and retrolaterally, ventral spines more strongly developed than dorsal ones; mid tarsus unarmed. Hind femur unarmed; hind tibia bears a pair of long apical spurs above, a pair of subapical spines above, and a pair of short apical spurs beneath; 2 proximal segments of hind tarsus each bear 2 apical spines above, 1 prolateral and 1 retrolateral; other 2 segments unarmed. Subgenital plate of female triangulate with rounded apex. Subgenital plate of male rectangulate, distal margin truncate.

Type species: *Parvotettix goedei* n. sp.

Parvotettix goedei Richards, new species Fig. 1 (1–6)

Color: Head, pronotum, mesonotum and metanotum dark brown mottled with light brown; abdominal terga light brown irregularly mottled with dark brown; femora and tibiae mottled or banded with dark brown and ochreous; all tarsi light brown; antennae mid brown; ovipositor light reddish brown.

Body: Length 10 mm in both ♂ and ♀. Antennae broken. Abdominal terga with prominent proximally directed setae, dark brown in ♀ and ochreous in ♂. Ovipositor 0.5 length of body; ventral valves armed distally 0.4 of total length to apex with 8 well developed teeth (fig. 1).

Antennae: As in generic description. Third segment on dorsal aspect 2.5 as long as pedicel, and on ventral aspect 2.7 as long. Sexual dimorphism absent. No spines present on flagella of

