A REVISION OF THE GENUS *CHTHONOCEPHALUS* Steetz (ASTERACEAE: INULEAE: GNAPHALIINAE).

by

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ABSTRACT

Short, P. S. A revision of the genus *Chthonocephalus* Steetz (Asteraceae: Inuleae: Gnaphaliinae). *Muelleria* 7(2): 225–238 (1990). The endemic Australian genus *Chthonocephalus* Steetz is revised. Six species are recognized, *i.e. C. pseudevax* Steetz and *C. tomentellus* (F. Muell.) Benth., and four new species, *C. spathulatus* P. S. Short, *C. oldfieldianus* P. S. Short, *C. muellerianus* P. S. Short and *C. viscosus* P. S. Short. *C. multiceps* J. H. Willis is excluded from the genus.

HISTORY & GENERIC DELIMITATION

The endemic Australian genus *Chthonocephalus* was first described by Steetz in 1845 in Lehmann's *Plantae Preissianae*. At the time only a single species, *C. pseudevax* Steetz, was recognized. A few years later Asa Gray (1851) described *C. drummondii*. Bentham (1867) subsequently reduced the latter to synonymy under *C. pseudevax*. He also reduced *Chamaesphaerion* A. Gray (June 1851), *Gyrostephium* Turcz. (Aug.-Oct. 1851; synonymous with the latter genus, both genera having been based on duplicate specimens of *Drummond 55*) and *Lachnothalamus* F. Muell. (1863) to synonymy under *Chthonocephalus*. Thus Bentham (1867) recognized three species: *C. pseudevax, C. pygmaeus* (A. Gray) Benth. and *C. tomentellus* (F. Muell.) Benth. He did not discuss the reasons for uniting the genera but one assumes from the key and from his treatment in Bentham & Hooker (1873) that he placed great emphasis on the presence of receptacular bracts or paleae. Of all other genera within the subtribe 'Angiantheae', only *Craspedia* Forst.*f.* was known to have such scales and members of it could be readily distinguished in the key. Thus *Craspedia* was distinguished by 'Pappus of several plumose-ciliate bristles or scales. Stems or peduncles elongated and erect' as opposed to 'Pappus none or of very short scales. Dwarf, diffuse or stemless annuals' for *Chthonocephalus* (Bentham 1867, p. 453).

There seems to have been no opposition to this treatment and a further species, *C. multiceps* J. H. Willis, was described in 1952. However, following a revision of *Angianthus* Wendl. *s. lat.*, it was realized (Short 1983) that *C. pygmaeus* was referrable to *Siloxerus* Labill., the species differing from *C. pseudevax* and *C. tomentellus* by virtue of its very different general receptacle, bract and fruit morphology. My studies have also shown that *C. multiceps* should be excluded from *Chthonocephalus* as it differs in features of the fruit and bracts. It is closely related to *Calocephalus aervoides* (F. Muell.) Benth. and both taxa should probably be referred to a separate genus. (The most distinctive feature pertains to the paleae which are confined to the centre of the receptacle and are partly fused at the base.) Thus of the species recognized by Bentham only two, *C. pseudevax* and *C. tomentellus*, are retained in the genus.

In this paper I attribute a further four species to the genus, *i.e. C. spathulatus, C. muellerianus, C. oldfieldianus* and *C. viscosus.*

All species have similar fruit and capitular bracts and these characters seem to separate them from other Australian compound-headed inuloid species. The brown, ovoid fruit has a thin pericarp and testa which lack a layer of collenchyma or sclerenchyma. Two vascular bundles occur in the pericarp and small myxogenic cells may be distributed over the surface. (Differences in the fruit anatomy do occur between species in that some lack a well-developed carpopodium, and a crystalline layer does not seem to be well developed in the pericarp of all species—see Fig.

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2.) The capitular bracts are in a single row and are usually predominantly green and opaque. (*C. viscosus* has bracts which are largely hyaline but there is a prominent midrib.) The presence of receptacular scales and the absence of a pappus also aid in the identification of the genus although a pappus of plumose bristles is found in *C. muellerianus* and paleae are absent in *C. viscosus*.

Within the genus several groups of species can be recognized. Thus *C. tomentellus* and *C. muellerianus* have a different habit to all other species, all plants having an obvious stem, and their fruit have an annular carpopdium. In other species the stem is inconspicuous. In the *C. pseudevax* group (*i.e. C. spathulatus, C. oldfieldianus* and *C. pseudevax*) all species seem to have fruit which lack a distinct carpopodium. (Only immature fruit of *C. oldfieldianus* have been examined but a carpopodium appears to be absent.) At least in *C. pseudevax* and *C. spathulatus* the fruit are also polymorphic in regard to their size, with about 5% of the fruit from the same compound head being much larger than the rest. Fruit of other species show little variation in size. Before I was aware of *C. viscosus* I had considered recognising two sections or subgenera. However *C. viscosus* has the habit of members of the *C. pseudevax* group, and fruit as in *C. tomentellus* and *C. muellerianus*. This same species could be placed in its own infrageneric category by virtue of the lack of paleae, thus allowing the recognition of three subgenera or sections but I see little merit in this action.

TAXONOMY

Chthonocephalus Steetz in Lehm., Pl. Preiss. 1:444 (1845); Benth., Fl. Austr. 3:581 (1867) *p.p.*; Benth. in Benth. & J. Hook., Genera Pl. 2:186 (1873) *p.p.*; Hoffman in Engler & Prantl, Natürl. Pflanzem. IV(5):195 (1890) *p.p.* TYPE: *C. pseudevax* Steetz.

Lachnothalamus F. Muell., Fragm. 3:156 (1863). TYPE: *L. tomentellus* F. Muell. [= *C. tomentellus* (F. Muell.) Benth.]

[*Chamaesphaerion auct. non* A. Gray, Hook. J. Bot. Kew Gard. Misc. 3:176 (June 1851), as to *Chthonocephalus pygmaeus* (A. Gray) Benth. (= *Siloxerus pygmaeus*), see Short, Muelleria 5:204 (1983).]

[*Gyrostephium auct. non* Turcz., Bull. Soc. Imp. Naturalistes Moscou 24(2):76 (Oct. 1851), as to *Chthonocephalus pygmaeus* (A. Gray) Benth., see Short, Muelleria 5:204 (1983).]

