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CONTRIBUTIONS TO THE FLORA OF SOUTH AUSTRALIA

BY D. E. SYMON

Summary

In this paper nineteen species of plants are described as new to the State. Details are given of the extended distribution of an additional eighteen species.

CONTRIBUTIONS TO THE FLORA OF SOUTH AUSTRALIA

by D. E. Symon*

(Communicated by C. M. Eardley)

[Read 9 May 1963]

SUMMARY

In this paper nineteen species of plants are described as new to the State. Details are given of the extended distribution of an additional eighteen species.

INTRODUCTION

The first part of this paper consists of an alphabetical list of plant species considered new to South Australia. Of these, thirteen are exotics now regarded as established here, the remaining six are native species previously recorded near the South Australian borders.

The second part of the paper consists of an alphabetical list of plant species previously recorded here from restricted or widely differing localities, and the list gives extended occurrences of nine exotic and nine native species.

Specimens of all the species listed are lodged in the Herbarium of the Waite Agricultural Research Institute (ADW).

RECORD OF NEW PLANT SPECIES

Arum L. (*Araceae*)

Perennial herbs with tuberous rootstocks. Leaves net veined, petioles sheathing at the base. Inflorescence a dense flowered simple spadix supported at its base by a leaf-like or coloured bract, the spathe, the upper part of the spadix without flowers, the flowers all unisexual female below, the upper ones sterile; male above, the upper sterile. Perianth segments absent. Ovary 1-celled, stigmas sessile.

Arum italicum Mill., Gard. Dict. ed. VIII 2 (1768).

An erect glabrous perennial, 50 cm, tuber depressed globular 3-4 cm diam. Autumn leaves small, hastate uniform green, later leaves long petioled, sagitate, white patterned above the larger veins, about 15 cm long. Spathe 20-30 cm erect, pale greenish yellow. Fruit 1 cm fleshy, scarlet, the fruiting spike standing naked and showy after the leaves have withered. Flowering in November-December. A native of southern Europe and a garden escape here.

Established at Mylor and Williamstown.

Avena ludoviciana Durieu in Bull. Soc. Linn. Bord. 20 (1855) 41; Malzew, Bull. Appl. Bot. Genet. Supp. 38 (1930) 363; Clapham, Tutin and Warburg, Fl. Brit. Isl. (1952) 1469; Hubbard, Grasses (1954) 215; Thurston, J. Agric. Sc. 49 (1957) 259.

Annual, to 1½ m tall; culms few or many, stout; leaves and sheaths glabrous or with a few ciliate hairs, coarse, 10-15 mm broad 40 cm long, ligule membranous, 7 mm; panicles pyramidal, loose, 15-45 cm long; spikelets 25-30 mm

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long, gaping when mature, 2-3 flowered, breaking above the glumes but not between the florets which fall together when ripe; florets pale or dark when ripe, and sparsely or densely covered with long hairs; lemma 15-20 mm long, the upper florets smaller, lower floret awned, the upper florets with or without awns, awn stout, 5 cm long, almost black.

A weed of cereal crop now widespread but nowhere as common as *A. fatua*, the common Wild Oat, from which it is readily separated by the spikelets falling as a group and not readily separating. In England at least *A. ludoviciana* is a serious weed of cereals on heavy soils in the southern counties, and in South Australia it has been collected from the better rainfall areas of the wheat belt.

Now established at Kybybolite, Melrose, Roseworthy, Turretfield, Yongala and in the Adelaide suburbs.

Calytrix longiflora F. Muell., Fragm. 1 (1858) 12; Benth., Fl. Aust. 3 (1867) 49; Black, Fl. S.A. ed. 1 (1926) 426.

An intricate shrub, the young branches pale with white leaf bases, the older branches grey; the leaves 2½-3 mm long, 1-1½ mm broad trigonous in section, the leaf edges and keel finely ciliate; flowers subsessile in the upper axils, solitary or more often forming terminal heads of 3-6 flowers; bracteoles 2, scarious, keeled, 9 mm long including a mucro of 1 mm, scarcely united; receptable 12 mm of which 7 mm is adnate to the ovary and the upper 5 mm is free and hollow; sepals ovate 5 x 2½ mm and terminated by an awn 9 mm long, petals 7 mm, acute, bright pink; stamens 30-40.

It may be separated from *C. tetragona* by the receptable above the ovary being hollow and by the shorter leaves, and from *C. involucrata* by the absence of an involucre of bracts surrounding the flowers.

Although mentioned in the first edition of the Flora of South Australia as likely to occur in this State, no account was given in the second edition. The species has now been collected from several localities in the far north, Mt. Moulden, between Mt. Moulden and the Blyth Range and at Mt. Vivian.

Cassia glutinosa DC., Prodr. 11 (1825) 495; Benth., Fl. Aust. 2 (1864) 286; Black, Fl. S.A. ed. 2 (1948) 430.

Glabrous shrub with viscid branchlets and pods. Leaves with 5-6 pairs of oblong leaflets 8-15 mm long and 2-3 mm wide, often with a short gland between each of the lowest pairs of leaflets. Flowers 2-6 in an umbel, bright orange yellow, relatively large, the petals 10-15 mm long. Pods with a varnished appearance when fresh, 3-6 cm long and 1 cm broad.

This species is listed and briefly described in the Flora of S.A. as likely to occur in our far north. It is widely spread but not common in northern Australia, and has been collected from near the nickel mine at Mt. Davies, Tomkinson Range.

Cyperus arenarius Retz. Obs. 4 (1786) 9.

A perennial 15-30 cm high with extensive, somewhat brittle, horizontal rhizomes, covered with fibrous sheaths, no tubers are formed; from the rhizomes arise vertical leafy shoots; leaves grass-like, distinctly grey-green in colour, channelled above but not keeled below, the margins often incurved, 2 mm wide and 10-20 cm long with loose sheaths; stems erect, terete, longer than the leaves, the inflorescence subtended by about 3 leaf-like bracts the shortest of which is 1-2 cm long and the longest 7 cm; inflorescence a compact umbel 10-15 mm in diameter of about 12-14 spikelets; the spikelets 5-6 mm long and consisting

of 10-12 flowers, the flowering glume 3 mm long speckled brown; style 3 branched, stamens 3; nut obovoid, planoconvex, 1½ mm long.

This species is firmly established and is proving a difficult weed in a garden on red sand at Port Augusta. It was reputedly brought in with soil filling, but other established areas have not yet been found. It would appear to be a new record for Australia.

Datura

The nomenclature of the genus *Datura* has been confused in South Australia. *Datura tatula* may be considered a variety or colour form only of *D. stramonium* and it is not usually maintained as a species. It should at least be reduced in rank from that of a species. Almost all specimens previously identified as *D. metel* are in fact *D. inoxia* which has not previously been recorded for South Australia. The only authentic specimen of *D. metel* seen so far has been a double flowered purple form, grown as an ornamental plant in a suburban garden. It is doubtful whether *D. metel* is in fact naturalised in South Australia.

Datura ferox L. is naturalised and should be added to the flora.

Most species of *Datura* contain powerful alkaloids and all the introduced species are declared noxious weeds.

The following key to the species in South Australia is offered.

Key to the species of Datura *in South Australia*

A. Fruits deflexed.

B. Leaves green and glabrous.

C. Flowers relatively small, 5 cm, white, the only native species *D. leichhardtii.*

CC. Flowers large, 10-15 cm, white or violet, fruit with tubercles or short spines ... ... *D. metel.*

BB. Leaves greyish green, downy, flowers large, 10-15 cm, white or violet, fruit with long spines ± 5 mm ... ... *D. inoxia*

AA. Fruits erect.

D. Spines markedly unequal, the basal ones smaller, the upper spines stout and long (to 2 cm) corolla white, relatively short, 4-6 cm. *D. ferox*

DD. Spines more or less equal, numerous, somewhat slender, corolla white or lavender, longer 6-10 cm. ... ... *D. stramonium*

Datura ferox L., Diss. Dem. Pl. in Amoen. Acad. 3 (1756) 403; Gardner and Bennetts, J. Dept. Agric. W.A., 2 (1953) 217; De Wolf, Baileya 4 (1956) 13; Avery, Satina, Rietsema, Blakeslee the Genus Datura (1959) 21.

A coarse annual herb, 15-50 cm tall. Leaves almost glabrous, ovate triangular, sinuate toothed. Flowers erect on short stout pedicels about 1 cm long, corolla white 3-6 cm long. Capsule erect, large, spines markedly unequal the basal ones smaller, the upper spines stout and long, to 2 cm; seeds reniform, dark, pitted, 4 mm long.

Native to Asia but now widely distributed, it has been reported in both Eastern and Western Australia and has been collected from Craddock, Kilburn, Meadows, Pygery, Lochiel and Koonamore in South Australia.

Datura inoxia Mill. Gard. Dict. ed. 8 1768.

A coarse ill-smelling annual or perennial herb up to a metre tall. Leaves large ovate, 12 cm long asymmetrical at the base, almost entire, greyish pubescent, not green and glabrous. Flowers erect, calyx half the length of the corolla, corolla white or faintly tinged with violet, trumpet-shaped to 17 cm long. Capsule globose, deflexed, to 4 cm diameter including the spines, which are numerous, slender, and about 5 mm long. Seeds pale buff colour, sub-reniform, 5 mm long.

Native to Mexico and the south-west portion of the United States, now widely distributed as a weed mostly in the drier parts of the State, Hawker, Stirling North, Mannum, Saltia and Adelaide suburbs.

Echium vulgare L., Sp. Pl. (1753) 139; Clapham, Tutin, Warburg, Fl. Brit. Isl. (1952) 846.

An erect, very rough hispid, annual or biennial, 15-50 cm; the radical leaves lanceolate, to 15 cm, petioled, with a prominent midrib and no apparent lateral veins, stem leaves sessile; flowers subsessile, cymes short, dense and arranged at the beginning of flowering in a long narrow panicle which broadens with maturity; corolla 15-20 mm, bright blue, four stamens long exserted.

The three species now in South Australia may be separated by the following summary of their characters:

E. lycopsis (*E. plantagineum*): two stamens exserted, flowers purple blue, leaves with obvious lateral veins.

E. vulgare: four stamens exserted, flowers bright blue, leaves with no apparent lateral veins.

E. italicum: five stamens exserted, flowers pink, lateral veins of the leaves almost obscured by the dense hispid hair covering.

Echium vulgare has been collected in South Australia at Clare and Mt. Gambier.

Eleocharis atricha R. Br. Prod. (1810) 225.

A specimen identified as such by Dr. S. T. Blake has been collected. The following condensed description is from the Monograph on the genus *Eleocharis* in Australia by Dr. S. T. Blake, Proc. Roy. Soc. Qld., 50 (1938) 88-132.

Stoloniferous, bearing ovoid tunicated tubers, 4 x 2·5 mm. Culms tufted, angular-sulcate 3-4 cm long, 0·5-0·7 mm wide, leaf sheaths membranous, oblique and somewhat scarious at the apex. Spikelets lanceolate to linear, acute, chestnut brown, often proliferous, 10-20 mm long, 2-3 mm wide, glumes oblong or ovate oblong, obtuse, membranous narrowly keeled, sides stained reddish-brown and streaked with linear red-brown glands, 3·5-5 mm long, style 3-fid. slender; stamens 3. Nut white to pallid straw coloured, shining, narrowly obovate or oblong 1·3-1·5 mm long, 0·6-0·7 mm wide, constricted immediately below the apex to a short neck about 2/3 as wide, trigonous, sides convex, prominently vertically ribbed and transversely trabeculate; style base with a rather prominent annulus, pyramidal deltoid or somewhat depressed, the base as wide as ¾-⅘ nut and ⅓-½ as long as wide, bristles constantly absent.

This species has been collected below the Barrage at Goolwa.

Eleusine indica (L.) Gaertn., Fruct. et Sem. 1 (1788) 8; Hitchcock, Man. Grasses of the U.S.A. (1951) 499; Gard, Fl. W.A. 1 (1952) 207; Bor, Grasses India, Burma, Ceylon, Pakistan, (1960) 493.

This species could be added to the Flora as of limited occurrence in South Australia.

Prostrate or ascending annual, smooth, with long hairs near the ligule. Spikes mostly 2-6 (5-6 in our specimens) flat, 4-9 cm long and 3-5 mm wide. It is readily separated from *Eleusine tristachya* which has fewer (1-3), shorter (1-2·5 cm), broader (5-10 mm) spikes, and is often purplish in colour. It is now sparingly established at Whyalla.

Elymus caput-medusae L., Sp. Pl. (1753) 84; Hitchcock, Man. Grasses of the U.S.A. (1951) 250; Munz, Calif. Fl. (1959) 1504.

Annual, culms ascending from a branched decumbent base, 15-30 cm tall. Leafblades flat, 15 cm long, 2-4 mm wide, sparsely hirsute on the upper surface. Spike 2-4 cm long without the awns, glumes subulate, smooth indurated, tapering to an awn 1-2 cm long. Lemma lanceolate, 3 nerved, very scabrous, with a flat awn 5-10 cm long.

A native to Europe, this grass has become a bad weed on the range country of California and is a potentially bad weed here. The sparse foliage and very long harsh awns make it of very little use as a pasture plant. It does not appear to have been recorded for Australia before and was well established at Black Springs, 10 miles south of Burra.

Eragrostis mexicana (Hornem.) Link., Hort. Berol. 1 (1827) 190; Hitchcock, Man. of the Grasses of the U.S.A. (1951) 158.

A summer growing annual, culms to 50 cm, spreading, leaves glabrous except for some hairs at the throat of the sheath, the blades flat 15 cm x 5 mm or less. Panicle to 30 cm long, open, the branches spreading and sometimes containing a few hairs in their axils, the pedicels slender, mostly as long or longer than the spikelets. The spikelets ovate to oblong, 5-8 flowered, 4-6 mm x 2 mm, lemmas about 1½ mm long, mature grain dark, almost globular, less than 1 mm diameter, the outer glumes and grain readily shed at maturity leaving the spikelet rachilla and palea intact.

Native to southern portions of North America, established in N.S.W. and about Adelaide suburbs.

Erodium malacoides (L.) Willd. Phyt. 1 (1794) 10; Carolin, Proc. Linn. Soc. NSW 83 (1958) 100; Munz, Calif. Fl. (1959) 144.

A sprawling or ascending annual, stems to 50 cm long, leaf blades cordate ovate, pilose, 2-5 cm long, shallowly lobed, crenate to dentate; stipules broad membranous, peduncle 5-8 cm, 4-8 flowered, very glandular pilose, sepals 4-5 mm, petals 4-5 mm, mature style column 2-3 cm long, carpel body 4-5 mm, column of the awn much twisted, bristle curved, about 10 mm. Native to the Mediterranean region but now naturalised in America and Australia.

It can be distinguished from the other *Erodium* species in S.A. by the cordate ovate leaves, and the relatively short awns to the fruits, and is established at Kadina.

Geranium dissectum L., Cent. 1 (1755) 21; Clapham, Tutin, Warburg, Fl. Brit. Isl. 387 (1952).

Branching annual 10-40 cm, stems retrorsely pubescent; leaves 2-5 cm broad, deeply dissected into 5 lobes which are divided into 3-6 broadly linear lobes, stiffly pubescent on the underside; lower petioles long and slender 6-15 cm;

peduncles about 3 cm long, 2-flowered; pedicels 1 cm glandular pubescent; sepals 5 mm with a linear point, petals dark rose purple about as long as the sepals, mature style column 10-15 mm carpel bodies 2-3 mm long, hispid; seed sub-globose, brown, strongly reticulate.

A native of Europe now widely spread in the temperate regions of the world, it is now established at National Park, Belair.

Distinguished from *G. molle* by the very much more dissected leaves and the strongly reticulate seeds.

Glycyrrhiza glabra L., Sp. Pl. (1753) 742.

Subshrubby perennial herb with a strongly developed woody root system. Annual growth about 50 cm high. Leaves imparipinnate 10 cm long, leaflets 4-6 pairs, oval 15-25 mm long and 8-15 mm wide, glabrous and slightly glutinous. Flowers in axillary racemes, pods reddish brown 10-15 mm long, 1-2 seeded.

A garden escape originally from Eurasia and now well established as large colonial patches, in many localities, but particularly in old market gardening areas along the River Torrens. The two species of *Glycyrrhiza* in South Australia may be separated by the following key.

Pods glabrous, leaflets oval ..... *G. glabra.*

Pods burr-like, with hooked prickles, leaflets lanceolate *G. acanthocarpa.*

Glycyrrhiza glabra has been collected from Angaston, Roseworthy and Paynehan.

Homoglossum watsonium (Thunb.) N.E. Br. Trans. Roy. Soc. S. Afric. 20 (1932) 278; Adamson and Salter, Fl. Cap. Penin. (1950) 263.

Rootstock a globose corm about 1 cm in diameter, surrounded by a louse tunic of flat, partly united fibres. A 104 cormils 6 mm or less in length, were counted from one corm, the comils have a markedly pitted tunic. Stem unbranched, slender, to 75 cm, the leaves about 4, glabrous, the lowest green, but largely sheathing, the second well developed to 75 cm x 6 mm with prominent marginal veins and midrib, upper leaves much shorter, mostly sheathing and without the very prominent veins. The spike 4-6 flowered, the bracts green, tapering, 5-6 cm, flowers red, the tube narrow for 2 cm then expanded for 2 cm, perianth lobes 2-3 cm long the uppermost broad, 18 mm, the lower ones narrower 7-10 mm, stamens 3, arched with the shortly 3-branched style under the upper perianth lobe. Capsule not seen.

Native to South Africa and sparingly established along the road between McLaren Flat and Meadows above Wickham Hill. It has been present there for at least 27 years.

Nothoscordum inodorum (Ait) Asch. et Gr., Syn. 3 (1905) 167; Ewart, Fl. Vict. (1930) 281; James, Herbertia 8 (1941) 156; Traub, Herbertia 10 (1954) 123. Syn. *Allium inodorum* Ait., *Allium fragrans* Vent., *Allium fragrans* Kunth. False Garlic, Wild Onion.

Bulb globose, white 2-3 cm diam. producing a large number of bulbils 3-6 mm long about its base, leaves basal, linear, 30 cm x 5-10 mm, scape 15-40 cm, spathe two valved, many flowered, pedicels 2 cm perianth white or very faintly pinkish 10 mm., sweetly scented.

The plant lacks completely the odor of onions. It is established in a number of suburban gardens and can be difficult to eradicate due largely to the

very numerous small bulbils produced. Most specimens collected have earlier been identified as *N. fragrans* Kunth.

A native of South America but now widely distributed in disturbed sites and as a garden escape in Adelaide suburbs.

Distinguished from *Allium* by the lack of the usual onion smell, the perianth segments joined at the base into a short tube and the ovules 4-12 in each cell.

Ornithogalum umbellatum L., Sp. Pl. (1753) 307; Hegi, Fl. Mittel-Europe 2 (1909) 252; Muenscher, Poison Plants U.S.A. (1939) 52; Clapham, Tutin, Warburg, Fl. Brit. Isl. (1952) 1226; Tackholm, Drar, Fl. Egypt 3 (1954) 168.

The bulb ovate, 2·5 cm wide and up to 4 cm long, often with 2-3 bulbils developing about it, the tunic pale and membranous. Leaves up to 6 in number, linear 15-20 cm x 6 mm, glabrous, grooved, with a white stripe down the midrib, the stripe fading late in the growing season. Scape 20 cm., the inflorescence at first a corymbose raceme but lengthening with maturity, 6-12 flowered, the pedicels ascending, the lower ones 3-4 cm long, the upper ones shorter; bracts thin and membranous 2-3 cm, linear lanceolate, acuminate. Perianth segments 12-17 mm, white, lanceolate-oblong, with a broad green band on the back. Stamens half as long as the perianth. Capsule not seen but described elsewhere as 1-1·5 cm, obovoid, 6 angled.

Native to the Mediterranean region and Europe. Well established near Monarto South where it has been present for at least 25 years. It has also been collected at Balhannah, and Petersville near Maitland.

Solanum lasiophyllum Dun. in Poir., Enc. Meth. Bot. Suppl. 3 (1814) 764; Dun. in DC Prodr. 13 (1852) 705; Benth., Fl. Aust. 4 (1868) 463.

A stout shrub, the branches, leaves and inflorescence very densely, softly, stellate tomentose; prickles slender 5-10 mm long on the stem, underside of the leaves and on the calyx; petioles short 5 mm, leaves ovate, blunt, 6 x 4 cm, entire or slightly undulate; peduncle 15-30 mm, few flowered; corolla densely tomentose outside and on the lobes inside; calyx 5-7 mm long in flower but greatly enlarged to cover the entire fruit at maturity and then up to 25 mm in diameter.

This species which is mainly western in its distribution has now been collected several times in South Australia. It may be distinguished from other species of *Solanum* in S.A. by the very dense, thick, tomentum on the leaves, the enlarged calyxes and the large fruits. It has been collected in the Tomkinson Range and on Mulgathing Station west of Tarcoola.

Utricularia sp. (*U. flexuosa*) Vahl., Enum. 1 (1804) 198; Benth., Fl. Aust. 4 (1868) 525; Tate, Fl. Extra trop. S.A. (1890) 252; Ewart, Fl. Vict. (1930) 1028.

Although this species was recorded by Tate for the Mt. Gambier district, it was not included in either edition of the Flora of South Australia by J. M. Black. Nor does it appear to have been collected in South Australia in recent years. Vegetative material provisionally identified as *U. flexuosa* has now been collected from the Wilpena Pound Creek, flowering specimens have not been available.

U. flexuosa differs from the other species of *Utricularia* in South Australia, in having long submerged stems, dissected leaves and yellow flowers. A winter bud of reduced hardened leaves appears to be formed.

EXTENDED RECORD OF PLANT SPECIES

The following species are established in South Australia and new or extended localities are recorded.

Amphipogon caricinus F. Muell., Linnaea 25 (1852) 445; J. Vickery, Contrib. N.S.W. Nat. Herb. 1 (1950) 289.

Further localities for this widely distributed but somewhat rare grass are as follows: Caralue, Lipson and between Lake Everard and Lake Gairdner on Eyre Peninsula and between the Musgrave and Mann Ranges.

Bifora testiculata (L.) DC., Prodr. 4 (1830) 249; Black, Fl. S.A., ed. 2 (1952) 536.

This weed was first reported in South Australia in 1936 from Riverton. A specimen has now been received from Maitland.

Brachiaria notochthona (Domin.) Stapf. in Prain Fl. Trop. Afr. 9 (1920) 597; Black Fl. S.A. ed. 2 (1948) 70.

This grass usually found much further north has been collected near Roseworthy and Gawler.

Carex chlorantha R. Br. Prodr. (1810) 242; Black, Fl. S.A. ed. I (1922) 98; Blake, Trans. Roy. Soc. S.A. 67 (1943) 42-61.

This species was included in the first edition of the Flora of South Australia, but not in the second edition. The species was originally reported from Lake Edward in the south-east of South Australia. A specimen has now been received from near Adelaide at South Henley.

Chloris virgata Swartz Fl. Ind. occ. 1 (1797) 203; Black, Fl. S.A. ed. 2 (1948) 132.

This weedy annual *Chloris* is common in northern Australia. Two new localities much further south are Mt. Lyndhurst Station and Port Augusta.

Chrysanthemum anethifolium (Willd.) Brouss. Emm. Hort. Berol. 904 (1809); Black, Fl. S.A. ed. 2 (1957) 878.

This aromatic shrub is now more widely spread. It is well established along the sea front at Tumby Bay and on the low cliffs along the river bank at Mannum.

Citrullus colocynthis (L.) Schrad. Linnaea 12 (1838) 414; Black, Fl. S.A. ed. 2 (1957) 806.

This weedy melon is much more widespread than is indicated in the Flora. It now occurs as far north as Anna Creek Station and westward to Tarcoola. The occurrences are sporadic and are usually found along creek lines and in sandy washes.

Cucumis chate Hasselq. Iter Palaest. (1957) 491; Black, Fl. S.A., ed. 2 (1957) 807.

This melon recorded for the far north of South Australia has now been collected further south near Mt. Lyndhurst.

Eleusine tristachya (Lam.) Lam. Tabl. Encyl. 1 (1792) 203; Williams, Trans. Roy. Soc. S.A. 76 (1953) 53.

Further localities for this grass first recorded by S.A. by L. D. Williams are as follows: Meningie, Myponga, and several Adelaide suburbs.

Grevillea eriostachya Lindl., Swan Riv. App. (1840) 36; Black, Fl. S.A. ed. 2 (1948) 269.

This species which was listed in the Flora of South Australia and briefly described has now been collected in the far north-west of the State, south-west of Mt. Hardy in the Deering Hills.

Lepidium strongylophyllum F. Muell ex. Benth. Fl. Aust. 1 (1863) 84; Tate, Fl. Extrat., S.A. (1890) 18 and 207; Ising, Trans. Roy. Soc. S.A. 78 (1955) 113.

This rare shrub was collected by Mueller and recorded by Bentham and Tate for Central Australia, but was not included in either editions of the Flora of South Australia. In recent years two specimens have been collected in South Australia. The first near Oodnadatta and a second one further south at Balt Baltana S.E. of Coober Pedy.

Mentha pulegium L., Sp. Pl. (1753) 577; Black, Fl. S.A. ed. 2 (1957) 731.

This Mint has now been collected from Kangaroo Island. It can be aggressive and weedy under some conditions and has been declared noxious in parts of W. Australia.

Neurachne munroi F. Muell. Fragm. 8 (1874) 200; 508; Black, Fl. S.A., ed. 2 (1948) 66.

This grass has now been collected in the Flinders Ranges at Copley Gorge.

Perotis rara R. Br. Prodr. (1810) 172; Black, Fl. S.A., ed. 2 (1948) 66.

It has now been collected in the far north of S.A. at Everard Park Station.

Senecio pterophorus DC Prodr. IV (1837) 389; Black, Fl. S.A., ed. 2 (1957) 885.

This weedy shrub, now declared noxious in South Australia, has spread to Kangaroo Island where efforts to eradicate it are being made. It is continuing to spread in the Adelaide Hills where it has increased greatly in recent years.

Sida leprosa (Ort.) K. Schum. in Mart., Fl. Brasil 12/3 (1886) 314; Clement, Contr. Gray Herb. 180 (1957) 50.

Sida hederacea was reduced by Schuman to varietal rank and included in S. *leprosa*.

It has been accepted in this position by Clement in his recent revision. The species contains four varieties, two of which occur in South Australia.

Sida leprosa var. *leprosa*. R. M. Kain 7-5 1948 (ADW 6076) Kadina; H. E. Orchard Oct. 1950 (ADW 21770) Wallaroo.

Sida leprosa var. *hederacea* (Dougl.) K. Schum. in Mart., Fl. Brasil 12/3 (1886) 342; I. Fry 15.12.1959 (ADW 21769) Riverton.

Trifolium cernuum Brot., Phyt. Lusit 1 (1816) 150; Black, Fl. S.A., ed. 2 (1948) 453.

This species has been recorded from the Adelaide Hills in addition to the south-east of the State.

THE COCCOIDEA (HOMOPTERA) NATURALIZED IN SOUTH AUSTRALIA: A SECOND ANNOTATED LIST

BY HELEN M. BROOKES

Summary

This paper lists nine species of scale insects, naturalized in South Australia, that have not previously been recorded as occurring in the State. All have been identified by the author since 1956. Of these, *Trionymus diminutus* (Leon), *Rhizoecus falcifer* Kunckel d'Herculais, *Phenucoccus graminosus* McKenzie and *Quadraspidiotus lenticularis* (Lind.) are reported from Australia for the first time. In addition, three species new to Australian records have been identified from material submitted from the other States.

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INTRODUCTION

Since an earlier record (Brookes, 1957) several species of scale insects (Coccoidea) that have become naturalized in South Australia, have been recognized. These include four that have not been reported previously from Australian records.

A complete synonymy for each species has not been attempted; it has been selected to give the following citations, if available: the original description; the first recorded occurrence in Australia; the synonyms used in the Australian literature and the currently accepted reference to the genus.

Specimens were examined after being treated by either of two methods: the first involved partial maceration in 10 per cent aqueous potassium hydroxide, staining with acid or basic fuchsin, and mounting in a synthetic neutral medium, such as "Sira"; the second, clearing in lacto-alcohol and mounting in Berlese's fluid.

Family PSEUDOCOCCIDAE

Maconellicoccus hirsutus (Green)

Phenacoccus hirsutus Green, 1908. Mem. Dep. Agric. India, **2** (2), p. 25. When recording type localities of this tropical species Green says "also occurs in Tasmania" (sic).

Pseudococcus hibisci Hall, 1921. Bull. Soc. ent. Égypt, **4**, p. 1.

Maconellicoccus hirsutus (Green), 1958. Ezzat, Y. M., 1958. Bull. Soc. ent. Égypte, **42**, pp. 377-383. In this paper the nomenclatorial status of the species has been clarified.

Hibiscus mealy bug.

Host-plants: On stems and leaves of *Gossypium* (cotton), and causing a bunching of new growth of leaves of *Citrus medica* var. *acida* (lime) at Kimberley Research Station, near Wyndham, Western Australia. This is the first record, apart from Green's reference to Tasmanian material, of this species for Australia.

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Phenacoccus graminosus McKenzie

Phenacoccus graminosus McKenzie, 1960. Hilgardia, 29 (15), p. 717.

Rye-grass mealy bug.

Host-plants: This species lives principally on members of the Gramineae, usually clustered along the sheathing leaf-bases and in the crown at ground level, but occasionally in colonies among the spikelets.

P. graminosus has been collected at the Waite Institute on *Medicago sativa* L. (lucerne), *Hordeum vulgare* L. (barley), and *Trifolium repens* L. (white clover) grown in pot-culture experiments in glasshouses, and on *Trifolium fragiferum* L. (strawberry clover) growing in the open in demonstration plots of various pasture plants, including grasses.

In the field, it has been recorded on barley at Brinkworth, Kybunga and Port Noarlunga; on *Triticum aestivum* L. (wheat) at Redbanks; on *Phalaris tuberosa* L. (phalaris) at Auburn. It is considered of no economic importance. Specimens collected from some of the localities shown above have been designated by McKenzie (1960) as metatypes. This is the first record of *Phenacoccus graminosus* for Australia.

Rhizoecus falcifer Künckel d'Herculais

Rhizoecus falcifer Künckel, 1878. Ann. Soc. ent. France, (5) 8, p. 164.

Ripersia terrestris Newstead, 1895. Ent. Mon. Mag., 31, pp. 213-236.

Rhizoecus terrestris (Newstead). Fernald, 1903. Coccidae of the World, p. 114.

Rhizoecus terrestris. Anon, 1952. Insect Pest Survey (Dep. Agric., N.S.W.). Heavily infesting plots of parsnips in the metropolitan area of New South Wales.

No common name.

Host-plants: On the roots of *Salvia, Petunia, Schotia, Polygonum* and other cultivated plants in home gardens in Adelaide. If present in large numbers this mealy bug may kill the host-plant.

Ripersiella rumicis (Maskell)

Ripersia rumicis Maskell, 1891. Trans. N.Z. Inst., 24, pp. 1-64.

Ripersiella rumicus (Maskell). Cockerell, T. D. A., 1901. Proc. Biol. Soc. Wash., 14, p. 165; Morrison and Morrison, 1922. Proc. U.S. Nat. Mus., 60 (12), p. 54.

Ripersiella Tinsley, 1899. Hambledon, E. J., 1946. Rev. Ent., Rio de J., 17, p. 59.

No common name.

Host-plants: Heavily infesting roots of grasses in a lawn, Adelaide. This occurrence represents the first record for Australia.

Trionymus diminutus (Leonardi)

Dactylopius calceolariae Maskell, 1879. Trans. N.Z. Inst., 11, pp. 187-228 (as a misidentification).

Pseudococcus diminutus Leonardi. Leonardi, G., 1918. Bull. Lab. Zool. Sc. Agr. Portici, 12, p. 198.

Pseudococcus (*calceolariae* Maskell?). Jarvis, E., 1916. Div. Ent. Sug. Exp. Sta. Qd., Bull. 3, p. 32. A mealy bug "thought to be identical with *P. calceolariae* of Maskell" extremely prolific on sugar-cane in Queensland.

Trionymus diminutus (Leonardi). Morrison, H., 1925. J. agric. Res., 31 (5), pp. 485-500. After examining specimens labelled "*Dactylopius calceolariae*" from the Maskell collection Morrison re-assigned them to several other genera, including *Trionymus*; the specimens collected on *Phormium tenax* Forst. (New Zealand flax) he identified as *Trionymus diminutus* (Leonardi).

Trionymus Bergroth, 1899. Ferris, C. F., 1950. Atlas of the Scale Insects of North America, 5, p. 251.

No common name.

Host-plant: On leaves of *Phormium tenax* Forst. (New Zealand flax) growing in a home garden in Adelaide. This is the first record of this species in Australia.

Family COCCIDAE

Coccus elongatus (Signoret)

Lecanium elongatum Signoret. Signoret, V., 1873. Soc. Ent. de France Ann. (5) 3, p. 404.

Lecanium longulum. Douglas, J. W., 1887. Ent. Mon. Mag., 24, p. 97.

Lecanium ficus Maskell, 1897. Ent. Mon. Mag., 33, p. 243.

Coccus elongatus (Signoret). Sanders, J. G., 1909. J. econ. Ent., 2, p. 438.

Lecanium longulum Douglas. Froggatt, W. W., 1921. Agric. Gaz. N.S.W., 26 (7), pp. 603-615. On *Anona reticulata* (custard apple) at Darwin.

Long, soft scale.

Host-plant: On *Ceratonia siliqua* L. (carob tree) growing as a hedge in a home garden in Adelaide. This is the only occurrence observed by the author.

Pulvinaria hydrangeae Steinweden

Coccus floccifera Westwood, 1870. Gard. Chron., p. 308 (misidentification).

Pulvinaria floccifera (Westwood). Essig, E. O., 1916. Calif. State Comm. Hort. Monthly Bull., 5, pp. 112-197.

Pulvinaria floccifera (Westwood). Froggatt, W. W., 1915. Agric. Gaz. N.S.W., 26, pp. 411-423.

Pulvinaria hydrangeae Steinweden. Steinweden, J. B., 1946. Microentomology, 11 (1), pp. 1-28. A critical study of North American species of *Pulvinaria* including *P. hydrangeae* n.sp.

