SOME MACROCHELID MITES (ACARI : MACROCHELIDAE) ASSOCIATED WITH AUSTRALIAN DUNG BEETLES (COLEOPTERA : SCARABAEIDAE)

BY M. M. H. WALLACE *

MACROCHELIDAE ON AUSTRALIAN DUNG BEETLES

ABSTRACT : Nine species of *Macrocheles* (Acari : Macrochelidae) were collected from Australian dung beetles (Coleoptera : Scarabaeidae), viz. *Macrocheles glaber* (and/or *M. perglaber*), *M. peregrinus* (introduced from South Africa), *M. kraepelini* (probably introduced from Indonesia via Fiji), *M. merdarius, M. peniculatus, M. robustulus, M. mammifer, M. novaezelandiae*, and *M. krantzi*. In addition, *M. subbadius* was found in dung used in dung beetle insectary cultures. Approximately 21 other unidentified species of *Macrocheles* were recorded either on beetles or in dung during this study.

MACROCHELIDAE DES BOUSIERS AUSTRALIENS

RÉSUMÉ : Nous avons récolté neuf espèces de *Macrocheles* (Acari : Macrochelidae) des bousiers Australiens (Coleoptera : Scarabaeidae), à savoir, *Macrocheles glaber* (et/ou *M. perglaber*), *M. peregrinus* (une espèce d'Afrique du Sud), *M. kraepelini* (peut-être une espèce de l'Indonésie via Fiji), *M. merdarius, M. peniculatus, M. robustulus, M. mammifer, M. novaezelandiae*, et *M. krantzi*. On a trouvé, aussi, *M. subbadius* dans la bouse des cultures des bousiers. Nous avons trouvé environ 21 espèces non identifiées de *Macrocheles* sur les bousiers et dans la bouse.

INTRODUCTION

EVANS and HYATT (1963) studied the collection of coprid beetles (Coleoptera) in the British Museum and found large numbers of mites attached to the pinned beetles, including 46 species of Macrochelidae, of which 38 were described as new. HALFFTER & MATTHEWS (1971) reviewed existing knowledge of the association between dung beetles and mites, and listed amongst the mesostigmatid mites 188 species belonging to 21 genera and seven families. No fewer than 139 species belonged to the family Macrochelidae and 68 of these to the genus *Macrocheles* Latreille.

A study of the phoretic mites associated with Australian dung beetles was initiated in 1975 and some of the *Macrocheles* species are recorded in this paper.

The Australian dung beetles were reviewed by MATTHEWS (1972, 1974, 1976) largely on the basis of material contained in the Australian National Insect Collection (ANIC) housed at the CSIRO, Division of Entomology, Canberra. There was thus available a very large collection of identified

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beetles and these were systematically examined for mites still attached to the beetles.

METHODS

Most mites were found on the undersides of the beetles, especially in the vicinity of the mouthparts and the fore coxae. However, many were also found attached to the legs as well as on the surfaces of the elytra and pronotum. It is known that some mites attach beneath the elytra but that area was not searched except occasionally when large numbers of specimens of a single beetle species were available.

Mites were removed with a fine brush or needle and placed in lactophenol, which was then heated until the mites were sufficiently cleared and their legs spread out. They were then transferred to Hoyer's mounting medium on slides, labelled and placed in a drying oven at 50° C for several days. They were then examined and photographed with a phase-contrast microscope.

Additional data on host beetles and distributions were gathered from numerous field collecting trips undertaken subsequent to the initial examination of the beetles in the ANIC.

It was not possible to examine the types of the mite species listed. Identifications are based on descriptions and figures in the references cited in each case.

RESULTS

Overall, almost 19,000 beetles were examined, representing 165 species of the Tribe Onthophagini, 22 species of Coprini and 88 species of Scarabaeini. Some species were represented in the ANIC by only one or two individual specimens whereas others were represented by several hundred specimens ; 962 for *Onthophagus rubrimaculatus* Macleay and 875 for *O. australis* Guérin-Méneville.

As shown in Table 1, the larger the number of specimens available of any one species the greater was the chance of finding a beetle with mites attached. Overall, mesostigmatid mites were found on 106 of the 275 beetle species examined. Over 2,000 mites were located on these beetles and 915 of them were mounted on slides for detailed examination. Seven families were represented, viz. the Macrochelidae, Parasitidae, Laelapidae, Eviphididae, Pachylaelapidae, Uropodidae and Ascidae.

TABLE 1

The occurrence of phoretic mesostigmatid mites on dung beetles (*Onthophagus* spp.) in the Australian National Insect Collection, Canberra.