Annual herbs consisting of a compound head surrounded by a flat, basal rosette of leaves *or* with a conspicuous stem and usually branching at basal and near basal nodes, the major axes prostrate to ascending, sometimes producing minor shoots. *Leaves* sessile, entire, in a basal rosette beneath the compound heads *or* alternate on the branches, vestiture eglandular, cobwebby or villous. *Compound heads* spheroid to lenticular or broadly depressed to depressed ovoid, rarely absent; bracts subtending the compound heads absent or of 1 or several rows of hyaline or leaf-like bracts; general receptacle disc-like, solid or shortly branched, the partial receptacles distributed evenly over its surface, glabrous or hairy. *Capitula* (2)5–50 per compound head; capitulum-subtending bracts absent. *Capitular bracts c.* 6, oblanceolate or spathulate, flat or distinctly curved, each with an opaque, green midrib, a hyaline apex and usually with narrow to broad hyaline margins, the margins with long hairs, midrib glabrous or with long hairs on the outer surface. *Paleae* usually present (absent in *C. viscosus*) subtending 1, rarely 2 florets, not resembling the capitular bracts, hyaline, lacking a midrib. *Partial receptacle* glabrous. *Florets* (2)5–40, tubular, bisexual, yellow; corolla 3–5-lobed. *Style* branches truncate, with short sweeping hairs. *Stamens* 3–5; *anthers* barely caudate, each with a sterile apical appendage; filament collar straight in outline and not thicker than the filament. *Cypselas* obovoid, brown, pericarp with two oblique or medial vascular bundles, a layer with crystals usually discernible in mature fruit, carpopodium absent or well-developed.

DISTRIBUTION (Fig. 1):

All six species occur in Western Australia and five are restricted to that state. *C. pseudevax* extends across the southern part of the mainland. The Shark Bay region of Western Australia is the centre of diversity of the genus.

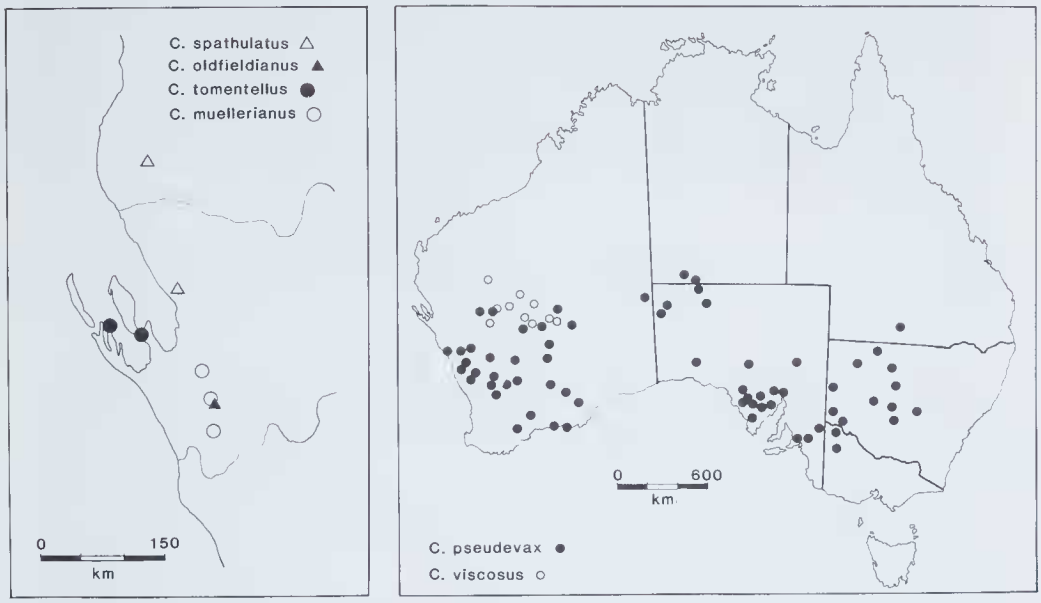

Fig. 1. Distribution of species of *Chthonocephalus*.

REPRODUCTIVE BIOLOGY:

The use of pollen:ovule ratios (P/Os) in the determination of plant breeding systems has been previously discussed (Short 1981). Within *Chthonocephalus* five of the six species, by virtue of P/Os of several thousand, can be regarded as outbreeders (*i.e.* cross-fertilization is common, if not obligatory) compared to *C. pseudevax* for which an average P/O of *c.* 150 has been determined. The inbreeding nature of the latter species is also reflected by its trimerous and tetramerous florets, instead of pentamerous florets which are found in all other species. As with many inbreeding/outbreeding species pairs *C. pseudevax* is a widespread species whereas its closest relative, *C. oldfieldianus*, is only known from a single population.

KEY TO SPECIES OF CHTHONOCEPHALUS

1. Receptacular bracts absent ..... 6. *C. viscosus*
1. Receptacular bracts present 2
2. Plants seemingly stemless, consisting of a compound head surrounded by a basal rosette of leaves, if branching then with an apparently sessile compound head immediately above the root 3
3. Plants branching, or if not branching then the compound head surrounded by *c.* 2–4 erect leaves ..... 1. *C. spathulatus*
3. Plants with a reduced, seemingly absent stem; leaves surrounding compound heads not held erect 4
4. Florets 5-lobed ..... 2. *C. oldfieldianus*
4. Florets 3 or 4-lobed ..... 3. *C. pseudevax*
2. Plants with all compound heads terminating major axes that are more than *c.* 1 cm long 5
5. Pappus absent ..... 4. *C. tomentellus*
5. Pappus of plumose bristles ..... 5. *C. muellerianus*

1. **Chthonocephalus spathulatus** P. S. Short, *sp. nov.*

Herba annua, caule inconspicuo; quaeque planta glomerulus rosula foliorum erectorum, vel planta ramificans sed glomerulo proxime super radicem, axibus maioribus prostratis, usque *c.* 6 cm longis, arachnoideis. *Folia* erecta, oblanceolata vel spathulata, *c.* 0.5–5 cm longa, 0.1–0.7 cm lata, praecipue ad basem glomerulorum, tomentosa. *Glomeruli* plerumque transverse ellipsoidei usque lenticulares, raro depresse late ovoidei, *c.* 0.35–0.5 cm alti, *c.* 0.5–2 cm diametro; bracteae glomerulos subtendentes aliquot-seriatae, late ovatae vel late obovatae saepe ita irregulariter, *c.* 4–4.5 mm longae, *c.* 2.5–4 mm latae, hyalinae, marginibus parce longe ciliatis; receptaculum glabrum. *Capitula c.* 5–10; bracteae intra capitulum 5–6, 3.6–4.3 mm longae, *c.* 0.4–0.5 mm latae, marginibus et apice parce pilosis. *Paleae* obovatae, 3.4–3.6 mm longae, 1.2–1.7 mm latae, hyalinae, marginibus integris vel parce longe ciliatis, pagina exteri glabra vel pilosa. *Flosculi* (2)5–12; corolla 5-lobed, tubos 2.1–2.5 mm longos. *Stamina* 5; antherae 0.96–1 mm longae, sporangiis 0.71–0.78 mm longis, appendicibus terminalibus triangularibus, 0.18–0.29 mm longi. *Pollinis grana* in quaque anthera *c.* 500. *Cypselae* 0.5–0.95 mm longae, 0.3–0.6 mm diametro. *Pappus* carens.