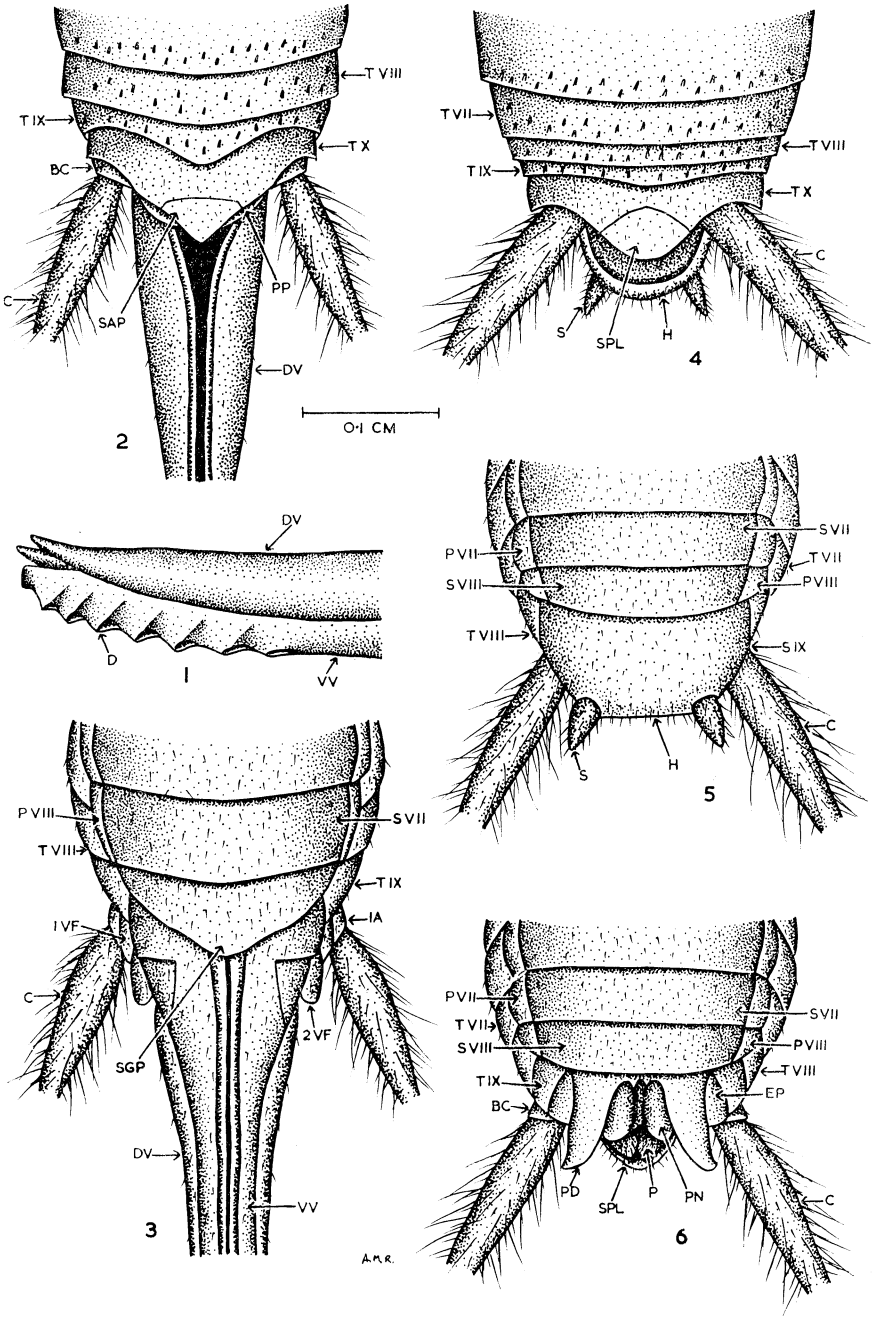

Fig. I. *Parvotettix goedei* n. sp.: 1, Distal portion of ovipositor showing teeth on ventral valve; 2, ♀ genitalia, dorsal view; 3, ♀ genitalia, ventral view; 4 ♂ genitalia, dorsal view; 5, ♂ genitalia, ventral view; 6, ♂ genitalia, ventral view, subgenital plate removed to expose structures beneath.

♂ or ♀. Legs: Fore and middle legs subequal in length, with hind leg 1.75 length of fore and middle legs. Sexual dimorphism absent. All legs thickly clothed with short setae. Hind tibia and proximal segment of hind tarsus armed with variable numbers of linear spines (Table 1). No linear spines on fore, middle and hind femora, or fore and middle tibiae and tarsi. Apical spines constant in number, as in generic description. Length of proximal segment of hind tarsus subequal with other 3 segments together. Ratio of length of legs to length of body: fore leg 1.2 : 1; middle leg 1.2 : 1; hind leg 2.1 : 1. *Genitalia*: ♀: Suranal plate, fig. 2 (SAP),

Table 1. Variability in number of linear spines on the legs of *Parvotettix goedei* n. sp.

		Mean		No. of Specimens		Standard Deviation		Range	
		L	R	L	R	L	R	L	R
Hind Tibia	Pro.	13	12.8	17	15	0.9	1.2	12–15	10–15
Sup.	Retro.	11.9	11.8	17	15	1.1	1.2	10–14	10–15
Hind Tarsus	Pro.	1.3	1.2	17	15	0.6	0.5	0–2	0–2
1 Sup.	Retro.	0.2	0.3	17	15	0.4	0.6	0–1	0–2

triangulate, slightly convex laterally, tapering to an acut eapex; whole plate sparsely clothed with setae. Subgenital plate, fig. 3 (SGP), triangulate with rounded apex; whole plate 0.3 as long as wide, sparsely clothed with setae. ♂: Suranal plate, fig. 4 (SPL), triangulate, concave laterally, tapering to a rounded apex; whole plate sparsely clothed with setae. Subgenital plate, figs. 4, 5 (H), rectangulate, approximately 2× as wide as long, convex laterally, distal margin truncate. Proximo-medianly plate is raised, then slopes towards margins. Whole plate sparsely clothed with setae. On ventral surface plate curves over anteriorly; pseudosternite and penis are located beneath this. Two styli, figs. 4, 5 (S), short, broad, conical, thickly clothed with shor tsetae, length of styli being 0.6 length of sternite IX (S IX). Parameres, fig. 6 (P), elongate, rounded at apex, 4× longer than wide, distal portion thickly clothed with setae. Pseudosternite, fig. 6 (PD), 1.4 wider than long, produced into 2 disto-lateral lobes which partly cover each lobe of penis. Penis, fig. 6 (PN), 2-lobed, each lobe 2.5× longer than wide. Paraprocts absent.

Locality. TASMANIA: Little Trimmer Cave, Mole Creek (type locality), coll. A. M. Richards, 9.XI.1966; A. Goede, 14.I.1967, 8.IV.1967.