Number of beetle specimens in collection	Number of beetle species in group	Number of species with mites attached	% species with mites attached
1- 10	66	2	3
11- 50	41	22	54
51-100	22	19	86
> 100	33	31	94

Many of the larger beetles carried mites and the mean number of mites per beetle was greater on the large beetles than on the small beetles (Figure 1).

IDENTIFIED SPECIES OF MACROCHELIDAE

Macrocheles (near) glaber (Müller)

(Fig. 2 A ; Plate 1-1)

Macrocheles glaber (Müller) : EVANS & BROWNING, 1956.

This is a tentative identification until further studies are undertaken. For the present this mite can be classified as a member of the *Macrocheles glaber* group of species as outlined by FILIPPONI & PEGGAZANO (1962) and KRANTZ (1981).

Host beetles in ANIC. — *Onthophagus australis, O. capella* Kirby, *O. dunningi* Harold, *O. granulatus* Boheman, *O. pentacanthus* Harold.

Host beetles in field collecting. — *O. mniszechi* Harold, *Aphodius tasmaniae* Hope.

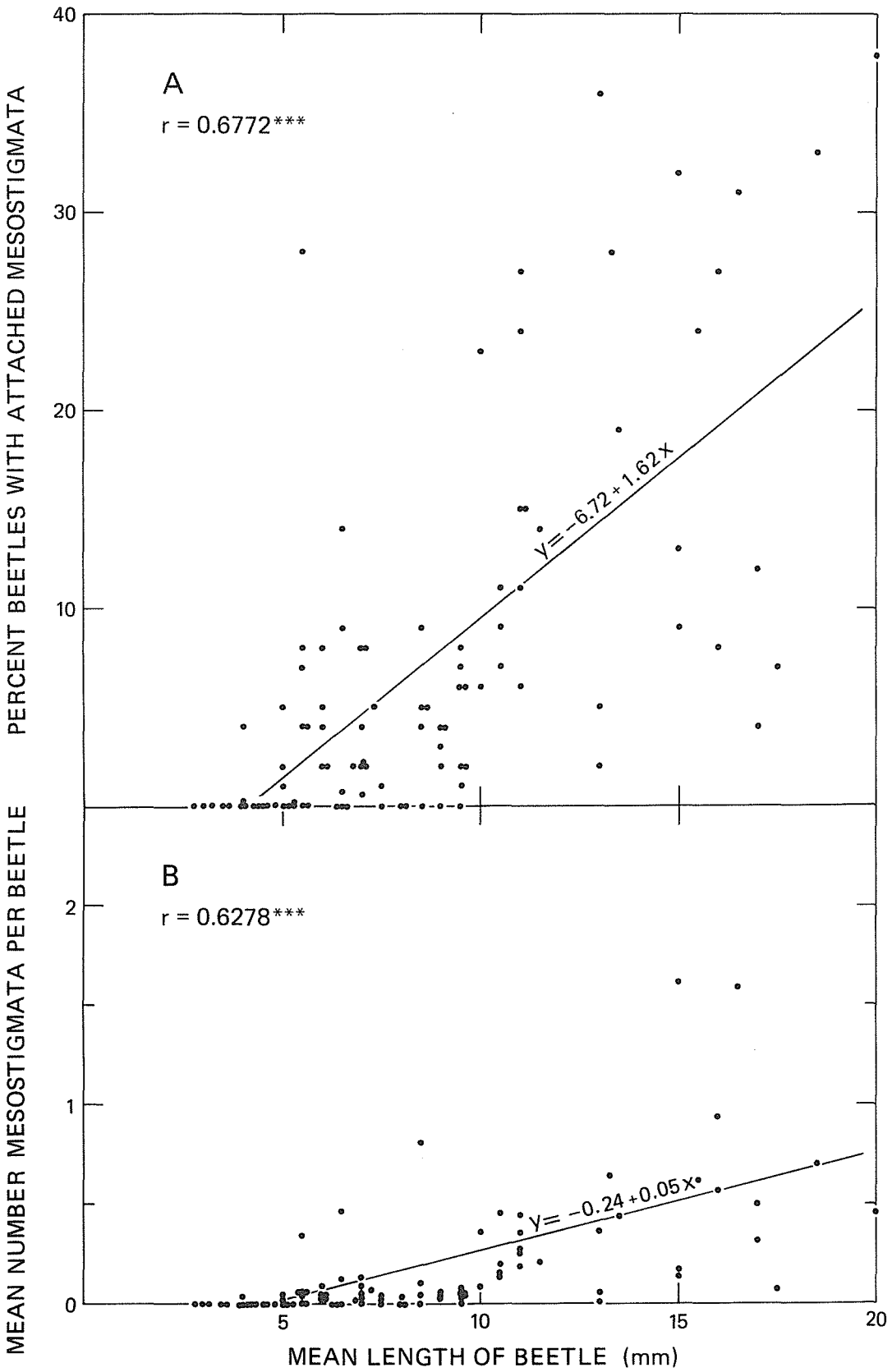

FIG. 1 : Relationship between size of beetle and the number of mesostigmatic mites carried.