Hydrangea "mealy bug".

Host-plant: A common pest on stems and leaves of *Hydrangea hortensis* in suburban gardens in Sydney.

Froggatt (1915) recorded *Pulvinaria floccifera* (Westwood) as being a very common insect on many garden shrubs, such as *Camellia*, *Euonymus*, etc., in Sydney.

Steinweden (1946) in describing the species *P. hydrangeae* stated that this insect has frequently been misidentified in the past as *P. floccifera* (Westwood), from which it is clearly distinct. Since none of the specimens identified by Froggatt is now available for re-examination, it is possible that they too were misidentified. Specimens submitted for identification by the Department of Agriculture of New South Wales were identified in 1960 by the author as *P. hydrangeae*.

Family DIASPIDIDAE

Hemiberlesia rapax (Comstock)

Aspidiotus camelliae Signoret (non Boisd.). Signoret, V., 1869. Soc. Ent. de France, Ann. (4), 9, p. 117.

Aspidiotus rapax Comstock. Comstock, J. H., 1881. Report of the Entomologist for 1880. In: U.S. Dep. Agr., Comm. Agr. Rept., pp. 235-373.

Aspidiotus camelliae Boisd. Maskell, W. M., 1894. Trans. N.Z. Inst., 27, pp. 35-75. On *Melaleuca nodosa* in Sydney.

Aspidiotus rapax Comstock. Fuller, C., 1899. Trans. ent. Soc. Lond., 1899, pt. 4, pp. 435-473. "This is a very common species, and occurs upon a large variety of indigenous plants."

Hemiberlesia Cockerell. Ferris, G. F., 1938. Atlas of the Scale Insects of North America. S11-232.

The greedy scale.

Host-plants: This cosmopolitan species was found for the first time in South Australia at Mypolonga on twigs of *Malus sylvestris* Mill. (apple) and *P. communis* L. (pear). It is of no economic importance.

Pinnaspis aspidistrae (Signoret)

Chionaspis aspidistrae Signoret. Signoret, V., 1869. Soc. Ent. de France, Ann. (4), 9, p. 443.

Chionaspis brasiliensis Signoret. Maskell, W. M., 1893. Trans. N.Z. Inst. 25, pp. 201-252. On *Orchid* sp., Tweed River, N.S.W. Maskell, W. M., 1896. Ent. Month. Mag., 32, pp. 223-226. Maskell considered that *C. brasiliensis* was a variety of *C. aspidistrae*.

Hemichionaspis aspidistrae (Signoret). Cooley, R. A., 1897. Mass. Agr. Exp. Stn. Spec. Bull. [not seen].

Pinnaspis aspidistrae (Signoret). Kuwana, I., 1926. The Diaspine Coccidae of Japan, IV. Dept. Finance, Imp. Plant. Quar. Serv. Tech. Bull., 4, p. 36.

Pinnaspis Cockerell. Ferris, G. F., 1937. Atlas of the Scale Insects of North America, S1-96.

Fern scale.

Host-plants: On stem and leaves of *Adiantum* in Adelaide. This represents the first record of this species for South Australia.

Pinnaspis stracheni (Cooley)

Hemichionaspis minor stracheni Cooley. Cooley, R. A., Mass Ag. Exp. Sta., Spec. Bull., p. 54 [not seen].

Hemichionaspis minor Maskell. Hill, G. F., 1915. Bull. Northern Territory of Australia No. 13 of the Dep. External Affairs. On *Agave sisalena* Perrine (sisal hemp).

Pinnaspis Cockerell. Ferris, G. F., and Rao, V. P., 1947. The Genus *Pinnaspis* Cockerell (Homoptera : Coccoidea : Diaspididae). Microentomology, 12 (2), pp. 25-58.

Hibiscus snow-scale.

On the stems of *Passiflora edulis* Sims (passion fruit) at Kimberley Research Station, Western Australia.

Quadraspidiotus lenticularis (Lindinger)

Aspidiotus lenticularis Lindinger. Lindinger, L., 1912. *Die Schildläuse (Coccidae) Europas, Nordafrikas und Vorderasiens, einschliesslich der Azoren, der Kanaren und Madeiras.* Stuttgart, Ulmen., pp. 149 and 230.

Targionidea lenticularis (Lindinger). MacGillivray, A. D., 1920. *The Coccidae*, p. 449, Scarab Co., Urbana, Illinois.

Aspidiotus lenticularis var. *marocanus* Green. Green, E. E., 1928. Ann. Mag. Nat. Hist., (10) 1, pp. 374-376. On a racial form of *Aspidiotus lenticularis* Lindgr. with some remarks upon the Leonardi classification of the Aspidioti.

Quadraspidiotus lenticularis (Lindinger). Balachowsky, A., 1950. Les Cochenilles de France, d'Europe, du Nord de l'Afrique et du Bassin méditerranéen, 5. Aspidiotini. Actualités Sci. et Indus. Ent. Appl., 1087, p. 433.

No common name.

Quadraspidiotus lenticularis was identified for the first time in Australia in November, 1958. It occurred as a light infestation on young wood and also on older, lichen-encrusted wood on *Pyrus communis* L. (pear) and *Prunus domesticus* L. (plum) at Mypolonga, South Australia. At about the same time this species was found ovipositing on young wood of plum at Paracombe in the Adelaide Hills, and on apple and *Crataegus* (hawthorn) at Coonawarra in the south-east of the State. *Q. lenticularis* was found on the older wood of *Olea europaea* L. (olive) at the Waite Institute. This species is of no economic importance.

Quadraspidiotus perniciosus (Comstock)

Aspidiotus perniciosus Comstock. Comstock, J. H., 1880. Rep. U.S. Dep. Agric., 1880, p. 304 (1801).

Aspidiotus perniciosus Comstock. Olliff, A. S., 1892. Agric. Gaz. N.S.W., 1892, p. 698. On pear trees at Maitland, N.S.W.

?*Aonidia fusca* Maskell. Maskell, W. M., 1894. Trans. and Proc. N.Z. Inst., 27, pp. 35-75. On *Persica vulgaris* (peach) at Bulga, N.S.W.

Quadraspidiotus McGillivray. Balachowsky, A., 1950. Les Cochenilles de France, d'Europe, du Nord de l'Afrique et du Bassin méditerranéen, 5. Aspidiotini. Actualités Sci. et Indus. Ent. Appl., 1087, pp. 397-488.

Quadraspidiotus perniciosus (Comstock). Kilpatrick, D. T., 1959. Jour. Agric. S. Aust., 63 (5), pp. 208-210.

San José scale.

Host-plants: *Pyrus communis* L. (pear), *Malus sylvestris* Mill (apple), *Prunus persica* (L.) Batsch., and *P. amygdalus* Batsch. (almond).

Quadraspidiotus perniciosus was recognized for the first time in South Australia in October, 1958, when it was found on a few peach trees growing in an irrigated citrus orchard at Mypolonga. This occurrence involved a light infestation of young laterals and a heavy infestation of older branches. Subsequently, almond, apple and pear trees in thirteen additional orchards were found to be infested. Following an intensive eradication campaign, two small infestations recurred in 1961 and 1962.

Small, isolated outbreaks of San José scale were discovered in 1960 at Mount Gambier in mature apple trees in three home gardens, and at Aldgate in the Adelaide Hills, where a few old apple trees in a commercial nursery were very lightly infested.

In February, 1961, an extensive outbreak was found on mature pear trees in the irrigated orchards of Renmark, about thirty properties being involved. Since then it has been identified on apple, plum, peach and walnut.

Smaller outbreaks of San José scale were found on pear at Waikerie in 1961 and on peach at Lyrup the following year. At Waikerie the infestation which was traced from imported nursery stock has spread to many trees in a newly planted area.

ACKNOWLEDGMENTS

The author is greatly indebted to Mr. H. L. McKenzie, University of California, Davis, California, for identifications of the mealy bugs *Phenacoccus graminosus*, *Rhizoecus falcifer* and *Ripersiella rumicis*, and to Dr. D. J. Williams, of the British Museum, for identification of *Coccus elongatus*. She would also like to acknowledge her appreciation of discussions with Mr. D. T. Kilpatrick and other officers of the South Australian Department of Agriculture, on records and field observations on some of the scale insects.

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ALBIAN AMMONITES FROM FOSSIL CREEK, OODNADATTA, SOUTH AUSTRALIA

BY R. A. REYMENT

Summary

Fifteen species of ammonites, of which one is new, are recorded from the South Australian part of the Albian sequence in the Great Artesian Basin at Fossil Creek, 30 miles west-north-west of Oodnadatta. Thirteen of the species are *heteromorphs*. They are assigned to *Labeceras s.* str., L. (*Appurdiceras*) and to *Myloceras*. The non-heteromorphic species belong to *Falciferella*. Connections with New Guinea are confirmed and relationships with the Albian of Portuguese East Africa pointed out. The descriptive presentation is supported by some simple bivariate biometric analyses. Remarks on the nekroplanktonic dispersal of heteromorphic ammonites are made. The currently accepted correlation of the beds containing heteromorphs on the international zonal scale is confirmed.

ALBIAN AMMONITES FROM FOSSIL CREEK, OODNADATTA, SOUTH AUSTRALIA

by R. A. Reyment*

[Read 9 April 1964]

SUMMARY

Fifteen species of ammonites, of which one is new, are recorded from the South Australian part of the Albian sequence in the Great Artesian Basin at Fossil Creek, 30 miles west-north-west of Oodnadatta. Thirteen of the species are heteromorphs. They are assigned to *Labeceras* s. str., *L.* (*Appurdiceras*) and to *Myloceras*. The non-heteromorphic species belong to *Falciferella*. Connections with New Guinea are confirmed and relationships with the Albian of Portuguese East Africa pointed out. The descriptive presentation is supported by some simple bivariate biometric analyses. Remarks on the nekroplanktonic dispersal of heteromorphic ammonites are made. The currently accepted correlation of the beds containing heteromorphs on the international zonal scale is confirmed.

INTRODUCTION

It is some 60 years since the first Albian ammonites were described from South Australia by Etheridge (1905). Later work on the Queensland extensions of the Great Artesian Basin disclosed the presence of a multitude of forms, largely heteromorphic; these could be tied up with a few earlier discoveries, including a small but important collection from New Guinea. The occurrence of certain species of the genera *Prohysteroceras* and *Mortoniceras* permitted incorporation of the Australian occurrences in the international zonal scheme. This was indeed fortunate, as it had not been possible to base correlation on the unique uncoiled forms, at least not at that time.

There seems to have been a lull in interest in the South Australian Lower Cretaceous, until the exploration for oil in the Great Artesian Basin once again provided the necessary incentive to further work. Up to the early fifties the South Australian ammonite faunas were badly known and it might have been thought strange that there was so little agreement with the sequence in Queensland. However, it is now possible to demonstrate complete faunal agreement between the two areas.

The material described and figured in the present paper has been deposited in the collections of the Geological Survey of South Australia, Adelaide.

LOCATION OF THE AREA

The area lies at about the intersection of 27° south latitude and 134° east longitude. The fossils were obtained from exposures in the Fossil or Wooldridge Creek, which lies roughly 30 miles west-north-west of Oodnadatta.

The ammonites were collected by the following people: Dr. R. O. Brunnschweiler (1955), Dr. H. Wopfner, Mr. A. Hess and Mr. D. Scott (1956), as well as officers of the Geological Survey of South Australia, among them Mr. J. Johnson.

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DESCRIPTIVE SECTION

Family LABECERATIDAE Spath, 1925

(Syn. *Aleteceratidae*, Whitehouse (1925), *Myloceratidae*, Spath (1939))

The encompassment given by Wright (1956) in the Treatise of Invertebrate Paleontology is here observed. The family is then considered to comprise heteromorphs which are at first coiled in an open spiral, but later whorls may be in contact, the shell terminating in a hook. The aperture is provided with weak to moderately prominent, rounded lappets. The whorl section is moderately to fairly strongly compressed. All genera have fine, branching ribs that cross the venter. Umbilical or ventrolateral tubercles, or both, occur. The suture consists of bifid saddles and smallish bifid lobes.

Genus LABECERAS Spath, 1925

Type Species.—*Labeceras bryani* Whitehouse, 1926.

Description.—Rather small shells with an open spire of a few whorls, followed by a curved shaft and a final hook, with the aperture usually facing inward. The ribs are fine, slightly sinuous and lean forwards; occasionally they bifurcate. Umbilical tubercles may occur on the shaft and hook, as also ventrolateral tubercles.

Age.—Albian.

Subgenus LABECERAS

Remarks.—*L.* (*Labeceras*) is considered to comprise forms lacking ventrolateral tubercles.

Labeceras (Labeceras) laqueum (Etheridge)

Pl. 1, Fig. 1

1892 *Hamites* (or *Hamulina*?) *laqueus*, Etheridge, p. 496, pl. 42, figs. 14, 15.

1909 *Crioceras taylori* (in part), Etheridge, pl. 49, fig. 4.

1926 *Labeceras laqueus* (Etheridge fil.), Whitehouse, p. 227.

1926 *Labeceras papulatum*, Whitehouse, p. 228, pl. 36, fig. 4; pl. 39, figs. 3a-b.

Description.—This species is characterized by the dense ribbing and its tendency, on the body chamber, to weaken, become less dense and to develop tubercles on the umbilicus. The whorl section is inflated oval, the venter is smoothly rounded. The last 4·5 cm up to the last suture have 33 ribs, counted on the venter (a rib density of $\epsilon = 7 \cdot 3$/cm).

Remarks.—There are genuine differences between this species and *L.* (*L.*) *bryani* Whitehouse with respect to the ribbing. The specimen studied has part of the altered shell material preserved on the umbilical area — here umbilical tubercles occur, whereas on the other (figured) side, on which the shell is missing, tubercles are only suggested. It would therefore seem that the presence or absence of tubercles on the body chamber is largely a matter of preservation, although infraspecific variation certainly plays a part.

Material.—One specimen, M 1439.

Labeceras (Labeceras) crassum Spath.

Pl. 1, Fig. 2

1892 *Crioceras* sp. Etheridge, p. 502, pl. 33, fig. 4.
1909 *Crioceras laqueus*, Etheridge, pl. 49, figs. 7 and 9 (not fig. 8).
1925 *Labeceras plasticum* sp. nov. var. *crassa*, Spath, p. 191, pl. 34, figs. 5-7.
1926 *Labeceras trifidum*, Whitehouse, p. 228.
?1958 *Labeceras trifidum* Whitehouse, Glaessner, p. 218, pl. 26, figs. 4a-c.

Description.—None of the specimens available is complete. The species is characterised by clavate umbilical tubercles on the body chamber, from which the ribs proceed in bundles of twos and threes. Two fragments may be from the septate part of the shell; these are also provided with umbilical tubercles, but these lie further down on the dorsolateral shoulders. The whorl sections of these two smaller fragments are subquadrate, whereas that of the body chamber is almost round.

Material.—Three specimens, M 1440, M 1441, M 1442.

Remarks.—Whitehouse (1926, p. 229) thought that the septate part of the shell of this species might not be tuberculate. The evidence of the present material, although not absolutely conclusive, suggests that the contrary may be true. It is still not possible to give a picture of the suture line; however, the fragment of the body chamber also has the last septal surface preserved. From this it may be inferred that the central lobe is narrow, the external saddle very broad, the first lateral saddle is narrow, but not as narrow as the ventral lobe, and the first lateral saddle is also broad. This accords well with the general form of the labeceratid suture. The ribbing of the form referred here by Glaessner (1958) appears coarser and the ridges formed by the saddles on the septal surface are wider than our material. Nevertheless, the original figures of Etheridge (1909, p. 49, figs. 7 and 9) indicate variability with respect to costation. The East African material figured by Spath (1925) agrees closely with the Australian.

Biometric Analysis.—It has already been observed that there appears to be variation with respect to the ontogeny of the whorl section of *L. crassum*. Measurements on maximum whorl height and whorl breadth were made and these

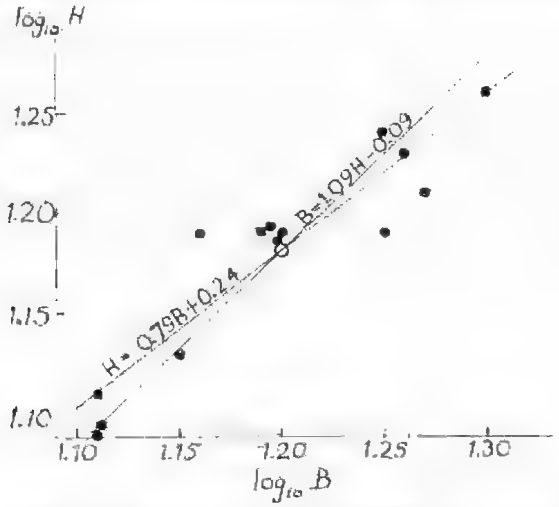

Fig. 1. Covariation in whorl breadth and whorl height of *Labeceras crassum* Spath.

were then subjected to regression analysis. It is worth mentioning that the whorl dimensions do not increase regularly and there are frequent slight diminutions shown by the largest specimen. In text Fig. 1 a plot of $\log_{10}$ (breadth) against $\log_{10}$ (height) is shown together with the regression lines of the data. The logarithmic transformation is necessary as the measurements are non-linear, thus indicating differential growth. The correlation coefficient between the transformed variables is 0·926, which is highly significant.

Labeceras (Labeceras) compressum Whitehouse

Pl. 1, Figs. 3-4

1926 *Labeceras compressum*, Whitehouse, p. 228, pl. 36, fig. 5; pl. 39, figs. 5a-b.

Description.—This species is characterised by the compressed whorl section, the numerous, thin ribs, which lean slightly forwards on the shaft of the body chamber, but straighten up on the hook thereof, and the rather tight bend of the crook. The ribs may bifurcate at the dorsolateral margin or in the outer third of the flanks. The rib density of the body chamber studied is $\epsilon = 7 \cdot 7$/cm. The lappets run from the dorsolateral shoulder to the beginning of the outer third of the flanks. The suture line has a relatively broad external lobe, a broad external saddle with a rather well developed median sublobe, a broad first lateral lobe and a first lateral saddle of about the same width as the first lateral lobe.

Material.—Two specimens. M 1415, M 1443.

Remarks.—Unfortunately, the photograph of the holotype supplied by Whitehouse (1926, p. 29, fig. 5a) is indistinct so that the details of the ribbing cannot be made out. However, the distinctive development of the lappets is clear, as also the compressed whorl section.

Labeceras (Labeceras) oodnadattaensis sp. nov.

Pl. 1, Fig. 5

Holotype.—A complete specimen, M 1444 and M 1445, figured in Pl. 1, Fig. 5.

Diagnosis.—A species of *L.* (*Labeceras*) with the following characteristics: Whorl section strongly compressed, sigmoidal ribbing, simple and bifurcated, leaning slightly forward; aperture not turned in towards shaft.

Description.—The coiling is ancyloceratid, the tip of the shell lying only about 1 mm. from the shaft. The body chamber takes up just less than one-half of the total shell length (= 0·47 of total length). The shell heightens rapidly (see text Fig. 2) during the first part of its length and thereafter the increase is less rapid. Height increase ceases around the hook of the shell, where periods of decrease in height also occur. The rib density is $\epsilon = 6 \cdot 5$/cm. The ribs are slightly flexed; they widen slightly outwards. Most ribs bifurcate either at the dorsolateral margin or at the outer third of the flank, but simple ribs also occur. The aperture is not directed towards the shaft, but faces instead outwards. The suture line is typical of *Labeceras*. Maximum length = 62 mm.

Material.—One complete specimen. This specimen is in two parts, the one an almost complete mould, lacking the first part of the shell, the other partly the impression of the shell, but bearing the first part of the shell.

Remarks.—The new species is most closely related to *L.* (*L.*) *compressum* Whitehouse, but differs in the following important aspects. The ribbing of

L. (*L.*) *oodnadattaensis* sp. nov. is somewhat coarser, the ribs are more sigmoidal and have a tendency to become club-shaped, the shell is smaller, and the aperture does not face inwards. The specimen is figured in its nekroplanktonic floating position in Pl. 1, Fig. 5.

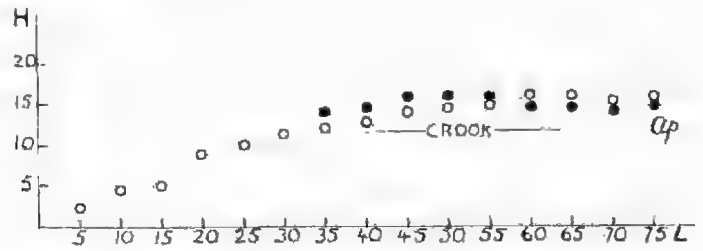

Fig. 2. Ontogeny of whorl height shown for 5 mm intervals of length for *Labeceras* (*Labeceras*) *oodnadattaensis* sp. nov. (open circles). The development of the body chamber of *L.* (*L.*) *compressum* Whitehouse (filled dots) is shown for comparison. Ap denotes the end of the body chamber. Measurements in mm.

Subgenus Appurdiceras Whitehouse, 1926

Type Species.—*Ancyloceras cordycepoides* Etheridge, 1905.

Description.—Ancyloceratidally coiled whorls with rounded subquadrate to rounded subrectangular whorls. The ribs are mainly simple but occasional bifurcation may occur. Some ribs bear ventrolateral tubercles.

Labeceras (Appurdiceras) cordycepoides (Etheridge)

Pl. 1, Figs. 6 and 7

1905 *Ancyloceras cordycepoides*, Etheridge, p. 14, pl. 1, figs. 3-5; pl. 2, fig. 4(?).

1926 *Appurdiceras cordycepoides* (Etheridge fil.), Whitehouse, p. 230.

Description.—This species is characterised by its subquadrate to circular whorl section, and the stout, only occasionally bifurcated ribs, which lean forwards, about every fifth of which is provided with a strong, spinate ventrolateral tubercle. The ribbing appears to become denser on the body chamber.

Material.—Two specimens, M 1446, M 1447.

Genus Myloceras Spath, 1925

(Syn. *Aleteceras*, Whitehouse, 1926, *Flindersites*, Whitehouse, 1926).

Type Species.—*Crioceras ammonoides* Etheridge, 1909.

Description.—Shells larger than *Labeceras* s. l. with the spire either crioceratid or ancyloceratid and more closely coiled than *Labeceras*; at some stage of development some whorls are in contact. The aperture does not face inward to the same degree as in most *Labeceras*. The whorl section varies from strongly compressed to strongly depressed. Ventrolateral tubercles may occur.

Remarks.—The differences considered by Whitehouse (1926) to be of generic importance in separating *Myloceras, Aleteceras, and Flindersites* are so slight as to be hardly of specific importance. In the present connection, therefore, the procedure adopted by Wright (1957) is adhered to and all are grouped under *Myloceras* Spath.

Myloceras nautiloides (Etheridge)

Pl. 2, Figs. 1, 2; Text-Fig. 3

1909 *Criceras nautiloides*, Etheridge, p. 148, pl. 45, text-fig. 8.
1926 *Aleteceras nautiloides* (Etheridge fil.), Whitehouse, p. 233.

Description.—The whorls partly embrace. The body chamber has a depressed whorl section, the early septate part of the shell has a square whorl section, this becoming depressed while the shell is still septate. The septate whorls bear occasional ventrolateral tubercles (on about every sixth or seventh rib). The later septate part lacks tubercles. There are both simple and bifurcated ribs, simple ribs being most common on the body chamber. The shell wall is almost 3 mm. in thickness. A complete final suture is shown in Text Fig. 3.

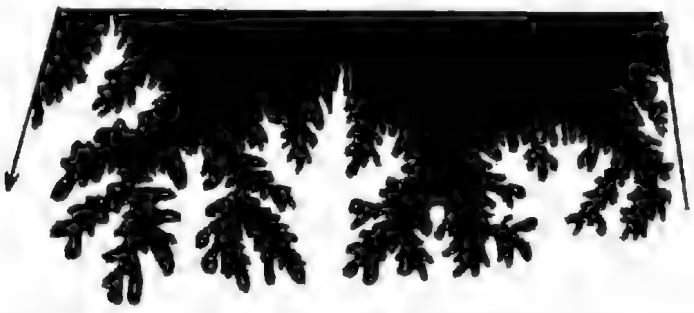

Fig. 3. Suture line of *Myloceras nautiloides* (Etheridge) M 1449 x 1.

Material.—Three specimens. M 1448, M 1449, M 1450 (3 pieces).

Remarks.—The material here described agrees with the specimen from Aramac, Queensland, very well. The depressed whorl section of the body chamber serves to distinguish the species well from other *Myloceras*.

Biometric Analysis.—The ontogeny of the whorl section was studied by plotting breadth of whorl against height of whorl (Text Fig. 4). There is obvious non-linearity in the data and it may be concluded that the growth rates for breadth and height change differentially with respect to each other. There is not sufficient material to permit a regression analysis.

Myloceras plectoides (Etheridge)

Pl. 2, Fig. 3; Pl. 5, Figs. 1, 2

1909 *Criceras plectoides*, Etheridge, p. 152, pl. 33, fig. 2; pl. 46, fig. 1; pl. 47, figs. 1-4.
1926 *Aleteceras plectoides* (Etheridge fil.), Whitehouse, pl. 40, figs. 2a-c.
1926 *Aleteceras tardicostatum*, Whitehouse, p. 232, pl. 40, figs. 1a-c.

Description.—The whorl section of this species begins by being rather compressed but by about a diameter of 45 mm. it is almost subquadrate. Judging from the material at hand there also appears to be an ornamental change during the ontogeny in that the early part of the shell has slightly flexed ribs, these tending to become straighter, sharper, and slightly reclined at more advanced growth stages. There seems to be some variability concerning the point at which the ventrolateral tuberculation becomes apparent. The tubercles of the figured specimen in Pl. 2, Fig. 3, are feeble.

Material.—Mostly fragments. Nine specimens. M 1419, M 1451, M 1452, M 1453, M 1454, M 1455, M 1456, M1457.

Remarks.—Owing to the fact that there would appear to be a fair degree of variation in the strength of the ventrolateral tubercles of this species, it may not always be easy to pick it out. It seems likely that Whitehouse based his new species *tardicostatum* on the inner whorls of *plectoides*.

Myloceras baccatum (Whitehouse)

Pl. 2, Fig. 4

1909 *Crioceras flindersi* Etheridge (in part), pl. 36, fig. 2; pl. 41, fig. 3; pl. 42, fig. 2; pl. 44, fig 2.

1926 *Flindersites baccatus*, Whitehouse, p. 236.

Description.—The shell is large. The ribs are spaced, fairly strong and slightly flexed. There are moderately prominent, rounded ventrolateral tubercles. The ribs occasionally bifurcate at the dorsolateral margin, or unite at a ventrolateral tubercle. Two ribs proceed from each ventrolateral tubercle.

Material.—One specimen, M 1458.

Remarks.—In general appearance this species is not unlike *M. intermedium* (Whitehouse), but the specimen available is insufficient to permit accurate analysis. The figured specimen, which is crushed, shows a suite of sutures.

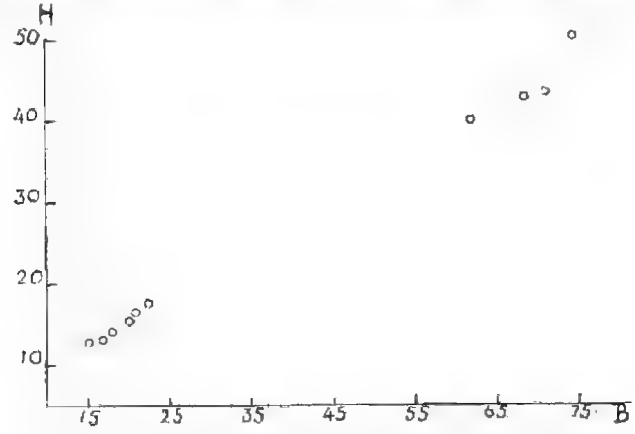

Fig. 4. Covariation in whorl breadth and whorl height for *Myloceras nautiloides* (Etheridge).

Myloceras intermedium (Whitehouse)

Pl. 1, Fig. 8

1909 *Crioceras flindersi* Etheridge (in part), pl. 40, figs. 1, 2.

1926 *Flindersites intermedius*, Whitehouse, p. 237.

Description.—This species has an almost rectangular whorl section, the venter is broad and arched. The ribs are thin, sharp and slightly flexed and lean strongly forwards. The ventrolateral tubercles are moderately strong and clavate. The ribs appear to be single on the flanks, but divide at the ventrolateral tubercles. On the dorsum the ribs sweep strongly forwards.

Material.—One specimen. M 1459.

Myloceras axonoides (Etheridge)

Pl. 3, Fig. 1

1909 *Crioceras axonoides*, Etheridge, p. 150, pl. 32, fig. 4; pl. 44, fig. 1.

1925 *Myloceras amaltheia*, Spath, p. 194, pl. 34, fig. 2.

1926 *Aleteceras*(?) *axonoides* (Etheridge fil.), p. 233.

Description.—This species is typified by the stout tuberculation of the septate whorls (the present material does not aid in clearing up the problem of whether the body chamber of the species really is non-tuberculate (cf. Spath, 1925, p. 194)), and the sharp nature of the costation, which leans slightly forwards.

Material.—A crushed fragment. M 1460.

Remarks.—Etheridge (1909, p. 151) definitely states the species to retain its tubercles throughout all growth stages, but this is not apparent from the figure. Spath distinguished his species *M. amaltheia* from *M. axonoides* on the basis of the non-tuberculation of the outer whorls of the latter and the "different" nature of the inner whorls of the two species. As far as is apparent from the illustration and our specimen there do not appear to be any significant differences. The specimen here figured agrees closely with the inner whorls of the specimen figured by Etheridge (1909, pl. 44, fig. 1).

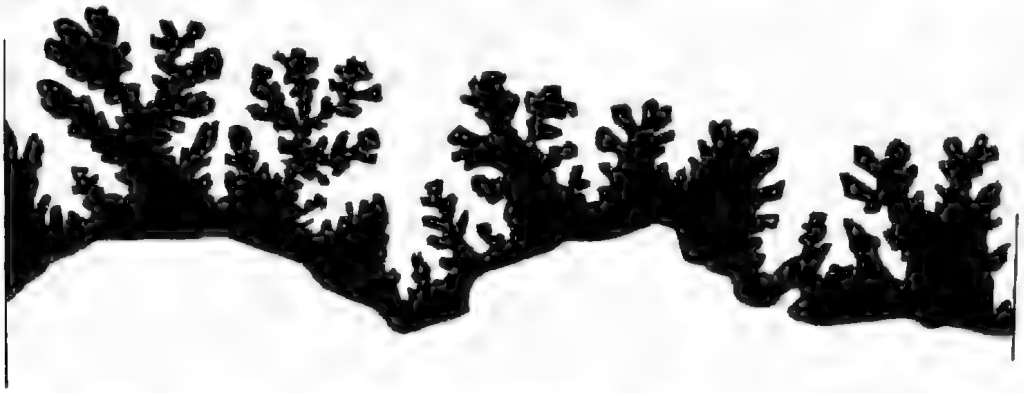

Fig. 5. Suture line of a large fragment of *Myloceras flindersi* (McCoy). M 1468. x1.

Myloceras flindersi (McCoy)

Pl. 3, Figs. 2, 3, Text Figs. 5, 6

1867 *Ancyloceras flindersi*, McCoy, p. 356.

1909 *Crioceras flindersi* Etheridge (in part), pl. 39, figs. 1, 2, 3.

1926 *Flindersites flindersi*, Whitehouse, p. 237.

1926 *Flindersites* aff. *flindersi* (McCoy), Whitehouse, p. 237.

Description.—This very large species is characterised by the clavate ventrolateral tubercle, which seem to disappear on the last parts of the body chambers of very large specimens and the sharp, though low, ribs, which may be almost straight to slightly flexed. After one turn the whorls are in contact. At a diameter of 19 mm. the ornament consists of single ribs, every fourth of which is provided with a spinate tubercle. Here the rib density is roughly $\epsilon = 8/\text{cm}$. A specimen with a radius of 46 mm. is somewhat more compressed than might be expected, but this may be a normal ontogenetic feature; it appears to have been slightly crushed. At this stage each rib bears an almost clavate tubercle and rib bifurcation is of frequent occurrence. Larger fragments are more

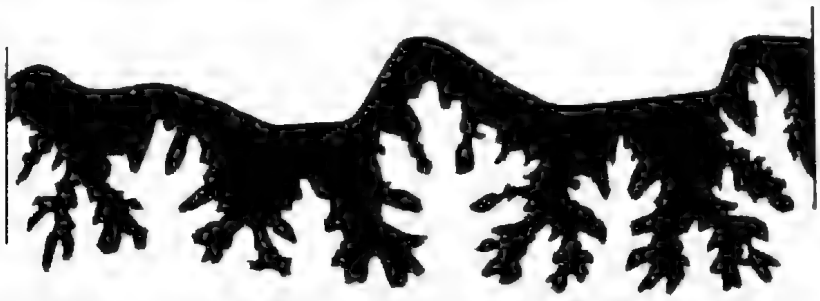

Fig. 6. Suture line of a fragment of *Myloceras* aff. *flindersi* (McCoy). M 1467, x0·75.

quadrate in whorl section. A large fragment of a septate specimen is similarly ornamented, but the whorl section is too depressed for it to be placed with *flindersi*. The suture of this specimen is figured in Text Fig. 6.

Material.—13 specimens. M 1461, M 1462, M 1463, M 1464, M 1465, M 1466, M 1467(?), M 1468, M 1469, M 1470.

Remarks.—The foregoing description is based on fragments and is therefore to a certain extent subjective. To date no complete specimen has been found.

Biometric Analysis.—Perusal of the plot of the data on whorl height and breadth in Text Fig. 7 indicates some departure from linearity, but this is not of the order as to necessitate the logarithmic transformation. The figure also indicates further support for the identifications of the fragments here made, as deviating specimens would show up by falling outside the path of ontogenetic development.