Holotype ♂, allotype ♀, and 2 paratypes (♂, ♀) in Australian National Insect Collection, C. S. I. R. O., Canberra. Two Paratypes (♂, ♀) in Australian Museum, Sydney.

Remarks. Named for Albert Goede who collected all adult specimens of this species, and who for a number of years has been interested in the cave fauna of Tasmania.

Genus **Micropathus** Richards

Micropathus Richards, 1964, *Pacif. Ins.* **6** (1) : 217–18.

The genus *Micropathus* contains two species, *M. cavernicola* Richards and *M. tasmaniensis* Richards, both from limestone caves in Tasmania. A third species, also from caves, is described here. The three species may be distinguished by the following key.

KEY TO THE SPECIES OF MICROPATHUS

1. Hind femora armed with linear spines..... 2

Hind femora without linear spines..... **tasmaniensis** Richards
2. Basic color pale brown; suranal plate of male bearing four spines on distal margin .....
..... **cavernicola** Richards
Basic color dark brown; suranal plate of male without spines on distal margin... **fuscus** n. sp.

Micropathus tasmaniensis Richards

Micropathus tasmaniensis Richards, 1964, *Pacif. Ins.* **6** (1): 218-20, fig. 1, table 1.

In 1966, I discovered a specimen of this species in the Tasmanian Museum, Hobart, which had been collected at an altitude of 300 m on a forestry track near the Denison River. This is the first record of Rhaphidophoridae from the Tasmanian bush. The species has also been taken from several more limestone caves. In August 1967, a colony was discovered in a fissure cave in dolerite in "The Lost World" area on Mt. Arthur, Hobart at an altitude of 1040 m. The range in altitude for the species now extends between 120-1040 m. The cave temperature on Mt. Arthur ranged from 4.7-5.5°C, making it the coldest cave in Australia from which rhaphidophorids have been recorded. The type locality for *tasmaniensis* was given as "Limestone cave, Florentine Valley" (Richards, 1964). The full reference to this cave is Wedge sheet (provisional edition) scale 1 : 63,360, grid reference 410635. The cave is approximately 270 m south south-east from Frankcombe Cave.

New Records. TASMANIA: Forestry track, near Denison River, coll. C.D.K. February 1939; Cashion Creek Cave, Florentine Valley, coll. A. Goede, 29.XII.1964, A.M. Richards, 7.XI. 1966; King George V Cave, Hastings, coll. K. Renwick, 20.VIII.1955, fissure cave in dolerite, Mt. Arthur (part of Mt. Wellington), Hobart, coll. A. Goede, 5.VIII.1967.

Micropathus cavernicola Richards

Micropathus cavernicola Richards, 1964, *Pacif. Ins.* **6**: 220-23, fig. 2, table 2.

Since this species was described fresh material has been collected from several new localities, and the species has been examined by the author in the field. The shape of the subgenital plate of the female in fresh material differs from that illustrated in the original description in that the distal margin is not folded back dorsally, and the two small lobes project distally. The condition in the type material is due to the age of some of the material and to bad preservation.

New records. TASMANIA: Little Trimmer Cave, Mole Creek, coll. A. M. Richards, A. Goede, T. Goede, 9.XI.1966; Unnamed cave, Bubs Hill, 25 km E of Queenstown, Franklin sheet (provisional edition) scale 1 : 63,360, grid reference 789150, coll. A. Goede, 26.XII. 1965; unnamed cave, Kelly Basin, Franklin sheet (provisional edition) scale 1 : 63,360, grid reference 634869, coll. A. Goede, 19.XI.1966.

Micropathus fuscus Richards, new species Fig. II(1-6).

Color: Head, pronotum, mesonotum, metanotum and abdominal terga dark brown, sparsely mottled with light brown; femora and tibiae mottled or banded with mid brown and ochreous; all tarsi light brown; antennae dark brown; ovipositor light reddish brown.