Other hosts. — A single specimen collected off *Australophthyra rostrata* (R. & D.) (Diptera : Muscidae).

DISTRIBUTION. — Restricted to south eastern Australia. It appears generally to favour areas experiencing cool moist summers. Hence its distribution westward in the cooler southern areas of New South Wales, Victoria and South Australia is well defined by the January isohyet for 25 mm. Further north increasing temperatures prevent it from reaching these rainfall limits (see FILIPPONI, 1959 ; FILIPPONI & PETRELLI, 1970) and the January maximum temperature isotherm of 32° C defines its western distribution limits reasonably well. In the higher summer rainfall areas of central eastern and north eastern New South Wales, where January rainfall exceeds about 80 mm, its temperature tolerance seems to be much reduced so that there is a further restriction to areas within the 26° C January maximum temperature isotherm. That isotherm closely matches the 600 m contour line enclosing the northern tablelands of New South Wales.

There are several records lying outside these defined limits. Two specimens were collected at Narrabri, N.S.W., in March 1977 but, despite intensive collecting over several years since then, the species has not been found again in that locality. Similarly, one specimen was collected near Cessnock, N.S.W., in February 1981, and four specimens were collected near St. George and Bollon in southern Queensland in June 1979. All these sites have since been re-examined by experienced collectors but no further specimens seen. It seems likely that in all these cases the mites were carried beyond their normal climatic limits to establish temporary populations during favourable periods but that the species failed to survive in the longer term. In view of the large distances that *Macrocheles peregrinus* Krantz was carried by dung beetles (WALLACE & HOLM, 1983) it is quite possible, and in fact likely, that many temporary populations are established well beyond the climatic limits of the permanent populations.

The southern record from near Swan Hill, Victoria, is probably associated with additional summer moisture from the Murray River but may also have been from a temporary population.

Based on the need for summer rainfall for the species to survive in Mediterranean climate regions, the only remaining areas yet to be fully colonized in Australia are the higher altitude localities to the north and south of Adelaide, South Australia, and the Esperance region of Western Australia. In fact one specimen has recently been collected near Strathalbyn, south of Adelaide. Irrigation could also provide small locally favourable sites within the Mediterranean environment.

REMARKS. — Whether this species is a native of Australia or a species introduced from Europe is a question yet to be resolved. Some specimens appear to be morphologically identical to *Macrocheles perglaber* Filipponi and Peggazano and, in fact, those authors (1962) noted a specimen believed to be *M. perglaber* collected by WOMERSLEY (locality unstated) in their discussion of that species. CICOLANI (1979) also listed Australia in the distribution records of *M. perglaber*. However, PEGGAZANO (personal communication) has advised that the specimen referred to in both instances is actually the holotype of *M. hyatti* Krantz & Filipponi (1964) which was collected in New Zealand (EMBERSON, 1973 b).

Similarly, CICOLANI (1979) listed *M. glaber* from Australia but again PEGGAZANO (personal communication) has advised that that record appears to have been based on the record of *M.* (*Coprholaspis*) *alecto* var. *australis* Berlese in the synonomy of *M. glaber* published by FILIPPONI & PEGGAZANO (1962). Those specimens — two females — actually originated from New Guinea, as listed by BERLESE (1918).

Thus, the first confirmed record of *M. glaber* (or a member of that group) from Australia is that of WALLACE *et al.* (1979).