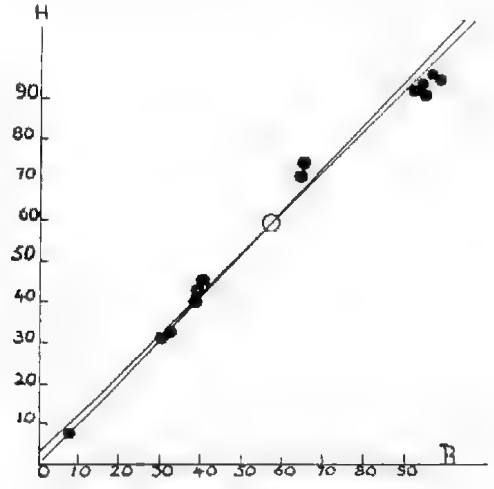

Fig. 7. Covariation of whorl height and whorl breadth for *Myloceras flindersi* (McCoy) with the regression lines. Measurements in mm.

The regression equations are:

$$B = 1{\cdot}02H - 0{\cdot}03$$
$$H = 0{\cdot}97B + 0{\cdot}04,$$

and the correlation coefficient is $r = 0{\cdot}993$, which is highly significant. As shown on the diagram, the regression lines almost coincide.

Myloceras ammonoides (Etheridge)

1909 *Crioceras ammonoides*, Etheridge, p. 502, pl. 30, figs. 8, 9.

1926 *Myloceras ammonoides* (Etheridge fil.), Whitehouse, p. 234, pl. 41, figs. 2a-b.

1926 *Myloceras orbiculus*, Whitehouse, p. 235, pl. 41, figs. 1a-b.

Material.—Two specimens, M 1471, 1472.

Remarks.—The two fragments referred here differ from the closely similar *M. davidi* in their whorl section. This is illustrated graphically in Text Fig. 8, in which the development of length and height of whorl section are compared for the two forms. Comparison with the figures published by Etheridge (1909) and Whitehouse (1926), and the accompanying descriptions, fails to bring forth criteria of sufficient importance as to warrant specific separation of *ammonoides* and *orbiculum*. Thus, both are reported to be compressed, to be more or less ovoid in section, to be densely ribbed with flexed costae that are straight on the venter; only occasional ribs bear tubercles, and the ribs do not bifurcate at the tubercles.

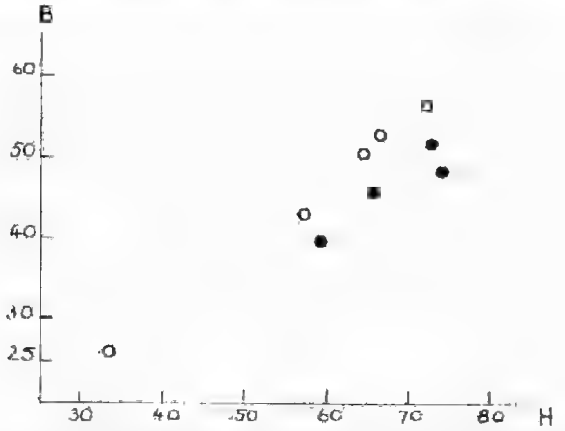

Fig. 8. Development of the whorl section of *Myloceras ammonoides* (Etheridge) and *M. davidi* Whitehouse. The filled dots indicate *ammonoides* and the open dots *davidi*. Measurements in mm.

Myloceras davidi Whitehouse

Pl. 3, fig. 4; pl. 4, figs. 1-4; pl. 5, figs. 3, 4

1909 *Crioceras* sp., Etheridge, p. 144, pl. 38, figs. 1, 2.

1926 *Myloceras davidi*, Whitehouse, p. 235, pl. 37, figs. 2a-c.

1958 *Myloceras davidi* Whitehouse, Glaessner, p. 217, pl. 26, figs. 2-3.

Description.—This species is characterised by the whorl section, compressed and broadest at the dorsolateral shoulders, the numerous thin, sharp, flexed costae, provided with small spinate ventrolateral tubercles and the initial coiling. Many ribs bifurcate at about the middle of the flanks and join up again at the ventrolateral tubercles (Pl. 4, Fig. 3) or two ribs may unite at a tubercle. The ribs swing forwards on the dorsum. On rounding the bend the whorl section becomes more quadrate but thereafter reverts to the usual compressed form. Suture shown in Pl. 4, Fig. 2.

Material.—19 fragments. M 1417, M 1420, M 1473, M 1474, M 1475, M 1476, M 1477, M 1478, M 1479, M 1480, M 1481, M 1482, M 1483, M 1484, M 1485, M 1486, M 1487.

Remarks.—This species is the most richly represented one in the collection. Unfortunately, very few of the fragments permitted measurements. *M. davidi* and *M. ammonoides* are not easy to hold apart, particularly in crushed specimens, as both are compressed and have much the same type of ornament. Moreover, one of the characteristics considered specific for *M. ammonoides*, namely, the bundling of ribs at the ventrolateral tubercle, has been observed to occur in *M. davidi*, together with rib division. In fact, on the basis of the information offered by the present material, it would seem that the whorl section offers the only more or less reliable way of holding the two species apart. The two specimens figured by Glaessner (1957) from New Guinea are typical of the species.

Family ACONECERATIDAE

Genus FALCIFERELLA Casey, 1954

Falciferella reymenti Brunnschweiler?

Pl. 5, Fig. 6

1959 *Falciferella reymenti*, Brunnschweiler, p. 16, pl. 1, figs. 7, 8.

Remarks.—The shell is not preserved on any of these specimens, hence it is not possible to provide observations concerning the ornament. Brunnschweiler (1959, p. 17) noted that whenever any indication of falcoid striation or ribbing is shown it is on the dorsolateral part of the flanks.

Material.—Five fragments. M 1488, M 1489, M 1490, M 1491, M 1492.

Falciferella sp. nov.

Pl. 5, Fig. 5

Remarks.—Several crushed specimens of a *Falciferella* occur in the material. These are of a form, smooth except for faint lateral striae. Unfortunately, the material is insufficient for description.

In addition to these aconeceratids the material also contains several fragments of ammonites possibly referable to the genera *Beudanticeras* and *Sanmartinoceras*.

Material.—Figured specimen. M 1493.

ON THE DISPERSAL OF HETEROMORPHIC AMMONITE SHELLS

Growth of the heteromorphic shell. Changes in the coiling of a cephalopod shell depend on fluctuations in the allometric relations governing growth of the same. For the purpose of simplifying the following discussion it will be taken that growth occurs by means of two centres, one controlling the dorsal part of the shell, and one its ventral part. If the growth rates of the dorsum and venter are equal (isometric growth), a straight shell results (for example, straight nautiloids). In ammonites, however, the growth rate of the venter is usually many times greater than that of the dorsum, and coiled shells with embracing whorls result – the greater the ventral growth rate, the greater will be the degree of involution of the shell. Hence, the position may be summarised by saying that the growth of the venter is always positive allometric with respect to the growth rate of the dorsum, apart from the special case of equality of the

growth rates. A heteromorphic shell will result when the two rates of growth fluctuate. Hence, in *Labeceras* the ventral rate of growth is initially slightly greater than the dorsal rate of growth, the difference being so slight, that the whorls are never in contact. This stage is followed by a period of isometric growth, after which a return to much the same growth differences as during earlier ontogeny is made. For *Myloceras* the growth differences are, for about the first whorl, similar to those pertaining in *Labeceras*, after which a period of increase in the positive allometric relationship takes place. Here, the whorls are just in contact with each other. This growth stage is followed by a period of isometric growth, after which a reversion to the earliest pattern occurs.

It is well known that the spiral of the ammonite shell may be described by the logarithmic spiral. That is: $r = ae^{\gamma\omega}$, where a is a constant, r the shell radius, ω the angle of the spiral, and γ is a factor which determines the shape of the curve. The factor γ thus decides whether the shell will be involute, evolute or with the whorls not in contact (Haarländer, 1952). During part of the growth of both *Labeceras* and *Myloceras* the shell describes a logarithmic spiral. However, particularly in connection with the formation of the body chamber this is not so. This is the most important difference between heteromorphic ammonites (excluding those in which the logarithmic spiral is followed at all growth stages — in a sense these are not genuine heteromorphs) and normal ammonites.

The Relationship Between Shell Shape and Shell Dispersal.—In this section the importance of the shape of the shell with respect to nekroplanktonic dispersive possibilities is reviewed and some formulae for the volume of certain idealised shell types given. According to the results obtained by my investigations on factors in the distribution of fossil cephalopods (Reyment, 1958) the orthoconic type of shell is one with excellent floating capabilities; hence, one likely to be widely spread nekroplanktonically. The volume of an idealised orthocone is given by the simple expression: $V = \frac{1}{3}\pi r^2 h$, where r is the radius of the base and h is the height of the shell. In this kind of shell the maximum exposure of surface area is achieved and the maximum relative uplift results. For dead shells the buoyancy is decreased by the weight of the body chamber. It could be shown experimentally (Reyment, 1958, p. 122) that the body chamber of an orthocone must exceed half of the total shell length if a shell is to sink. A rough expression for the mass of the aragonite in a conical shell, assuming a thickness of 1 mm., is $M = 0{\cdot}98\,\pi\,(r_1^2 h_1 - r_2^2 h_2)$, where r_1 and r_2 are the differences in radius due to wall thickness and h_1 and h_2 are the corresponding differences in height. Similar expressions may be derived for shells of elliptical cross section (the baculitid type).

For coiled shells the effective volume depends on the degree of involution of the shell, the lesser the degree of evolution the greater the effective volume. The effective volume of a coiled evolute shell the whorls of which are just in contact is given by the following expression (kindly derived for me by Dr. I. R. Nystedt, Dept. Mathematics, University of Stockholm):

$$V = \int_{-\infty}^{\omega} a^2 \left(e^{\omega\cot\Omega} - e^{(\omega-2\pi)\cot\Omega}\right)^2 \cdot \pi k \frac{a}{2}\left(e^{\omega\cot\Omega} - e^{(\omega-2\pi)\cot\Omega}\right) d\omega$$

$$- \frac{a^3 k \sin\Omega}{6} k_1^3 k_2 R^3$$

where Ω is the tangential angle to the radius, ω the angle of rotation, r the radius, k and a constants, $R = ae^{\omega\cot\Omega}$, $k_1 = 1 - e^{-2\pi\cot\Omega}$, and $k_2 = 1 + e^{-2\pi\cot\Omega}$.

This will also apply to heteromorphic shells as long as the logarithmic spiral is followed. Generally, the combination of the properties of straight shells and evolute shells met with in heteromorphic ammonites, as in *Labeceras* and *Myloceras*, indicates high buoyancy properties, owing to the maximum utilisation of the entire length of the cone in the effective volume. Consequently, it is to be expected that heteromorphic ammonites will be good floaters in the nekroplanktonic state (Reyment, 1958, p. 172), depending naturally on the length of the body chamber. For *Labeceras oodnadattaensis* sp. nov. the body chamber makes up 47 per cent of the total shell length, which is within the bounds required in order for the empty shell to float. In Fig. 9a-b the nekroplanktonic floating positions for *Labeceras* and *Myloceras* are shown.

Fig. 9. a, Floating position for *Labeceras*; b, floating position for *Myloceras*.

Evidence for Nekroplanktonic Dispersal.—This is of two kinds, geographic and sedimentologic. The relatively wide geographic distribution of some of the species treated in this paper is suggestive. Firstly, we have the expected wide distribution of species in the Great Artesian Basin—practically all of the forms among the heteromorphic ammonites treated by Whitehouse (1926) in his monograph also occur in the South Australian material. Secondly, there is the occurrence of these heteromorphs in New Guinea, amongst them the forms recorded by Claessner (1958), including *Labeceras crassum* Spath and *Myloceras davidi* Whitehouse. Finally, there is the important occurrence of *Labeceras crassum* Spath and *Myloceras axonoides* (Etheridge) in Portuguese East Africa. The buoyant structure of these shells suggests that possibilities of wide-ranging oceanic transport, as has been observed for the shells of *Nautilus* (cf. Reyment, 1958).

The nature of the sediment in which the ammonites occur is of the calcareous tidal mud type, such as that forming in the Bahamas Islands area today (cf. Reyment, 1958), and also in the Jurassic deposits of Solnhofen and Holzmaden, Germany. The drifting shells finally fastened in the shallow water calcareous sediment.

The actual living place of the ammonites was probably in the sea nearby and even further out, but this can, of course, only be a matter of speculation. The only certain fact is that the places of occurrence of the ammonite shells do not represent the area in which they actually lived.

STRATIGRAPHIC CONCLUSIONS

All ammonites are of Albian age and are to be correlated with the *varicosum-equatoriale* zones of the standard English Gault succession (Spath, 1925), and possibly the *orbignyi* zone (Whitehouse, 1926).

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* All ammonites were coated with ammonium chloride prior to photographing. It is, however, not possible to achieve a smooth distribution of this substance on plasticene casts of whorls, which usually means that the cast must be photographed without preparation. Mr. Kutnar found that by first chilling the cast and then spraying with an acrylate fixing base (Zapon plastic lacquer—used for fixing pencil drawings) a surface could be produced on which the ammonium chloride will fasten satisfactorily.

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EXPLANATION OF PLATES

PLATE 1

Fig. 1. *Labeceras* (*Labeceras*) *laqueum* (Etheridge). View of part of the shaft and the crook and the last six sutures (observe the crowding of the final two sutures). M 1439, X1.

Fig. 2. *Labeceras* (*Labeceras*) *crassum* Spath. Portion of the body chamber. M 1440, X1·8.

Fig. 3. *Labeceras* (*Labeceras*) *compressum* Whitehouse. An entire body chamber, running from the final suture to the apertural lappets. Fragments of shell material of the same species attached. This specimen retains largely its (altered) shell material. M 1441, X1·4.

Fig. 4. The same species. Ventral view showing the sutures. M 1415, X2·1.

Fig. 5. *Labeceras* (*Labeceras*) *oodnadattaensis* sp. nov. Lateral view of the holotype showing several of the final sutures. S.A.M., M 1444, X1·2.

Fig. 6. *Labeceras* (*Appurdiceras*) *cordycepoides* (Etheridge). Lateral view of a fragment showing three sutures. M 1446, X1·3.

Fig. 7. Same species. A body chamber. M 1447, X1·3.

Fig. 8. *Myloceras intermedium* (Whitehouse). Part of a body chamber. M 1459, X1.

PLATE 2

Fig. 1. *Myloceras nautiloides* (Etheridge). Ventral view of part of a body chamber. M 1448, X1.

Fig. 2. Same species. Lateral view of septate whorls. M 1450, X1·3.

Fig. 3. *Myloceras plectoides* (Whitehouse). Early septate part of a shell. M 1451, X1·2.

Fig. 4. *Myloceras baccatum* (Whitehouse). Part of the body chamber and the last three sutures. M 1458, X0·6.

PLATE 3

Fig. 1. *Myloceras axonoides* (Etheridge). Lateral aspect of part of an inner whorl. M 1460, X1·5.

Fig. 2. *Myloceras flindersi* (McCoy). Crushed fragment showing the swung ribbing. M 1465, X1·6.

Fig. 3. Same species. M 1469, X0·5.

Fig. 4. *Myloceras davidi* Whitehouse. Specimen showing part of an early whorl. M 1486, X1.

PLATE 4

Fig. 1. *Myloceras davidi* Whitehouse. Impression. M 1473, X1·3.

Fig. 2. Same species. Cast showing the suture line. M 1417, X1·1.

Fig. 3. Same species. Crushed cast showing flexed ribs and the nature of the tuberculation. M 1474, X1·1.

Fig. 4. Same species. M 1481, X1·3.

PLATE 5

Fig. 1. *Myloceras plectoides* (Etheridge). Specimen showing sutures. M 1419.

Fig. 2. Same species. Plasticene mould of a specimen. M 1457, X1.

Fig. 3. *Myloceras davidi* Whitehouse. Plasticene mould of a specimen. M 1485, X1·2.

Fig. 4. Same species. Internal structure of chambers. M 1487, X1.

Fig. 5. *Falciferella* sp. Crushed specimen in the body chamber of a *Myloceras*. M 1493, X2.

Fig. 6. *Falciferella reymenti* Brunnschweiler? Specimen showing the development of the inner whorls. M 1488, X6.


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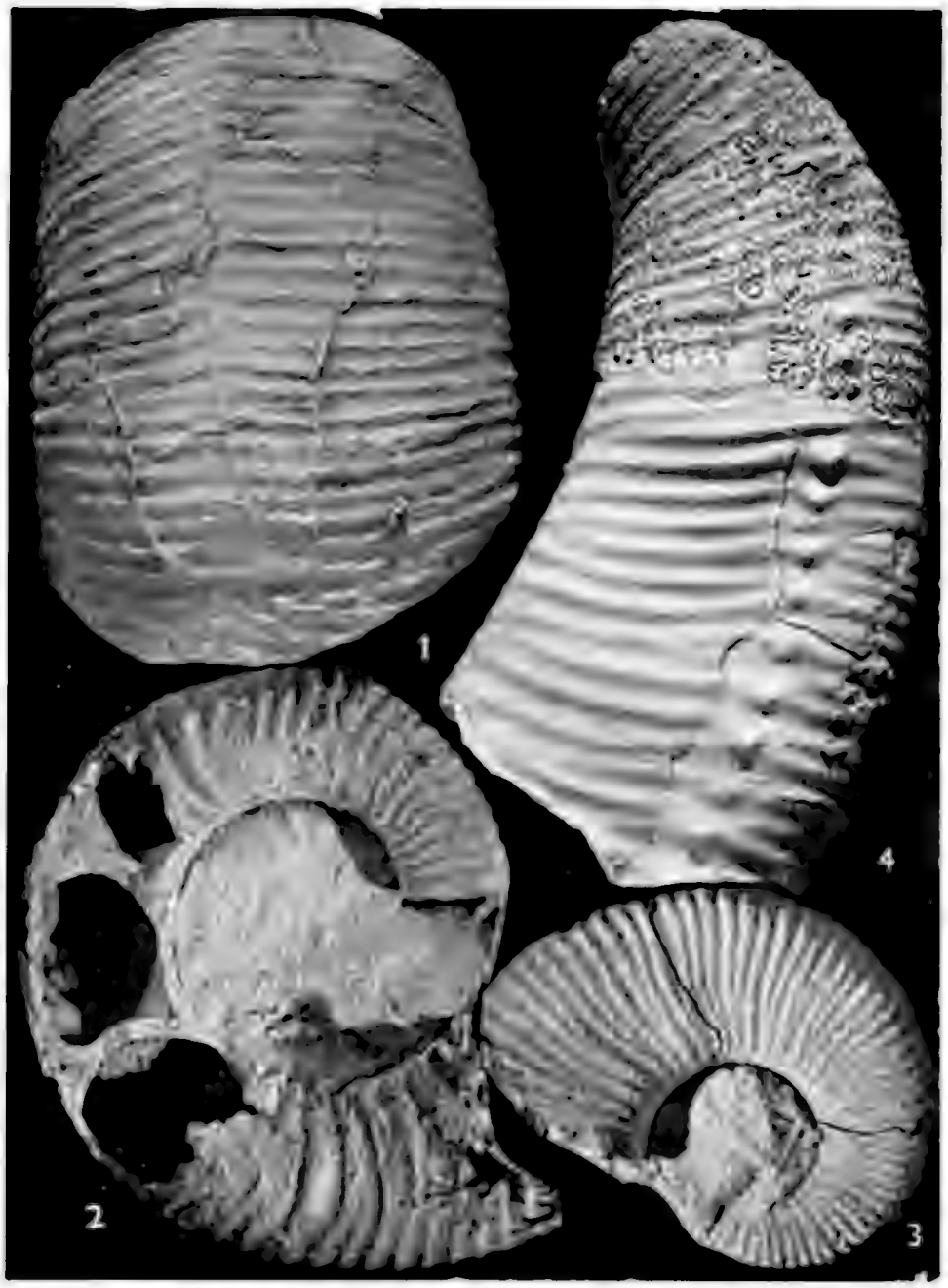
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COILING AND FORM IN SOUTH AUSTRALIAN LABECERATIDAE (ALBIAN; CRETACEOUS)

BY R. A. REYMENT

Summary

Observations are presented on the mode of coiling and the shell form of some typical labeceratid ammonites from the Albian of Fossil Creek, near Oodnadatta.

COILING AND FORM IN SOUTH AUSTRALIAN LABECERATIDAE (ALBIAN; CRETACEOUS)

By R. A. Reyment*

[Read 9 April 1964]

SUMMARY

Observations are presented on the mode of coiling and the shell form of some typical labeceratid ammonites from the Albian of Fossil Creek, near Oodnadatta.

There has been a recent awakening of interest in Lower Cretaceous heteromorphic ammonites. Wiedmann (1962) has published a rather far-going revision of many heteromorphs, including Labeceratidae, which he prefers to see as a subfamily of Anisoceratidae. The purpose of the present note is to present certain observations on the mode of coiling and shell form, particularly of the apertural region, of a few typical labeceratids, selected from a large collection of ammonites from South Australia, the taxonomic examination of which is the subject of the foregoing paper.

The ammonites derive from a limestone in Fossil or Woolridge Creek near Oodnadatta, South Australia.

It is not here proposed to enter into any form of phylogenetic discussion. Suffice it to say that the writer is largely in agreement with Wiedmann's analysis of Anisoceratidae and related groups.

In order to assist the representation of the ammonites approximate stereoscopic photographs were made. Shadows tend to reduce the clarity of stereoscopic pictures of fossils. In an attempt to minimise the development of shadows an electronic flash apparatus, mounted to the camera, was used (film Kodak 23 DIN). Coating with sal ammoniac gave unsatisfactory results owing to the excessive reflection from the pure white surface produced. Better results were obtained by using medium grey poster colour. Specimens are deposited in the museum of the Geological Survey of South Australia.

Labeceras crassum Spath.

Pl. 1, fig. 5; pl. 2, fig. 2a-h (stereopair)

Labeceras is coiled in roughly ancyloceratoid form; some species are morphologically not unlike certain *Idiohamites*, the youngest part of the shell usually forming less than one whorl. The initial part is generally spirally coiled, but

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may appear planispiral. The stereopair in Pl. 2, Fig. 2a-b, show the form of an almost complete specimen, and the nature of the aperture. The body chamber begins at the point marked by an arrow in Pl. 1, Fig. 5. It is here worth noting, that although *Labeceras* mostly has the aperture directed towards the shaft, *L. oodnadattaensis* sp. nov. (Reyment, 1964) has the aperture directed outwards.

Fig. 1 shows the plot of shell length against shell height. We observe that these two variables are not linearly related; that is, whorl height and shell length do not increase regularly with respect to each other. The correlation coefficient, computed from the logarithmically transformed measurements, is 0·9728, which is highly significant.

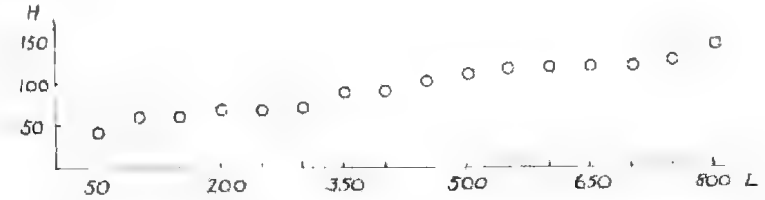

Fig. 1. Relationship between length and height of shell of *Labeceras crassum* Spath. In this Fig. and Figs. 2 and 3, the units are (mm x 10).

Myloceras davidi Whitehouse

Pl. 1, fig. 3a-b (stereopair); pl. 2, fig. 1a-b (stereopair)

The specimen figures in Pl. 1, Fig. 3a-b, and Pl. 2, Fig. 1a-b shows the form of the uncoiled part of a shell, including the aperture. The shell height increases at first on the body chamber and then ceases to increase towards the aperture. The plot of shell height against shell length is shown in Fig. 2; it will be observed that there is some departure from an even growth relationship. The correlation coefficient, computed from the logarithmically transformed variables, is 0·6671, which is significant on the 1 per cent level.

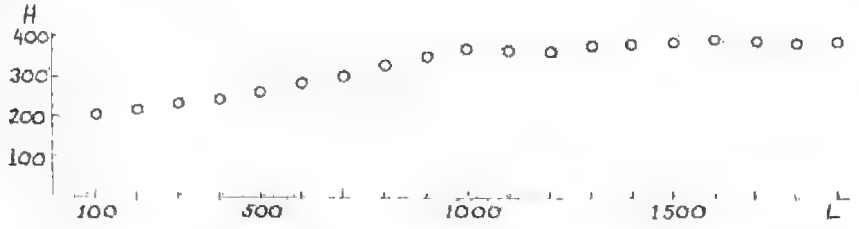

Fig. 2. Relationship between length and height of shell of *Myloceras davidi* Whitehouse.

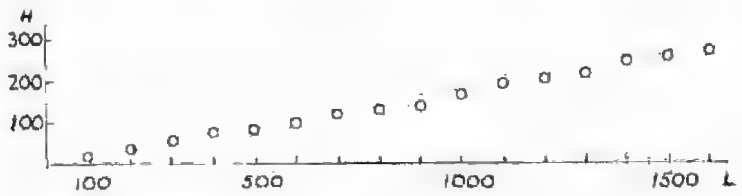

Fig. 3. Relationship between length and height of shell of *Myloceras ammonoides* (Etheridge).

Myloceras ammonoides (Etheridge)

Pl. 1, fig. 1a-b (stereopair), fig. 2a-b (stereopair); fig. 4; pl. 2, figs. 3-5.

This specimen shows well the spiral coiling of the early part of *Myloceras* (Pl. 1, Fig. 2a-b; Pl. 2, Figs. 3, 5); this is not so clearly apparent in all species. The specimen consists of the three initial whorls—the shaft and the hook are missing. The whorls are barely in contact and in places do not touch (Pl. 1, Fig. 1a-b—space between dorsum of last whorl and venter of penultimate whorl in the upper part of the specimen). The plot of shell length against shell height in Fig. 3 shows an almost completely regular increase relationship to exist between the two variables. The correlation coefficient, computed from logarithmically transformed observations, is 0·9579, which is very highly significant.

REMARKS

The scattergrams of length and height of whorl suggest that one might expect some sort of differential growth relationship between these variables. The regression equations for each species were computed to yield for:

Labeceras crassum: $y = 6{\cdot}76x^{0.44}$;
Myloceras davidi: $y = 67{\cdot}61x^{0.23}$;
Myloceras ammonoides: $y = 0{\cdot}28x^{0.91}$.

We have here the interesting result that the coiled whorls of *Myloceras ammonoides* grow almost isometrically with respect to length and height of shell, whereas the uncoiled parts of *Labeceras crassum* and *Myloceras davidi* grow in some kind of allometric relationship.

Another interesting feature of the present analysis is that log length and log height of shell are highly correlated for the shaft and crook of *L. crassum* and for the whorls of *M. ammonoides*, but less strongly correlated for the shaft and crook of *M. davidi*.

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EXPLANATION OF PLATES

Plate 1

Fig. 1a-b. *Myloceras ammonoides* (Etheridge). Stereopair. X0·62. Coated.

Fig. 2a-b. Same species. Stereopair. X0·62. Coated. G.S.S.A. M 1497.

Fig. 3a-b. *Myloceras davidi* Whitehouse. Approximate stereopair. X0·65. Coated. G.S.S.A. M 1495.

Fig. 4. *Myloceras ammonoides* (Etheridge). X0·58. Uncoated. G.S.S.A. M 1497.

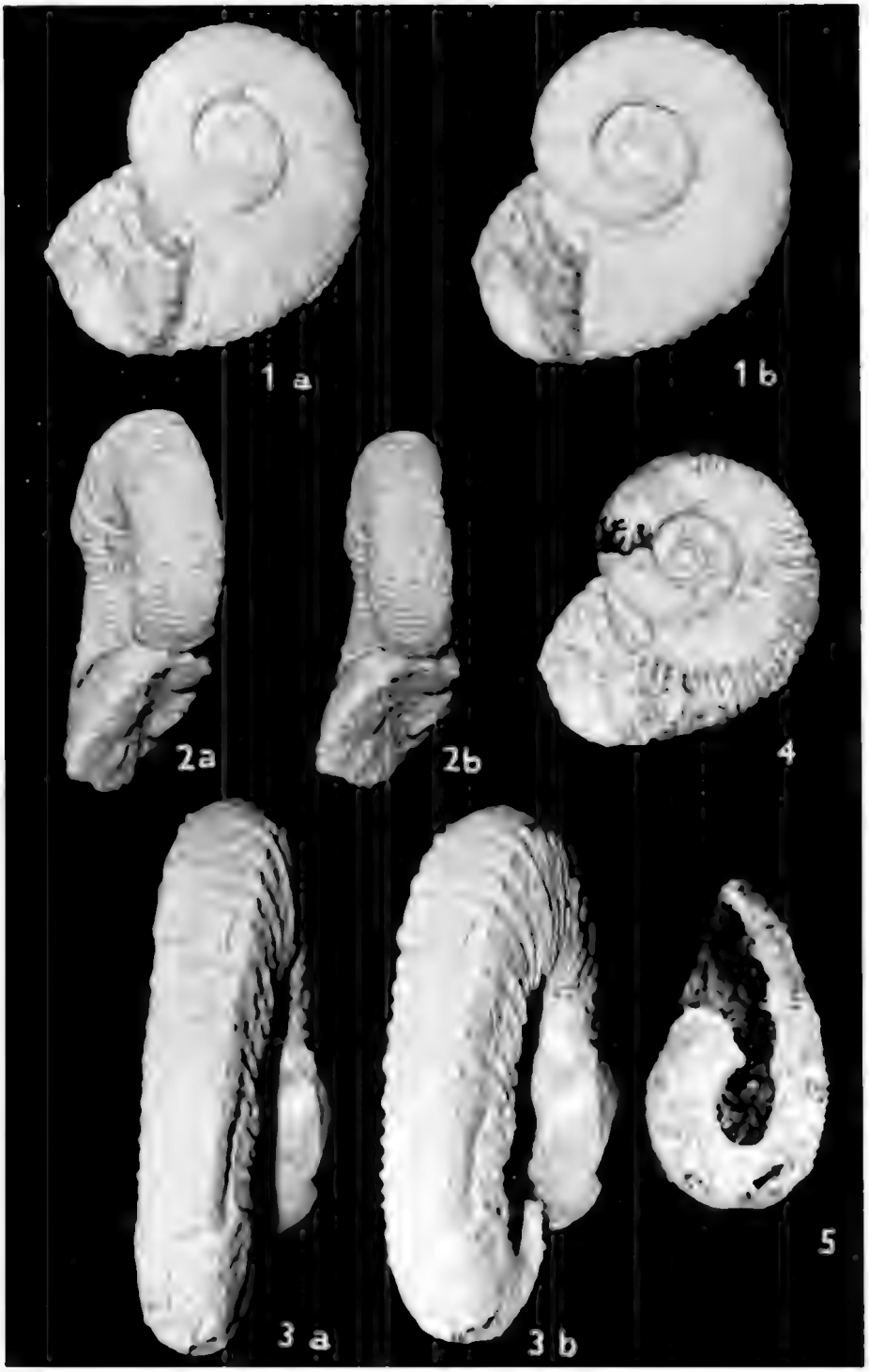
Fig. 5. *Labeceras crassum* Spath. The arrow marks the end of the septate part of the shell. Approximately natural size. Uncoated. G.S.S.A. M 1494.

Plate 2

Fig. 1a-b. *Myloceras davidi* Whitehouse. Approximate stereopair. X0·65. Coated. G.S.S.A. M 1495.

Fig. 2a-b. *Labeceras crassum* Spath. Stereopair X0·65. The impression of a shaft of the same species occurs in the upper left-hand corner. Uncoated. G.S.S.A. M 1494.

Figs. 3-5. *Myloceras ammonoides* (Etheridge). Figs. 3 and 5 show clearly the spiral coiling of the younger part of the shell. X0·58. Uncoated. G.S.S.A. M 1497.



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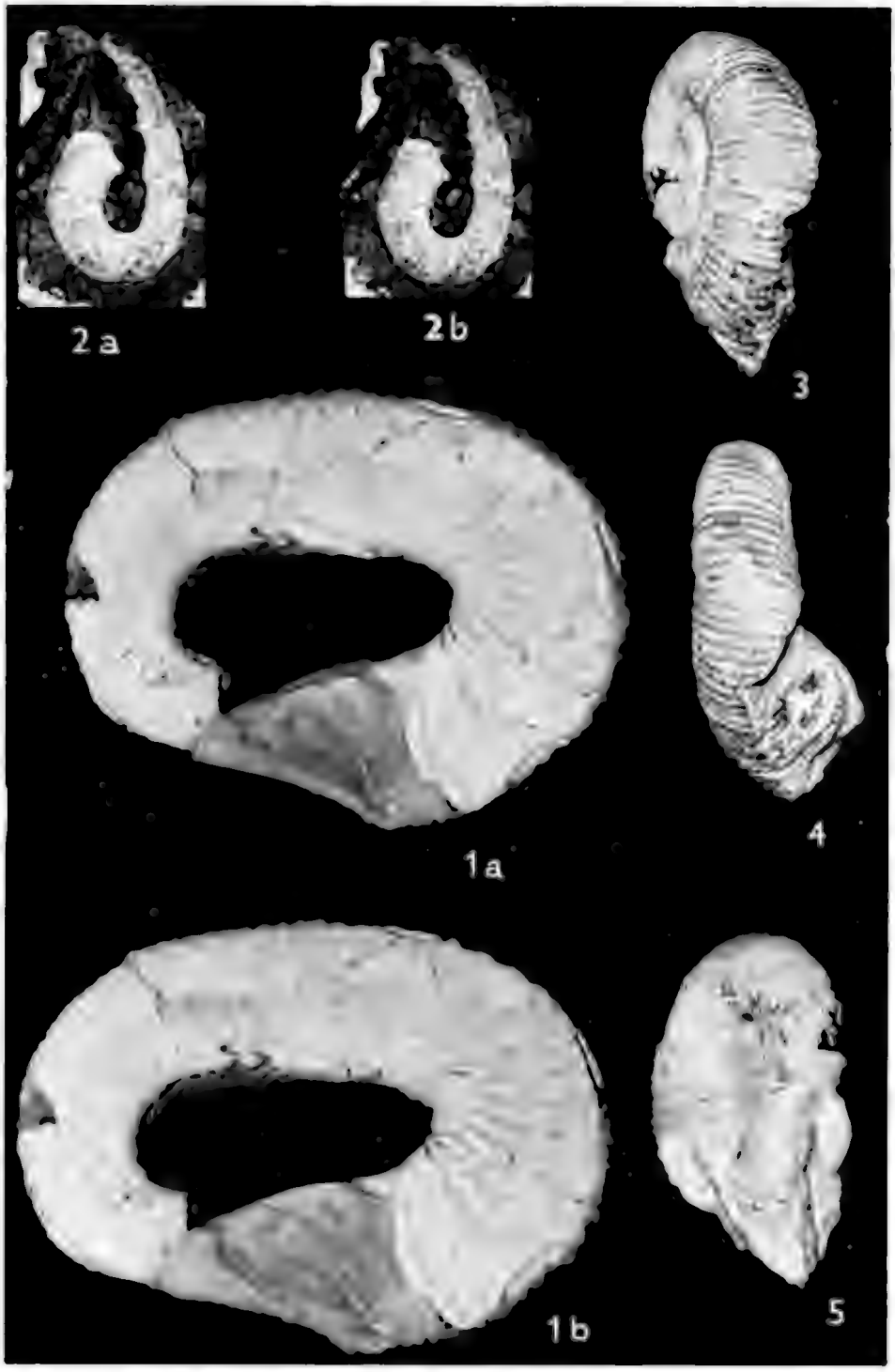
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AUSTRALIAN ACANTHOCEPHALA, NO. 11

BY S. J. EDMONDS

Summary

Two new species of Acanthocephala are described from Australian fish; *Telosentis australiensis* from *Anguilla reinhardtii* Steindachner *and Neogorgorhynchus robustus* from *Siganus lineatus* (Cuvier and Valenciennes).