Body: Length 18 mm in both ♂ and ♀. Dorsal and ventral surfaces of body thickly clothed with setae. Antennae broken. Fastigium as high as long. Maxillary palps with segments 3 and

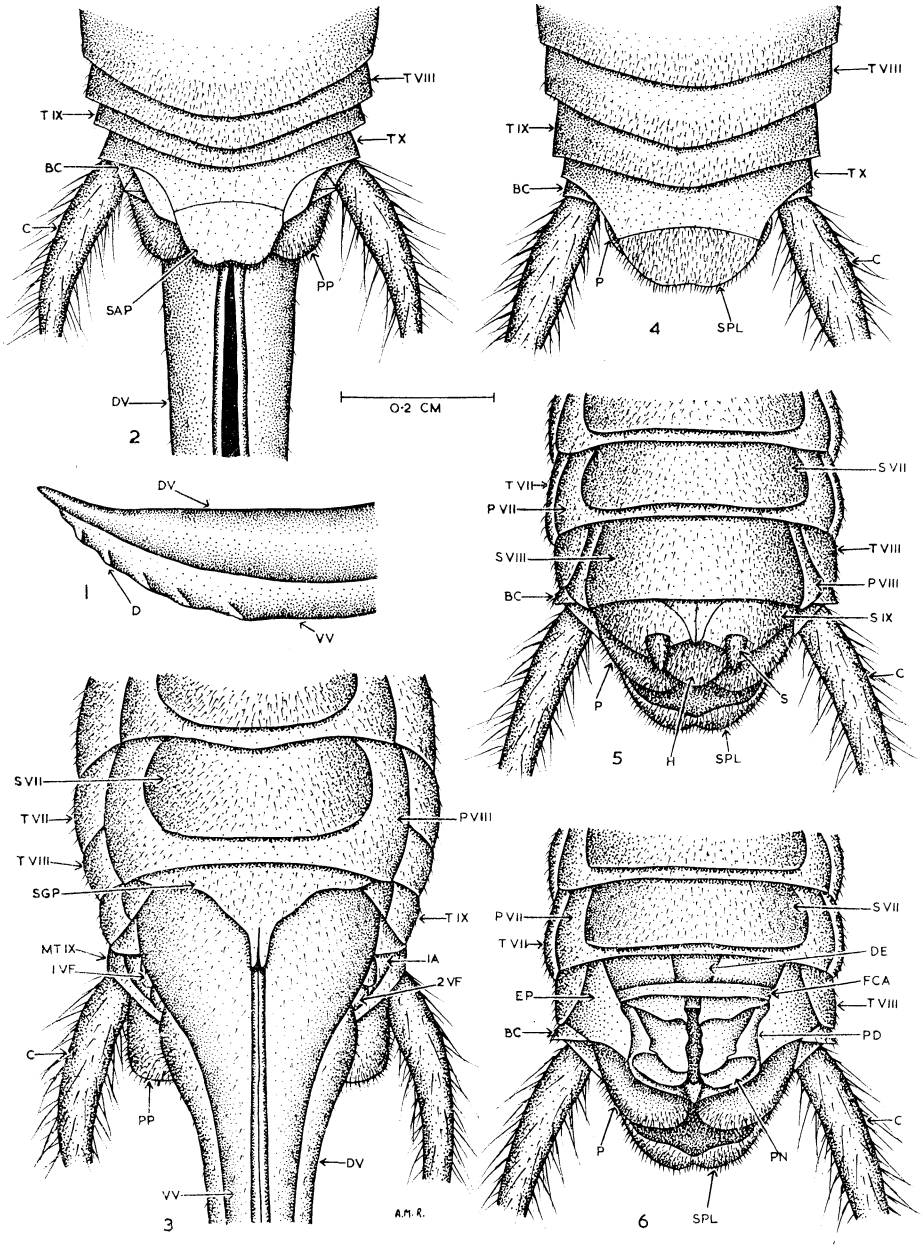

Fig. II. *Micropathus fuscus* n. sp.: 1, Distal portion of ovipositor showing teeth on ventral valve; 2, ♀ genitalia, dorsal view; 3, ♀ genitalia, ventral view; 4, ♂ genitalia, dorsal view; 5, ♂ genitalia, ventral view; 6, ♂ genitalia, ventral view, subgenital plate removed to expose structures beneath.