EMBERSON (1973 a and b) records three species of the European *M. glaber* group, viz. *M. glaber, M. perglaber* and *M. scutatus* Berlese, from New Zealand. Those records are based on a study of the females only but it is now known that the

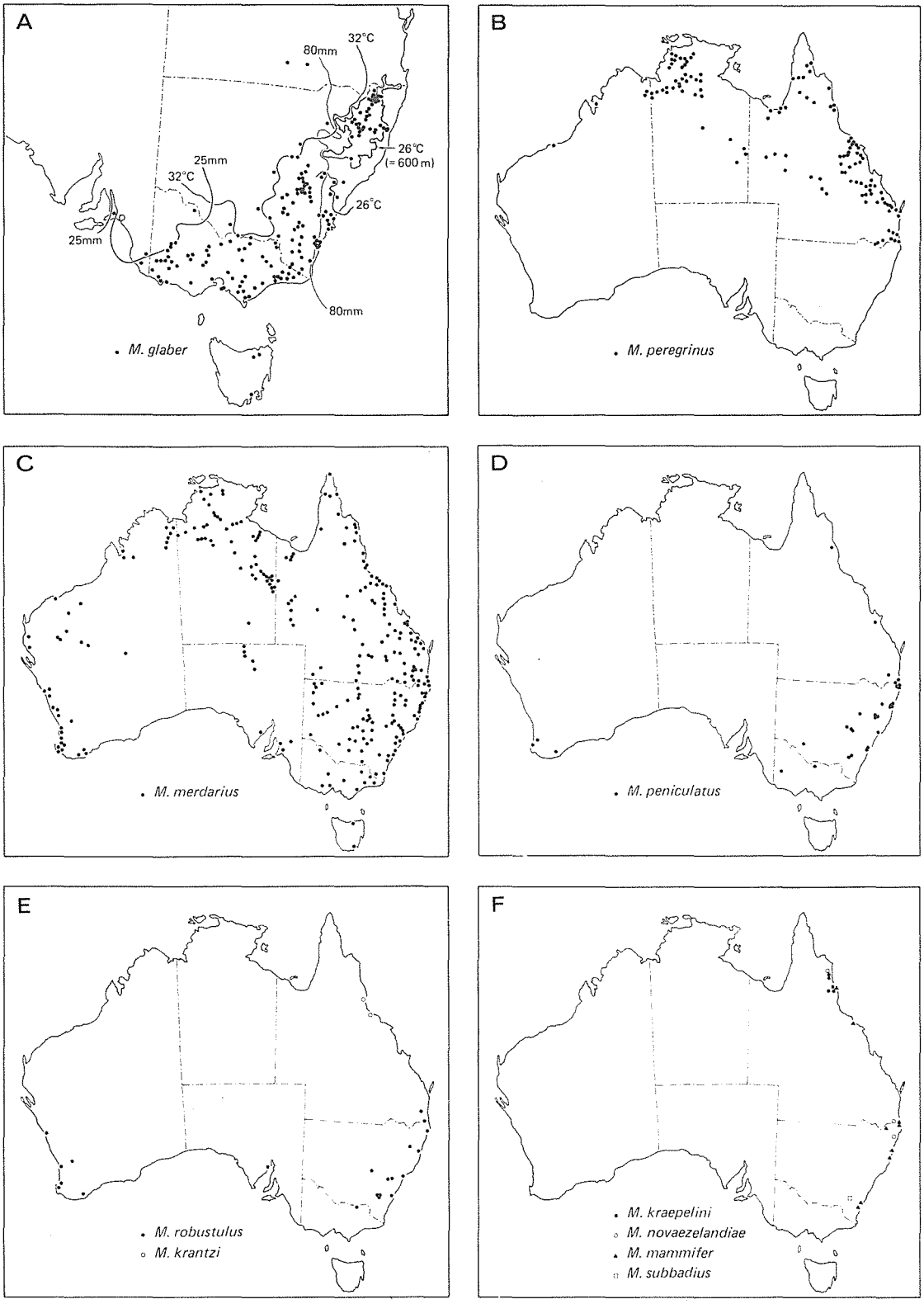

FIG. 2 : Australian distributions of *Macrocheles* spp.

female characters used are inconsistent and intergrade at least between *M. glaber* and *M. perglaber*. However, it is entirely possible that all three species do, in fact, occur in New Zealand specially in view of their sympatric association in Europe (CICOLANI, 1979 ; CICOLANI *et al.*, 1981). Perhaps, too, the same three species may contribute to the *M. glaber* group of species in Australia.

Macrocheles peregrinus Krantz

(Fig. 2 B ; Plate 1-2)

Macrocheles peregrinus Krantz : KRANTZ, 1981.

This is an introduced species from southern Africa (KRANTZ, 1981) and was first released at Rockhampton, Queensland, in December 1980, and near Darwin, Northern Territory, in February, 1981 (WALLACE & HOLM, 1983).

Host beetles in ANIC. — Nil.