HOLOTYPUS: Western Australia, Boologooro Homestead. 24° 20′S, 114° 02′E. Red-brown loam. Open *Acacia* shrubland. 18.viii.1986, *Short 2484, Lander & Fuhrer* (MEL 1555156). ISOTYPI: AD, PERTH.

Annual herb consisting of a compound head (rarely a single capitulum) surrounded by *c.* 2–7 erect leaves, or branching at basal and near basal nodes, if branching then with a compound head immediately above the root, the major axes prostrate, to *c.* 6 cm long, cobwebby. *Leaves* erect (at least in freshly watered specimens), oblanceolate or spathulate, the lower part sometimes dilated, hyaline, *c.* 0.5–5 cm long, 0.1–0.7 cm wide, mainly restricted to the base of the compound heads, tomentose. *Compound heads* usually transversely elliptic to lenticular but broadly depressed ovoid in small plants, *c.* 0.35–0.6 cm high, *c.* 0.5–2 cm diam.; bracts subtending compound heads consisting of several rows of hyaline bracts, the bracts widely ovate or widely obovate but the shape often very irregular, *c.* 4–4.5 mm long, *c.* 2.5–4 mm wide, with sparsely long-ciliate margins; general receptacle disc-like, solid, glabrous. *Capitula c.* 5–70 per compound head; capitular bracts 5–6, in a single whorl and each bract consisting of an opaque, green midrib with a hyaline apex and narrow hyaline margins, the entire bracts 3.6–4.3 mm long, *c.* 0.4–0.5 mm wide and with a few hairs on the margins and near the apex. *Paleae* obovate, 3.4–3.6 mm long, 1.2–1.7 mm wide, midrib absent, margins entire or with a few long-ciliate hairs, outer surface glabrous or with long hairs. *Florets* (2)5–12 per capitulum; corolla 5-lobed, the tube 2.1–2.5 mm long. *Stamens* 5; anthers 0.96–1 mm long; microsporangia 0.71–0.78 mm long; apical appendage triangular, 0.18–0.29 mm long. *Pollen grains c.* 500 per anther. *Cypselas* obovoid, 0.5–0.95 mm long, 0.3–0.6 mm diam. *Pappus* absent. (Figs 2, 3)

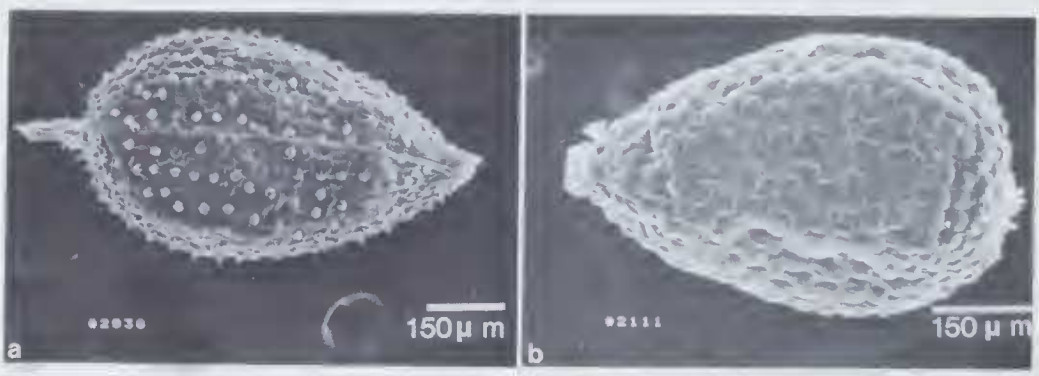

Fig. 2. Fruit of *Chthonocephalus*. a—*C. landeri (Short 2038)*. b—*C. muellerianus (Short 2111)*.