4 subequal in length. Ovipositor 0.6 length of body; ventral valves very weakly armed distally 0.2 of total length to apex with 6 small teeth gradually decreasing in size towards apex (Fig. 1). *Antennae*: As in generic description. Segment 3 on both dorsal and ventral aspects 1.6 as long as pedicel in both ♂ and ♀. Sexual dimorphism absent. No spines present on flagellum of either ♂ or ♀. *Legs*: Fore and middle legs subequal in length, with hind leg 1.7 length of fore and middle legs. Sexual dimorphism absent. Hind femora, all tibiae and proximal 2 segments of hind tarsi armed with variable numbers of linear spines (Table 2). No linear spines occur on fore and middle femora or tarsi. Apical spines constant in number, as in generic description, except that hind femur in adult frequently bears a very small prolateral apical spine. Length of proximal segment of hind tarsus subequal with other 3 segments together. Ratio of length of legs to length of body; fore leg 1.8 : 1; middle leg 1.7 : 1; hind leg 2.9 : 1. *Genitalia*: ♀. Suranal plate, fig. 2 (SAP), convex laterally, distal margin emarginate; distal margin thickly clothed with setae, rest of plate sparsely clothed with setae. Subgenital plate, fig. 3 (SGP), concave laterally, tapering to distal, apex which is produced as 2 narrow lobes 0.4 total length of plate, each lobe rounded at apex; whole plate 0.4 as long as wide, sparsely clothed with setae. ♂. Suranal plate, fig. 4 (SPL), rounded laterally, distal margin emarginate; distal margin curved over ventrally, but without processes or spines, whole plate thickly clothed with setae. Subgenital plate, fig. 5 (H), triangulate, 2.3× wider than long, convex laterally tapering to a rounded apex; whole plate thickly clothed with setae. On ventral surface plate curves over anteriorly; pseudosternite and penis are located beneath this. Two styli, fig. 5 (S), short, broad, conical, thickly clothed with setae, length of styli being 0.4 length of sternite IX, (S IX). Parameres figs. 5, 6 (P), elongate, rounded at apex, 3× longer than wide, distal portion thickly clothed with setae. Pseudosternite, fig. 6 (PD), 1.2 wider than long, concave laterally, disto-lateral margin rounded; disto-medianly the plate is slightly keeled. Penis, fig. 6 (PN), 2-lobed, each lobe 1.5 longer than wide; each lobe consists of a solid triangular-shaped lobe overlying a larger membranous lobe. Paraprocts absent.

Locality. TASMANIA: Unnamed cave, situated 34 chains due north of Heka, 5 km SW of Gunns Plains (type locality), coll. A. Goede, 7.V.1967.

Table 2. Variability in number of linear spines on the legs of *Micropathus fuscus* n. sp.

		Mean		No. of Specimens		Standard Deviation		Range	
		L	R	L	R	L	R	L	R
Fore Tibia	Pro.	4.0	4.1	18	18	0.3	0.4	3-5	3-5
Inf.	Retro.	4.1	4.1	18	18	0.3	0.4	4-5	3-5
Mid Tibia	Pro.	4.1	4.1	18	18	0.3	0.3	4-5	4-5
Inf.	Retro.	4.0	3.9	18	18	0.5	0.4	3-5	3-5
Hind Femur	Pro.	4.1	4.1	18	17	0.9	1.0	3-6	3-6
Inf.	Retro.	0.7	0.7	18	17	0.4	0.6	0-1	0-2
Hind Tibia	Pro.	24.2	24.8	18	17	2.5	2.5	21-30	20-29
Sup.	Retro.	27.1	25.9	18	17	2.6	2.7	22-31	22-31
Hind Tarsus	Pro.	1.3	1.2	18	17	0.6	0.4	1-3	1-2
1 Sup.	Retro.	1.3	1.1	18	17	0.5	0.5	1-2	0-2
Hind Tarsus	Pro.	1.0	1.1	18	17	0.3	0.4	0-2	0-2
2 Sup.	Retro.	0.9	1.0	18	17	0.4	0.3	0-2	0-2

Holotype ♂, allotype ♀, and 2 paratypes (♂, ♀) in Australian National Insect Collection, C.S.I.R.O Canberra. Two paratypes (♂, ♀) in Australian Museum Collection, Sydney.

Remarks. Very closely related to *M. cavernicola* and *M. tasmaniensis.* Separated from them by several characters.

1. Greater number of linear spines on hind femora.
2. Basic color dark brown.
3. Absence of spines from distal margin of suranal plate of male.
4. Shape of subgenital plate of female.
5. Pseudosternite more elongate.
6. Each lobe of penis longer than wide.