Host beetles in field collecting. — Four introduced species from southern Africa, viz. *Euoniticellus intermedius* (Reiche), *Onthophagus gazella* (Fabricius), *Onitis alexis* Klug. and *Sisyphus spinipes* Thunberg, and one Australian species, *Onthophagus parvus* Blanchard.

DISTRIBUTION. — Since its release *M. peregrinus* has spread rapidly and now colonizes a large part of northern Australia. It is still moving southwards in both eastern and western Australia, and based on its known distribution in Africa, from Kenya in the north to the south western Cape Province of South Africa, it could eventually colonize most of the continent. However, in the winter rainfall regions it may well be restricted to localities receiving additional summer moisture, either naturally or artificially.

REMARKS. — *M. peregrinus* was described by KRANTZ (1981) as a member of the *glaber* group of species based largely, but not solely, on the ornamentation of the sternal shield. On present knowledge it is difficult to distinguish between females of *M. peregrinus*, *M. perglaber* and *M. glaber*, although in *M. peregrinus* the sternal shield is usually relatively longer so that the ratio of length along the central line to breadth at the narrowest point exceeds 1.1, whereas in the other two species that ratio is usually less than 1.0.

In the male the condition of the dorsal setae allows a reasonably reliable separation of *M. peregrinus* from both *M. glaber* and *M. perglaber* as outlined in the following key :

1. Dorsal setae z2, s2 and r4 simple and pointed. 2
   Dorsal setae z2, s2 and r4 pilose..... *M. perglaber*
2. Dorsal setae s6, r2 and r3 simple..... *M. glaber*
   Dorsal setae s6, r2 and r3 pilose..... *M. peregrinus*

Unfortunately, these characters are of limited value since males are rarely found on beetles in the field and can be obtained only by Berlesate extraction of recently dropped dung pads (3-5 days old) or by breeding from field collected females.

On the basis of information now available it seems unlikely that the species currently known in Australia as *M. glaber*, will extend further northwards into the summer rainfall region. For the present therefore any specimen of the *glaber* group collected in Queensland, the Northern Territory or Western Australia is almost certain to be *M. peregrinus* (but see also *M. kraepelini* below).

Macrocheles kraepelini (Berlese)

(Fig. 2 F ; Plate 1-3)

Macrocheles kraepelini (Berlese) : KRANTZ & FILIPPONI, 1964.

Also a member of the *glaber* group as defined by KRANTZ (1981).

Host beetles in ANIC. — *Onthophagus laminatus* Macleay.

Host beetles in field collecting. — *Coptodactyla ducalis* Blackburn, *Pachylister chinensis* Quens.

DISTRIBUTION. — Known only from five sites all in the Cairns district of north eastern Queensland.

REMARKS. — *M. kraepelini* was originally described from specimens collected at Tijbodas, Indonesia (BERLESE, 1905). It was re-described by KRANTZ and FILIPPONI (1964) from eight females collected from *Copris incertus* at Suva, Fiji, in February 1945, and one female collected on *Pachylister chinensis* in June 1945 in the CSIRO insectaries at Canberra. That histerid beetle came from a consignment of beetles sent to Canberra from Fiji for release in Queensland as part of a project on the biological control of the buffalo fly, *Haematobia irritans exigua* de Meijere (BORNEMISSZA, 1967). The first shipment of *P. chinensis* was received in Canberra on 11 September 1944, followed by a second shipment in February 1945. Some of these beetles were then sent to Queensland and liberated on a dairy property near Cairns. A third shipment on June 7, 1945, was never released because of a severe infestation of mites. Those mites are in the collection of the South Australian Museum and were labelled as *M. multihamatus* Vitzthum, a name that was later syonymised under *M. kraepelini* (Berlese) by KRANTZ & FILIPPONI (1964).

In a survey conducted in April 1981 FEEHAN (personal communication) collected both *P. chinensis* and *M. kraepelini* from dung pads within the same area near upper Daintree.

As with other members of the *glaber* group of species reliable identification is difficult. However, on present knowledge of the group in Australia, the female of *M. kraepelini* is unique in having most of the setae of the dorsal shield pilose. The male has not been described.

Macrocheles merdarius (Berlese)

(Fig. 2 C ; Plate 1-4)

Macrocheles merdarius (Berlese) : EVANS & BROWNING, 1956 ; KRANTZ & FILIPPONI, 1964.

This is the commonest macrochelid mite found attached to Australian dung beetles.