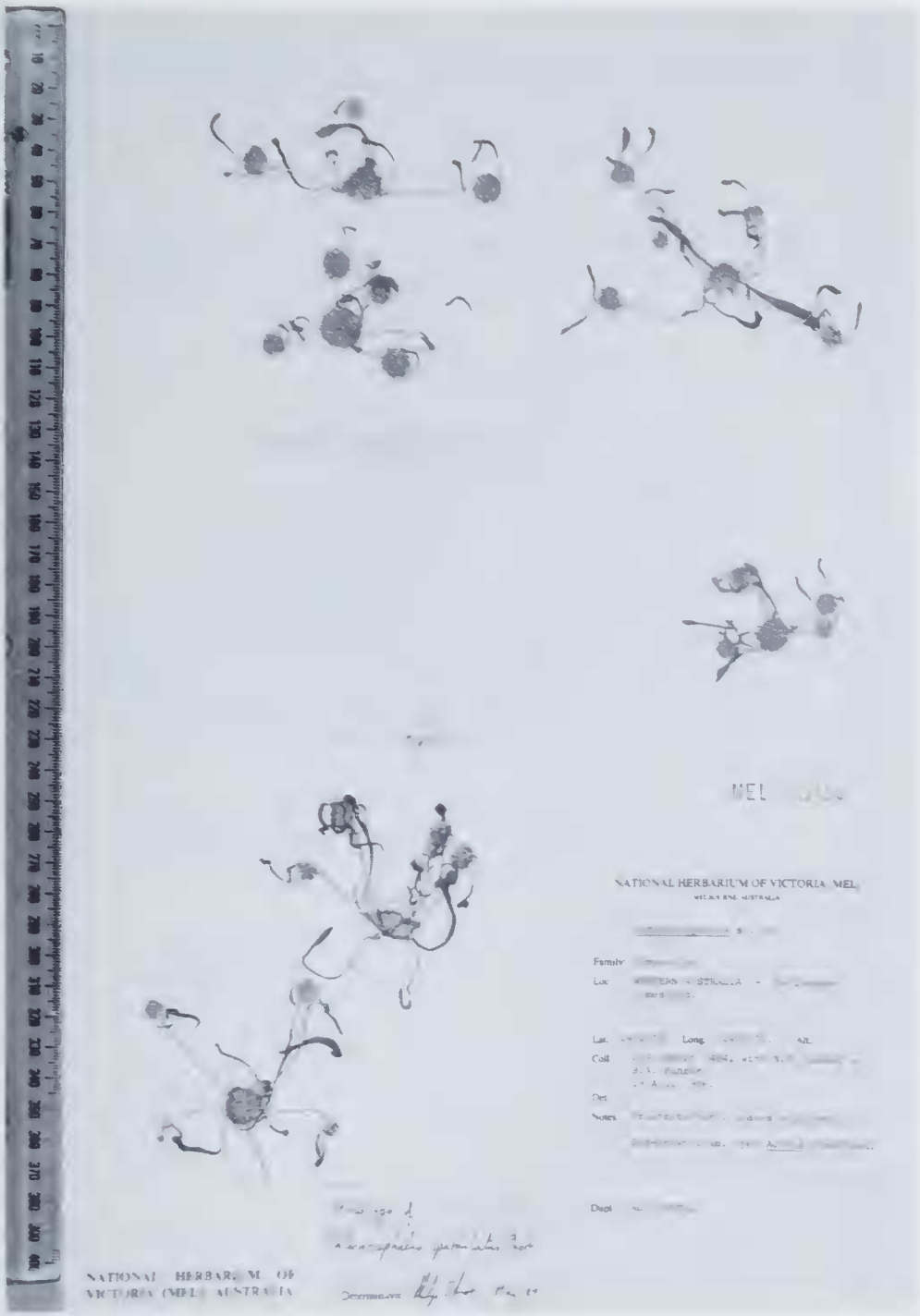

Fig. 3. Holotype sheet of *C. spathulatus (Short 2484 et al.)*

DISTRIBUTION (Fig. 1):

Restricted to the Carnarvon region of Western Australia. Of the five collections all but one have been collected in the vicinity of Boologooro homestead (*i.e. Butler 53, Short 1554, Short 2038*, and the type colln).

ECOLOGY & REPRODUCTIVE BIOLOGY:

Restricted to arid shrubland. Collectors notes include 'Amongst open shrubland. In reddish brown sandy clay.' and 'Flat sand plain. In open areas between shrubs of *Eremophila, Hakea* and chenopod shrubs. Associated with annual composites such as *Pogonolepis* sp., *Gnephosis* spp. and *Actinobole condensatum*.'

A P/O of 2,428 was determined from a single individual of *Short 2484* (type).

NOTES:

1. The specific epithet refers to the spathulate leaves which, along with the branching habit, readily differentiate this species from its closest relatives, *C. pseudevax* and *C. oldfieldianus*. Spathulate leaves do occur in *C. viscosus* but it is readily differentiated from *C. spathulatus* by the presence of the sticky florets and the absence of paleae.

SELECTED SPECIMENS EXAMINED (Total 5):

Western Australia—Boologooro, 1963, *Butler 53* (PERTH); Wooramel Roadhouse, 17.viii.1986, *Lander 1341, Fuhrer & Short* (AD, BRI, CANB, MEL, NSW, PERTH).

2. **Chthonocephalus oldfieldianus** P. S. Short, *sp. nov.*

Chthonocephalus sp. aff. pseudevax Steetz, Short, Muelleria 4:395-417 (1981).

Herba annua, caule inconspicuo; quaeque planta glomerulus rosula foliorum, *c.* 0.7–4 cm diametro. *Folia* oblanceolata usque obovata, *c.* 0.5–2.4 cm longa, 0.25–0.7 cm lata, basi hylinia, tomentosa. *Glomeruli* plerumque transverse ellipsoidei usque lenticulares, raro depresse late usque depresse ovoidei, *c.* 0.4–0.5 cm alti, *c.* 0.6–2.4 cm diametro; bracteae glomerulos subtendentes uni-vel bi-seriatae, oblongae, *c.* 2.8–3.5 mm longae, *c.* 1.4–1.5 mm latae, hyalinae, marginibus longe ciliatis; receptaculum glabrum. *Capitula c.* 5–50; bracteae intra capitulum 5–6, 1.8–2 mm longae, *c.* 0.2 mm latae, marginibus pauce pilosis. *Paleae* obovatae, 2.3–2.7 mm longae, 1.1–1.3 mm latae, paginis exteribus et marginibus pilis longis. *Flosculi c.* 9–16 in quoque capitulo; corolla 5-lobata, tubos *c.* 1.5–1.7 mm longos. *Stamina* 5; antherae 0.6–0.79 mm longae, sporangiis 0.45–0.6 mm longis, appendicibus terminalibus triangularibus, 0.14–0.2 mm longi. *Pollinis grana* in quoque anthera 200–440. *Cypselae* obovoideae. *Pappus* carens.

HOLOTYPUS: Western Australia, 100 km N of Murchison River on NW coastal highway, *c.* 27° 00′S, 114° 38′E. Red sand dunes—dominant *Acacia ?linophylla*. Very common. 19.viii.1977, *Short 394* (AD 97742595). ISOTYPI: AD (wet colln), CANB, K, MEL, PERTH.

Annual herb, stem inconspicuous, each plant consisting of a compound head surrounded by a flat, basal rosette of *c.* 7–30 leaves, the entire plant *c.* 0.7–4 cm diam. *Leaves* oblanceolate to obovate, the lower part somewhat hyaline, the entire leaf *c.* 0.5–2.4 cm long, 0.25–0.7 cm wide, tomentose, the innermost leaves fused together and partly making up the general receptacle. *Compound heads* usually transversely ellipsoid to lenticular but broadly depressed to depressed ovoid in small plants, *c.* 0.4–0.5 cm high, *c.* 0.6–2.4 cm diam.; bracts subtending compound heads in 1 or 2 rows, oblong, *c.* 2.8–3.5 mm long, *c.* 1.4–1.5 mm wide, hyaline, with long-ciliate margins; general receptacle disc-like, solid, glabrous. *Capitula c.* 5–50 per compound head; capitular bracts 5–6, 1.8–2 mm long, *c.* 0.2 mm wide and with a few *c.* 1–2 mm long hairs on the margins. *Paleae* obovate, 2.3–2.7 mm long, 1.1–1.3 mm wide, hyaline, the outer surface and margins with long hairs. *Florets c.* 9–16 per capitulum; corolla, 5-lobed, the tube *c.* 1.5–1.7 mm long. *Stamens* 5; anthers 0.6–0.79 mm long; microsporangia 0.457–0.6 mm long; apical appendages narrowly triangular, 0.14–0.2 mm long. *Pollen grains* 200–440 per anther. *Cypselas* (mature) not seen. *Pappus* absent. (Fig. 4)

DISTRIBUTION (Fig. 1):

Only known from the type collection.