Distribution of Micropathus

Since *Micropathus cavernicola* and *tasmaniensis* were described (Richards, 1964), the range of both species has been extended, and a third species *fuscus* has been added to the genus (Fig. III). *Micropathus* now extends throughout the western and southern parts of Tasmania, and appears to be the dominant rhaphidophorid genus on the island. There is no overlap in the distribution of the three species.

M. cavernicola has recently been collected from caves at Bubs Hill and Kelly Basin. This, in addition to specimens from a cave near the junction of the Gordon and Franklin Rivers, firmly establishes the species in the central-western part of Tasmania. At the moment, Mole Creek is an isolated locality in the north. During the last Pleistocene glaciation small ice caps occurred on the Central Plateau and an area to the west, while extensive valley and cirque glaciation occurred further south (Goede, in press). Ice moved down the valleys of the Princess and Nelson Rivers only a few miles west of Bubs Hill, while cirque glaciation occurred on the Raglan Range a short distance to the south-east. *M. cavernicola* may have been forced out of much of the central-western part of Tasmania by the extensive glaciation, but as the insects are troglophiles and show no signs of cave adaptation, it is also possible that they have colonised the area after the retreat of the ice and the return of a milder climate. When the western part of Tasmania becomes better known, it is possible that more locality records will be added between the central-west and Mole Creek.

M. fuscus is known from only one cave near Gunns Plains, in the north-west of Tasmania, and so has a very localised distribution. It forms the most northern occurrence of the genus. *Micropathus* appears to be absent from caves at Redpa, Loongana and Flowery Gully (Goede, pers. comm.), but extensive exploration is needed in northern Tasmania, particularly in the area between Gunns Plains and Mole Creek.

The distribution of *M. tasmaniensis* is still confined to the southern part of the island where it occurs in caves at Ida Bay, Hastings, Hobart and the Florentine Valley. "The Lost World" area on Mount Arthur, Hobart was completely burnt out in the February 1967 bushfires, and in August 1967 was still without vegetation (Goede, pers. comm.). Both nymphs and adults of *tasmaniensis* survived the severe fires, and they have colonised or re-colonised the dolerite cave in this barren area in a remarkably short period of time. lead to a clarification of the full range of distribution of the genus.