Host beetles in ANIC. — *Onthophagus atrox* Harold, *O. auritus* Erichson, *O. australis, O. consentaneus* Harold, *O. conspicus* Macleay, *O. cuniculus* Macleay, *O. dandalu* Matthews, *O. dunningi, O. ferox* Harold, *O. fissiceps* Macleay, *O. flavoapicalis* Lea, *O. gangalu* Matthews, *O. glabratus* Hope, *O. haagi* Harold, *O. incanus* Macleay, *O. jangga* Matthews, *O. laminatus, O. mjobergi* Gillet, *O. mniszechi, O. muticus* Macleay, *O. nodulifer* Harold, *O. parrumbal* Matthews, *O. parvus, O. pugnacior* Blackburn, *O. queenslandicus* Blackburn, *O. quinquetuberculatus* Macleay, *O. rubrimaculatus, O. semimetallicus* Lea, *O. sloanei* Blackburn, *O. villosus* Macleay, *Coptodactyla depressa* Paulian, *C. glabricollis* Hope, *C. lesnei* Paulian, *C. monstrosa* Felsche, *Notopedaria tuberculata* Matthews, *Lepanus palumensis* Matthews.

Host beetles in field collecting. — *Onthophagus pentacanthus, O. capitosus* Harold, *O. pexatus* Harold, *O. dummal* Matthews, *O. latro* Harold, *Aphodius pseudolividus* Balthazar, *A. tasmaniae* Hope.

Host beetles introduced from overseas. — *Onthophagus gazella, O. taurus* (Schreber), *O. sagittarius* (Fabricius), *Euoniticellus intermedius, Liatongus militaris* (Castelnau).

DISTRIBUTION. — Throughout Australia. Recorded from all States and Territories but generally encountered less frequently in the southern areas. Thus there are only two records from Tasmania, five from South Australia and nine from Victoria despite extensive collecting in the latter States. Evidence from south eastern Australia (WALLACE unpublished) indicates that numbers build up only during the warmer summer months so that although present throughout the year intensive collecting may be needed to locate it other than during mid-summer.

REMARKS. — *M. merdarius* is a cosmopolitan species.