ECOLOGY & REPRODUCTIVE BIOLOGY:

The type collection was gathered from red sand-dunes which were dominated by *Acacia* shrubs.

An average P/O of *c.* 1,540 has been recorded for the species (Short 1981).

Fig. 4. Holotype sheet of *C. oldfieldianus (Short 394).*

NOTES:

1. The specific epithet commemmorates Augustus Frederick Oldfield who collected extensively in Tasmania and Western Australia. In 1858-1859 he collected in the vicinity of the Murchison River (Maiden 1911) and it was from this region that he collected the type specimen of *C. tomentellus.*

2. The innermost leaves of this species could possibly be regarded as bracts of the general involucre. However they are clearly delimited from the hyaline bracts, there being no gradation from leaf to hyaline bract as occurs, for example, in *C. muellerianus*.

3. Although it is only known from the type collection I suspect that the species will prove to be locally common. When I gathered the type collection, which includes about fifty individuals, there were hundreds of plants growing in an area of about 500 square metres and the population seemed to extend much further into the surrounding *Acacia* shrubland. However I have not observed the plant on subsequent visits to the general area in 1982, 1983 and 1986. Its absence probably reflects adverse seasonal conditions for the species although in 1986 its close relative, *C. pseudevax*, was common in that region. Following Leigh *et al.* (1984) the species should be given the conservation status '1K'.

3. **Chthonocephalus pseudevax** Steetz in Lehm., Pl. Preiss. 1:445 (1845); Benth., Fl. Austr. 3:582 (1867); J. M. Black, Fl. S. Aust. 1st ed. 651 (1929), 2nd ed. 932 (1957); Willis, Handb. Pl. Vict. 2:734 (1973); Grieve & Blackall, W. Aust. Wildfls 820, pl. 14 (1975); Short in Jessop, Fl. Central Aust. 387, fig. 496 (1981); Cunningham *et al.*, Pl. Western N.S.W. 711 (1982); Short in Jessop & Toelken, Fl. S. Aust. 1508 (1986). TYPE: 'In solo limoso arenoso ad fluvium Avon haud procul ab oppidulo York, d.10. Sept. 1839. Herb. Preiss. no. 2414b.' LECTOTYPE (here designated): In Nova Hollandia, (Swan-River Colonia) in solo limoso arenoso ad fluvium Avon, haud procul ab oppidulo York leg. cl. Preiss . . . emi 1843, *s. dat., Preiss 2414* (MEL 543283). ISOLECTOTYPES: GH (ex herb. F. W. Klatt, fragmentary), LD, MEL 542226 (ex herb. Sonder), MEL 543282, P, S. (See note 1 below).

Chthonocephalus drummondii A. Gray, Hook. J. Bot. Kew Gard. Misc. 3:178 (1851). TYPE: 'Swan River, Drummond.' LECTOTYPE (here designated): Sw. riv., *s.dat., Drummond s.n.* (K). POSSIBLE ISOLECTOTYPE: GH (fragment only). REMAINING LECTOPARATYPES: Swan-River, 1843/1844, *Drummond s.n.*, (BM, K, P—2 sheets). (See note 2 below.)

Annual herb consisting of a compound head surrounded by a flat, basal rosette of *c.* 10–30 (*c.* 70) leaves, the entire plant (*c.* 0.7) 1–4 cm diam. *Leaves*, oblanceolate to obovate, the lower part somewhat hyaline, the entire leaf *c.* 0.6–2 (*c.* 3) cm long, 0.15–0.4 cm wide, tomentose, with both long thin hairs and short broad hairs. *Compound heads* usually transversely elliptic to lenticular but broadly depressed to depressed ovoid in small plants, *c.* 0.4–0.5 cm high, *c.* 0.5–2 cm diam.; bracts subtending compound heads absent; general receptacle disc-like, solid, glabrous. *Capitula* (2) 5–30 (*c.* 40) per compound head; capitular bracts *c.* 5–6, *c.* 3.3–3.8 mm long, *c.* 0.3–0.7 mm wide, the outer surface of the midrib and the hyaline margins with long hairs. *Paleae* elliptic, 2.9–3.4 mm long, 1.3–1.7 mm wide, hyaline, the margins entire to slightly laciniate and/or with a few long cilia. *Florets c.* 10–40 per capitulum; corolla yellow, 3, 4 (5)-lobed, the tube 1.6–2 mm long. *Stamens* 3, 4 (5); anthers 0.32–0.5 mm long; microsporangia 0.17–0.3 mm long; apical appendage widely deltate, *c.* 0.1–0.2 mm long; microsporangia 0.17–0.3 mm long. *Pollen grains* 20–60 per anther. *Cypselas* polymorphic, the majority *c.* 0.5–0.6 mm long, *c.* 0.35 mm diam. but a few (*c.* 5%) *c.* 0.9–1 mm long, *c.* 0.6–0.7 mm diam. *Pappus* absent.

DISTRIBUTION (Fig. 1):

Widespread across much of Australia, occurring between latitudes *c.* 25° S and *c.* 36° S and west of longitude *c.* 148° E.

ECOLOGY & REPRODUCTIVE BIOLOGY:

C. pseudevax occupies a variety of habitats, commonly occurring in sand or sandy loam depressions on granite outcrops and in sandy soil amongst samphire and *Melaleuca* around saline depressions. It is also common in open areas between

shrubs and trees of various semi-arid and arid zone communities which favour sandy soil.

An average pollen:ovule ratio of *c.* 150 has been recorded for the species.

NOTES:

1. The selection of MEL 543283 as the lectotype of *Chthonocephalus pseudevax* is consistent with the argument previously put (Short & Sinkora 1988) that in the case of names originally coined by Steetz specimens in his own herbarium should usually be chosen as the lectotype.

The use of the number *Preiss 2414b* in the protologue, not *Preiss 2414* as on the lectotype, merely reflects a duplication of numbers for Preiss collections. The duplication of numbers was presumably not noticed until after Steetz had received his specimens.