AUSTRALIAN ACANTHOCEPHALA, No. 11

by S. J. Edmonds*

[Read 14 May 1964]

SUMMARY

Two new species of Acanthocephala are described from Australian fish: *Telosentis australiensis* from *Anguilla reinhardtii* Steindachner and *Neogorgorhynchus robustus* from *Siganus lineatus* (Cuvier and Valenciennes).

Telosentis australiensis n.sp.

Figs. 1-5

Telosentis Van Cleave, 1923; Golvan, 1960.

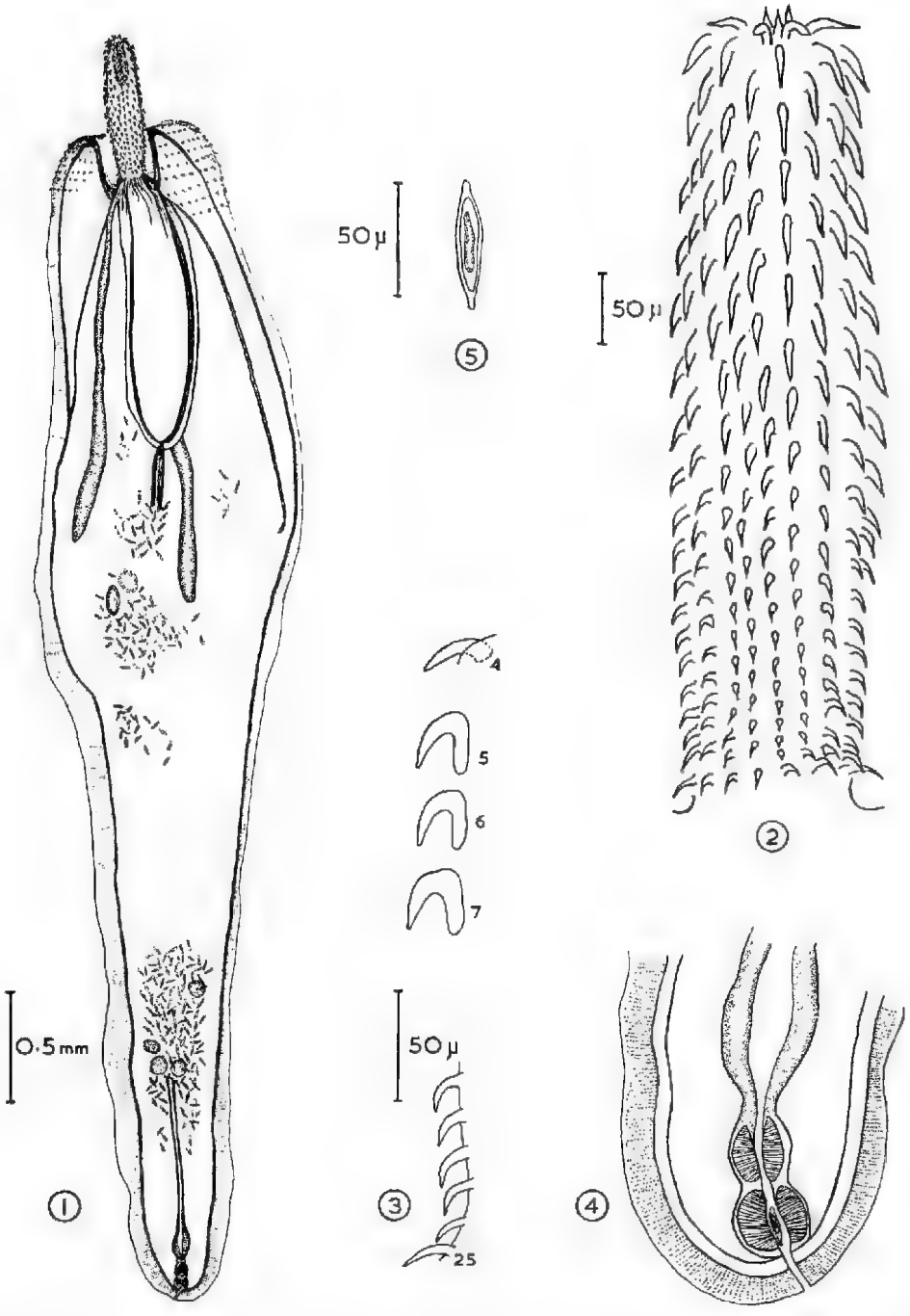
Host and Locality—One male and two female specimens collected by F. A. Ballantyne, Oct., 1962, from the small intestine of *Anguilla reinhardtii* Steindachner at Moggil Creek, Brisbane, Australia (specimens sent for identification by Dr. J. Pearson, Dept. of Parasitology, University of Queensland).

Description—The length of the trunk of the male is 4·0 mm. and its maximum width in the middle of the trunk is 0·6 mm. The length of the females is 5·1-5·6 mm. and their maximum width in the anterior half of the trunk is 0·65-1·00 mm. The anterior region of the trunk is armed with numerous rows of posteriorly directed spines which extend for about one-third of the way along the ventral surface. They are about 25-30 μ long. The introvert of the male is almost cylindrical; its length is 0·72 mm. and maximum width 0·14 mm. The maximum length of the introvert of the female is 0·78 mm. and the maximum width 0·18 mm. The introvert is armed with 16 longitudinal rows of 23-26 hooks per row. The size and shape of some of the hooks is shown in Fig. 3. The hooks on the anterior two-thirds of the introvert are largest and possess rooting processes. The most posterior hook of each longitudinal row is slightly larger than those immediately anterior to it. The difference in the size of the dorsal and ventral hooks that is found in *T. exiguus* (von Linstow, 1901) and in *T. tenuicornis* (Van Cleave, 1918) is not noticeable in the Australian specimens.

Although the body wall is thick, the outer epidermal layer itself seems to be thin and easily distorted. The receptaculum is 1·2-1·5 mm. long and double walled. The lemnisci are as long as or slightly longer than the receptaculum. The testes are ellipsoidal and about 0·3 mm. long; they lie almost one behind the other. The cement glands are long pyriform and pressed closely together; their number was not able to be determined. The uterus is long and the vaginal complex consists of two bulbs. No genital spines were observed in the female and only four in the posterior region of the male. The eggs are spindle-shaped (55-56) μ long and (10-13) μ wide, and the female aperture is subterminal.

Systematic Position—The generic position assigned to these specimens is not altogether satisfactory. They closely resemble species of the genus *Telosentis* Van Cleave, 1923, but the female lacks genital spines, the presence of which is a generic character. Golvan (1960, p. 159) says that the genital spines of *Telosentis* are fragile. This being so, I prefer to place them in the genus *Telosentis* rather than create another genus within the family *Rhadinorhynchidae* to contain them.

* Department of Zoology, the University of Adelaide.



Figs. 1-5. *Telosentis australiensis*. 1, female; 2, introvert of female; 3, some introvert hooks; 4, posterior region of female; 5, egg.

The specimens differ from (1) *T. molini* Van Cleave, 1923, the introvert of which is armed with 12 longitudinal rows of 20 hooks and (2) *T. exiguus* (von Linstow, 1901) armed with 12 rows of 16-18 hooks. They are closely related to *T. tenuicornis* (Van Cleave, 1918), the introvert of which is armed with 10-14 rows of 26 hooks. The introvert of the Australian specimens, however, possesses more longitudinal rows of hooks than *T. tenuicornis* (Van Cleave, 1918, Plate III B) and the spines on the anterior region of the trunk are relatively smaller but far more numerous than those of *T. tenuicornis* as shown by Van Cleave (1918, Plate III, Fig. 3). For these reasons they are regarded as a new species.

Type Specimen—Australian Museum, Sydney.

Type Host—Anguilla reinhardtii.

Neogorgorhynchus robustus n.sp.

Figs. 6-9

Neogorgorhynchus Golvan, 1960, pp. 150-151.

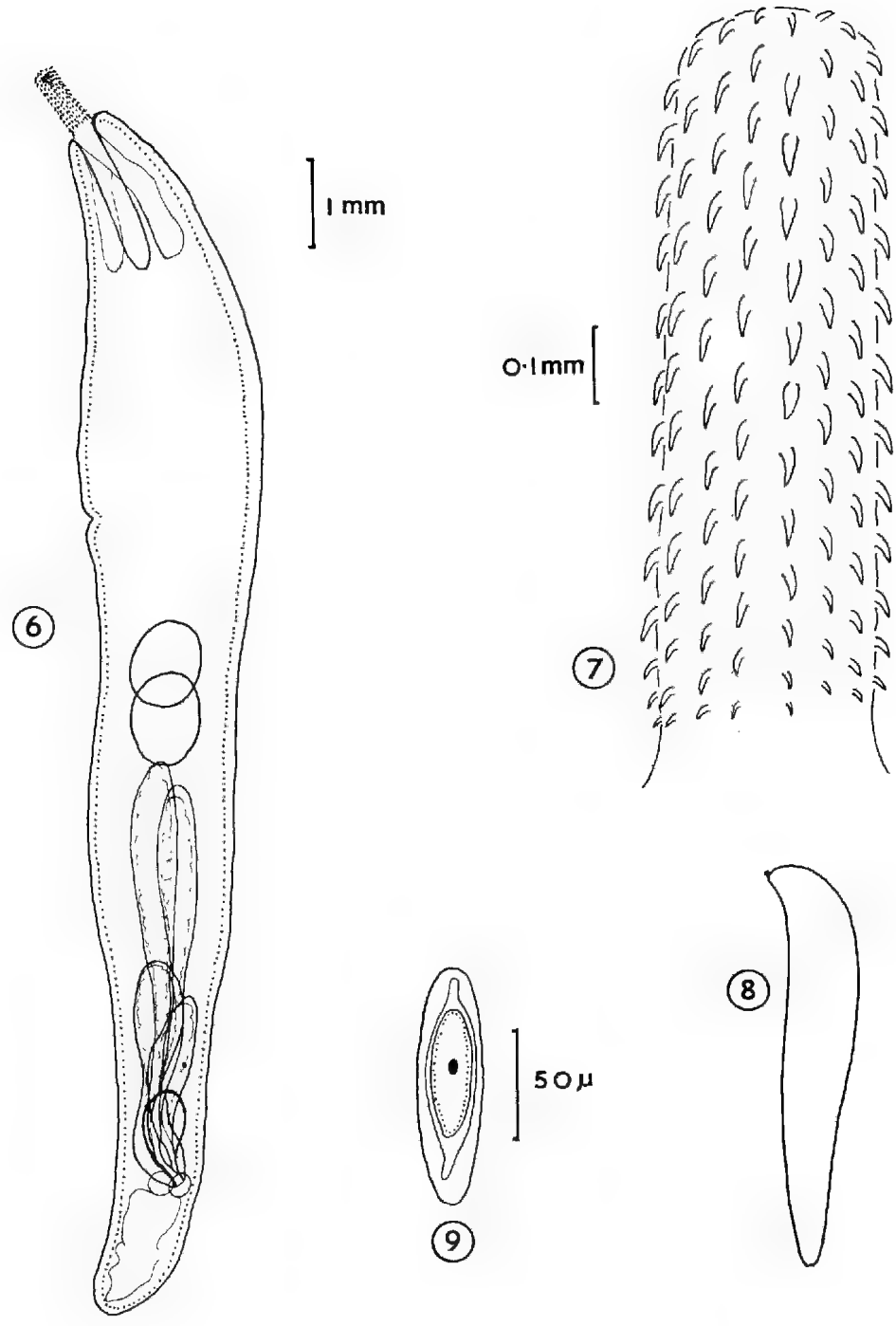
Host—One male and four female specimens were collected from the intestine of the fish, *Siganus lineatus* (Cuv. et Val.). Collector Dr. J. Pearson (University of Queensland), June 2, 1956.

Locality—Heron Is., Queensland.

Description—The specimens show marked sexual dimorphism, the females being about two and a half times as long as the males. The trunk of both sexes is stout and curved ventrally to some extent in the anterior region. Posteriorly it tapers gradually. Two lateral lacunae show up clearly in the body wall of each of the specimens.

The trunk of the male is 15 mm. long and its maximum width—in the middle of the trunk—is about 2 mm. A cylindrical introvert arises somewhat ventrally from the anterior region of the trunk. Compared with the size of the trunk the introvert is small. The armed part is 0·75 mm. long and 0·25 mm. wide, and there is a short unarmed section about 0·08 mm. long. The former bears 14 longitudinal rows each containing 12-13 hooks per row. The posteriorly placed hooks are smallest. The trunk is without spines. The receptaculum is double-walled, 2·2 mm. long and 0·3 mm. wide. The lemnisci are short and sac-like. The testes are ellipsoidal and 1·2-1·5 mm. long. They overlap slightly. There are four cement glands that are arranged in pairs and that arise at different levels. The genital opening is terminal.

The trunk of the female is 28-37 mm. long and about 3·5 mm. wide in the mid-region. The fully extended introvert is cylindrical, 0·9-1·0 mm. long and about 0·3 mm. wide. There is in addition a short unarmed section 0·05-0·08 mm. long. The introvert is armed with 14-16 longitudinal rows each of 12-14 hooks per row. A double-walled receptaculum is 2·4-2·8 mm. long and 0·35 mm. wide. The lemnisci are stout and sac-like and about as long as the receptaculum. The female genitalia are about 4-5 mm. long and the anal aperture is sub-terminal. Ripe eggs are (100-115) μ long and (22-29) μ wide and have polar prolongations of the middle shell.



Figs. 6-9. *Neogorgorhynchus robustus*. 6, male; 7, introvert; 8, female; 9, egg.

Systematic Position

These specimens from Queensland closely resemble *Neogorgorhynchus aspinosus* (Fukui and Morisita, 1938) from the fish, *Teuthis fuscescens*. The introvert of *N. aspinosus* according to Fukui and Morisita (1938) and Yamaguti (1939) is armed with 17-18 longitudinal rows of 16-19 hooks per row while that of the specimens from *Siganus lineatus* is armed with 14-16 rows of 12-14 hooks per row. The introvert of *N. nudus* (Harada, 1938), the only other species in this genus, is armed with 14 longitudinal rows of 24-25 hooks per row. For these reasons the specimens from *Siganus lineatus* are regarded as new and because they are stout are given the specific name *robustus*.

Type Specimen—Australian Museum, Sydney.

Type Host—Siganus lineatus.

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THREE NEMATODE SPECIES (STRONGYLOIDEA : TRICHONEMINAE) FROM QUEENSLAND WALLABIES

BY A. MAGZOUB

Summary

This paper includes descriptions of a new genus and two new species, and a redescription of a known species; parasites and hosts are as follows: *Oesophagonastes gullardi* (Johnston and Mawson) from *Protemnodon bicolor, Rugopharynx rufogrisea,* n.sp., from *P. rufogrisea,* and *Pararugophurynx protemnodontis,* n.g., n.sp., from *P. rufogrisea.* all hosts are from Logan Village, Queensland.

THREE NEMATODE SPECIES (STRONGYLOIDEA : TRICHONEMINAE) FROM QUEENSLAND WALLABIES

By A. Maczoub*

(*Communicated by S. J. Edmonds*)

[Read 14 May 1964]

SUMMARY

This paper includes descriptions of a new genus and two new species, and a redescription of a known species; parasites and hosts are as follows: *Oesophagonastes gallardi* (Johnston and Mawson) from *Protemnodon bicolor*, *Rugopharynx rufogrisea*, n.sp., from *P. rufogrisea*, and *Pararugopharynx protemnodontis*, n.g., n.sp., from *P. rufogrisea*; all hosts are from Logan Village, Queensland.

INTRODUCTION

The nematodes described in this paper were collected by the Queensland Institute of Medical Research, and sent to the University of Adelaide for examination by Dr. M. J. Mackerras, then of that Institute. I am very grateful to Dr. Mackerras for the opportunity provided. Among these fresh and well-preserved specimens it has been possible to identify one previously described species, and two new species, for one of which a new genus, *Pararugopharynx*, is proposed.

The material is plentiful, and it has been possible to measure ten mature specimens of each sex for each species; these measurements are given in Table 1. The length of the vestibule and of the oesophagus is taken in each case from the anterior end of the worm to the base of the structure.

The material received came from seven specimens of *Protemnodon rufogrisea* (all of which were parasitised in the oesophagus as well as the stomach) and one specimen of *P. bicolor*, with nematodes in both oesophagus and stomach. All the hosts were from Logan Village, Queensland.

DESCRIPTIONS

The incidence of the species described in this paper is as follows:

Protemnodon rufogrisea (Desm.), *Rugopharynx rufogrisea*, n.sp. (oesophagus, one of seven hosts; stomach, seven of seven hosts); *Pararugopharynx protemnodontis*, n.g., n.sp. (oesophagus, two of seven hosts; stomach, three of seven hosts).

* Part of work done for thesis for M.Sc. degree, Department of Zoology, University of Adelaide, under UNESCO Scholarship.

Protemnodon bicolor (Desm.), *Oesophagonastes gallardi* (Johnston and Mawson) (oesophagus).

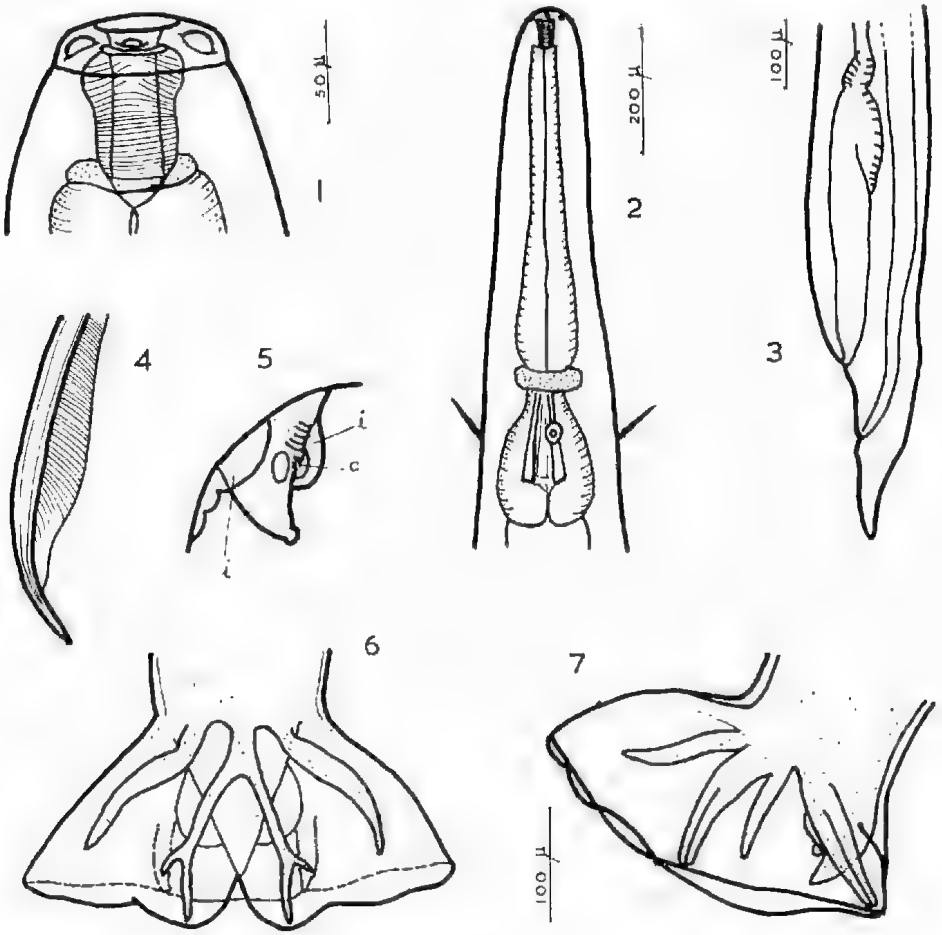
Oesophagonastes gallardi (Johnston and Mawson)

(Figs. 1-7)

Pharyngostrongylus gallardi Johnston and Mawson, 1942, 110.
Spirostrongylus gallardi (Johnston and Mawson), Mawson, 1955, 2.

Host and Locality—Protemnodon bicolor (syn. *Macropus nallabatus*), Logan Village, Queensland. *O. gallardi* is now identified in fresh material from the type host, and it is possible to give a fuller description.

Relatively large worms, often curved in two spirals; cuticle transversely striated. Mouth with six shallow lips, the 2 lateral with amphids and the 4 submedian ones with simple papillae. Vestibule elongate, thick-walled with



Figs. 1-7. *Oesophagonastes gallardi*. 1, head; 2, oesophageal region; 3, tail of female; 4, distal end of spicule; 5, genital cone; 6 and 7, dorsal and lateral views of bursa. c, cloaca; i, inflated cuticle. Figs. 6 and 7 to same scale.

fine annular striae except anteriorly where walls are thicker and striae not annular. Anterior three-quarters of oesophagus, in front of constriction, is wider in second half; terminal bulb oval. Thick cuticular ring (typical of genus) between oesophagus and vestibule. Nerve ring at oesophageal constriction; stout hair-like cervical papillae in region of bulb, and excretory pore at level of anterior part of bulb.

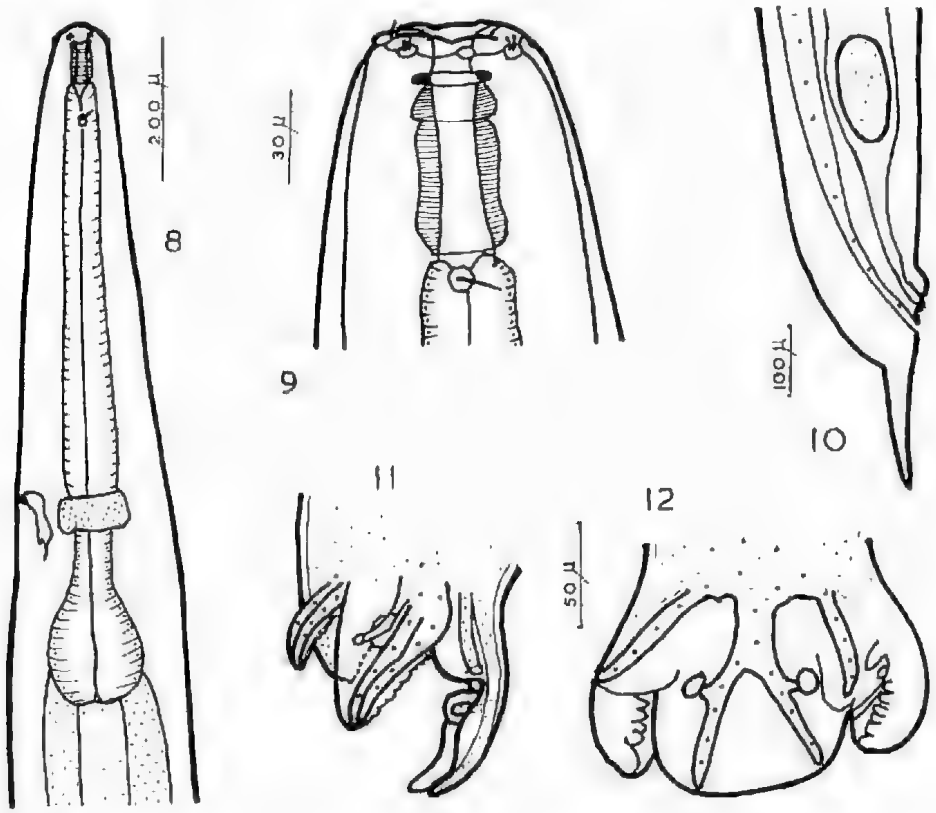
Bursa not deeply lobed, ventral lobes joined; bursal rays as in Figs 6 and 7. Slight inflation of inner wall of bursa at each side of genital cone (Fig. 5). Gubernaculum present; spicules alate nearly to pointed tips. Tail of female conical; eggs 65-95 μ by 40-55 μ.

Rugopharynx rufogrisea n. sp.

(Figs. 8-12)

Host and Locality—Protemnodon rufogrisea, Logan Village.

Short straight worms; submedian cephalic papillae with bifid setae; amphids distinct; buccal capsule short. Vestibule elongate, lumen cylindrical, wall narrowed at annular constriction at end of first quarter of its length; striations in wall radial, finer anterior to constriction.



Figs. 8-12. *Rugopharynx rufogrisea*. 8, oesophageal region; 9, head; 10, tail of female; 11 and 12, lateral and dorsal views of bursa. Figs. 11 and 12 to same scale.

Anterior part of oesophagus about three-quarters its length, followed by constriction and rather elongate terminal bulb. Nerve ring at constriction and excretory pore at about same level; cervical papillae close to posterior end of vestibule.

Body of female narrows sharply, especially dorsally, behind anus, to end in distinctive narrow tapering tail. Eggs 140-160 μ by 70-80 μ. Bursa heavily papillated except on dorsal lobe. Arrangement of rays shown in Figs. 11 and 12. Spicules with rounded tips alate nearly to end.

The species is close to *R. australis* Mönnig; it is distinguished from it by the shape of the vestibule and the position of the cervical papillae, and in the female by the very distinctive shape of the tail.

Pararugopharynx n. gen.

Trichoneminae: short straight worms, four setiferous submedian cephalic papillae, external leaf crown of ten bulbous elements, buccal capsule short, vestibule longer, annulated, oesophagus of two parts, anterior longer, almost cylindrical, separated by constriction from posterior part with terminal bulb; nerve ring at oesophageal constriction, excretory pore and stout hair-like cervical papillae about level of oesophageal bulb. Male: bursa entire, lobes poorly separated, longer dorsally; ventral rays together, to edge bursa, ventrolateral ray short, medio- and postero lateral rays together, to edge bursa; externodorsal ray short, separate; dorsal ray stout, bifurcates proximal to midlength, giving off two short branches before bifurcation; gubernaculum present; spicules long, stout, alate nearly to tips; genital cone surrounded by lobes of cuticle forming an "internal bursa". Female: tail elongate, vulva shortly in front of anus, vagina long. Parasites of wallabies.

Type Species—P. protemnodontis, n.sp.

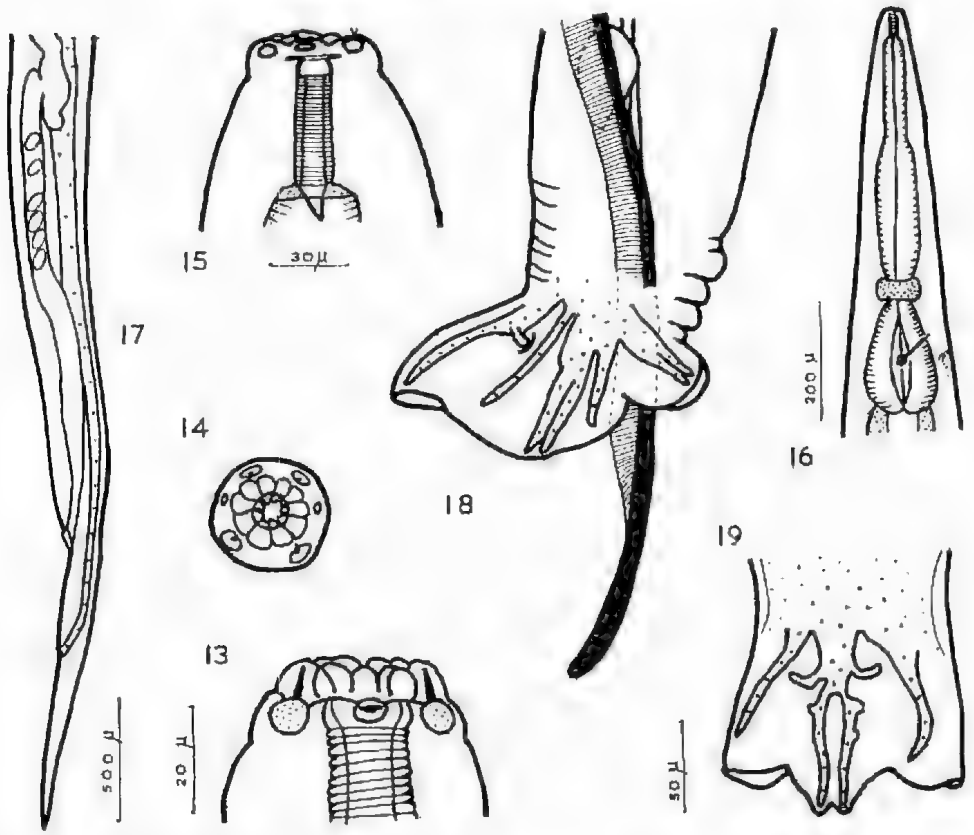
This genus is close to *Oesophagonastes* Mawson (1964, in press). It differs from it in the presence of a leaf crown, the form of the dorsal ray, and the presence of an "accessory bursa" around the genital cone.

Pararugopharynx protemnodontis n.g., n.sp.

(Figs. 13-19)

Host and Locality—Protemnodontis rufogrisea, Logan Village, Queensland.

Short straight worms, cuticle transversely striated. Leaf crown of ten rounded elements. Four submedian papillae with bifid setae; amphids distinct on lateral cuticular elevations. Buccal capsule well developed, slightly convex in longitudinal section. Anterior to buccal capsule is shallow cuticular ring, very like buccal capsule of *Rugopharynx* spp. Vestibule cylindrical, coarsely and regularly annulated. Oesophagus consists of long anterior part separated by constriction from elongate terminal bulb; anterior part narrower in first half of its length than in second half. Nerve ring at oesophageal constriction; excretory pore and hair-like cervical papillae in region of bulb.



Figs. 13-19. *Pararugopharynx protemnodontis*. 13 and 14, lateral and en face views of head; 15, anterior end; 16, oesophageal region; 17, tail of female; 18, posterior end of male, lateral view; 19, dorsal view of bursa. Figs. 14 and 15 to same scale; Figs. 18 and 19 to same scale.

Bursal lobes hardly distinct, ventral lobes joined. Rays as in Figs. 18 and 19. Cuticle around genital cone lobed, forming a type of accessory bursa. Gubernaculum present, resembling that in *Rugopharynx* spp. Spicules stout, alae extending nearly to tips.

Posterior end of female narrows distal to vulva, tail hardly tapering, ending in blunt point. Eggs about 100 μ by 50 μ.

The species resembles those of the genus *Oesophagonastes* in the shape of the oesophagus, in the position of the associated structures, and in the type of bursa. It is distinguished by the longer and more definite buccal capsule and the form of the dorsal rays, as well as by the presence of an "accessory bursa"; this latter structure is, however, present in *O. leptos* Mawson (in press).

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NEW TAXA OF PTILOTUS (AMARANTHACEAE)

BY G. BENL

Summary

Descriptions and illustrations are given of two new species of *Ptilotus, Pi. blackii* from South Australia and Western Australia, *Pt. lophotrichus* from Northern Territory, and of a new variety. *Pt. obovatus* (Gaudich.) F.v.Muell. var. *griseus* from Northern Territory. The type specimens are cited and some critical notes are made on some characters of the new taxa which are compared with previously described forms. Brief remarks are made on the material studied.

NEW TAXA OF *PTILOTUS* (AMARANTHACEAE)

By G. Benl*

(Communicated by Hj. Eichler)

[Read 14 May 1964]

SUMMARY

Descriptions and illustrations are given of two new species of *Ptilotus*, *Pt. blackii* from South Australia and Western Australia, *Pt. lophotrichus* from Northern Territory, and of a new variety, *Pt. obovatus* (Gaudich.) F.v.Muell. var. *griseus* from Northern Territory. The type specimens are cited and some critical notes are made on some characters of the new taxa which are compared with previously described forms. Brief remarks are made on the material studied.

A recent examination of specimens of *Ptilotus* sent from the State Herbarium of South Australia (AD) revealed the existence of three hitherto unknown taxa which are here described as follows:—

1. **Ptilotus blackii** Benl, sp.nov. (Fig. 1).

Planta perennis tenera (caulibus 15-25 cm longis et 1·5-3 mm diametro) vel valida (caulibus ad 40 cm longis, ad 7 mm diametro), pluricaulis; rhizomate tortuoso 0·5-1 cm et ultra crasso, adscendente. Caules virgato-erecti pallido-virides, iuveniles puberuli dein glabri, angulato-striati aut sulcati, per totam longitudinem foliati, basi lignosi, plerumque (corymboso-) ramosi, rarius usque ad inflorescentiam indivisi. Rami ramulique divaricati vel adscendentes, summi approximati.