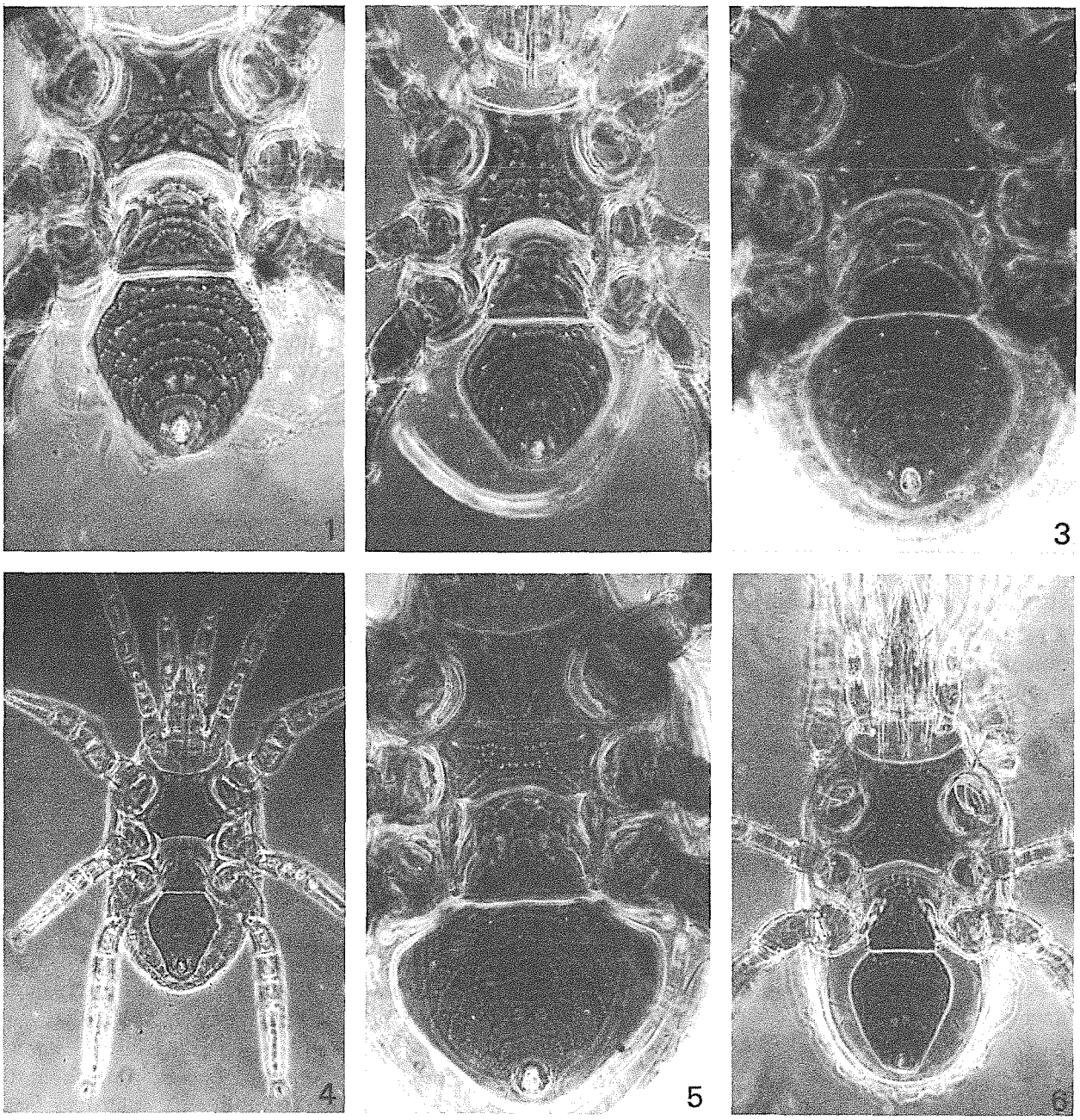

PLATE 1 : Ventral shield of : 1. — *Macrocheles glaber* ; 2. — *M. peregrinus* ; 3. — *M. kraepelini* ; 4. — *M. merdarius* ; 5. — *M. peniculatus* ; 6. — *M. robustulus*.

Macrocheles peniculatus Berlese
(Fig. 2D ; Plate 1-5)

Macrocheles peniculatus Berlese : GHILYAROV & BREGETOVA, 1977.

A relatively rare species only occasionally found attached to dung beetles ; more frequently encountered in the dung pad.

Host beetles in ANIC. — *Onthophagus pentacanthus, O. jangga.*
Host beetles in field collecting. — *O. quinquetuberculatus.*
Host beetles introduced from overseas. — *O. gazella, Liatongus militaris.*

DISTRIBUTION. — Recorded from all States except South Australia and the Northern Territory. Most collections are from the north eastern part of New South Wales. No clear cut climatic limitations although it appears to favour areas receiving substantial summer rains.

REMARKS. — *M. peniculatus* was first described by BERLESE from specimens collected in Argentina (La Plata) where it was associated with ant nests. Although a cosmopolitan species it was not listed by HALFFTER & MATTHEWS (1971) in their review of mites associated with dung beetles. It seems to occur largely independently of dung beetles in a variety of habitats and its attachment to some beetles may be a casual one. The species is known to be thelytokous in Europe (FILIPPONI, 1964) and females only have been recovered from CSIRO breeding trials involving Australian specimens. KRANTZ & FILIPPONI, (1964) refer to one female of *M. peniculatus* from Australia but that record is in error. The actual locality of that specimen was Otaki, north of Wellington, New Zealand.

Macrocheles robustulus (Berlese)
(Fig. 2E ; Plate 1-6)

Macrocheles robustulus (Berlese) : KRANTZ & FILIPPONI, 1964.

Like *M. peniculatus* this species, although widespread, is not frequently encountered either on dung beetles or in individual dung pads.

Host beetles in ANIC. — Nil.
Host beetles in field collecting. — *Onthophagus granulatus, Aphodius tasmaniae.*

DISTRIBUTION. — In all States and Territories except Tasmania.

REMARKS. — WOMERSLEY (1942) first recorded this species in Australia, then describing it as a new species, *M. coprophila* (see KRANTZ & FILIPPONI, 1964). It was not located on any of the dung beetles in the ANIC and is referred to only once by HALFFTER & MATTHEWS (1971) in their list of species.

It appears that *M. robustulus* is relatively rare in the dung pad environment and attains high numbers only in dung accumulations such as occur in dairies, poultry houses, etc. However, RIDSDILL SMITH and HALL (1984) recorded a mean monthly catch of 454 *M. robustulus* in dung-baited pitfall traps near Geraldton, Western Australia, in August 1979. The traps were near a watering point for cattle, and large accumulations of dung, so that under specially favourable conditions this mite can attain high numbers.

Macrocheles mammifer Berlese
(Fig. 2F ; Plate 2-7)

Macrocheles mammifer Berlese : GHILYAROV & BREGETOVA, 1977.

A relatively rare species with restricted distribution.