2. Gray (1851) described *C. drummondii* from a collection made by James Drummond in Western Australia and forwarded to him by Sir William Hooker. At K there is a sheet containing three individual plants plus an envelope containing fragments. This sheet, which I have chosen as the lectotype of *C. drummondii*, is annotated 'Chthonocephalus Drummondii n.sp.' in Gray's hand. A fragmentary collection at GH is presumably a duplicate of the lectotype. It is contained within an envelope, is labelled in Gray's hand as 'Chthonocephalus Drummondii' and like the lectotype lacks a Drummond collection number.

Collections labelled as *Drummond 185* exist in BM, P (2 sheets) and K. One of the sheets in P is labelled as 'Chthonocephalus n.sp.' in Gray's hand and was probably annotated by Gray when he visited Paris during his journey to Europe from June 1850 to August 1851 (Farlow 1888). The collections are regarded here as remaining syntypes and isosyntypes of *C. drummondii*. They possibly could be regarded as isolectotypes as they bear a strong resemblance to the lectotype collection.

3. The species exhibits variation with respect to leaf size and number, specimens from southern localities tending to have smaller and fewer leaves than plants found elsewhere. There is also noticeable variation in the density of hairs on the leaves and the presence or absence of ciliate margins on the paleae. The variation observed does not warrant formal recognition.

SELECTED SPECIMENS EXAMINED (Total *c.* 160):

Western Australia—Near British King Mine, 13.viii.1977, *Barker 1923* (AD); 32 km ENE of Cosmo Newberry, 1.ix.1973, *Chinnock 687* (AD); *c.* 10 km from Three Springs on Morawa road, 15.viii.1977, *Short 354* (AD); S of Beacon Hill, 28.viii.1968, *Wilson 7391* (AD).

Northern Territory—Yununba Hill, 21.viii.1973, *Donner 4331* (AD); Ayers Rock, 24.vii.1973, *Latz 4133* (AD, DNA).

South Australia—Arcoona, 23.viii.1956, *Lothian 2060* (AD); *c.* 146 km S of Kingoonya, 26.vii.1968, *Orchard 940* (AD); Carappee Hill, 23.ix.1978, *Short 768* (AD).

Queensland—Gilruth Plains, 17.ix.1938, *Everist 1645* (BRI).

New South Wales—Dunderboo Range, 1.ix.1969, *Dunlop 1517* (CBG); 11.2 km NW of Condoblin, 18.ix.1971, *Lander 26B* (NSW); 25 miles SE of Louth, 20.ix.1966, *Moore 4022* (CANB).

Victoria—Wyperfeld National Park, 4.ix.1978, *Muir 5886* (MEL); Rocket Lake, 2.viii.1968, *Willis s.n.* (MEL 85307).

4. **Chthonocephalus tomentellus** (F. Muell.) Benth., Fl. Austr. 3:581 (1867); Grieve & Blackall 4:820 (1975).—*Lachnothalamus tomentellus* F. Muell., Fragm. 3:156 (1863). TYPE: 'In planitiebus arenosis ad ostium fluminis Murchinson. Oldfield.' LECTOTYPE (here designated): Sand Plain, Mouth of Murchison R., W. Aust., *s. dat., Oldfield s.n.* (MEL 542229). ISOLECTOTYPE: K.

Annual herb. Stem simple or forming major branches at basal nodes; major axes prostrate to ascending, *c.* 1.5–14 cm long, hairy. *Leaves*, obovate to oblanceolate or elliptic 0.5–3.5 cm long, *c.* 0.2–0.5 cm wide, tomentose, with both long thin hairs and short broad hairs. *Compound heads* spheroid to transversely ellipsoid, *c.* 0.4–0.7 cm high, *c.* 0.4–1.3 cm diam.; bracts subtending compound heads inconspicuous, in 1 or 2 ill-defined rows, hyaline, elliptic or ovate, 2.7–3 mm long,

c. 1–1.6 mm wide, stereome variably conspicuous, the lamina with long hairs on the margins; general receptacle disc-like but not entire, hairy. *Capitula* 8–40 per compound head; capitular bracts 4–6, oblanceolate or spathulate, *c.* 1.5–1.7 mm long, *c.* 0.4–0.5 mm wide, with long hairs on the outer surface. *Paleae* elliptic or ovate, 1.9–2.4 mm long, 0.8–1.3 mm wide, hyaline, with long hairs on the outer surface, the hairs usually entwining 1 or sometimes 2 florets. *Florets* (2)5–27 per capitulum; corolla yellow, 5-lobed, the tube *c.* 1.3–1.6 mm long. *Stamens* 5; anthers 0.78–0.82 mm long; microsporangia 0.6–0.66 mm long; apical appendage triangular, 0.16–0.18 mm long. *Pollen grains c.* 320 per anther. *Cypselas* 0.5 mm long, *c.* 0.35 mm diam. *Pappus* absent.

DISTRIBUTION (Fig. 1):

Restricted to the Shark Bay-Murchison River region of Western Australia.

ECOLOGY & REPRODUCTIVE BIOLOGY:

The species seems to favour deep sandy soils. With the exception of the following collectors' notes, 'growing in red sand bordering saline clay depression' and 'red sand' information on the habitat of the species is not available.

A P/O of 1,688 was determined for a single floret of *Short 439.*

SPECIMENS EXAMINED:

Western Australia—Shark Bay, 26.viii.1931, *Blackall 544* (PERTH); Shark Bay, 7.ix.1940, *Blackall 4642* (PERTH); Useless Harbour, *s. dat., Brown s.n.* (MEL 85335); 36 miles S of Denham, 26.viii.1969, *George 9556* (PERTH); Between the Murchison River & Shark Bay, –.x.1877, *Mueller s.n.* (MEL 85332, PERTH); Hamelin Harbour, Shark Bay, –.x.1877, *Mueller s.n.* (MEL 85333); 57 km from Denham [toward] Overlander Roadhouse, 21.viii.1977, *Short 439* (AD).