Folia primo puberula dein glabra, viridia, plus minusve coriacea, integerrima, interdum marginibus subsinuatis, nervo medio subtus prominulo, inaequalia: basalia (ad 10) congesta spathulata, 4-7·5 cm longa et 1·5 cm lata, in petiolum distinctum, superne leviter alatum, ca. 3 cm longum contracta; caulina alterna oblongo-lanceolata, ad 4 cm longa et 1·2 cm lata, apicem versus gradatim minora, summa interdum in bracteas quasi transeuntia. Inflorescentiae capitatae, subhemisphaericae, pedunculato-erectae, ramos ramulosque terminantes, non amplae (2 cm longae, 3 cm latae), coloribus bractearum et tepalorum autem conspicuae, haud densiflorae; rhachis brevis lanuginosa. Flores (10-20) iuveniles apicibus nudis inter bracteas atrofuscas erumpentes, dein bracteis duplo longiores perianthio roseo vel (pallide) carneo spectabiles.

Bractea bracteolaeque carinatae, setaceo-acuminatae, pilosae (pilis spinuloso-articulatis apicem haud attingentibus), inaequales: bractea inferior rigida, oblongo-ovata, 8 mm longa, ad 3 mm lata, opaca, (atro-)fusca, in dorso omnino villosula (Fig. 1, a); bracteolae laterales membranaceae, ovato-lanceolatae, in toto ad 9 mm longae et 2·5 mm latae, nervo medio piloso, atrofusco, in aristam usque 2·5 mm longam excurrenti (Fig. 1, b), lateribus glabris, hyalinis, nitentibus, nervum versus fuscescentibus.

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Perianthium elongato-erectum, dein campanulato-patens, basim induratam versus indurescens, tubum turbinatum (1·5 mm longum) formans. Tepala rigida sublinearia, indistincte trinervia, carinata, obtusa, apice plus minusve erosodenticulato, extus pilis articulatis, ad 5 mm longis, plerumque dimidio inferiori tantum orientibus induta (Fig. 1, c), supra tubum densissime breviterque hirsutum macula 1·5 mm longa, nonnihil convexa, nuda insignia, intus laevigata, opaca, integerrima vel marginibus apicem versus subserrulatis, subaequalia: 2 exteriora ad 15 mm longa et 1·8 mm lata, in parte superiore (ad 6·5 mm longa) nuda, extus nitida, apice vix angustato; 3 interiora paullum breviora sed angustiora, inferne pilis crispis, marginalibus, haud copiosis munita (Fig. 1, d).

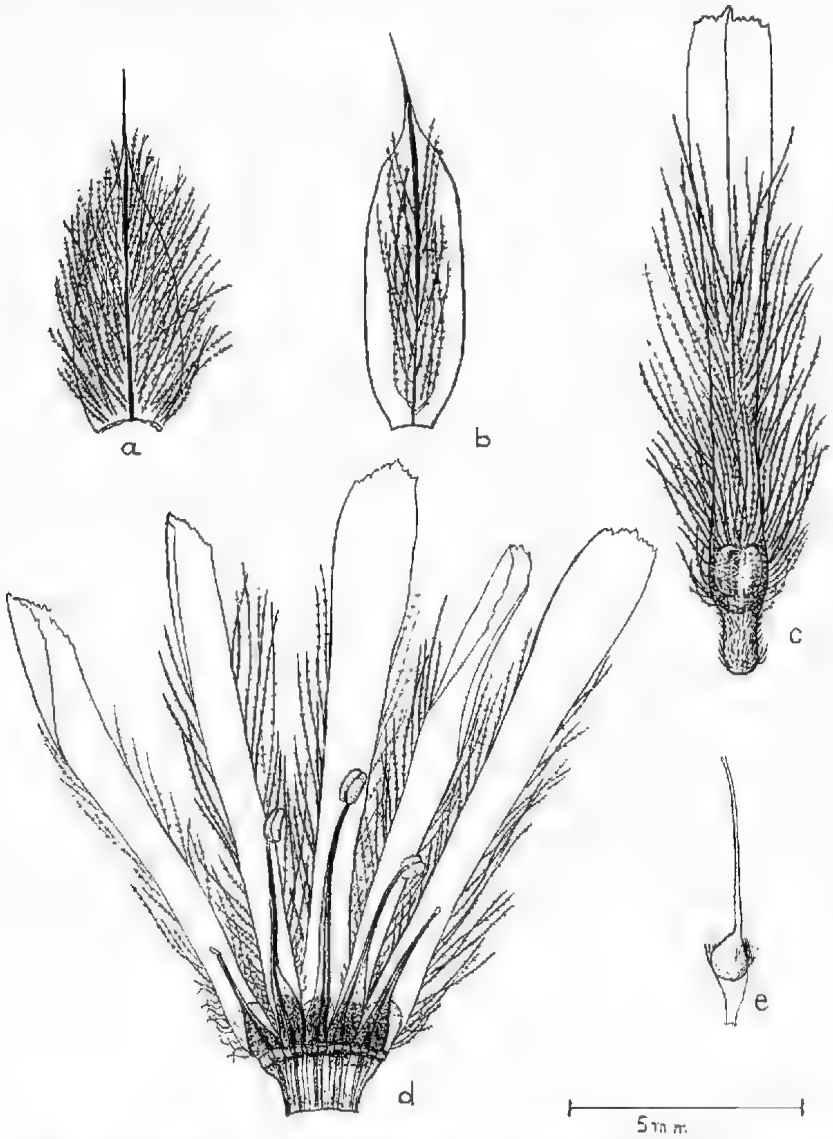

Fig. 1. *Ptilotus blackii* Benl (AD 96215189, paratype): (a) bract; (b) bracteole; (c) outer perianth-segment, outer view; (d) perianth with stamens and staminal cup spread open, inner view; (e) pistil.

Stamina 5, basi valde (ad 0·8 mm) dilatata (Fig. 1, d), extus parce pilosa, in tubum membranaceum, 1·5 mm longum, tubo perianthii arcte insidentem-anulo libero nullo, pseudostaminodiis interiectis nullis—transeuntia, inaequalia: 2-3 fertilia filamentis applanatis, superne subulatis, 5-6 mm longis, antheris biloculuribus obscure flavis, ovato-oblongis, 0·8 mm longis et 0·5 mm latis; 3 vel 2 abortiva filamentis brevioribus, rudimentis antherarum.

Ovarium subclavatum longe stipitatum, 2 mm longum (stipite circiter 1 mm incluso) et 0·8 mm latum, superne pilis paucis, ad 0·5 mm longis, articulatis indutum (Fig. 1, e); stylum glabrum, circa 4 mm longum, excentricum, stigma parvum, haud capitellatum.

Holotype of species – Great Victorian Desert, W.A.; Camp 57 – ca. 220 km east-north-east of Kalgoorlie, ca. 260 km north-east of Lake Lefroy; R. Helms, 20.IX.1891, AD No. 962 16 157.

Isotypes—Idem, AD No. 962 15 164. Idem, MEL.

Paratypes—Arkaringa Creek, south-west of Oodnadatta, S.A.; Miss Stacr, VIII.1914, AD No. 962 15 188 (ex Herb. J. M. Black). – Blood's Creek, ca. 160 km north of Oodnadatta, S.A.; S. A. White, 20.VII.1921, AD No. 962 15 190 (ex Herb. J. M. Black). – Dalhousie near Oodnadatta, S.A.; S. A. White, 21.VII.1921, AD No. 962 15 189 (ex Herb. J. M. Black).

Habitat—R. Helms' specimens were growing in a sandy place; the more vigorous plants of the other collectors might have been gathered from richer soil.

Characteristics—This variously appearing form, which I treat as a distinct species, bears a superficial resemblance to *Pt. indivisus* Benl (= *Pt. gomphrenoides* Moq., s. in Mitt.Bot.St.Sammlg. München, 3: 38, 1959). J. M. Black (in schedulis), however, had already drawn attention to the most evident differences: "Differs from *T. gomphrenoides* in the branching hairy stem and want of acute tips in inner segments." Besides, in *Pt. indivisus* the bracts and especially the bracteoles are decidedly less tapering – they cannot be called awned there. The indumentum of the perianth is finer and considerably denser, the glabrous tips of the tepals are shorter. Further differences concern the structure and the proportions of inner floral organs, particularly as regards the cupula, showing a free ring only in *Pt. indivisus*. There is, therefore, no close relationship between these two easily distinguishable species.

Very young inflorescences of the new species resemble the corresponding stages of *Pt. manglesii* (Lindl.) F.v.Muell. in their habit (colour, indumentum). A blunt, naked and distinctly visible apex of the perianth-segments is a characteristic feature not only of the above form, of *Pt. indivisus* and *Pt. manglesii*, but of some other species as well; yet they cannot be confused. The conspicuously acuminate bracts and bracteoles represent an additional and noteworthy characteristic found also in a few other species (s.l.c. 4: 80, 1961). From these, however, the taxon in question is sharply separated.

Name—The plant is named in honour of the well-known, distinguished botanist, J. M. Black (Flora of South Australia), who had dealt with this form (in schedulis) forty years ago. It was first defined by him as a variety ('*aristatum*') of '*Trichinium exaltatum*', then as '*Trichinium beckerianum*'. One annotation reads "appearing a new species", but finally he misinterpreted it as '*Trichinium semilanatum* Lindl.', which is, by no means, conspecific with *Pt. blackii*.

Material—The description is drawn up from a series of specimens differing in habit and maturity. R. Helms' plant (AD 962 16 157), selected as holotype because of its age, measures 22 cm to the top of the inflorescence and has more than a dozen spikes more or less undeveloped. The Adelaide isotype resembles the holotype in appearance and maturity; it consists of several stems (11·5 to 19 cm), apparently detached from one piece of rhizome and each carrying up to 6 immature spikes. S. A. White's specimen from Dalhousie (28 cm) with 3 mature and 5 younger spikes is better developed, and the inflorescences carry a greater number of flowers. S. A. White's second sheet (AD 962 15 190) consists of two parts (35 and 26 cm long, 3 to 4 mm thick) of stouter stems with five and one spikes, respectively, and a slender stem (26 cm) with one half-developed spike; it bears J. M. Black's annotations and figures on the attached label. The third paratype (AD 962 15 188) seems to be somewhat doubtful at first sight. The scrappy material of a big and branched plant measuring 40 cm in length and 7 mm in diameter does not carry any spikes; besides, the measurements given by J. M. Black on the sheet do not quite agree with those I ascertained. However, a separate cover attached to the sheet contains two immature spikes matching the holotype; and Black had evidently examined a young stage of the flower. On a label stuck to the same sheet he describes some details of a flower belonging to the same species, this flower being actually a part of R. Helms' find in the Victoria Desert of 29.(?)9.1891.

2. **Ptilotus lophotrichus** Benl, sp.nov. (Fig. 2).

Herba in specimine examinato annua; caule ad 50 cm longo et 3 mm crasso, tereti-striato vel angulato-sulcato, per totam longitudinem tomentosiusculo—pilis crispis subnodosis—, usque ad inflorescentiam indiviso an pauciramoso, modice foliato, pluristachyo.

Folia basalia opposita vel fasciculata, caulina alterna 0·5-5 cm distantia, omnia petiolata, petiolo plus minusve distincto ad 1·5 cm longo; laminis (sub-) linearibus usque 3 cm longis et 4 mm latis, primo puberulis dein glabrescentibus, viridibus, inferne attenuatis, in apice acutiusculis.

Inflorescentiae longe spicatae, elongato-cylindraceae, plus minusve curvatae, circa 10 cm longae et 1 cm diametro, ad quinas congestae, terminales (paucae inferiores, rudimentares, axillares additae), multi- et confertiflorae, floribus (siccatione?) stramineo-flavescentibus, inferioribus delapsis; rhachis parce villosula.

Bracteae bracteolaeque ovato-lanceolatae, incoloratae, scariosae, hyalinae, extus apicem versus pilis teneris, articulatis, ad 2 mm longis (apicem circiter 1 mm excedentibus) indutae, inaequales: bractea 5·5 mm longa et 2 mm lata (Fig. 2, a), perianthium superans, post defloration em conspicua, demum glabra; bracteolae minores (4 mm longae et 1·2 mm latae) et acutiores, conspicue carinatae, comate pilosae (Fig. 2, b).

Perianthium in ima basi crispo-villosiusculum, in apice comosum. Tepala usque ad basim libera, oblongo-elliptica, obtusiuscula, integerrima, apicem versus lato-limbata, diaphana, in dimidio inferiore distincte trinervia—nervis lateralibus areolam medianam, impellucidam, incrassatam, rigidam includentibus-, superne pilis dorsalibus et marginalibus (ad 30) tenuibus, rectis, articulatis, ad 2 mm longis, apicem ca. 1 mm superantibus (Fig. 2, c), inferne extus

pilis brevissimis, crispatis, densis induta, inaequalia: 2 exteriora 4 mm longa et 1·2 mm lata, intus glabra; 3 interiora angustiora 3·5 mm longa et 0·8 mm lata, nervis distinctioribus (areola mediana longiore), intus in parte angustata (i.e. supra pseudotubum) pilis intricatis, praecipue marginibus orientibus et introflexis praedita (Fig. 2, d).

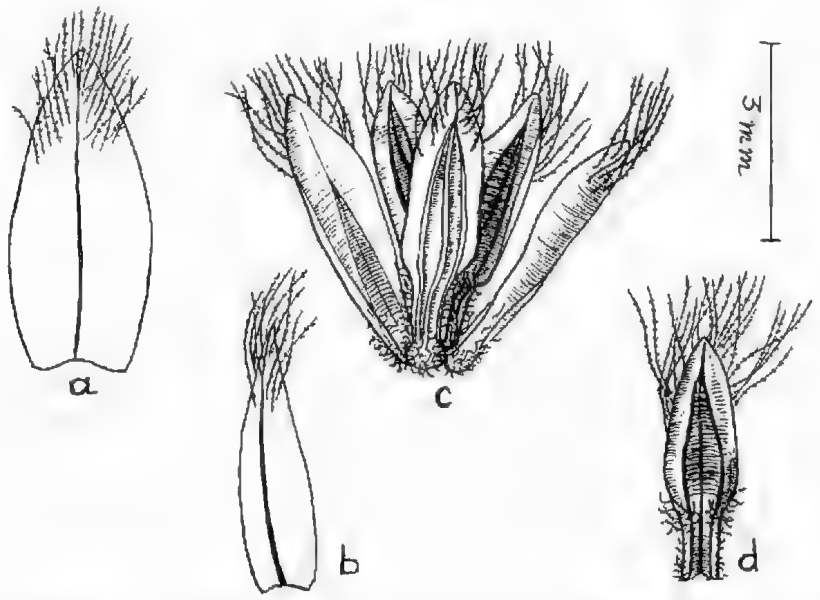

Fig. 2. *Ptilotus lophotrichus* Benl (AD 962 06 050, holotype): (a) bract; (b) bracteole; (c) perianth, half-opened; (d) inner perianth-segment, inner view.

Stamina 5, omnia subaequilonga, fertilia, basi dilatata cupulam ad 0·8 mm altam, membranaceam, hyalinam, glabram, integram – pseudostaminodiis nullis-, liberam, basi perianthii insidentem formantia. Filamenta ligulata, superne subulata, brevia (circa 1·2 mm); antherae biloculares flavae, lato-ellipsoideae, 0·35 mm longae et 0·25 mm latae.

Ovarium sessile subglobosum 0·8 mm longum et 0·7 mm latum, glaberrimum. Stylum gracile breve, centrale, glabrum 0·8 mm longum et 0·06 mm diametro; stigma globosum.

Holotype of species – Arnhem Land, N.T.; H. Basedow No. 63, 1928, AD No. 962 06 050.

Isotype—Idem, K.

Characteristics—At first glance the specimens cited above and misidentified at Kew Herbarium with '*Pt. cunninghamii* Benth.', do somewhat resemble our *Pt. lanatus* A. Cunn. ex Moq. in general facies. But apart from its longer and more densely standing spikes the newly established species is readily distinguishable from *Pt. lanatus* (var. *lanatus* and var. *glabrobracteatus*). It has, amongst other characters, a scantier pubescence of the rhachis, larger and differently pilose bracts, a dissimilar appearance of the bracteoles (s. in Muelleria 1, 2: 107, 1959). The most conspicuous feature, however, is an unmistakably different indumentum of tepals: on the outside the lower part, in *Pt. lanatus*, is

covered with relatively thin crispy hairs, the rest with thicker, scarcely nodose and very dense bristly hairs, like fur. In *Pt. lophotrichus* there is only a tuft of relatively few, thin and distinctly articulate hairs. This is a striking peculiarity of outstanding diagnostic importance. The three inner tepals of the latter are obviously woolly inside, whereas in *Pt. lanatus* all tepals are glabrous. Nevertheless, a closer alliance between the two species may be taken for granted, as they agree largely with regard to the structure (though not the proportions) of inner floral organs, particularly the cupula.

Because of its characteristic tufts of hairs (hence the specific name!) on the bracts and bracteoles as well as chiefly on the perianth-segments, *Pt. lophotrichus* cannot be confused with any previously described species.

Material—The holotype-sheet consists of four fragments (21 to 24 cm each) from two (?) plants. Taken together they give a very good idea of the characteristic features of the new taxon, especially those of the flower, since the long spikes are well developed and preserved.

3. **Ptilotus obovatus** (Gaud.) F.v.Muell. var. **griseus** Benl, var. nov. (Fig. 3).

Planta fruticulosa, caulibus ad 0·5 m et ultra longis, 6 mm crassis, erecto-virgatis, ramosis. Rami ramulique et folia crassiuscula, elliptica sive obovata (ad 3 cm longa et 1 cm lata), apiculata, plus minusve petiolata tomento pilorum dendroideorum (articulatorum, in nodis verticillatorum), usque 2 mm longorum induta.

Spicae pedunculatae complures ramos terminantes, in paniculam laxam dispositae, hemisphaericae vel subovoideae (ad 1·8 cm diametro), haud densiflorae. Flores (10-20) perianthio purpureo, inferne tubum induratum, 1 mm longum formanti, apicibus glabris tepalorum exteriorum conspicuis.

Bracteae bracteolaeque distincte acuminatae, nervo medio in cuspidem producto, inaequales. Bractea fusca vel fuscescens indumento abscondita, visu grisea (unde nomen varietatis!), opaca, rigida, concava, subrotunda usque oblonga-ovata, 5-6 mm longa (cuspide setacea 1 mm inclusa) et 3 mm lata, extus pilis articulatis, ad nodos denticulatis, circa 2 mm longis, praecipue areae medianae orientibus, praeter cuspidem densissime obtecta (Fig. 3, a). Bracteolae tenues, ovato-orbiculares, aristatae, nervum medium fuscescentem versus pilis denticulato-nodosis, 2 mm longis, aristam partim involventibus dense obsessae (Fig. 3, b), lateribus glabris, hyalinis, nitidis, usque 5 mm longae (arista 1·5 mm inclusa) et 3 mm latae, adpressae, ventricosae.

Tepala (6-7 mm longa) extus modice et inaequaliter pilosa (Fig. 3, c), pilis superioribus rectis ad 2 mm tantum longis; intus omnia glabra.

Stamina 3 fertilia, 2 ananthera filamentis brevioribus, brunnescentibus, involutis. Ovarium glaberrimum (Fig. 3, d).

Ceterum ut in var. obovato.

Holotype of variety – Northern Territory, Central Australia. On summit of low rock (about 150 feet above plain) in Mount Olga area—ca. 360 km south-west of Alice Springs. E. N. S. Jackson No. 118, 16.VIII.1959, AD No. 961 02 032.

Differt a typo speciei caulibus et foliis pilosioribus (pilis in foliis dendroideis!), bractea maiore et densissime villosa, bracteola aristata, tepalis minus pilosis, ovario glaberrimo.

Recedit a var. *parviflora* (Lindl.) Benl indumento multo ampliore, bractea obscura et bracteolis aristatis duplo maioribus et densius pilosis, tepalis pilosioribus.

Differt a var. *lanicifolia* Benl indumento multo ampliore, spicis pauci- et laxifloribus brevioribus, bracteis maioribus fuscis, bracteolis maioribus.

Characteristics—The most striking feature of the present plant is its relatively long and extremely pilose bracts. A grey or dull grey colour, not only of the bracts but of the entire spike, is a result of the white hair growing on a brown to dark brown epidermis. This has been unknown in *Pt. obovatus* so far. Furthermore, the newly described taxon is conspicuous among the numerous forms of the exceedingly variable species (s. in Mitt.Bot.St.Sammlg. München 3: 510-512, 1960) for its quite uncommon indumentum in the vegetative parts: the hairs, especially of the leaves, are not stellate but dendroid, as is usual in *Pt. incanus*.

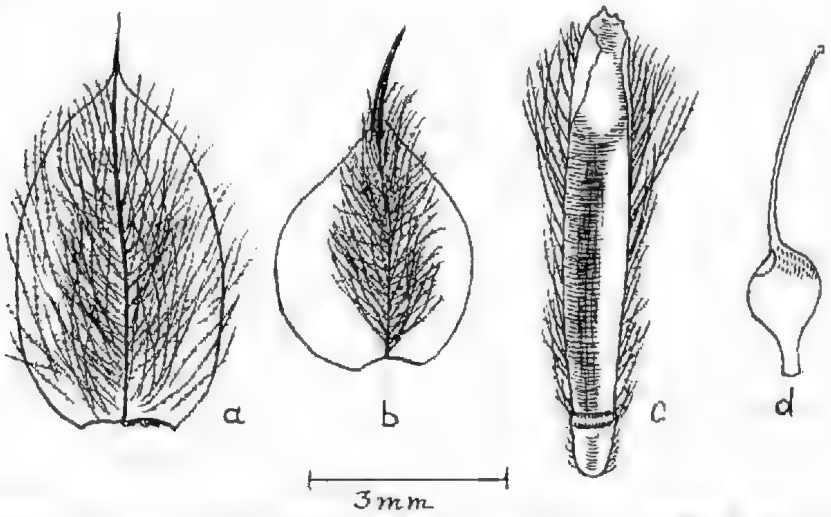

Fig. 3. *Ptilotus obovatus* (Gaud.) F.v.Muell. var. *griseus* Benl (AD 961 02 032, holotype): (a) bract; (b) bracteole; (c) outer perianth-segment, inner view; (d) pistil.

In spite of some outward resemblance with *Pt. incanus* there can, however, be no doubt that the above form, following the general trend of *Pt. obovatus*, is correctly to be placed within the range of that species. This is indicated not only by the habit of its inflorescences (long-pedunculated spikes, right-angled inferior peduncles; s.l.c. 4: 280-281, 1962), but also by the floral details: besides other characters, the aristae of the bracts and bracteoles as well as the glabrous tips of perianth-segments are still considerably longer in *Pt. incanus*.

Among the representatives of var. *obovatus* bearing brown bracts there can be found certain plants which may represent intermediates leading to the present form, such as No. 408/1958 gathered by D. J. E. Whibley on Gawler Range, S.A. (AD No. 959 31 010; B, K, M, UC). It looks like the typical *obovatus* as regards the kind of its indumentum of leaves and the intensity of pubescence in the tepals, whereas its large long-acuminate brown, although less pilose, bract and the entirely glabrous pistil, seem to accord better with the respective organs in our well-defined plant. Entirely hairless ovaries may be found, it is

true, in var. *parviflorus* as well as in var. *lancifolius*. Either of them, however, has quite a different facies of the spikes; specimens representing transitional forms were not to be found, though.

In conclusion, the combination of the cited characters makes the new form distinctive enough to be given a varietal name.

Material—The description is based on one specimen only, measuring about 45 cm in height and 25 cm in width. But the well-prepared plant has more than 30 spikes at the tops of its numerous branches and branchlets, thus representing a very good type-specimen of the new variety.

ACKNOWLEDGMENTS

I wish to express my appreciation to Dr. Hj. Eichler (State Herbarium of South Australia, Adelaide) for his courtesy, which made it possible for me to study a great number of specimens of Ptilotus, among them the new taxa analysed and described above.

CYRILWHITEA, A NEW GENUS IN CHENOPODIACEAE

BY ERNEST H. ISING

Summary

A new genus of Chenopodiaceae, *Cyrilwhitea* Ising, and its only species, which was known as *Bassia walkeri* White, from Queensland, are described and a key provided to show the distinctive characters of related genera

CYRILWHITEA, A NEW GENUS IN CHENOPODIACEAE

By Ernest H. Ising*

(Communicated by Hj. Eichler)

[Read 11 June 1964]

SUMMARY

A new genus of Chenopodiaceae, *Cyrilwhitea* Ising, and its only species, which was known as *Bassia walkeri* White, from Queensland, are described and a key provided to show the distinctive characters of related genera.

Cyrilwhitea E. H. Ising, gen.nov.— Flores minuti, bisexuales, axillares, sessiles. Stamina 5. Perianthium in fructu longitudinaliter biloculare; embryo in loculo superiore inclusus; loculus inferior vacuus, occlusus, in 5 cellulas incompleto divisus; lobi 5. Appendici 5, non-spinosi. Stylus in parte inferiore connatus; rami 2.— Typus: *Cyrilwhitea walkeri* (White)Ising.

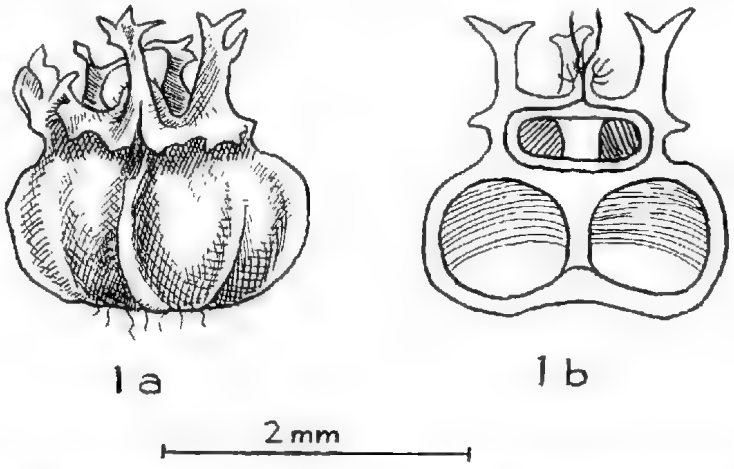

Fig. 1. *Cyrilwhitea walkeri* (White)Ising, fruit (type).—1a: side view; 1b: vertical section.

Flowers small, bisexual, axillary, sessile. Stamens 5. Fruiting perianth longitudinally bilocular; upper locule containing embryo, lower locule empty, closed, incompletely divided into 5 cells; lobes 5. Appendages 5, non-spinous. Style connate in lower part; branches 2.

The genus is named in honour of the late Cyril T. White (1890-1950), formerly Government Botanist, Brisbane.

Only one species:

* State Herbarium of South Australia, Adelaide.

Cyrilwhitea walkeri (White)Ising, comb.nov.— Basionym: *Bassia walkeri* C. T. White, Proc.Roy.Soc.Queensland 55(1944)77, t.IV.— Slender undershrub; branches terete, slightly ribbed, lanate to tomentose. Leaves linear 3-10 mm long, ca. 1 mm wide, obtuse, sparsely pubescent. Flowers solitary. Fruiting perianth depressed globular, chartaceous, ca. 2½ mm diam., ca. 1½ mm long without the appendages, tomentose, undulating wing at summit; ribs 10, 5 of which prominent, longitudinal, decurrent from appendages, sometimes winged and 5 weak ones alternating with them; upper locule small; lower locule larger, equally divided into 5 cells by erect membranous radiating septa; lobes 5 erect, obtuse, ciliate; base umbilicate, circular, small. Appendages 5, ca. 1 mm long, usually angular and 1 amply winged, furcate with 2 or 3 lobes, erect, soft, almost glabrous. Style thickened downwards, glabrous; branches 2, red. Seed horizontal; radicle lateral. Utricle thick in upper part, glabrous.— Fig. 1a, 1b.

Queensland. Diamantina-Mackunda Creek, channels. Gregory North District, on flats associated with Soda Bush (*Threlkeldia proceriflora*), L. G. Walker (flowers), July 1941; (fruits, type), Feb. 1942: BRI (*holotype*), AD 96021148 (isotype).

The large closed lower cavity (locule) divided into five cells in the fruiting perianth and the furcate, soft appendages, characteristic of *Cyrilwhitea walkeri*, do not occur in any species of *Bassia* All. (s.lat.).

Key to Related Genera

1. Appendages to fruiting perianth 1 to many, spinous, hard. *Bassia*
1. Appendages to fruiting perianth 3-5, not spinous, soft.
   2. Appendages simple, 3-4, horizontal. *Malacocera*
   2. Appendages furcate, 5, erect. *Cyrilwhitea*

THE SPECIES OF BASSIA ALL. (CHENOPODIACEAE) IN AUSTRALIA

By Ernest H. Ising*

(Communicated by Hj. Eichler)

[Read 11 June 1964]

SUMMARY

All specimens of *Bassia* All. (s.lat.) in the Australian State Herbaria and some private collections have been examined and a key is provided for the 79 species (of which one is introduced) and their varieties recognized in Australia. One section, twenty-four species and three varieties are described as new, necessary nomenclatural changes are introduced, and important details are added to some species. In many cases only a selection of the specimens examined is quoted in order to indicate the known geographical distribution. The index provides an easy reference to the accepted names, synonyms and excluded or doubtful species.

INTRODUCTION

Since my paper "*Bassia uniflora* (R.Br.)FvM. (Chenopodiaceae) and its Allies" [Trans. Roy. Soc. S. Austral., 48 (1961) 87-98], I have examined *Bassia* specimens of all other species in the larger Herbaria in Australia. After having examined specimens of *B. muricata* (L.) Aschers., the type species of the genus, I feel confident in still considering the Australian species concerned as congeneric. It may appeal at first sight to segregate the species occurring in the two geographically isolated regions into *Bassia* All., comprising the Mediterranean and South-West Asian species, and *Sclerolaena* R.Br., with the Australian species. *Sclerolaena* R.Br. and *Anisacantha* R.Br. are the oldest generic names available; the type species of *Anisacantha* (*A. divaricata* R.Br.) was transferred to *Sclerolaena* by Domin (1925), whereas none of the original species of *Sclerolaena* were ever transferred to *Anisacantha*. However, I could not find any greater discontinuity in the variation of morphological characteristics between *B. muricata* (L.) Aschers. and the nearest Australian species than between some of the Australian species and their closest allies. An ultimate segregation into various genera may become reasonable when revised on the level of a tribe, but as the distinction of genera as outlined by Ulbrich [in Engler and Prantl, Nat Pflfam. ed. 2, 16c (1934) 529-540] does not seem acceptable since many more species are now known which cannot satisfactorily be placed in either of these genera, the complex genus *Bassia* All. is here maintained in the wide sense applied by R. H. Anderson in his revision of the genus [Proc. Linn. Soc. N.S. Wales 48 (1923), 317-355, t. 34-36].

Material Investigated

Specimens of the herbaria of the following institutions and persons have been investigated: A. C. Beauglehole, Portland, Victoria (A.C.B.); State Herbarium of South Australia, Adelaide (AD); Waite Agricultural Research Institute (ADW); British Museum (Natural

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History), London (BM); Botanic Museum and Herbarium, Brisbane (BRI); C.S.I.R.O., Divisions of Plant Industry and of Land Research and Regional Survey, Canberra (CANB); C. K. Ingram, Bathurst, N.S. Wales (Ingr.); Herbarium, Royal Botanic Gardens, Kew, England (K); National Herbarium of Victoria, Melbourne (MEL); University of New England, Armidale, N.S. Wales (NE); National Herbarium of New South Wales, Sydney (NSW); Animal Industry Branch, Northern Territory Administration, Alice Springs (NT); Western Australian Herbarium, Perth (PERTH); Department of Botany, University of Western Australia, Perth (PERTHU); Botanical Department of the National Museum, Praha, Czechoslovakia (PR); Herbarium, School of Biological Sciences, University of Sydney (SYD). The study was undertaken at the State Herbarium of South Australia, Adelaide.

Sundry Notes on some Morphological Characters

Indumentum. Quite a number of species are practically glabrous; usually, however, hairs are found on the limb and in the axils of the leaves. Other species are pubescent. Chiefly three types of hairs are represented in the Australian species: (1) Simple hairs are the most common; *Bossia lanicuspis* is an example of long, dense, straight hairs. (2) Hairs with short spreading teeth which are several times longer than the thickness of the hair; *B. fimbata* is the only species with such hairs. (3) Verticillately branched hairs, the main hair axis, usually curly, has a number of whorls of teeth which are about 0·25 mm long; this is found only in *B. cremacea*; the whole plant is very densely covered with these hairs.

Leaves. Most of the species have narrow leaves, linear to lanceolate, and in quite a number the leaves are terete or semiterete. Unusual leaf-shapes are spathulate (*B. luehmannii*), obovate (*B. birchii*), oblanceolate (*B. cordyshiana*). Some leaves are straight or slightly curved while others are irregularly bent.

Inflorescence. It is noteworthy that some species have two flowers in the axil. This has been observed in *B. luehmannii*, *B. symoniana* and *B. albolanata*. All other Australian species have flowers solitary or in clusters in the axil. Black [Fl.S.Austral. 2.ed.(1948)301] in his description of the genus refers to "flowers sessile, usually solitary", but no species in his Flora are mentioned as having two flowers in the axil. Anderson [Proc.Linn.Soc.N.S.Wales 48(1923)319] observes "flowers solitary or in clusters".

Fruiting perianths. In many cases the shape of the perianth is difficult to describe because of its irregular structure. There is sometimes a variation in the same plant when a flower is probably not pollinated, in that case the perianth's development is arrested. This appears to be the case in *B. tatei* which, in the fertile fruit, has a large unilateral gibbous base which is not developed in the infertile fruits.

The fertile fruit of *B. anisacanthoides* has a large empty cavity below the embryo with an open mouth but the infertile fruit has a cavity much reduced in size and the mouth is absent.

In the great majority of species the perianth becomes hardened in fruiting stage but in others it remains thin and chartaceous from flower to fruit.

In some species the fruits are deciduous or easily detached while in others they are so firmly attached to the branch that they can be removed only with difficulty.