Host beetles in ANIC. — Nil.
Host beetles in field collecting. — *Onthophagus laminatus.*

DISTRIBUTION. — Found only in coastal high rainfall areas of eastern Australia from temperate south coastal New South Wales to the tropical coast of Queensland.

REMARKS. — In the key to soil inhabiting mesostigmata published by GHILYAROV & BREGETOVA (1977) this species keys out to *M. mammifer*, within the subgenus *Macrocheles* sens. str., except that the width of the ventri-anal shield is much greater than its length and not as described in the key. The brief description and drawings appear to fit well. Those authors record the species from southern Asia (Singapore) as well as from Europe and the Americas.

Macrocheles novaezelandiae Emberson
(Fig. 2 F ; Plate 2-8)

Macrocheles novaezelandiae Emberson : EMBERSON, 1973.

Host beetles in ANIC. — *Onthophagus pugnax* Haròld, *Amphistomus trispiculatus* Matthews.
Host beetles in field collecting. — Nil.

DISTRIBUTION. — Recorded from three localities only, viz. Gibralter Range in north eastern New South Wales, Tamborine Mountain in south eastern Queensland, and Mt Webb in north eastern Queensland. All sites are rain forest habitats.

REMARKS. — EMBERSON (1973 b) first described *M. novaezelandiae* from New Zealand from tree fern litter indicating that there too the species probably preferred the rain forest habitat.

Macrocheles krantzi Evans and Hyatt
(Fig. 2 E ; Plate 2-9)

Macrocheles krantzi Evans and Hyatt : EVANS & HYATT, 1963.
Macrocheles krantzi (?) : KRANTZ & FILIPPONI, 1964.
Not *Macrocheles krantzi* : ANWARULLAH & IRSHAD, 1971.

Host beetles in ANIC. — *Onthophagus nodulifer.*
Host beetles in field collecting. — *O. laminatus.*

DISTRIBUTION. — Two localities only, viz. Townsville and Ingham, north eastern Queensland.

REMARKS. — *M. krantzi* was first described by EVANS & HYATT (1963) from specimens in the British Museum on coprid beetles collected in southern India and Ceylon. Subsequently, KRANTZ & FILIPPONI (1964) assigned "dubiously" three Australian specimens from Townsville to *M. krantzi.* The single specimen from Ingham appears to be identical with the Townsville specimens and the name *M. krantzi* is retained pending examination of the type.

It should be noted that a homonym of *M. krantzi* was used in describing a new species from India (ANWARULLAH & IRSHAD, 1971). As far as can be judged from the description and drawings that species is quite different from the *M. krantzi* described by EVANS and HYATT.

Macrocheles subbadius (Berlese)
(Fig. 2 F ; Plate 2-10)

Macrocheles subbadius (Berlese) : AXTELL, 1963.

This species has been collected from one site only in Australia, viz. the dung beetle breeding insectaries of the CSIRO, Division of Entomology, Canberra, A.C.T. It was found in Berlese funnel samples from dung pads used in experiments on the biological control of the bush fly, *Musca vetustissima* Walker, and attached to sep-

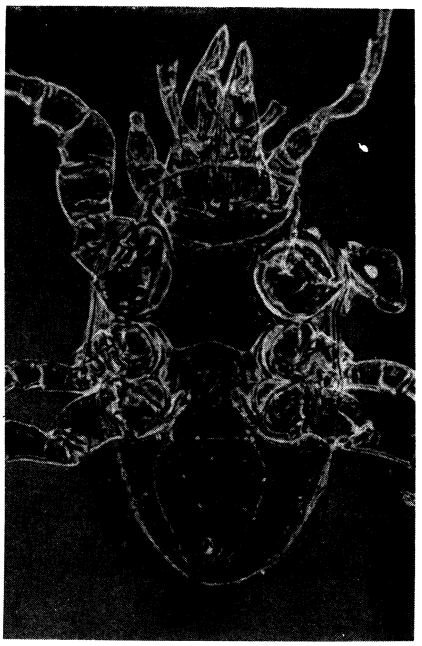

PLATE 2 : Ventral shields of : 7. — *Macrocheles mammifer* ; 8. — *M. novaezelandiae* ; 9. — *M. krantzi* ; 10. — *M. subbadius*.

sid flies attracted to the dung pads. No beetle hosts have been recorded.

UNIDENTIFIED SPECIES of *Macrocheles*

In addition to those listed, this study recovered at least 21 other species of *Macrocheles* which have not yet been identified. Thirteen of those species were found attached to Australian native dung beetles and eight were found either in dung pads or caught in dung-baited pitfall traps to which dung beetles were attracted.

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