5. **Chthonocephalus muellerianus** P. S. Short, *sp. nov.*

Herba annua, caule simplici vel e nodis basalibus ramificanti, axibus maioribus prostratis usque ascendentibus, 2–7.5 cm longis. *Folia* obovata vel elliptica, 0.5–2 cm longa, *c.* 0.2–0.7 cm lata, pilis longis tenuibus et brevibus latis. *Glomeruli* spheroidei usque transverse ellipsoidei, *c.* 0.4–0.7 cm longa, *c.* 0.4–1 cm diametro; bracteae glomerulos subtendentes *c.* 5–10, ellipticae, *c.* 0.4–0.5 cm longae, *c.* 0.13–0.25 cm latae, foliiformes sed interdum apicibus hyalinis, pilosae; receptaculum villosum. *Capitula c.* 8–35; bracteae intra capitulum 5–6, 2.8–3.1 mm longae, *c.* 0.3–0.6 mm latae, marginibus et regione apicali pilosis. *Paleae* ellipticae vel oblongae, 2.5–3.5 mm longae, 1.4–2.1 mm latae, hyalinae, paginis exteriis glabris vel sparse pilosis. *Flosculi c.* 5–25 in quoque capitulo; corolla 5-lobata, tubos 2–2.4 mm longos. *Stamina* 5; antherae 0.82–1 mm longae, sporangiis 0.63–0.84 mm longiis, appendicibus terminalibus triangularibus, 0.17–0.2 mm longi. *Pollinis grana c.* 400 in quaque anthera. *Cypselae c.* 0.5–0.55 mm longae, *c.* 0.35 mm diametro. *Pappi* setis 6–9(–11) plumosis, corollae tubi circa aequantibus.

HOLOTYPUS: Western Australia, 14 km S of Billabong Roadhouse. 26° 56′S, 114° 39′E. 11.ix.1986, *Short 2831, Amerena & Fuhrer* (MEL 1555860). ISOTYPI: AD, PERTH.

Annual herb, stem simple or forming up to *c.* 10 major branches at basal nodes; major axes prostrate to ascending, *c.* 2–7.5 cm long. *Leaves* obovate or elliptic, 0.5–2 cm long, *c.* 0.2–0.7 cm wide, with both long thin hairs and short broad hairs. *Compound heads* spheroid to transversely ellipsoid, *c.* 0.4–0.7 cm long, *c.* 0.4–1 cm diam.; bracts subtending compound heads *c.* 5–10, elliptic, *c.* 0.4–0.5 cm long, *c.* 0.13–0.25 cm wide, leaf-like but sometimes with hyaline apices, hairy; receptacle disc-like but not entire, villous. *Capitula c.* 8–35; capitular bracts 5–6, oblanceolate or spathulate, 2.8–3.1 mm long, *c.* 0.3–0.6 mm wide, with long hairs on the margins and on the outer surface near the base of the hyaline apex. *Paleae* elliptic or oblong, 2.5–3.5 mm long, 1.4–2.1 mm wide, hyaline, outer surfaces glabrous or with a few long hairs. *Florets c.* 5–25; corolla 5-lobed, the tube 2–2.4 mm long. *Stamens* 5; anthers 0.82–1 mm long; microsporangia 0.63–0.84 mm long; apical appendage triangular, 0.17–0.2 mm long. *Pollen grains c.* 400 per anther. *Cypselas* obovoid, *c.* 0.5–0.55 mm long, *c.* 0.35 mm diam., brown. *Pappus* with 6–9 (–11) plumose bristles with dense apical tufts, the entire bristles approximately the length of the corolla tube. (Figs 2, 5)

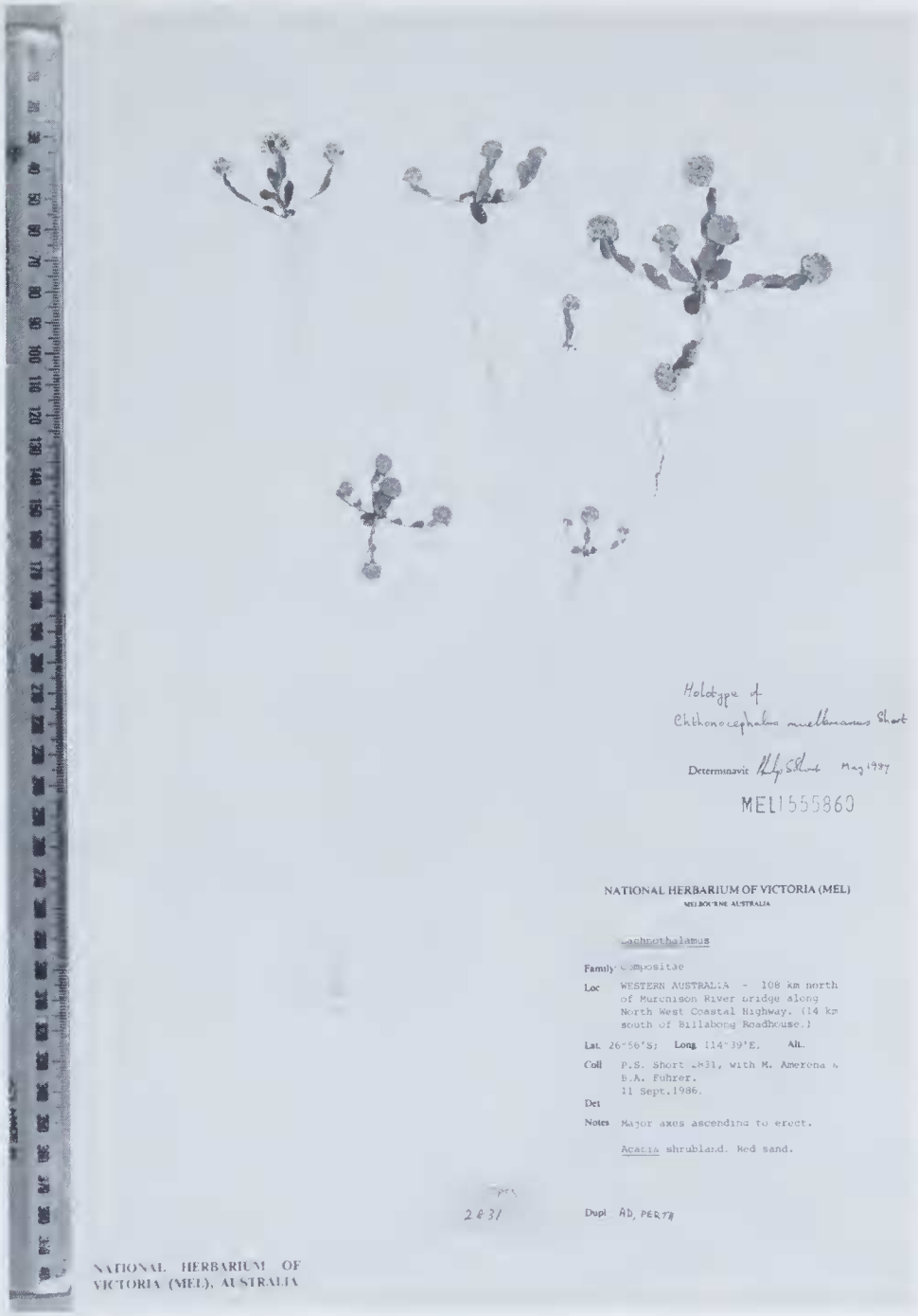

Fig. 5. Holotype sheet of *C. muellerianus (Short 2831 et al.)*.