Spines. There is a remarkable variation in the spines of the various species. The acicular type is predominant, and they may be straight or recurved. Some are awn-like (*B. eurotioides*), others flattened (*B. tridens*, *B. murrayae*, *B. ramsayae*), while in *B. luehmannii* they are very irregular. In *B. symoniana* the spines are most irregular and numerous and are developed on the margins of five lobate lobes. Two species, *B. stelligera* and *B. brachyptera*, have tooth-like spines. Spines are usually borne on the summit of the perianth, but in *B. biflora* there are only rarely one or two short, subulate, spreading spines on the connate perianths. In *B. urceolata* the spines are soft and obtuse. Quite unusual is *B. elelandii* in which the perianth summit is produced into two recurved lobes having two or three short spines at the apex of each lobe. There are quite a number of species with five spines of which two are close together at the base and usually shorter than the others. These have usually been described as a bifid spine. The term bifid is not used in this paper, and instead the "bifid spine" is recorded as two spines.

Tubercle. The erect appendage protruding from the summit of the fruiting perianth, which occurs in many species, is called tubercle in the descriptions. It is usually a receptacle for the radicle when turned upwards (superior). This is seen particularly in *B. caput-casuarii* where the appendage is quite prominent. In many of the species the tubercle is small and inconspicuous, in some absent.

KEY TO AUSTRALIAN SECTIONS, SPECIES AND VARIETIES OF GENUS *BASSIA* All.

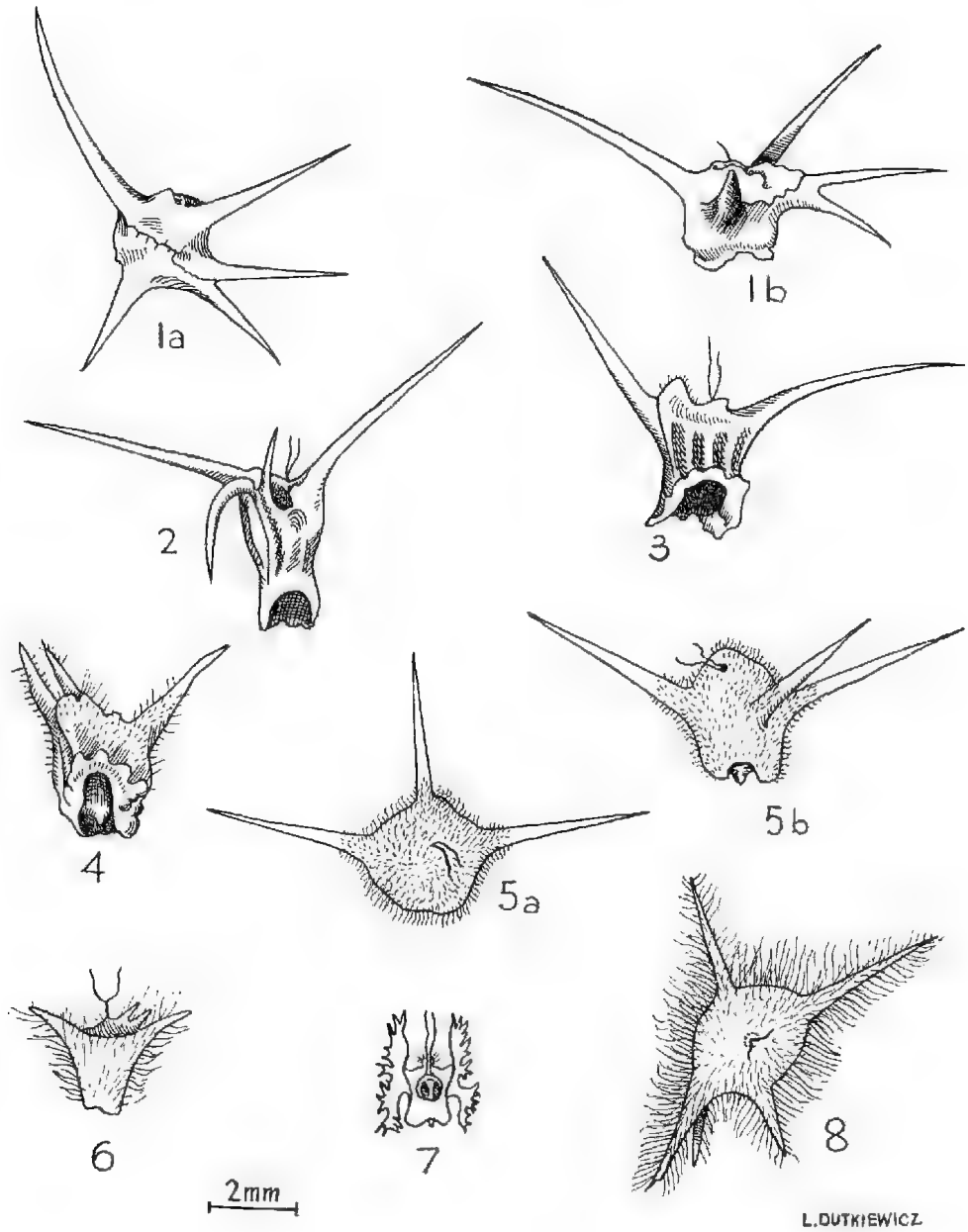
Ripe fruits are necessary for safe determination of most species. In this key emphasis was placed on externally visible characters. If not stated otherwise, the characters given for the perianth are those shown in the mature fruit. A species occurs in several places in the key if the number of spines of its fruits varies. This character is used to divide within sect. *Anisacantha*.

1. Perianth remaining membranous, not at all or very slightly hardened in fruit.
  2. Fruiting perianth without any appendages other than spines. (Sect. *Bassia*)
    3. Spines circinnate. ..... 1. *B. hyssopifolia*
    3. Spines straight.
      4. Spines under 3 mm long. ..... 2. *B. muelleri*
      4. Spines 8-15 mm long, weak. ..... 3. *B. eurotioides*
  2. Fruiting perianth with erect appendages in addition to the spines. (Sect. *Eriochiton* Anders.) 4. *B. sclerolaenoides*

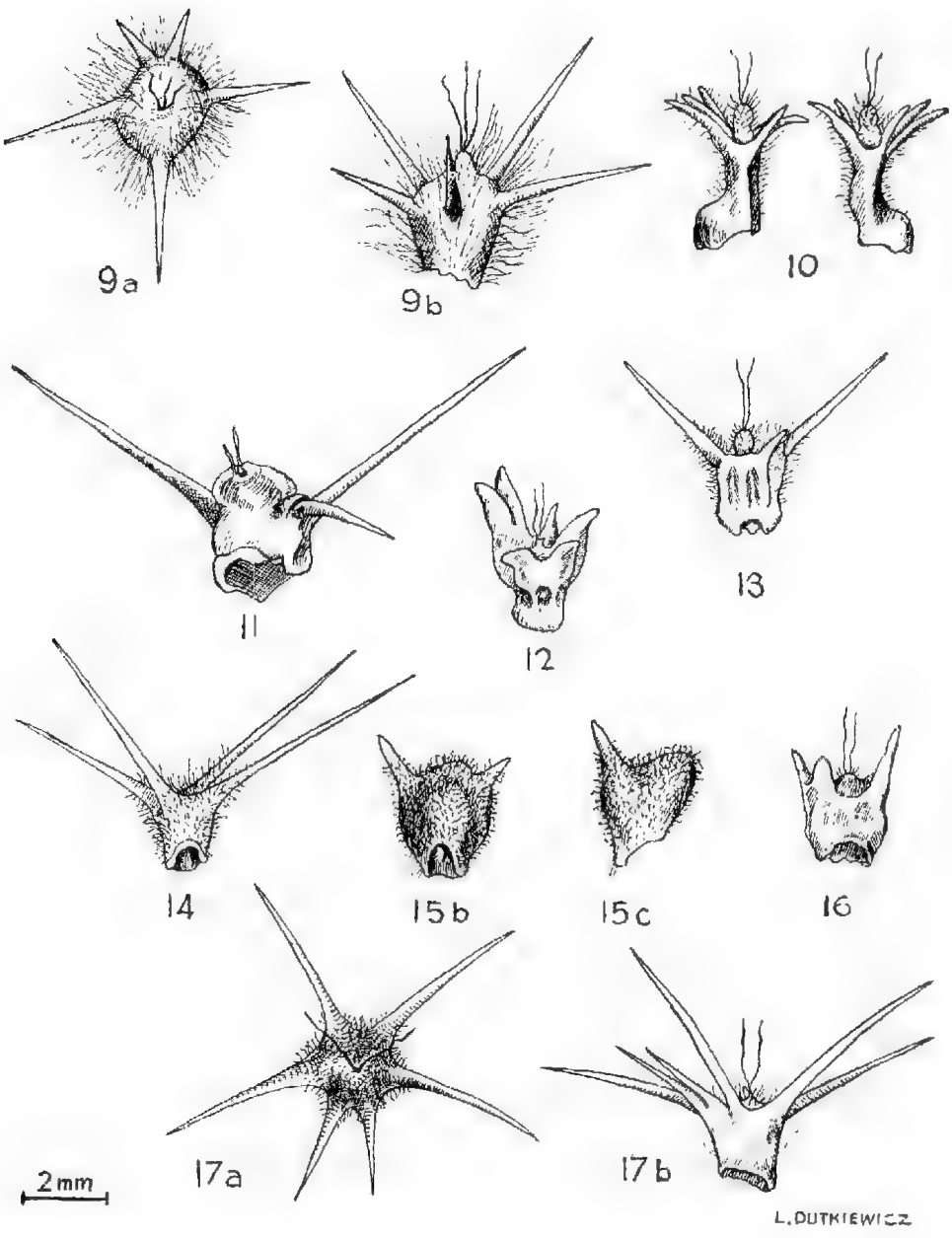
1. Perianth becoming hardened from base in fruit.
  5. Flowers clustered, fruiting perianths two to many, mostly in globular heads. (Sect. *Dissocarpus* Volkens)
    6. Spines 5-6, always present; fruits 2-16 per axil, connate.
      7. Spines 5; fruits 6-16; plant hairy; leaves flat.
        8. Leaves linear, usually less than 3 mm wide. ..... 5. *B. paradoxa*
        8. Leaves oblong-cuneate, usually 5-8 mm wide. ..... 5. *B. paradoxa* var. *latifolia*
      7. Spines usually 6; fruits 2-3, connate, sometimes solitary; plant glabrous in age; leaves terete. 6. *B. georgei*
    6. Spines 0-2, usually absent, erect.
      9. Fruits 3-7, connate in head. ..... 7. *B. biflora* var. *cephalocarpa*
      9. Fruits 2, connate at base.
        10. Perianths tomentose. ..... 7. *B. biflora*
        10. Perianths densely villous with very long hairs. ..... 7. *biflora* var. *villosa*
  5. Flowers 2 or 1 per axil, when 2, not connate.
    11. Flowers 2 in axil, separate, spines very irregular. Sect. *Spinosissimae* Ising)
      12. Spines bordering perianth. ..... 8. *B. luehmannii*
      12. Spines bordering 5 free lobes. ..... 9. *B. symoniana*
    11. Flowers 1 in axil.
      13. Fruiting perianth bordered by a narrow rim or wing-like expansion, broken up into spines. [Sect. *Asterocarpus* (FvM.) Ising]
        14. Spines or teeth 8-15. ..... 10. *B. stelligera*
        14. Spines 5. ..... 11. *B. brachyptera*
      13. Fruiting perianth without any wing-like expansion; spines present.
        15. Spines broadly flattened, 3-4. (Sect. *Platyacantha* FvM.) ..... 12. *B. tridens*
        15. Spines not flattened, usually acicular, 1-6. (Sect. *Anisacantha* Volkens)
          16. Spine 1 (rarely 1-3 in *B. tatei*). ..... 13. *B. caput-casuarii*
          16. Spines 2-6.
            17. Spines 2 (sometimes 3 in *B. hieuspis*, 3 or 4 in *B. globosa* and *B. decurrens*).
              18. Base deeply hollowed.
                19. Perianth silky-villous. ..... 14. *B. eriacantha*
                19. Perianth tomentose, pubescent or glabrous.
                  20. Tubercle hooked; perianth pubescent. ..... 15. *B. gardneri*
                  20. Tubercle not hooked.
                    21. Spines erect.
                      22. Spines parallel, equal; base oblong ..... 16. *B parallelicuspis*
                      22. Spines unequal; base gibbous on one face. ..... 17. *B. tatei*
                    21. Spines divergent.
                      23. Tubercle large, longer than spine.
                        24. Perianth glabrous. ..... 18. *B. burbidgeae*
                        24. Perianth hairy. ..... 19. *B. uniflora*
                      23. Tubercle inconspicuous. ..... 20. *B. diacantha*
                        25. Areole margin crenate; base expanded. ..... 21. *B. crenata*
                        25. Areole margin not crenate or expanded.
                          26. Limb crested at one end. ..... 22. *B. cristata*
                          26. Limb not crested.
                            27. Spines to 7 mm long. ..... 23. *B. holtiana*
                            27. Spines to 4 mm long.
                              28. Perianth globular. ..... 24. *B. eichleri*
                              28. Perianth not globular.
                                29. Perianth constricted in middle. ..... 25. *B. constricta*
                                29. Perianth not constricted. ..... 26. *B. wilsonii*
              18. Base not or slightly hollowed.
                30. Perianth globular or almost so.
                  31. Spines opposite when only 2. ..... 27. *B. globosa*

31. Spines divergent; perianth subglobular.
32. Spines 10-15 mm long; perianth 7-8 mm diam. ..... 28. *B. bicorn*
32. Spines usually 5 mm long; perianth ca. 5 mm diam. ..... 28. *B. bicornis* var. *horri*
30. Perianth not globular.
33. Spines not in same vertical plane.
34. Leaves to 7 mm long, linear. ..... 29. *B. obliquicusp*
34. Leaves to 4 mm long, obovate. ..... 30. *B. brevifo*
33. Spines in same vertical plane
35. Plant glabrous.
36. Limb ridge-like. ..... 31. *B. glab*
36 Limb dome-like. ..... 32. *B. bicusp*
35. Plant hairy.
37. Limb as long as perianth.
38. Perianth tomentose, not ribbed ..... 33. *B. limba*
38. Perianth glabrous, ribbed. ..... 34. *B. decurre*
37. Limb shorter than perianth.
39. Perianth ribbed, base circular. ..... 35. *B. everistia*
39. Perianth not ribbed, base ovate. ..... 36. *B. patenticusp*
17. Spines 3-6.
40. Spines 3 (sometimes 1-2 in *B. tatei*, 2 or 4 in *B. globosa*, 4 in *B. ventricosa* and *B. andersonii*, 4-6 in *B. lanicuspis*).
41. Perianth villous or tomentose.
42. Perianth villous. ..... 37. *B. lanicusp*
42. Perianth tomentose.
43. Spines erect or divergent; perianth; swollen in lower part ..... 38. *B. ventrico*
43. Spines horizontal or divergent; perianth globular. ..... 27. *B. globo*
41. Perianth glabrous.
44. Perianth much gibbous at base, ribbed. ..... 17. *B. ta*
44. Perianth not gibbous.
45. Spines spreading or recurved.
46. Spines usually recurved; perianth cylindrical. ..... 39. *B. articul*
46. Spines mostly horizontal; perianth ± oblong. ..... 40. *B. oppositicusp*
45. Spines ± diverging upwards.
47. Perianth conical, base expanded. ..... 41. *B. tricusp*
47. Perianth not conical, base not expanded.
48. One spine ± hooked; perianth laterally attached. ..... 42. *B. anderso*
48. No spines hooked; perianth basally attached.
49. Perianth urceolate. ..... 43. *B. aella*
49. Perianth not urceolate.
50. Leaves 3-6 mm long. ..... 44. *B. drummon*
50. Leaves 10-15 mm long.
51. Limb dome-shaped. ..... 32. *B. biscusp*
51. Limb truncate-conical. ..... 34. *B. decurre*
40. Spines 4-6.
52. Spines 4 (2 or 5 sometimes in *B. decurrens*, 5-6 in *B. lanicuspis*).
53. Plant hairy.
54. Perianth globose. ..... 27. *B. globo*
54. Perianth not globose.
55. Spines ca. equal in length.
56. Spines filiform. ..... 45. *B. filifor*
56. Spines subulate. ..... 46. *B. ramsay*
55. Spines unequal in length.
57. Longer spine to 20 mm long. ..... 47. *B. forrestia*
57. Longer spine under 10 mm long.
58. Perianth ca. 1½ mm long. ..... 48. *B. minu*
58. Perianth ca. 3 mm long.
59. Perianth ribbed, glabrous. ..... 34. *B. decurre*
59. Perianth not ribbed, sparsely tomentose. ..... 38. *B. ventrico*
53. Plant glabrous.
60. Limb cucullate. ..... 49. *B. cucull*
60. Limb not cucullate.
61. Spines recurved; perianth cylindrical. ..... 50. *B. recurviusp*
61. Spines erect to horizontal (1 recurved in *B. blakei* and *B. oppositicuspis*)
62. Perianth urceolate ..... 51. *B. blak*
62. Perianth not urceolate.
63. Limb recurved. ..... 52. *B. divarica*
63. Limb erect.
64. Perianth conical. ..... 53. *B. longicusp*

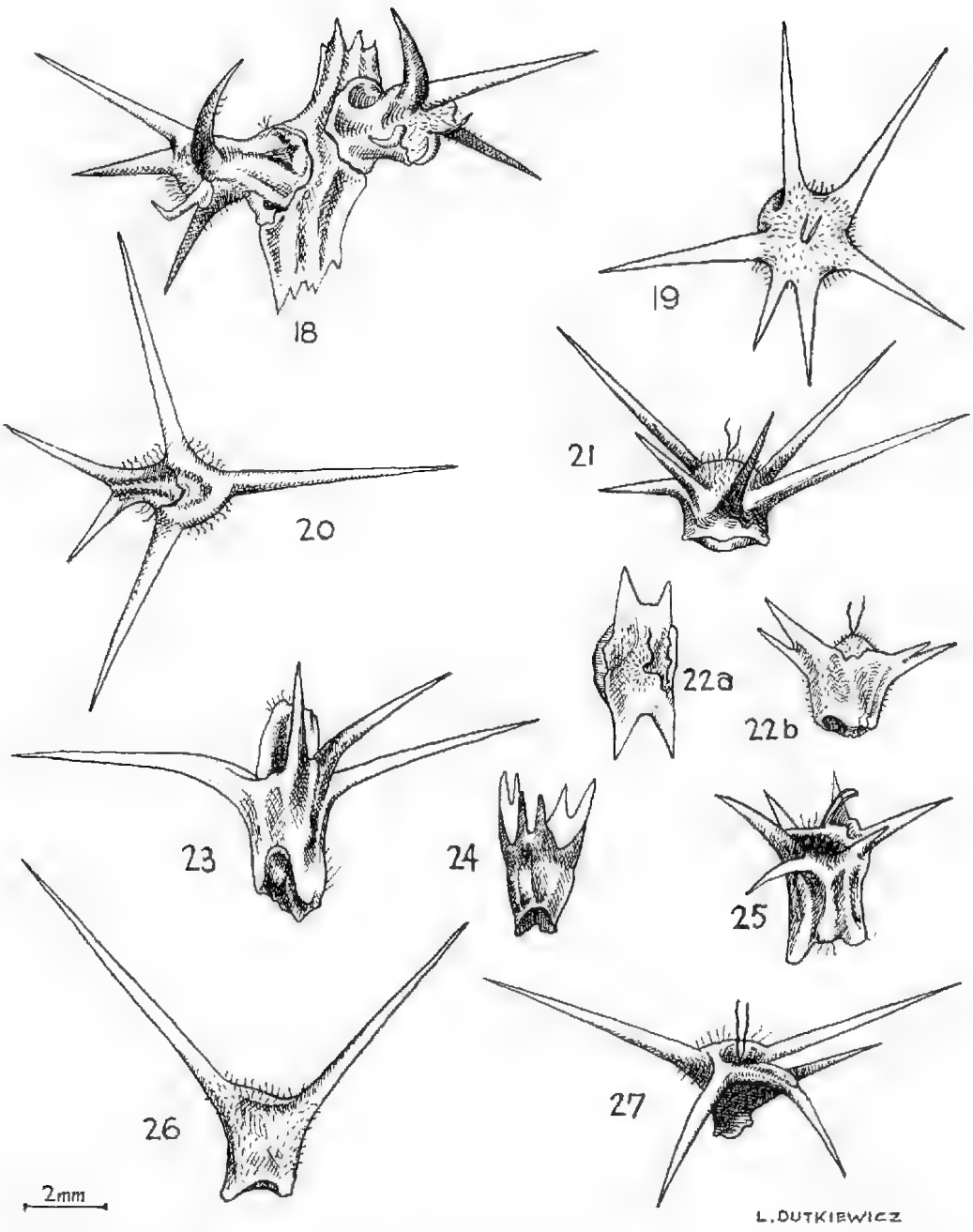
64. Perianth cylindrical.
65. Spines irregularly spaced, usually diverging to horizontal.
66. 1 spine hooked; base hollowed. ..... 42. *B. andersonii*
66. 1 spine erect, short; base not hollowed. ..... 40. *B. oppositicuspis*
65. Spines ± equally spaced, diverging–erect.
67. Perianth ca. 1½ mm wide, summit flat. ..... 54. *B. tetracuspis*
67. Perianth ca. 5 mm wide, summit concave. ..... 55. *B. hostilis*
52. Spines 5-6.
68. Spines 5 (sometimes 6 in *B. alboIanata*, *B. ramulosa* and *B. lanicuspis*).
69. Plant hairy.
70. Plant hairs verticillate. ..... 56. *B. cremaea.*
70. Plant hairs simple.
71. Spines on 2 perianth lobes. ..... 57. *B. clelandii*
71. Spines on perianth summit.
72. Perianth urceolate, spines recurved. ..... 58. *B. blackiana*
72. Perianth not urceolate.
73. One spine toothed at apex; densely white woolly plant. ..... 59. *B. alholanata*
73. All spines with simple points.
74. Spines evenly spaced. ..... 60. *B. astrocarpa*
74. Spines irregularly spaced.
75. Limb erect; conspicuous.
76. Perianth villous; 2 spines collateral.
77. Collateral spines equal in length. ..... 61. *B. densiflora*
77. Collateral spines unequal in length. ..... 37. *B. lanicuspis*
76. Perianth glabrous; 2-3 spines tooth-like, at base of others. ..... 34. *B. decurrens*
75. Limb recurved, inconspicuous.
78. Spines diverging upwards.
79. Plant densely white tomentose. ..... 62. *B. chippendalei*
79. Plant with few hairs.
80. Perianth depressed globular. ..... 63. *B. ramulosa*
80. Perianth obconic. ..... 64. *B. obconica*
78. Spines ± horizontal.
81. Leaves obovate-oblanceolate.
82. Leaves glabrous above, dark green. .. 65. *B. quinquecuspis* var. *semiglabra*
82. Leaves hairy all over. ..... 66. *B. birchii*
81. Leaves linear-lanceolate.
83. Perianth ribbed; summit flat. ..... 67. *B. costata*
83. Perianth not ribbed.
84. Perianth globular, deciduous, summit convex. ..... 68. *B. convexula*
84. Perianth depressed persistent.
85. Plant ± villous. ..... 65. *B. quinquecuspis* var. *villosa*
85. Plant woolly, leaves narrow-oblanceolate. 65. *B. quinquecuspis* var. *lanata*
69. Plant glabrous.
86. Perianth much longer than wide.
87. Perianth attached basally. ..... 69. *B. tubata*
87. Perianth attached laterally. ..... 70. *B. intricata*
86. Perianth ca. as long as wide.
88. Perianth attached basally; leaves terete, pale green. ..... 71. *B. johnsonii*
88. Perianth attached obliquely; leaves flat, rarely terete, dark glaucous. ..... 65. *B. quinquecuspis*
68. Spines 6 (sometimes 5 in *B. alholanata* and *B. ramulosa*).
89. Perianth 2-spurred at base, glabrous. ..... 72. *B. calcarata*
89. Perianth not spurred at base.
90. Perianth urceolate.
91. Spines lanceolate, pungent. ..... 73. *B. murrayae*
91. Spines ± terete, obtuse.
92. Perianth smooth, not ribbed. ..... 74. *B. anisacanthoides*
92. Perianth strongly obtusely winged. ..... 75. *B. urceolata*
90. Perianth not urceolate.
93. Spines recurved, very short. ..... 76. *B. microcarpa*
93. Spines not recurved, ± straight.
94. Leaves clavate, short. ..... 77. *B. clavata*
94. Leaves not clavate.
95. Spines ± horizontal.
96. Spines ca. 1 mm long. ..... 78. *B. parviflora*
96. Spines 4-9 mm long. ..... 79. *B. cornishiana*
95. Spines diverging upwards or erect.
97. Plant densely white woolly; 1 spine toothed at apex. ..... 59. *B. alholanata*
97. Plant with few hairs; all spines simple. ..... 63. *B. ramulosa*



Figs. 1-8. Fruits of *Bassia* species (all drawings from type specimens).—1: *Bassia johnsonii* Ising; 2: *B. blakei* Ising; 3: *B. crenata* Ising; 4: *B. cristata* Ising; 5: *B. globosa* Ising; 6: *B. minuta* Ising; 7: *B. symoniana* Ising, vertical section; 8: *B. chippendalei* Ising.



Figs. 9-17. Fruits of *Bassia* species (all drawings from type specimens).—9: *Bassia albolanata* Ising; 10: *B. clelandii* Ising; 11: *B. cucullata* Ising; 12: *B. urceolata* Ising; 13: *B. everistiana* Ising; 14: *B. filiformis* Ising; 15: *B. wilsonii* Ising; 16: *B. aellenii* Ising; 17. *B. clavata* Ising.



Figs. 18-27. Fruits of *Bassia* species (all drawings from type specimens).—18: *Bassia crèmaea* Ising, part of branch with 2 fruits, hairs deleted; 19 and 21: *B. ramulosa* White; 20 and 27: *B. obconica* Ising; 22: *B. ramsayae* Willis; 23: *B. oppositicuspis* Ising; 24: *B. murrayae* Ising; 25: *B. calcarata* Ising; 26: *B. brevifolia* Ising.

Fig. 28. *Bassia georgei* Ising (type): three connate fruits.

Bassia All.

Allioni, Mel.Phil.Mathém.Soc.Turin 3(1766)177, t.4 fig. 2 [Lectotypus: *Bassia muricata* (L.)Aschers. (*Salsola muricata* L.)]; Volkens in Engler and Prantl, Nat.Pflfam. 31/a(1893)70; Anderson, Proc.Linn.Soc.N.S.Wales 48(1923) 317-355, t.34-36; Ulbrich in Engler and Prantl, Nat. Pflfam. ed.2, 16c(1934)530.— *Sclerolaena* R.Br., Prod. 1(1810)410 [Lectotypus: *Sclerolaena uniflora* R.Br.].— *Anisacantha* R.Br., Prod. 1(1810)410 [Typus: *Anisacantha divaricata* R.Br.].— *Kentropsis* Moq., Chenop.Monogr.Enum. (1840)83 [Typus: *Kentropsis lanata* Moq.].— *Dissocarpus* FvM., Trans.Phil.Inst.Vict. 2(1858)75 [Typus: *Dissocarpus biflorus* (R.Br.)FvM. (*Sclerolaena biflora* FvM.)].— *Coilocarpus* FvM. ex Domin, Bibl.Bot. 89(1921)625 [Typus: *Coilocarpus brevicuspis* (FvM.) Domin (*Anisacantha brevicuspis* FvM.)].— *Austrobassia* Ulbrich in Engler and Prantl, Nat.Pflfam. ed.2,16c(1934)532 [Lectotypus: *Austrobassia ventricosa* (Black)Ulbrich (*Bassia ventricosa* Black)].— *Sclerobassia* Ulbrich in Engler and Prantl, Nat.Pflfam. ed.2,16c(1934)539 [Typus: *Sclerobassia litoralis* (Diels) Ulbrich (*Bassia litoralis* Diels)].

Sect. 1. *B a s s i a* [Lectotypus: *Bassia muricata* (L.) Aschers.(*Salsola muricata* L.)].— *Chenolea* sect. *Echinopsilon* Hook.f. in Benth. and Hook.f., Gen. Pl. 3/1(1880)60 (syn. excl.); *Bassia* sect. *Echinopsilon* Volkens in Engler and Prantl, Nat.Pflfam. 3/1a(1893)70 (syn. excl.).— *Bassia* sect. *Uncinatae* Ulbrich in Engler and Prantl, Nat.Pflfam. ed.2,16c(1934)531.— *Bassia* sect. *Muricatae* Ulbrich in Engler and Prantl, Nat.Pflfam. ed.2,16c(1934)530.

1. **Bassia hyssopifolia** (Pallas)Kuntze, Rev.Gen. 2(1891)547; Volkens in Engler and Prantl, Nat.Pflfam. 3/1a(1893)70; Gürke in Richt., Pl.Europ. 2(1897) 151; Reichb., Ic.Fl.Germ. 24(1909)155,t.275,fig.1-7; Aschers. and Graebn., Synops.Mitteleurop.Fl. 5/1(1913)165; Aellen in Hegi, Ill.Fl.Mitteleur. ed.2, 3/2(1961)712,fig.312a.— *Salsola hyssopifolia* Pall., Reise 1(1771)491,t.2, fig.1.— *Chenopodium villosum* Lam., Encycl.Meth.Bot. 1(1783)196.— *Chenopodium lanuginosum* Moench, Meth. (1794)330.— *Willemetia lanata* Maerkl., Schrad.Journ. 3,1(1800)330.— *Kochia hyssopifolia* Roth, Neue Beitr. (1802)176; Schrad.NeuesJourn. 3(1809)86; Schult. in Roem. and Schult.,Syst. 6(1820)247; Boiss., Fl.Or. 4(1879)926.— *Suaeda hyssopifolia* Pall., Illustr. (1803)44,t.36.— *Salsola lanata* Vahl in Hornem., Hort.Hafn. (1813)259.— *Echinopsilon lanatum* Moq. in Ann.Sc.Nat. II 2(1834)127.—

Echinopsilon hyssopifolium (Pall.)Moq., Chenop. Monogr. Enum. (1840) 87; Moq. in DC.Prod. 13/2(1849)135; Fenzl in Ledeb., Fl.Ross. 3/2(1851) 751.—

Victoria. Johnson and Constable NSW 48546; AD, NSW; NT: Mildura, Victoria, 16.III.1959. "Spreading sub-shrub to 25 cm (but said to grow to 90 cm at times). Leaves fairly flat. Locally common on salt patch (clay soil). Not found on saltless areas. In grounds of Mildura High School."— Native in Russia, Europe and Asia.

2. **Bassia muelleri** (Benth.)FvM., Cens. 1(1882)30; Fv.M., Fragm. 12(1882)13, Fitzgerald, Jour.Proc.R.Soc.W.Austral. 3(1918)36; Anderson, Proc.Linn.Soc. N.S.Wales 48(1923)326; Gardner, En.Pl.Austral.Occid. (1930)38.— *Chenolea muelleri* Benth., Fl.Austral. 5(1870)191.

Western Australia. F. Mueller: MEL (*holotype*), NSW: Shirts Creek, 1856.

3. **Bassia eurotioides** (FvM.)FvM., Cens. 1(1882)51; Vict.Nat. 5(1889)98; Fv.M., Ic.Austral.Salsol.Pl. 9(1891)t.81; Anderson, Proc.Linn.Soc.N.S.Wales 48 (1923)325; Gardner, En.Pl.Austral.Occid. (1930)38; Blackall, W.Austral. Wildfl. 1(1954)153.— *Echinopsilon eurotioides* FvM., Fragm. 7(1869) 13.— *Chenolea eurotioides* (FvM.)FvM.exBenth., Fl.Austral. 5(1870)191.

Western Australia. W. E. Blackall 4702: PERTH: Comet Vale.— N. T. Burbidge 2740: CANB: Lake Cowan.— J. Drummond 5th Coll.sup.n.83: MEL (*holotype*).— W. V. Fitzgerald: NSW 20532; Nannine. id.: NSW 20531; Boulder.— Fitzgerald and Fraser: NSW 57301: Kurnunoppin.— C. A. Gardner: PERTH: Lake Darlot.— id. 6533: PERTH: Mt. Stirling, Kellerberrin.— id. 2401: PERTH: S. Wiluna.— A. S. George 5528: PERTH. 14 miles E. of Carnegie H.S.— id. 4682: PERTH: Lake Throssell, Laverton-Warburton Rd.— B. Helms: AD 96129041: Great Victoria Desert.— A. W. Humphries: PERTH: Wagga-Badja.— J. T. Jutson 135: NSW: Comet Vale.— M. Koch 1153: AD, NSW: Cowcowing.— N. H. Speck 708: CANB: S.E. Mileura.

Sect. 2. *Eriochiton* Anderson, Proc.Linn.Soc.N.S.Wales 48(1923)320. [Typus: *Bassia sclerolaenoides* (FvM.)FvM. (*Echinopsilon sclerolaenoides* FvM.).]

4. **Bassia sclerolaenoides** (FvM.)FvM., Cens. 1(1882)30; FvM. and Tate, Trans. Roy.Soc.S.Austral. 13(1890)99; 16(1896)346; FvM., Ic.Austral.Salsol.Pl. 9(1891)t.82; Black, Trans.Roy.Soc.S.Austral. 41(1917)636; 45(1921)7; Paulsen in Ostenf.,Dansk.Bot.Ark. 2/8(1918)58; Ising, Trans.Roy.Soc.S. Austral. 46(1922)587, 593, 596; Anderson, Proc.Linn.Soc.N.S.Wales 48(1923) 327; Black, Fl.S.Austral. (1924)191; (1929)684; ed.2 (1948)302,fig.389; Chippendale. Trans.Roy.Soc.S.Austral. 82(1959)327.— *Echinopsilon sclerolaenoides* FvM., Trans.Phil.Inst.Vict. 2/2(1858)75.— *Chenolea sclerolaenoides* (FvM.)FvM. ex Benth., Fl.Austral. 5(1870)192.— *C. dallachyana* Benth., l.c. 191.— *Bassia dallachyana* (Benth)FvM., Cens. 1(1882)30; Black, Fl.S.Austral. (1924)191 in obs.— *Austrobassia sclerolaenoides* (FvM.)Ulbrich, Pflfam. ed.2, 16c(1934)532.

New South Wales. J. Dallachy: MEL (*holotype* of *Chenolea dallachyana*, immature specimen but probably this species): Murray Desert.— A. Morris 284: ADW 17055: Broken Hill.— B. R. Paterson: NE: Fowlers Gap.

Northern Territory. A. S. George 5097: PERTH: near Orange Ck. H.S.