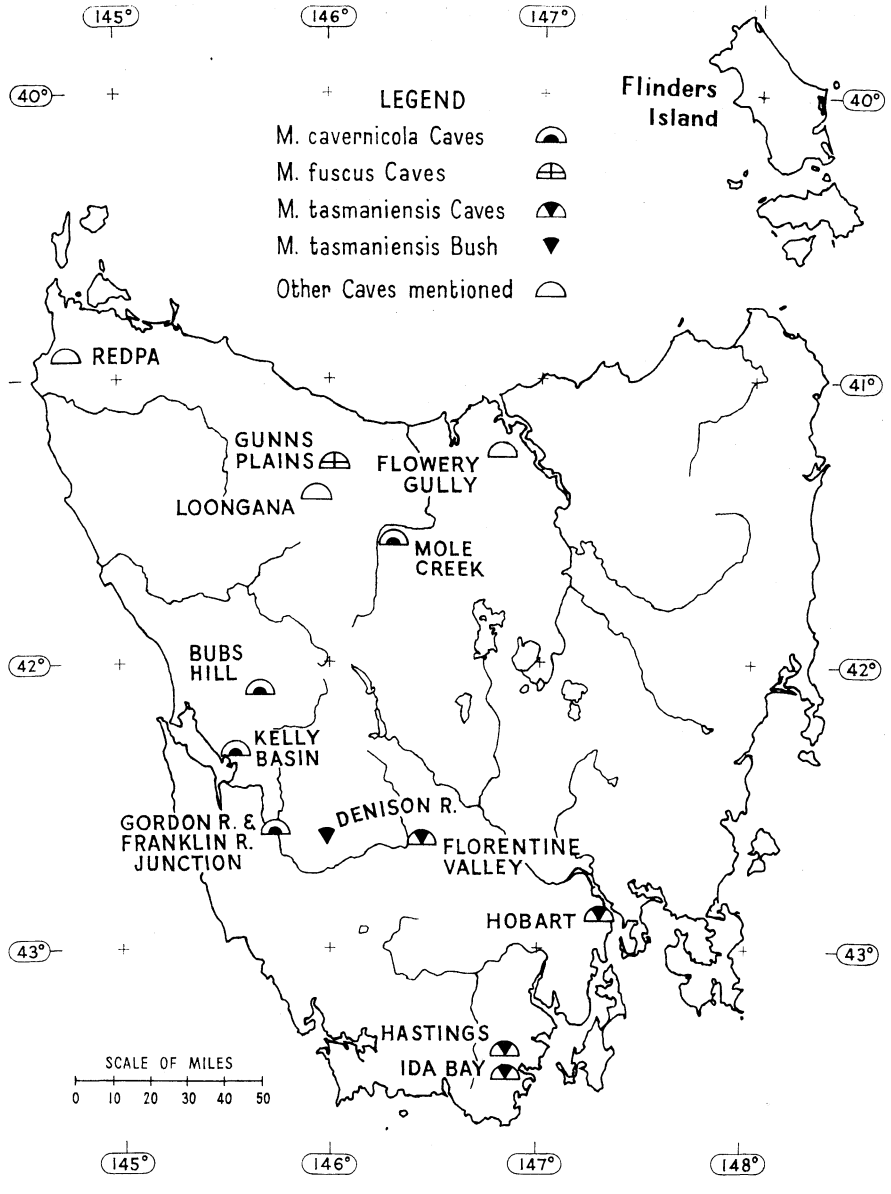

Fig. III. Distribution of *Micropathus* Richards throughout Tasmania.

A specimen of *tasmaniensis* collected on a forestry track near the Denison River extends the range of this species some distance west of the Florentine Valley, and considerably reduces the distance separating it from *M. cavernicola* (fig. III). This suggests that *M. tasmaniensis* may be migrating west, but has not yet become established in western caves. Further exploration and collecting in the limestone areas of western Tasmania should

Acknowledgements: I should like to thank A. Goede, University of Tasmania, Hobart, for taking me to Little Trimmer Cave, Mole Creek, and for subsequently collecting more material from there and from Gunns Plains. I should like to thank J. N. Jennings, Australian National University, Canberra for helpful discussions on the glacial history of Tasmania. I am grateful to Dr W. Bryden, Director of the Tasmanian Museum, Hobart, for permission to examine material in the Museum Collections; and also to C. Wilkinson, Geography Department, University of New South Wales, Sydney, for drawing the map of Tasmania.

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INDEX TO TABLES

L.—Left leg.
R.—Right leg.
Sup.—Superior.
Pro.—Prolateral.
Retro.—Retrolateral.

INDEX TO FIGURES

BC—basal segment of cercus.
C—cercus.
D—teeth.
DE—ductus ejaculatorius.
DV—dorsal valve.
EP—endoparamere.
FCA—feebly chitinised arch.
H—subgenital plate, ♂.
IA—intersegmental apodeme.
MT IX—membrane of tergite IX.
P—paramere (ectoparamere).
P VII, P VIII—pleurite VII, VIII.
PD—pseudosternite.
PN—penis.
PP—paraproct.
S—stylus.
S VII, S VIII, S IX—sternite VII, VIII, IX.
SAP—suranal plate, ♀.
SGP—subgenital plate, ♀.
SPL—suranal plate, ♂.
T VII, T VIII, T IX, T X—tergite VII, VIII, IX, X.
1 VF—1st valvifer.
2 VF—2nd valvifer.
VV—ventral valve.

ADDENDA

Since this paper was submitted for publication both *M. cavernicola* and *M. fuscus* have been collected from new localities in northwestern Tasmania. *M. cavernicola* occurs in Swallownest Cave L5 and Old Tourist Cave L4, L6, Loogana. *M. fuscus* occurs in Leven Cave L3, Loongana and in the Trowutta Caves, Trowutta, 32 km ESE of Redpa. Thus *M. fuscus* is now recorded from 3 limestone areas in NW Tasmania and the range of the 2 species converges at Loongana. Rhaphidophorids now occur in 10 of the 21 main limestone areas on the island.