DISTRIBUTION:
Restricted to the Shark Bay region of Western Australia.

ECOLOGY & REPRODUCTIVE BIOLOGY:
Information on the habitat of the species is scarce but it is evident that it

grows in sand. It has been recorded as growing in a shrub community with *Eremophila leucophylla* as the dominant species.

A P/O of 1,998 was recorded for a single floret of *Short 419*.

NOTES:

1. The specific epithet commemorates Ferdinand J. H. Mueller. One of the many species described by him was the closely related *C. tomentellus*.

2. The species differs from *C. tomentellus* in having a more well-defined general involucre (many bracts being leaf-like), the plumose pappus, and the frequently glabrous paleae.

SPECIMENS EXAMINED:

Western Australia—near Shark Bay, 17.ix.1941, *Gardner 6011* (PERTH); 22.5 km S of Wannoo, 17.ix.1968, *Phillips WA68/1122* (PERTH); *c.* 57 km N of Murchison River Bridge, 19.viii.1977, *Short 391* (AD); *c.* 28 km S of Overlander Roadhouse, 20.viii.1977, *Short 419* (AD).

6. **Chthonocephalus viscosus** P. S. Short, *sp. nov.*

Herba annua; quaeque planta glomerulus rosula foliorum prostratorum usque erectorum, vel planta ramificans sed glomerulo proxime super radicum, axibus maioribus prostratis, ad *c.* 9 cm longis, gossypinis. *Folia* oblanceolata vel spathulata vel sublinearia, 0.4-6.5 cm longa, 0..05-0.9 cm lata, gossypina. *Glomeruli* depresse late usque depresse ovoidei, 0.4-1 cm alta, 0.5-2.5 cm diametro; bracteae glomerulos subtendentes involucrum conspicuum longitudine glomeruli formantes, foliiformes, paginae exteria lanata, interia glabra; receptaculum brevissime, ramosum sparsim pilosum. *Capitula* usque ad *c.* 50; receptaculum glabrum. *Bracteae intra capitula c.* 6-7, uniseriatae, plerumque hyalinae sed costa prominentie basi per longitudinem 3/5-2/3 bracteae extendenti, marginibus longe ciliatis, apici longe piloso. *Paleae* absentes. *Flosculi* 6-17; corolla 5-lobata, tubos 2.1-2.5 mm longos. *Stamina* 5; antherae 0.96-1 mm longae, sporangiis 0.76-0.8 mm longis, appendicibus terminalibus triangularibus, 0.18-0.23 mm longi. *Cypselae* obovoideae, 0.35-0.4 mm longae, 0.25-0.3 mm diametro; carpopodium conspicuum. *Pappus* absens.

HOLOTYPUS: Western Australia, *c.* 18 km from Bandya Homestead along road to Laverton. *c.* 27° 50′S, 122° 19′E, 21.viii.1982, *Short 1541* (MEL 621022). ISOTYPI: AD, K, PERTH, S.

Annual herb consisting of a compound head (rarely a single capitulum) surrounded by prostrate to erect leaves, or branching at basal and near basal nodes, if branching then with a compound head immediately above the root, the major axes prostrate, to *c.* 9 cm long, cottony. *Leaves* oblanceolate or spathulate or linear, 0.4-6.5 cm long, 0.05-0.9 cm wide, cottony. *Compound heads* broadly depressed to depressed ovoid, 0.4-1 cm high, 0.5-2.5 cm diam.; bracts subtending compound heads forming a conspicuous involucre about as long as the head, leaf-like, the outer surface woolly, inner surface glabrous; general receptacle shortly branched, sparsely hairy. *Capitula* to *c.* 50 per compound head; receptacle glabrous; capitular bracts *c.* 6-7, uniseriate, mainly hyaline but with a prominent midrib extending 3/5-2/3 the length margins long-ciliate, with long hairs near the apex. *Paleae* absent. *Florets* 6-17 per capitulum; corolla 5-lobed, the tube 2.1-2.5 mm long. *Stamens* 5; anthers 0.96-1 mm long; microsporangia 0.76-0.8 mm long; apical appendage triangular, 0.18-0.23 mm long. *Cypselas* obovoid, 0.35-0.4 mm long, 0.25-0.3 mm diam.; carpopodium conspicuous. *Pappus* absent. (Fig. 6)

DISTRIBUTION (Fig. 1):

Restricted to central Western Australia between latitudes *c.* 24° and 28° S and longitudes *c.* 117° and 123° E.

ECOLOGY & REPRODUCTIVE BIOLOGY:

The type collection was gathered from an area of open mulga scrub with an understorey of herbs. Plants were growing in a loamy soil overlain by ironstone gravel. Other collectors' notes include '*Acacia aneura—Danthonia* community',

Fig. 6. Holotype sheet of *C. viscosus (Short 1541).*

'Rocky sandstone breakaway in mulga shrubland' and 'on wandarrie country. On bank areas (deep sand) and yellow clay-loam'.

A P/O of 1,812 has been recorded for a single floret of *Short 1541* (type).

NOTES:

1. The specific epithet alludes to the sticky corolla tubes which cause florets to adhere to one another in the capitula.

SELECTED SPECIMENS EXAMINED (Total 15):

Western Australia—Meekatharra, 24.viii.1963, *Aplin 2469* (PERTH); 5 miles N of Cunya Homestead, 15.ix.1973, *Beard 6563* (NSW, PERTH); 16 km S of 10 Mile Tank, 3.ix.1973, *Chinnock 729* (AD); 3 miles SW of Millrose, 8.ix.1958, *Speck 1378* (CBG *n.v.*, MEL); 56 km from Meekatharra along road to Wiluna, 7.ix.1982, *Strid 20208* (AD, C *n.v.*, MEL, PERTH, S).

EXCLUDED SPECIES

Chthonocephalus pygmaeus (A. Gray) Benth., Fl. Austr. 3:582 (1867). [= *Siloxerus pygmaeus* (A. Gray) P. S. Short, Muelleria 5:208 (1983).]

Chthonocephalus multiceps J. H. Willis, Proc. Roy. Soc. Queensl. 62:105, pl.7, figs 25–33 (1952). [Congeneric with *Calocephalus aervoides* (F. Muell.) Benth., Fl. Austr. 3:576 (1867).]

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