South Australia. R. L. Crocker: CANB 11697: Blanchetown.— Hj. Eichler 12473: AD: Koonamore.— N. Forde 392: CANB: Emu.— E. H. Ising: ADW 11536: Mt. Willoughby.— F. M. Hilton: ADW 13198: Wudinna.— F. Mueller s.n.: MEL (*lectotype*): Cudnaka (Kanyaka).

WESTERN AUSTRALIA. N. T. Burbidge 91: PERTH; Glenorn Stn, Malcolm.— id. 1891: CANB; Kalgoorlie.— A. S. George 5659; PERTH; 22 miles N. of Sandstone.— R. Helms: AD 96130190; Great Victoria Desert.

Sect. 3. *Dissocarpus* (FvM.)Volkens in Engler and Prantl, Nat.Pflfam. 3/1a(1893)70. *Dissocarpus* FvM., Trans.Phil.Inst.Vict. 2(1858)75. [Typus: *Bassia biflora* (R.Br.)FvM. (*Sclerolaena biflora* R.Br.; *Dissocarpus biflorus* (R.Br.)FvM.).]

5. **Bassia paradoxa** (R.Br.)FvM., Cens. 1(1882)30; FvM., Fragm. 12(1882)13; FvM., Ic.Austral.Salsol.Pl. 7(1891)t.62; Black, Trans.Roy.Soc.S.Austral. 39 (1915)829; 40(1916)459; 41(1917)380, 635; Black, Fl.S.Austral. (1924) 192; ed.2 (1948)307,fig.416; Ising, Trans.Roy.Soc.S.Austral. 46(1922)593, 596; Anderson, Proc.Linn.Soc.N.S.Wales 48(1923)350; Chippendale, Trans. Roy.Soc.S.Austral. 82(1959)327.— *Sclerolaena paradoxa* R.Br. Prod. 1(1810)410; Moq. in DC., Prod. 13/2(1849)123; FvM., Fragm. 7(1869)11; 8(1873)38; 8(1874)149; Benth., Fl.Austral. 5(1870)196.— *Chenolea paradoxa* (R.Br.)FvM., Fragm. 10(1876)91.— *Dissocarpus paradoxus* (R.Br.) FvM. ex. Ulbrich, Pflfam. ed.2, 16c(1934)533.

NEW SOUTH WALES. A. Morris 197: ADW: Broken Hill.

NORTHERN TERRITORY. G. Chippendale 9137: AD, NT: 28 miles N. Alice Springs.— J. B. Cleland: AD 96019168: 35 miles S. Henbury.— M. Lazarides 5935: CANB: Macdonald Stn.— T. R. N. Lothian 273: AD: Haasts Bluff.— R. A. Perry 3234: CANB; Alice Springs.

QUEENSLAND. R. C. Baker G878: CANB: Gilruth Plains.— S. L. Everist 4067: CANB: Cuddapan.

SOUTH AUSTRALIA. R. Brown 3077: [BM n.v.], AD (photo of *lectotype*): Bay XII, South Coast, 1802.— E. C. Black: AD 96309195 (Herb. J.M.B.) Baronta.— N. T. Burbidge: CANB 12222: Yudnapinna.— Hj. Eichler 12454: AD: Koonamore.— N. Forde 356: CANB: Ernu.

WESTERN AUSTRALIA. C. A. Gardner 2390: PERTH: W. Wiluna.— A. S. George 4810: PERTH: Between Cavanagh and Blackstone Ra.— id. 5577: PERTH: Brockwan Ck., Wongawol Stn.

5b. *Bassia paradoxa* var. **latifolia** Black, Trans.Roy.Soc.S.Austral. 46(1922)567; 47(1923)368; Black, Fl.S.Austral. (1924)192; ed.2 (1948)307; Anderson, Proc.Linn.Soc.N.S.Wales 48(1923)350.— *Dissocarpus paradoxus* var. *latifolius* (Black)Ulbrich Pflfam. ed.2, 16c(1934)533.

NEW SOUTH WALES. Johnson and Constable: NSW 39853: Winnathee Stn., 60 miles W. Milparinka.

QUEENSLAND. Lothian and Francis 672: AD: 35 miles S.E. Arrabury Stn.

SOUTH AUSTRALIA. S. A. White: AD 96340088 (*holotype*), NSW 61600: Strzelecki Creek.

6. **Bassia georgei** Ising, sp.nov.—Fig. 28.

Suffrutex; rami teretes, striati vel costati, in statu juvenili lanati, demum glabri. Folia ± teretia, 4-7 mm longa, ± obtusa, marginibus ad basim membranaceis, in statu juvenili pubescentia, demum glabra, incurva, longitudinaliter rugosa; axillae pilosae. Fructus compositus plerumque 2-3 perianthiorum ad basim connatorum (vel interdum perianthiis solitariis), axillaris; perianthium cyliudratum, ca. 2 mm longum latumque apice concavi, induratissimum, in statu juvenili villosum, demum glabrum. Spinae plerumque 6, interdum 5, inaequales, acutae vel obtusae, erectae, 1-3 mm longae, basi lata, plerumque 2 connatae. Limbus erectus, ca. 1 mm longus, dense ciliatus. Basis ± oblonga, obliqua. Stylus conicus, crassus, glaber; rami stigmatici 2, rubidi. Semen non vidi. Flores 1-3 in axilla.

HOLOTYPUS: Western Australia. A. S. George 2985: PERTH; Lake Throssell (east edge), Warburton Road: 31:VIII.1961, "on salt flat".— [Isotype: AD.]

Undershrub; branches terete, striate or ribbed, lanate when young, becoming glabrous. Leaves ± terete, 4-7 mm long, ± obtuse, margins at base membranous, hairs in axil, pubescent when young, becoming glabrous, incurved, longitudinally rugose. Fruiting perianth usually 2-3 connate at base, sometimes solitary in axil, cylindrical, ca. 2 mm long, ca. 2 mm wide, summit concave, much hardened, villous when young becoming glabrous. Spines usually 6, sometimes 5, unequal, acute or obtuse, erect, 1-3 mm long, wide at base, usually 2 connate. Limb erect, ca. 1 mm long, densely ciliate. Base ± oblong, oblique. Style conical, thick, glabrous; stigmatic branches 2, dark red. Seed not seen. Flowers 1-3 in axil.

The only other species with the perianths connate to those of neighbouring flowers are *Bassia biflora* and *B. paradoxa*. The new species differs from these in shape of perianth, the indumentum, leaves, spines, etc., and is most marked in its distinction.

7. **Bassia biflora** (R.Br.) FvM., Cens. 1(1882)30; FvM., Fragm., 12(1882)13; FvM., Ic.Austral.Salsol.Pl. 7(1891)t.61; Black, TransRoy.Soc.S. Austral. 38 (1914)463; 41(1917)636; Black, Fl.S.Austral. (1924)192; ed.2 (1948)307, fig. 417; Ising, Trans.Roy.Soc.S.Austral. 46(1922)596; Anderson, Proc.Linn. Soc.N.S.Wales 48(1923)349; Chippendale, Trans.Roy.S.Austral. 82(1959) 327.— *Sclerolaena biflora* R.Br., Prod. 1(1810)410; Moq. in DC., Prod. 13/2(1849)123; Benth., Fl.Austral. 5(1870)196.— *Chenolea biflora* (R.Br.) FvM., Fragm. 10(1876)91.— *Dissocarpus biflorus* FvM., Trans.Phil.Inst. Vict. 2(1858)75; FvM., Fragm. 7(1869)11; Ulbrich, Pflfam. ed.2 16c(1934) 533.

New South Wales. R. Carolin 324: SYD: Fowlers Gap.— M. Collins: NSW 61583: Barrier Range.— A. Morris 718: NSW: Mt. Sturt Stn.

Northern Territory. G. Chippendale 8053: NSW, NT: Burt Plain: "Grey perennial to 1 ft. Common, mostly growing with butts of Kochia aphylla R.Br. on clay plain." Some of the perianths on this specimen have one erect spine, up to 4 mm long, on each side of the common base, most of the perianths however have an obtuse tubercle in place of the spine. The perianths usually diverge equally in relation to the common base or one is perpendicular to it. The limb has 5 subulate lobes up to 2 mm long. G. Chippendale 9153: NT, AD: 34 miles N. Alice Springs.— B. Swinbourne 440: NT, AD: Burt Plain.

Queensland. S. T. Blake 11811: AD: Nockatunga.—

South Australia. J. B. Cleland: AD: Port Noarlunga.— H. M. Douglas: ADW 3641, 4691: Yudnapinna.— Hj. Eichler 12420: AD: Koonamore.— F. M. Hilton 678,708: ADW: Yudnapinna.— M. Koch: NSW 61580: Mt. Lyndhurst.

7b. *Bassia biflora* var. **cephalocarpa** (FvM.) Anderson, Proc.Linn.Soc.N.S.Wales 48(1923)349; Black, Fl.S.Austral. ed.2 (1948)307, fig. 418.— *Sclerolaena biflora* var. *cephalocarpa* FvM., Fragm. 8(1873)38.

New South Wales. M. Collins: NSW 61582: Corona Stn.— C. K. Ingram 6593: Ingr., Nth. Bourke.— Johnson and Constable: NSW 32056, NT: Coally.— A. Morris 719: NSW: Mt. Sturt Stn.— B. R. Paterson: NE 000448: Fowlers Gap. J. T. Waterhouse: SYD: Collarenebri.

Queensland. C. H. Allen 468: CANB: Cunnamulla.— S. T. Blake 10544: AD: Noondoo.— id. 10203: AD: Cunnamulla.— id. 10658: AD: Elderslie.— id. 11837: AD: Nockatunga.— Ed. Bowman: MEL: Broad Sound.— C. W. Birch: MEL: Roma and Barcoo.— R. Roe: CANB 3355: Thallon.— S. L. Everist 6264: BRI: Thylungra.— Holland and Gnauck 1045: CANB: Cunnamulla.

South Australia. J. M. Black: AD: Farina.— J. B. Cleland: AD: Mt. Lyndhurst. F. M. Hilton 1354: ADW: ibid.— id. 1469: ADW: Brachina.— M. Koch: PERTH. Mt Lyndhurst.— Lothian and Francis 288: AD: Mulka Bore, N.E. Marree.

7c. *Bassia biflora* var. villosa Ising, var.nov.

Perianthia in fructu cum pilis longis dense villosa.

Holotypus: E. H. Ising: AD 96140125: S.Austral., Twins Stn., ca. 64 miles north of Kingoonya, 24.II.1956.

Fruiting perianths densely villous with long hairs. The connate fruiting perianths are usually unequal in length and have a strong tuberculate ring at their bases which are quite prominent; this character sometimes occurs, in some degree, in the species.

South Australia. H. M. Douglas: ADW: Yudnapinna.— F. M. Hilton: AD 96140124, ADW: ibid.— E. H. Ising 1805: AD, MEL, NSW 61783: Kingoonya.— id. 3747-8: AD: Evelyn Downs.

Sect. 4. *Spinosissimae* Ising, sect. nov.— Spinae numerosissimae, amplitudo et forma irregulari; flores axillares, duo. [Typus: *Bassia luehmannii* FvM.]

8. **Bassia luehmannii** FvM., Viet.Nat. 7(1890)47; FvM., Bot.Centralbl. 43(1890) 37; FvM., Ic.Austral.Salsol.Pl. 7(1891)t.70; Anderson, Proc. Linn. Soc. N.S. Wales 48(1923)351; Black, Fl.S.Austral. (1924)191; 2.ed. (1948)307, fig. 420; Chippendale, Trans.Roy.Soc.S.Austral. 82(1959)327.— *Austrobassia luehmannii* (FvM.) Ulbrich, Pflfam. ed.2, 16c(1934)532.

Northern Territory. W. F. Schwarz: *MEL (*holotype*), *NSW 55256; Finke River.— G. Chippendale *3398: CANB, NSW, NT: Lake Mackay.— id. 6378: NT: Lake Amadeus.— J. B. Cleland: *AD 96019099: 44 miles W. Erldunda.— M. Lazarides *6188: CANB, NSW, NT: near Ebenezer Stn.— R. Swinbourne 490: NT: nr. Mt. Wedge Stn.— id. 5: Ingr.: ibid.— W. F. Schwarz: *MEL: Macdonnell Range, leaves broadish, 1889.— D. E. Symon 25: *ADW: 50 miles S. Henbury.— R. E. Winkworth 72: NT: near Erldunda.

South Australia. S. A. White: *AD 96309299: Dalhousie Springs.

Western Australia. D. E. Symon *2340: AD, ADW: Hopkins Lake.

* All these specimens have 2 flowers in the axil, the others were not examined to check this character. This appears to be the first time that this detail has been recorded.

9. **Bassia symoniana** Ising, sp.nov.—Fig. 7.

Suffrutex; rami tomentosi. Folia linearia 10-20 mm longa, 1-1·5 mm lata, ± obtusa, dense cano pubescentia. Flores in axilla duo. Perianthium in fructu globulare, 1·5-2 mm diam., sparse tomentosum; apex ± planus; appendices 5, loratae, spinis pluribus irregularibus ornatos sunt. Spinae numerosissimae, 0·5-2 mm longae, irregulares, super marginem 5 appendicum loratarum affixae. Limbus 5-lobatus, rectus, brevissimus, pilosus; lobi 5, triangulares, obtusi. Basis circularis, tumida, umbilicata. Stylus hirsutus; rami stigmatici 2, rubri. Semen horizontale; radicula lateralis.

Holotypus: D. E. Symon 2341: AD 96241040: Western Australia. West end of Hopkins Lake (South of Sir Frederick Range), 1.VIII.1962.— [Isotype: ADW 25419.]

Undershrub; branches tomentose. Leaves linear, 10-20 mm long, 1-1½ mm wide, ± obtuse, densely grey-pubescent. Flowers 2 in axil. Fruiting perianth globular, 1½-2 mm dia., sparsely tomentose; summit ± flat; appendages 5, lorate with many irregular spines. Spines very numerous, ½-2 mm long, irregular, situated on margins of 5 lorate appendages. Limb 5-lobed, erect, very short, pilose; lobes 5, triangular, obtuse. Base circular, tumid, umbilicate. Style hirsute; stigmatic branches 2, red. Seed horizontal; radicle lateral.

This is a remarkable species being one of 3 having 2 flowers in the axil. The fruiting perianth has 5 regular dorsal strap-like strongly recurved appendages bearing on their margins very numerous unequal pungent, subulate spines. The spines are also most irregular

in their size, shape and point of direction or divergence. The part below the ovary, which is quite half the size of the fruiting perianth, is solid and hard. The margins of the appendages also extend above the summit of the perianth.

Sect. 5. *Asterocarpus* (FvM.)Ising, comb.nov.— Basionym: *Maireana* sect. *Asterocarpus* FvM., Fragm. 1(1859)139. [Typus: *Bassia stelligera* (FvM.) FvM. (*Maireana stelligera* FvM.).]— *Bassia* sect. *Maireana* Moq. ex Volkens in Engler and Prantl, Nat.Pflfam. 3/1a(1893)70 [non *Maireana* Moq.] [Lectotypus: *Bassia stelligera* (FvM.)FvM.].— *Austrobassia* sect. *Stelligerae* Ulbrich in Engler and Prantl, Nat.Pflfam. ed.2,16c(1934)532. [Lectotypus: *Bassia stelligera* (FvM.)FvM.]

10. **Bassia stelligera** (FvM.)FvM., Ic.Austral. Salsol.Pl. 7(1891)t.68; Anderson, Proc.Linn.Soc.N.S.Wales 48(1923)351; Black, Fl.S.Austral. (1924)192; ed.2. (1948)307,fig.419. - *Maireana stelligera* FvM., Fragm. 1(1859)139.— *Echinopsilon stelligerus* (FvM.)FvM., Fragm. 7(1869)16; *Kochia stelligera* (FvM.)Benth., Fl.Austral. 5(1870)189; FvM., Fragm. 12(1882)15; FvM., Cens. (1882)30.— *Austrobassia stelligera* (FvM.)Ulbrich, Pflfam. ed.2. 16c(1934)532.

New South Wales. J. L. Boorman: NSW 55260, AD: Berrawinia.— A. and D. Carson: MEL: Namoi River.— J. Dallachy: MEL: Salt Plains on River Darling.— W. J. Holding: MEL: June. Darling and Murray Rivers.— C. K. Ingram 7709: Ingr.: Euabalong.— C. W. E. Moore 350: CANB: Trangie.— id. 1431: CANB: Jerilderie. — J. A. Thompson 190: NE: Condobolin.

Queensland. G. H. Allen: NE: Cunnamulla.— S. T. Blake 10851: AD: Roma.— id. 10549: AD: Noondoo.— id. 10428: AD: Yelarbon.— id. 11768: AD: Norley. id. 10477: AD: Goodiwindi.— R. Roe: CANB 3409: Balagna.

South Australia. J. M. Black: AD 96309220: Renmark.

Victoria. H. S. McKee 7111: CANB: Merbein.

11. **Bassia brachyptera** (FvM.)Anderson, Proc.Linn.Soc.N.S.Wales 48(1923)351: Black, Fl.S.Austral. (1924)192; ed.2 (1948)308,fig.421.— *Sclerochlamys brachyptera* FvM., Trans.Phil.Inst.Vict. 2/2(1858)76.— *Echinopsilon brachypterus* (FvM.)FvM., Fragm. 7(1869)13.— *Kochia brachyptera* [FvM., Sec.Gen.Rep. (1854)15, *nom.nud.*] (FvM.)FvM. ex. Benth. Fl. Austral. 5(1870)189; FvM., Fragm. 12(1882)15; FvM., Ic.Austral.Salsol.Pl. 6(1890)t.59.— *Austrobassia brachyptera* (FvM.)Ulbrich, Pflfam. ed.2. 16c(1934)532.

New South Wales. F. Mueller: MEL (*lectotype*): salt flats on Murray River (Victoria).— L. Abraham: NSW 61612: Bourke.— B. Ament: NSW 61613: Nyngan.— E. Betche: NSW 61609: Warrego Riv.— id.: NSW 61610: Yandarlo.— id.: NSW 61617: Deniliquin.— Blandowski: MEL: Murray River (or Victoria).- J. L. Boorman: NSW 61611: Brewarrina. — E. Breakwell: NSW 61615: Condobolin.— B. G. Briggs 594: NE: Fowlers Gap.— E. F. Constable: NSW 4624: Roto.- J. J. Fletcher: NSW 61618: Hay — C. K. Ingram 9815: Ingr.: Nyngan-Brewarrina.— L. Johnson 547/60: NSW 61614: Cobar.— id.. NSW 61626: Umberumberka.— Johnson and Constable: NSW 47320: 20 miles W. Balranald.— A. Morris 304: ADW: Campbells Creek.

Queensland. S. T. Blake 11813: AD: Nockatunga.— id. 12163: AD: 30 miles S.E. Betoota

South Australia. Beckwith: AD 96309278: Mt. Gunson.— J. B. Cleland: AD 95820080: Anna Creek.— Hj. Eichler 12987: AD: Leigh Creek.— R. Hill 65: AD: Mt Nofwest Stn.— M. Koch: NSW 61605: Mt. Lyndhurst.— E. H. Ising: ADW 11553: Evelyn Downs.— R. A. Perry 5572: AD, CANB, NT: 15 miles N. Maralinga.

Victoria. J. Vickery: NSW 1979: 25 m. S.E. Swan Hill.— C. Walter: NSW 61604: Lake Hindmarsh.

Some specimens have a tumid margin to the areole and 5 ± prominent decurrent wings instead of the usual ribs, there are usually 5 very small pits or perforations in the basal hollow of the fruiting perianth.

Sect. 6. *Platyacantha* FvM., Fragm. 12(1882)12. [Typus: *Bassia tridens* FvM.]

12. **Bassia tridens** FvM., Fragm. 12(1882)12; FvM., Ic.Austral.Salsol.Pl. 7(1891) t.64.— [*Chenolea tridens* FvM., Fragm. 12(1882)12 *pro syn.*].— *Sclerolaena tridens* (FvM.)Domin, Bibl.Bot. 89(1921)624; Ulbrich, Pflfam. ed.2, 16c(1934)533.

Western Australia. J. Forrest: MEL (*holotype*), NSW: Gascoyne River.— C. A. Gardner 3291, 6194: PERTH: Wandagee, Minilya River.— id.: PERTH: Gascoyne River, Bidyemia.— A. W. Humphries: PERTH: Wooleen, Killer Paddock.

Sect. 7. *Anisacantha* (R.Br.)Volkens in Engler and Prantl, Nat. Pflfam. 3/1a(1893)70.— *Anisacantha* R.Br., Prod. 1(1810)410. [Typus: *Bassia divaricata* (R.Br.)FvM. (*Anisacantha divaricata* R.Br.).]

13. **Bassia caput-casuarii** Willis, Vict.Nat. 73(1957)153; Ising, Trans.Roy.Soc.S. Austral. 84(1961)96, fig.8A-D.

South Australia. B. L. Crocker: AD 96129023, NSW: Yudnapinna Stn.

Victoria. Mrs. E. Ramsay: MEL (*holotype*), AD 95715012: near Benetook.

14. **Bassia eriacantha** (FvM)Anderson, Proc.Linn.Soc.N.S.Wales 48(1923)328; Black, Fl.S.Austral. ed.2 (1948)303,fig.390.— *Kentropsis eriacantha* FvM., Fragm. 2(1861)140.— *Sclerolaena eriacantha* (FvM.)Ulbrich, Pflfam.ed.2, 16c(1934)534.— Further references: Ising, Trans.Roy.Soc.S.Austral. 84 (1961)94.

Further Collections:

New South Wales. J. B. Cleland: AD 96247291: Mootwingie.— W. MacGillivray: ADW 17045: Broken Hill.— A. Morris 2290: ADW: Thorndale.— id. 427: ADW: Umberumberka.

Northern Territory. N. T. Burbidge 122: CANB: Tanami.— C. Chippendale 2735: NSW, NT: Maryvale.— Chippendale and Johnson 3948: CANB, NSW, NT: 12 miles S. Andado.— id. 2762: AD, CANB, NT: 38 miles S.W. Tobermory. J. B. Cleland: AD 96019165: 50 miles N.E. Ayers Rock.— id.: AD 96019163: Yuendumu.— E. H. Ising: AD 96131111: India Range, Macdonald Stn.— M. Lazarides 5760: AD, CANB, NT: Deep Well.— A. J. Mahood 8728: NT: 70 miles W. Granites. — C. J. Mulhearn 887: ADW, NT: Renners Rock.— R. A. Perry 3301: CANB, NT: Arltunga.— R. Swinbourne 412: AD: 25 miles S. Alice Springs.— R. E. Winkworth 779: NT: 15 miles E. Orange Creek Stn.— S. A. White: AD 96309340: Charlotte Waters, Crown Point.

Queensland. S. T. Blake 15968: AD, BRI: Yelvertoff, Camooweal.— id. 11783: AD: Thargomindah.— id. 12029: AD: Tenham Stn.— id. 11378: AD: Tranby.— id. 12374: AD: Boulia.— S. L. Everist 3253: CANB: Ardmore.

South Australia. N. T. Burbidge: CANB 12226: Yudnapinna.— F. M. Hilton 737: ADW: ibid.— E. H. Ising: ADW 11550: Evelyn Downs.— id. 2897: AD: Pedirka.— R. H. Kuchel 439: AD. 150 miles N. Coober Pedy.— R. Schodde 361: AD: Everard Range.— B. Spencer: NSW 57355: Lake Eyre.

Western Australia. N. T. Burbidge 82: PERTH. Glenorn Stn, Malcolm.— J. B. Cleland: AD 96131061: Giles, Rawlinson Range.— C. A. Gardner: PERTH: Nannine.— id. 2454: PERTH: Beria, near Laverton.— A. S. George 906: PERTH: 44 miles N. Mundiwindi.— id. 3985: PERTH: Windulda, Laverton-Warburton Rd.— D. A. Herbert: PERTH: Mt Keith.— N. H. Speck 555: CANB: Meekatharra.— I. Tyson 82: PERTH: Mt. Narryer, Murchison River.

15. **Bassia gardneri** Ising, Trans.Roy.Soc.S.Austral. 84(1961)94,fig.4A-D.

WESTERN AUSTRALIA. Ankitell: PERTH: Trans.Rly.Survey.— N. T. Burbidge 235: PERTH: Glenorn Stn.— W. V. Fitzgerald: AD 95938008: Nannine.— A. S. George 5567: PERTH: 21 miles W. of Carnegie H.S.— id. 4460: PERTH: Mill, 3 miles E. of Laverton, on White Cliffs Rd.— id. 2781: PERTH: 7 miles W. of Mt. Morgan.

16. **Bassia parallelicuspis** Anderson, Proc.Linn.Soc.N.S.Wales 48(1923)331,t.34 H-L; Black, Fl.S.Austral. ed. 2 (1948)303,fig.393; Ising, Trans.Roy.Soc.S. Austral. 84(1961)95.— *Austrobassia parallelicuspis* (Anders.) Ulbrich Pflfam. ed.2, 16c(1934)532.

Further collections:

NEW SOUTH WALES. N. C. Beadle: SYD: Yalpunga.— Miss Light: ADW: White Cliffs.

NORTHERN TERRITORY. R. L. Crocker: AD 95852018: Charlotte Waters.— id. 2: AD: Abminga.— S. A. White: AD 95951002: Crown Point-Horseshoe Bend.

QUEENSLAND. S. T. Blake 11784: AD: Thargomindah.— id. 11971: AD: Mt. Howitt.

SOUTH AUSTRALIA. J. B. Cleland: AD 95951001, AD 95820070: Pedirka.— id.: AD 95951001, AD 96131016: Mt. Chambers Gorge.— id.: AD 95820076: Ilbunga. - id.: AD 95820012: Oodnadatta.— E. H. Ising 2682: AD: Abminga.— id. 2665: AD: Oodnadatta.— id. 2659: AD: Callana.— M. Koch 292 p.p.: NSW 45492 (*lectotype*); BM: Mt. Lyndhurst.— B. J. Murray 191: AD: Arcoona.— D. E. Symon 2731: AD, ADW: Wintinna.

17. **Bassia tatei** FvM., Vic.Nat.7(1890)66; FvM., Ic.Austral.Salsol.Pl. 8(1891),t.71; Anderson, Proc.Linn.Soc.N.S.Wales 48(1923)331; Black, Fl.S.Austral. (1924) 193; ed. 2 (1948)303,fig.392; Ising, Trans.Roy.Soc.S.Austral. 58(1933)93; 84(1961)95.— *Austrobassia tatei* (FvM.) Ulbrich, Pflfam.ed.2, 16c(1934) 532.

Further collections:

SOUTH AUSTRALIA. M. Koch 192: PERTH: Mt. Lyndhurst.— Lothian and Francis 295: AD: Near Mulka H.S.— R. Tate: MEL (*holotype*): Lake Torrens.

18. **Bassia burbidgeae** Ising, Trans.Roy.Soc.S.Austral. 84(1961)97,fig.10 A-D.

Further collections:

WESTERN AUSTRALIA. Y. Chadwick 936: PERTH, AD: 36 km from Mt. Magnet on Geraldton Rd., 12.VII.1963.

19. **Bassia uniflora** (R.Br.)FvM., Cens. (1882)30.— *Scleroluena uniflora* R.Br., Prod. 1(1810)410.— Further references: Ising, Trans.Roy.Soc.S.Austral. 84 (1961)90.

Further collections:

NEW SOUTH WALES. R. Catolin 323: SYD: Fowlers Gap.— J. T. Waterhouse: SYD: N. of Fowlers Gap.

SOUTH AUSTRALIA. D. J. E. Whibley 620: AD: Head of Great Australian Bight.

VICTORIA. A. C. Beauglehole 5246: A.C.B.: N. Hattah, Kulkyne National Park.

WESTERN AUSTRALIA. F. L. Hill: CANB 29021: Tremoville, Monte Bello Is., 10.XI.1953.

20. **Bassia diacantha** (Nees)FvM., Cens. (1882)30.— *Anisacantha diacantha* Nees in Lehm., Pl.Preiss. 1(1945)635.— *Kentropsis diacantha* (Nees) Moq. in DC., Prod. 13/2(1849)138.— ?*Anisacantha kentropsidea* FvM., Trans. Vict.Inst. 1(1855)133.— *Scleroleana diacantha* (Nees) Benth., Fl.Austral. 5(1870)194 [incl. var. *longispina*? Benth., l.c.,p.p.]— *Chenolea diacantha* (Nees) FvM., Fragm. 10(1876)91.— Further references: Ising, Trans.Roy. Soc.S.Austral. 84(1961)91.

21. **Bassia crenata** Ising, sp.nov.— Fig. 3.

Rami fructiferi saepe undulati. Folia linearia vel semiteretia, 5-14 mm longa, ca. 1 mm lata, obtusa, tenuia, villosa demum fere glabra, axillis hirsutis. Flores axillares, solitarii. Perianthium in fructu oblongum, in medio constrictum, 3-3·5 mm longum, 2-2·5 mm latum, glabrum; costae plures, prominentes, longitudinales. Spinae 2 (raro 3), 1-8 mm longae, inaequales, divergentes, aciculares (vel spina brevissima saepe obtusa); tuberculum solitarium in basi unae spinae. Limbus erectus, ca. 1 mm longus, ca. 2 mm latus, jugiformis, chartaceus, ciliatus. Basis obliqua, triangularis, plerumque unilateraliter valde gibbosa, glabra, profunde cavata; stipes parvus; margo plerumque crenatus. Stylus glaber; rami stigmatici 2-3, rubri. Semen verticale.

Holotypus: M. Lazarides 6337: CANB: Western Australia, 17 miles N.N.E. of Margaret River Stn., Kimberleys, 15.VIII.1959.— [Isotype: AD.]

Branches usually undulate in fruiting part. Leaves linear to semiterete, 5-14 mm long, ca. 1 mm wide, obtuse, thin, villous becoming almost glabrous, hairs in axil. Flowers solitary in axil. Fruiting perianth oblong, constricted in centre, 3-3½ mm long, 2-2½ mm wide, glabrous; ribs several, prominent, longitudinal. Spines 2 (rarely 3), 1-8 mm long, unequal, divergent, acicular but shortest often obtuse: tubercle at base of one. Limb erect, ca. 1 mm long, ca. 2 mm wide, ridge-like, chartaceous, ciliate. Base oblique, triangular, usually strongly gibbous on one side, glabrous, deeply hollowed; stipes small; margin usually crenate. Style glabrous; stigmatic branches 2-3, red. Seed vertical.

Note. In the unilateral expanded or gibbous base it resembles *B. tatei*, but in this latter species the spines are very short and erect, there are also other differences in the leaves, limb and style.

The specific epithet refers to the crenate margin of the areole at the base of the fruiting perianth.

22. **Bassia cristata** Ising, sp.nov.— Fig. 4.

Suffrutex; rami dense albo tomentosus. Folia linearia, 8-15 mm longa, ca. 1 mm lata crassa, ± acuta, dense albo pubescentia. Flores axillares, solitarii. Perianthium in fructu ca. 2 mm longum et latum, sparse pubescens; uterque lati convexi cum aliquot costis longitudinalibus. Spinae 2, 1-4 mm longae, inaequales, divergentes aciculares, in parte inferiore tomentosae. Limbus incurvus, brevis, ciliatus, in uno extremo extendo in cristam albam pilosam. Basis elliptica, profunde cavata, obliqua; margo glaber, in parte superiore tuberculatus; septa radiata. Stylus glaber; rami stigmatici 2, rubri. Semen obliquum; radicula superior.

Holotypus: D. E. Symon 2649: AD 96241028: South Australia, Base of Mt. Woodroofe, Musgrave Ranges, ± 131°15'E., 26°20'S., 10.VIII.1962. [Isotype: ADW 25414.]

Small undershrub; branches densely white tomentose. Leaves linear, 8-15 mm long, ca. 1 mm wide, thick ± acute, densely white pubescent. Flowers solitary in axil. Fruiting perianth ca. 2 mm long and wide, sparsely pubescent; both faces convex with several longitudinal ribs. Spines 2, 1-4 mm long, unequal, divergent, acicular, tomentose in lower part. Limb incurved, short, ciliate, extended at one end into a white hairy crest. Base elliptic, deeply hollowed, oblique; margin glabrous, tuberculate in upper part; radiating septa. Style glabrous; stigmatic branches 2, red. Seed oblique; radicle superior.

The new species is near to *B. uniflora* which has no ribs on perianth, no crest to the limb, and has a hirsute style. It is also near to *B. crenata* Ising which has thin leaves, limb without a crest, and base crenate all round.

The specific epithet refers to the crest of hairs at one end of the elongated limb.

23. **Bassia holtiana** E. H. Ising, Trans.Roy.Soc.S.Austral. 78(1955)111,fig.I,17-19; Ising, Trans.Roy.Soc.S.Austral. 84(1961)98.

Further collections:

South Australia. E. H. Ising E56, 3644, 3751; AD: Evelyn Downs.— id.: AD 96225202, 3, 5, 6; ibid.— id.: AD 96225000, 35, 36, 37, 38; ibid.— id.: AD 96225192, 3, 4, 6, 7, 8, 9; ibid.— id.: AD 96225034; Oodnadatta.— id.: AD 96225006, 195, 201; Mt. Barry Stn. 60 miles S. Oodnadatta.

24. **Bassia eichleri** Ising, Trans.Roy.Soc.S.Austral. 84(1961)96,89,fig.9 A-D.

South Australia. Known only from the type locality: Evelyn Downs, ca. 120 km south-west of Oodnadatta [see Ising (1961)].

25. **Bassia constricta** Ising, Trans.Roy.Soc.S.Austral. 84(1961)95,fig.7 A-D.— *B. uniflora* var. *incongruens* Black, Trans.Roy.Soc.S.Austral. 48(1924)254.

Further collections:

New South Wales. N. C. Beadle: SYD: White Cliffs.

South Australia. R. Hill 61: AD: Mt. Norwest.— T. R. N. Lothian 1211: AD: ibid.— H. Mincham 11: AD: Lyndhurst.

26. **Bassia wilsonii** Ising, sp.nov.— Fig. 15.

Suffrutex; rami albo tomentosi. Folia linearia, 8-13 mm longa, ca. 1 mm lata, ± acuta, plerumque recurva, dense albo pubescentia. Perianthium in fructu ± oblongum, ca. 3 mm longum, ca. 2·5 mm latum, tomentosum; facies anterior cum ca. 4 costis longitudinalibus ornatum est. Spinae 2, 1-2 mm longae, divergentes, prope glabrae. Limbus incurvus, brevissimus, ciliatus. Basis plerumque ovata, obliquissimus, profunde cavata, septa radiata. Stylus glaber, geniculata; rami stigmatici 2, rubri. Semen verticale; radicula superior.

Holotypus: P. G. Wilson 2310: AD 96241002; South Australia, Wintinna, ca. 160 km West of Oodnadatta, 29.VII.1962.

Undershrub; branches white tomentose. Leaves linear, 8-13 mm long, ca. 1 mm wide, ± acute, usually recurved, densely white pubescent. Fruiting perianth ± oblong, ca. 3 mm long, ca. 2½ mm wide, tomentose; ribs ca. 4, longitudinal, on anterior face. Spines 2, 1-2 mm long, divergent, almost glabrous. Limb incurved, very short, ciliate. Base usually ovate, very oblique, deeply hollowed; radiating septa. Style glabrous, geniculate; stigmatic branches 2, red. Seed vertical; radicle superior.

Nearest to *B. uniflora* (R.Br.)FvM. which has tomentose leaves, perianth with a large obtuse tubercle, base circular, style straight and seed horizontal.

Named in honour of Mr. P. G. Wilson, State Herbarium of South Australia, Adelaide.

27. **Bassia globosa** Ising, sp.nov.— Fig. 5.

Rami tomentosi. Folia anguste linearia, 7-20 mm longa, ca. 0·5 mm lata, obtusa, in statu juvenili villosa demum fere glabra, irregulariter flexa. Perianthium in fructu globulare, 2·5-3 mm diam., durissimum, dense tomentosum. Spinae 2-4 (plerumque 3), 2·5-6 mm longae, inaequales, dispositione regulari, 1 vel 2 spinis saepe cum tuberculis substitutis, late divergentes, rectae, glabrae, aciculares. Limbus rectus, brevissimus, chartaceus, lanato ciliatus. Basis ± ovata, leviter obliqua, leviter cavata. Stylus glaber; rami stigmatici 2, rubri. Semen horizontale; radicula superior.

Holotypus: S. T. Blake 11790: BRI 028611: Queensland. West of Thargomindah, coolibah flat in stony range, red soil, 25.VI.1936: "somewhat spreading, bushy, glaucous perennial of about 2 ft."— [Isotype: AD 96131036.]

Branches tomentose. Leaves narrow-linear, 7-20 mm long, ca. ½ mm wide, obtuse, villous when young becoming almost glabrous, irregularly bent. Fruiting perianth globular, 2½-3 mm dia., much hardened, densely tomentose. Spines

2-4 (usually 3), 2½-6 mm long, unequal, evenly spaced, 1 or 2 spines often substituted by tubercles, diverging widely, straight, glabrous, acicular. Limb erect, very short, chartaceous, woolly ciliate. Base ± ovate, slightly oblique, slightly hollowed. Style glabrous; stigmatic branches 2, red. Seed horizontal; radicle superior.

The new species differs from most others in the globular fruiting perianth and the evenly spaced spines and tubercles. It resembles *B. tetracuspis* which has ± cylindrical glabrous fruiting perianths and glabrous stems and leaves.

The specific epithet refers to the shape of the fruiting perianth.

28. **Bassia bicornis** (Lindl.)FvM., Cens. 1(1882)30; FvM., Ic.Austral.Salsol.Pl. 8 (1891)t.79; Black, Trans.Roy.Soc.S.Austral. 38(1914)462; Anderson, Proc. Linn.Soc.N.S.Wales 48(1923)343; Black, Fl.S.Austral. (1924)190, (1929) 684; ed. 2 (1948)306,fig.408; Ising, Trans.Roy.Soc.S.Austral. 57(1933)93; Chippendale, l.c. 82(1959)327.— *Sclerolaena bicornis* Lindl. in Mitch., Three Exped.Austral. 2(1838)47; Moq. in DC., Prod. 13/2(1849)123; Benth. Fl.Austral. 5(1870)195; Domin,Bibl.Bot. 89(1921)623; Ulbrich, Pflfam. ed. 2, 16c(1934)534.— *Anisacantha bicornis* (Lindl.) FvM., Fragm. 7(1869)14.— *Chenolea bicornis* (Lindl.)FvM. ex Tate, Trans.Roy.Soc.S.Austral. 3(1880) 58; FvM, l.c. 9(1887)213.

New South Wales. T. L. Mitchell: CGE (*holotype*, n.v.) [photo CANB No. 80]: Between Lachlan and Darling Rivers.— N. C. Beadle: SYD: Tibooburra.— C. K. Ingram: Ingr.: Weilmoringle.

Northern Territory. G. Chippendale 234: CANB; Tobermory.— id. 7202: AD, NT; Ranken.— D. J. Nelson 38: AD; 13 miles E. Alice Springs.— R. Swinbourne 325: NT: Alice Springs.

Queensland. S. T. Blake 12289; AD: Glengyle.— id. 5509: AD; Warrabin.— id. 8855: AD; Camooweal.— R. Roe 189: CANB; Gilruth Plains.

South Australia. J. B. Cleland: AD 95820046: Mungeranie.— E. H. Ising 2908: AD; Pedirka.— D. E. Symon 1146: NE; 40 miles S.E. Kingoonya.— S. A. White: AD 96309261: Marree.— P. C. Wilson 2309: AD; Wintinna.

28b. *Bassia bicornis* var. **horrida** (Domin)White, Roy.Soc.Queensl. 55(1941)75 — *Sclerolaena bicornis* var. *horrida* Domin, Bibl.Bot. 22(1921)623.

New South Wales. B. Ament: NSW: Nyngan.— J. L. Boorman: NSW: Brewarrina.— K. Carn: NSW: Coonamble.— Chippendale and Constable: NSW: Walgett.— E. F. Constable: NSW: Bourke.— O. E. Couch: NSW: Burren Junc.— P. G. Couch: NSW: Tibooburra.— H.A. Hunter: NSW: Gulargambone.— A. Morris 1283: NSW: Yowi Lake, near Broken Hill.— Shire Clerk: NSW: Narromine.— C. K. Ingram: Ingr.: Bourke-Cobar Road.

Northern Territory. G. Chippendale 234: NT: Tobermory.— Chippendale and Johnson 3849: CANB: 21 miles N. Rockhampton Downs.— C. J. Mullhearn: ADW 5853: Alcoota Stn.— D. E. Symon 40: ADW: Harts Range.

Queensland. S. T. Blake 5333: NSW: Charleville. id. 6642: NSW: Arilalah.— id. 6665: NSW: Isisford.— id. 6600: NSW: Longreach.— id. 9981: AD: Milray Stn.— id. 10546: AD: Noondoo.— id. 11218: AD: Oppham-Coongoola.— id. 11353: AD: Ilfracombe.— id. 11468: AD: Frensham Stn.— id. 11566: AD: Hughenden.— id. 11808: AD: Nockatunga.— C. T. White 11701: NSW: Wyandra.

South Australia. G. H. Clarke: ADW 3198: Abminga.— E. H. Ising: ADW 11518: Oodnadatta.

Note. I have not seen Domin's type specimen, but suppose that the specimens listed above agree best with his description of the variety. They all have, however, + pubescent leaves.

29. **Bassia obliquicuspis** Anderson, Proc.Linn.Soc.N.S.Wales 48(1923)337,t.34,fig. D-G; Black, Fl.S.Austral. (1924)192; ed. 2 (1948)305,fig.403.— *Sclerolaena obliquicuspis* (Anders.) Ulbrich, Pflfam. ed.2, 16c(1934)533.— *Sclerolaena diacantha* var. *longispina* ? Benth., Fl.Austral. 5(1870)195 p.p.

New South Wales. N. C. Beadle: SYD: Packsaddle.— W. MacGillivray: ADW 17035: Broken Hill.— A. Morris 210: NSW 34333 (*lectotype*): Broken Hill, 3.V.1920.— id. 292: NSW: ibid.— J. A. Thompson 25: NE: E. Menindee.— J. Vickery: NSW 1976: 30 m. W. Wentworth.

South Australia. J. M. Black: AD 96249076-8: Leigh Creek.— id.: AD 96249070 Tarcoola.— id.: AD 96249073 Pt. Augusta West.— S. T. Blake 16862: CANB: Pichi Richi Pass.— N. T. Burbidge: CANB 12223: Yudnapinna.— J. B. Cleland: AD 95820085: Wilgena.— id.: AD 96131071: Musgrave Range.— Hj. Eichler 12590: AD: Chambers Gorge, Flinders Range.— id.— 12701: AD: Gammon Ranges.— id. 16186: AD: Pt. Augusta.— N. Forde 360: CANB: Emu.— A. S. George 5206: PERTH: 32 miles E. of Mt. Davies.— F. M. Hilton: ADW 18200: Ooldea.— E. H. Ising: ADW 10603: Mt. Willoughby.— id.: AD 96243383: Evelyn Downs.— Lattorf: MEL: Near Spencer Gulf.— B. J. Murray 98: AD: Arcuona.— R. Schodde 1116-7: AD: Koonamore.— D. E. Symon: ADW 22080: Near Pt. Augusta.— D. J. E. Whibley 252: AD: Whyalla-Cowell.— S. A. White: AD 96024089: Pt. Augusta West.— P. G. Wilson 2299: AD: Mt. Eba.

Victoria. A. C. Beauglehole 980, 5254: A.C.B.: Kulkyne Nat. Park.— id. 5245: A.C.B.: Sunny Cliffs.— W. Hartley: CANB 3391: Redcliffs.

Western Australia. A. S. George 799: PERTH: Lake Austin.— id. 3802: PERTH: Elder Ck., Warburton Mission.— H. Salasoo 575: NSW: Deakin

30. **Bassia brevifolia** Ising, sp.nov.— Fig. 26.

Herba ± erecta, fere glabra; rami et ramuli densissimi. Folia ± clavata, 2-4 mm longa, obtusa, pubescentia; margines ad basim tenues. Flores axillares solitarii. Perianthium in fructu cylindratum vel conicum, saepe ad basim lati, ca. 2 mm longum, ± pubescens, numerosum. Spinae 2, 5-10 mm longae, graciles, aciculares, rectae, in planis verticalibus diversis, divergentes; una spina ad basim tuberculo parvo ornata. Limbus minimus, recurvus, ciliatus. Basis ± ovata, saepe versus tubum orthogonia vel obliqua. Stylus glaber vel fere glaber; rami stigmatici 2, rubri. Semen verticale; radicula superior.

Holotypus: P. G. Wilson 544: AD 95931014: South Australia. Eyre Peninsula. West of Peterby Tanks, 24 km north of Minnipa, 16.X.1958.— [Isotype: P. Aellen (Basel)]

Plant ± erect, almost glabrous; branches and branchlets very dense. Leaves ± clavate, 2-4 mm long, obtuse, pubescent; margins thin at base. Flowers solitary in axil. Fruiting perianth cylindrical to conical, often wide at base, ca. 2 mm long, ± pubescent, numerous. Spines 2, 5-10 mm long, slender, acicular, straight, not in same vertical plane, divergent, small tubercle at base of one. Limb very small, recurved, ciliate. Base ± ovate, often at right angle or oblique to tube. Style glabrous or almost so; stigmatic branches 2, red. Seed vertical, radical superior.

South Australia. E. C. Black: AD 96309225: Kimba, E.P.— J. B. Cleland: AD 95820138: Kimba, E.P. id.: AD 95820136.— Bight Well, near White Well, E.P.— id.: AD 95820143: Colona, Koonibba, E.P.— id.: AD 95820157: Pintumba, E.P.— id.: AD 95820159: Yardea-Nonning, E.P.— E. H. Ising: AD 96251097: Wudinna, E.P.— J. Miller: MEL: Fowlers Bay, E.P.— C. Pearce: AD 96131073: Thevenard, E.P.— Mrs. T. Richards: AD, MEL: Eucla-Fowlers Bay, E.P.— K. D. Rohrlach 186: AD: Pinkawillinie, E.P.— id. 305: AD: Buckleboo, E.P.— J. H. Willis: MEL: Colona, E.P.— P. G. Wilson 1515: AD: near Kulambi, E.P.

Western Australia. S. Brooke: MEL: Mt. Rugger-Victoria Spring.— M. Crmuin: PERTH: Blackwood River-Lake Lefroy.— J. Oliver: MEL: Eucla.— D. J. E. Whibley 637: AD: near old Eucla.— J. H. Willis: MEL: 72 miles E. Balladonia.

Note. This species has previously been included in *B. obliquicuspis* Anders. which has whitish woolly tomentum on branches and perianths; leaves ± semiterete 7-12 mm long; base of fruit ± gibbous and furrowed.

31. **Bassia glabra** (FvM.)FvM., Cens. 1(1882)30; FvM., Ic.Austral.Salsol.Pl. 7 (1891),t.66,figs.2-5,7-10; Anderson, Proc.Linn.Soc.N.S.Wales 48(1923)332; *Kentropsis glabra* FvM., Fragm. 1(1859)139.— *Anisacantha glabra* (FvM.) FvM. ex Benth., Fl.Austral. 5(1870)200.— *Sclerolaena glabra* (FvM.) Domin, Bibl.Bot. 89(1921)623-4; Ulbrich, Pflfam. ed.2, 16c(1934)553.

Northern Territory. F. Mueller: MEL (*holotype*); Sturts Creek, 1856.— G. Chippendale 5594: AD, NSW, NT: Tanami Bore; "herb 6-9", flowers green; common in lateritic red soil."

32. **Bassia bicuspis** (FvM.)FvM., Cens. 1(1882)30; FvM., Ic.Austral.Salsol.Pl. 8 (1891),t.73; Anderson, Proc.Linn.Soc.N.S.Wales 48(1923)333; Black, Fl.S. Austral. (1924)190; ed.2, (1948)303,fig.395.— *Anisacantha bicuspis* FvM., Trans.Vict.Inst. (1855)133; FvM., Hook.J. Bot.KewMisc. 8(1856)204; FvM., Fragm. 7(1869)13; Benth., Fl.Austral. 5(1870)200.— *Chenolea bicuspis* (FvM.)FvM. ex Tate, Trans.Roy.Soc.S.Austral. 3(1880)58.— *Sclerolaena bicuspis* (FvM)Domin, Bibl.Bot. 89(1921)624; Ulbrich, Pflfam. ed.2, 16c (1934)533.

South Australia. F. Mueller: MEL (*holotype*): Cudnaka (Kanyaka) towards Lake Torrens from Quorn: 1851.— H. L. Crocker: ADW 23011: Yudnapinna.— R. Tate: AD 96309260: Parachilna.

33. **Bassia limbata** Black, Trans.Roy.Soc.S.Austral. 46(1922)567; Anderson, Proc. Linn.Soc.N.S.Wales 48(1923)342; Black, Fl.S.Austral. (1924)190; ed.2. (1948)306,fig.409.— *Sclerolaena limbata* (Black)Ulbrich, Pflfam. ed.2, 16c (1934)534.

New South Wales. N. Allison: AD 95909019: Fowlers Gap, 70 miles N. Broken Hill.— N. C. Beadle: SYD: Wilcannia.— D. M. Dinning: NE: Fowlers Gap.— C. K. Ingram: NE: Bourke.— Johnson and Constable: NSW 39916: Fowlers Gap.— A. Morris: AD 96131085: Umberumberka.— id. 301: NSW, AD, ADW: Campbells Creek.— id. 916: ADW, NSW: Mundi Mundi Plain.— B. R. Paterson: NE: Fowlers Gap.— Pidgeon and Vickery: NSW 20471: Silverton.— J. T. Waterhouse: SYD: Pokotaroo.

Northern Territory. R. Swinbourne 430: AD: Alice Springs.

Queensland. S. T. Blake 10228: AD 96134018: Jericho.

South Australia. H. W. Andrew: AD 96230352 (*lectotype*): Parachilna.— id.: AD 95708140: Murnpeowie.— N. T. Burbidge: CANB 12809: Blinman.— J. B. Cleland: AD 96230391: Curnamona.— id.: AD 95819070: Alawoona and Parachilna.— id.: AD 95820123. Beltana.— C. M. Eardley: AD 96130082: Koonamore. R. Hill 66a: AD: Mt. Norwest Stn.— id. 1056: AD: Koonamore.— F. M. Hilton 1244: ADW: Hawker.— E. H. Ising: AD 96131084: Orroroo.— M. Koch: NSW 61427, PERTH: Mt. Lyndhurst.— T. B. Paltridge: AD 96130081: Koonamore.— R. Tate: AD 96140136: Wallaroo.— D. J. E. Whibley 468: AD: Parachilna.— S. A. White: AD: Leigh Creek.

Western Australia. A. S. George 1239: PERTH: 14 miles E. Bullara H.S.— Pollack: MEL: Gascoyne River [*B. pollackiana* FvM. nomen nudum].

34. **Bassia decurrens** Black, Trans.Roy.Soc.S.Austral. 46(1922)567; Black, Fl.S. Austral. (1924)193, (1929)684; ed.2., (1948)304,fig.401; Anderson, Proc. Linn.Soc.N.S.Wales 48(1923)337; White, Trans.Roy.Soc.Queensl. 60(1944) 75.— *Austrobassia decurrens* (Black)Ulbrich, Pflfam. ed.2, 16c(1934)532.

New South Wales. N. C. Beadle: SYD: Lake Yantara.— E. Betche: NSW 57434: Warrego River.— id.: NSW 57433: Paroo River.— E. F. Constable: NSW 4682: Byrnedale Stn.— id.: NSW 10491: Mt. Stuart.— D. M. Dinning: NE: Fowlers Gap.— L. A. S. Johnson 686: NSW: Menindee.— Johnson and Constable: NSW 48434: Moorna Stn. — id.: NSW 39778, NT: Wilcannia.— M. Kartzoff: NSW 57416: Menindee.— K. H. L. Key:

CANB 21731: Milparinka.— W. MacGillivray: ADW: Broken Hill.— A. Morris 283: NSW, AD: Broken Hill.— T. G. B. Osborn: AD 96331113 (Herb. J.M.B.) NSW: Broken Hill.— B. R. Paterson: NE: Fowlers Gap.— J. A. Thompson 150: NE: Sayers Lake.

Northern Territory. R. Swinbourne 9: Ingr.: Alice Springs.— id.: AD, NT 9031: ibid.

Queensland. S. T. Blake 11811, 11835, 11838: CANB: Nockatunga.— id. 6850; NSW: Barcaldine-Lochnagar.— id. 12250; CANB: Birdsville.— id. 12438: CANB: Tambar-Canterbury.

South Australia. C. D. Andrew: AD 96309298 (Herb. J.M.B.): Lake Bonney.— C. W. Bonython: ADW 8008: Lake Eyre.— N. T. Burbidge: CANB 12225: Yudnapinna.— J. B. Cleland: AD 95820091: Strzelecki Creek.— id.: AD 95820092: Carawena.— id.: AD 95820095: Lake Callabonna.— id.: AD 95820141: Tarcoola.— H. M. Douglas: ADW 3609, 23015: Yudnapinna.— F. M. Hilton 750: ADW 11564: ibid.— P. Hughes: AD 96229455: Lake Eyre.— C. K. Ingram 9746: Ingr.: Cockburn.— J. H. Maiden: NSW: Pt. Augusta.— B. J. Murray 101: AD: Arcoona.— T. B. Paltridge: AD, CANB 3367: Koonamore.— F. D. Warren: AD 96132086, 96309297: Finniss Springs.— S. A. White: AD 96331098 (*lectotype*): Pt. Augusta West, 29.IX.1920.— id.: AD 96331117: Wantapella Swamp near Everard Range.— Woodroofe and Trumble: ADW 349: Yudnapinna.

35. **Bassia everistiana** Ising, sp.nov.— Fig. 13.

Suffrutex, gracilis; rami hirsuti. Folia linearia, 5-12 mm longa, obtusa, hirsuta. Flores axillares, solitarii. Perianthium in fructu compresse cylindratum, ca. 2 mm longum et latum, uterque facei cum aliquot costis longitudinalibus, costa horizontali absenti. Spinae 2, ca. 3-5 mm longae (interdum inaequales), aciculares, divergentes, in parte inferiore hirsutae, interdum cum tertia spina brevi vel tuberculo in costam crassam decurrenti. Limbus erectus, ca. 1 mm longus, chartaceus, hirsutus. Basis nec obliqua, ± circularis, leviter cavata; septa radiata 5, 5 cavis parvis alternata. Stylus glaber vel fere glaber; rami stigmatici 2, rubri. Semen verticale; radicula superior.

Holotypus: S. T. Blake 6502: AD 96207139: Queensland. Woodstock, W. of Winton Gidgee country on more or less stony lateritic soil, 29.VI.1934. "Rather spreading, at length ascending, more or less glaucous."— [Isotypes: BRI, NSW 61410.]

Undershrub, slender; branches hirsute. Leaves linear, 5-12 mm long, obtuse, hirsute. Flowers solitary in axil. Fruiting perianth compressed cylindrical, ca. 2 mm long and wide, both faces with several longitudinal ribs, horizontal rib absent. Spines 2, ca. 3½ mm long (sometimes unequal) acicular, divergent, hirsute in lower part, sometimes a third short spine or a tubercle decurrent in a thick rib. Limb erect, ca. 1 mm long, chartaceous, hirsute. Base not oblique, ± circular, slightly hollowed; radiating septa 5, alternating with 5 small cavities. Style glabrous or almost so; stigmatic branches 2, red. Seed vertical; radicle superior.

Note. *B. everistiana* is nearest to *B. patenticuspis* Anders. which has the fruiting perianth oblong, without ribs, indumentum sparsely pubescent or tomentose, base ovate, oblique, not hollowed, without stipes.

Named in honour of Mr. S. L. Everist, Government Botanist, Botanic Museum and Herbarium, Brisbane.

36. **Bassia patenticuspis** Anderson, Proc.Linn.Soc.N.S.Wales 48(1923)338,t.34,fig. A-C; Ising, Trans.Roy.Soc.S.Austral. 46(1922)587, 596; Black, Fl.S.Austral. (1924)193; Ising, Trans.Roy.Soc.S.Austral. 58(1934) 216; Black, Fl.S.Austral. ed.2, (1948)305,fig.402; Chippendale, Trans.Roy.Soc.S.Austral. 82(1959) 327.— *Sclerolaena diacantha* var. *longespina*? Benth. Fl.Austral. 5(1870)195 p.p.— *S. patenticuspis* (Anders.)Ulbrich, Pflfam. ed.2, 16c(1934)534.

New South Wales. M. Collins: NSW 34334 (*lectotype*): Barrier Ranges.— F. F. Constable: NSW 4534: Bourke.— A. Morris 1076. ADW: Broken Hill.— B. R. Paterson: NE: (spines short and thick) Fowlers Gap.— T. M. Waite 1804: NSW: 14 miles E. Buronga.

NORTHERN TERRITORY. Chippendale and Johnson 3964: NT: 14 miles S.E. Finke.— M. Lazarides 6071: CANB: Bond Springs Stn.— id. 6118: AD, CANB: Tempe Downs Stn.— R. Swinbourne 7: Ingr.: Alice Springs.

SOUTH AUSTRALIA. J. M. Black: AD 96024074: Barnota.— id.: NSW 61402: Pt. Augusta. N. T. Burbidge: CANB 12221: Yudnapinna.— H. M. Douglas: ADW 23021: ibid.— Hj. Eichler 12519. AD: Koonamore.— N. Forde 390: CANB: Emu.— R. Hill 1055: AD: Koonamore.— E. H. Ising: AD 96309221: Nullarbor Plain.— id.: ADW 10604: Evelyn Downs.— id. 1548: ADW: Hughes.— E. McCrennon: PERTH: Reid.— F. Mueller: MEL: Wheal Barton near Truro.— R. A. Perry 5581: AD, CANB: 15 miles N. Maralinga.— Specht and Carrodus 9: AD: Nonning.— Sullivan: MEL: Gawler Ranges.— D. E. Symon 2172: AD, ADW: Tomkinson Range.— id. 669: ADW: Near Wilpena.— See also note after Western Australia.

VICTORIA. H. R. Browne 32: CANB: 61 miles W. Mildura.— J. P. Eckert: MEL: Lake Victoria, Wimmera.

WESTERN AUSTRALIA. W. E. Blackall: PERTH: Yandil.— N. T. Burbidge 80: PERTH: Glenorn.— A. S. George 5660: PERTH: 22 miles N. of Sandstone.— id. 4022: PERTH. 35 miles S.E. of Windulda.— id. 4681: PERTH: L. Throssell.— id. 4799: PERTH: N.W. end of Cavanagh Ra.— R. Helms: AD 96138044: Fraser Range.— L. Kriep: PERTH. Sandstone.— G. R. L. Reid 27: PERTH: Near Forrest.— Ankitell: PERTH: Trans.Rly. Survey.— Hj. Eichler 16174: AD: Rawlinna, 6.IX.1959; this specimen has some perianths with 2 spines 5-7 mm long, unequal, acicular or subulate; others with spines 1-2½ mm long, unequal, clavate, very obtuse; sometimes 1 spine is ca. 5 mm long and the 2nd one ca. 1 mm long, clavate, obtuse; plant almost glabrous. This could be a new species if the spines were consistently clavate. Only one collecting has been made

NOTE. South Australia furnishes a variation in the spines of this species and not markedly different from the above Rawlinna specimen. It is interesting to note that more than half of the specimens so far collected come from the Nullarbor Plain. One spine is longer and the 2nd one is thicker and obtuse, and the specimens showing this variation are as follows: E. C. Black: AD 96309218: Purnamoota.— J. M. Black: AD 96024076: Pt. Augusta.— J. B. Cleland: AD 95820082: Ooldea Soak.— id.: AD 95820128: Oodnadatta-Alice Springs.— M. Davis 213: AD: Watson. Hj. Eichler 16184: AD: Cook.— E. H. Ising: AD 96018141, 4: Hughes.— id.: AD 96130136: Koonoolop.— D. J. E. Whibley 652: AD: Cook.— P. G. Wilson 1673: AD: Cook.— id. 1705: AD: Watson.

37. **Bassia lanicuspis** (FvM.)FvM., Cens. 1(1882)30; 2(1889)51; FvM., Frag. 12 (1882)13; FvM., Ic.Austral.Salsol.Pl. 8(1891),t.80; Black, Trans.Roy.Soc.S. Austral. 41(1917)636; Black, Fl.S.Austral. (1924)193, ed.2. (1948)304,fig. 400; Anderson, Proc.Linn.Soc.N.S.Wales 48(1923)335; Ising, Trans.Roy.S. Austral. 57(1933)93; 58(1934)216; Chippendale, Trans.Roy.Soc.S.Austral. 82(1959)327.— *Anisacantha lanicuspis* FvM., Fragm. 2(1861)170; 7(1869) 14.— *Sclerolaena lanicuspis* (FvM.)FvM. ex Benth., Fl.Austral. 5(1870)195; Ulbrich, Pflfam. ed.2, 16c(1934)534.

NEW SOUTH WALES. Dr. H. Beckler: MEL (*holotype*): Salt Plains along the western side of Barrier Range, N.S.Wales, Victorian Expedition 1860.— D. M. Dinning: NE: Fowlers Gap.— C. K. Ingram 9783: Ingr.: Thackaringa.— A. Morris 607: ADW: White Cliffs.

NORTHERN TERRITORY. N. T. Burbidge 4189: CANB: Undoolya Gap.— C. Chippendale 7267: AD, NT: Avon Downs.— J. B. Cleland: AD 96019102: Henbury.— id.: AD 96019097: Macdonald Downs.— A. S. George 5029: PERTH: 3 miles S. of Fluke River Crossing, Stuart Highway.— E. H. Ising 2818: AD: Horseshoe Bend.— Johnson and Chippendale 3791: CANB, NSW, NT: Woodgreen H.S.— M. Lazarides 5887: AD, CANB, NSW, MEL, NT: 30 miles W.N.W. Mt. Riddoch Stn.— E. E. Lord: AD 9620753: Granite Downs.— R. A. Perry 1600: AD, CANB, NSW, NT: 30 miles S.S.E. Brunette Downs.— R. Swinbourne 438: AD, NT: Burt Plain.

QUEENSLAND. S. T. Blake 6562: NSW: Darr.— S. L. Everist 6248: AD: 15 miles W. Adavale.— R. A. Perry 874: CANB 65 miles W.S.W. Lake Nash.— id. 784: AD, CANB: 24 miles S. Mt. Isa.

SOUTH AUSTRALIA. J. B. Cleland: AD 95820117: Cordillo Downs.— R. L. Crocker: AD: Andado.— R. Hill 55: AD: Mt. Norwest Stn.— F. M. Hilton 1270: ADW: Beltana.—

R. H. Kuchel 434: AD: 150 miles N. Coober Pedy.— Lothian and Francis 273: AD: Mulka Bore, 155 km N.N.E. Marree.— M. Murray: AD 96130090: Cootanoorinna.— D. E. Symon 1028: NE: Andamooka-Stuarts Creek.

WESTERN AUSTRALIA. W. E. Blackall: PERTH: Yandil.— C. A. Gardner 2370: PERTH. East Merkatharra.— M. Lazarides 6329, 6332: CANB, NSW: Margaret River Stn.— P. G. Wilson 2458A: AD: Giles.

NOTE. The type specimen [Dr. H. Beckler, salt plains along the western side of the Barrier Range, N.S.Wales, 1861: MEL (*holotype*)] has 3 spines, 2 of them divergent and a shorter recurved one on the opposite posterior face. Specimens have been collected with spines up to 6 and it is generally agreed to accept this increase in the number of spines for the species because of the agreement with the type in other respects. An example of this is Perry 5447, near Hale River Crossing, ca. 100 miles E.S.E. of Alice Springs, N.Terr., 8.IX.1955; out of 20 fruiting perianths examined spines were noted as follows: 5 perianths, 4 spines all free and separated; 7 perianths, 5 spines all free and separated; 7 perianths, 5 spines, 2 of which are collateral; 1 perianth, 6 spines, 2 of which are collateral; one of the 2 collateral spines is usually short to very short, not half as long as the other, none seen were equal in length. The similar, *B. densiflora* Fitzg. has consistently 5 spines, 2 of them collateral and all equal in length, and I retain it as a valid species because I have seen no specimens of the "*lanicuspis*" group having the 2 collateral spines of equal length. *B. dentiflora* is endemic in W.Austral. and does not appear to vary in the spine character. *B. lanicuspis* also occurs in W.Austral. and has there similar spine variation as in the eastern States.

38. **Bassia ventricosa** Black, Trans.Roy.Soc.S.Austral. 46(1922)566; Anderson, Proc.Linn.Soc.N.S.Wales 48(1923)342; Black, Fl.S.Austral. (1924)191; ed.2, (1948)306,fig.407; Ising, Trans. Roy.Soc.S.Austral. 57(1933)93.— *Austrobassia ventricosa* (Black)Ulbrich, Pflfam. ed.2, 16c(1934)532.

NEW SOUTH WALES. B. G. Briggs: NE: Fowlers Gap.— E. F. Constable 10496: CANB: Tiboobunna.— C. K. Ingram: Ingr.: Louth.— id. 9721: Ingr.: Silverton.— L. A. S. Johnson: NSW 48513: Balranald-Hatfield.— K. H. L. Key: CANB 21379: Oolo Stn., Lake Poopallae. A. Morris 77: NSW: 209AD: Broken Hill.— B. R. Paterson: NE: Fowlers Gap.— J. H. Riches 71: CANB: 40 miles E.N.E. Broken Hill.— J. A. Thompson 124: NE: S.W. Wilcannia.— id. 62, 150: NE: Sayers Lake.

QUEENSLAND. W. MacGillivray: ADW 17038: Blackall Range.— R. Roe: NE: Gilruth Plains.

SOUTH AUSTRALIA. J. M. Black, s.n.: AD 96230281 (*lectotype*): Hergott Springs, 10.X.1917.— id.: NSW 61436: Pt. Augusta West.— N. T. Burbidge: CANB 13163: Parachilna Gorge.— id.: CANB 12220: Yudnapinna.— J. B. Cleland: AD 96247289: Brachina.— id: AD 96140085: Woomera.— C. M. Eardley: ADW 969: Mt. Victor Stn.— Hj. Eichler 13027: AD: Edeowie.— N. Forde 358: CANB: Emu.— E. H. Ising: ADW 11566, AD 96230033-4: Oodnadatta.— M. Koch: PERTH: Mt. Lyndhurst.— T. B. Paltridge: CANB 3431: Koonamore.— R. A. Perry: CANB 18301: Pt. Augusta.

39. **Bassia articulata** Black, Trans.Roy.Soc.S.Austral. 57(1933)150,t.9,fig.2; Ising, Trans.Roy.Soc.S.Austral. 58(1934)215; Black, Fl.S.Austral. ed.2, (1948)304, fig.398.

Further collections:

NEW SOUTH WALES. Johnson and Constable: NSW 39988: Mt. Poole-Theldarpa. Pidgeon and Vickery: NSW 61440: 90 miles E. of Broken Hill.

SOUTH AUSTRALIA. J. B. Cleland: AD 96420023 (*holotype*), MEL, NSW 61441: Pedirka.— E. H. Ising 2859, 2869, 2909: AD: Pedirka.

40. **Bassia oppositicuspis** Ising, sp.nov.— Fig. 23.

Suffrutex; divaricatus, ferè glaber; ramulosus; costae graciles. Folia teretia, 5-11 mm longa, ca. 1 mm lata, acuta, patula, basi plana, tenui, latiore; in statu juvenili ptilosa. Perianthium in fructu cylindratum, ca. 2-3 mm longum, ca. 2 mm latum, glabrum; apex concavus; aliquot costae longitudinales, una horizontali. Spinae 3-4 inaequales, aciculares, glabrae, plerumque ± horizontales; una spina ad 12 mm longa; 2-3 spinae oppositae, in

basi contiguae, 1-11 mm longae; una spina erecta, brevis vel rudimentaria. Limbus erectus, 1-1·5 mm longus, coriaceus, latus, ciliatus. Basis ± ovata obliqua, leviter cavata. Stylus in parte superiore leviter lanatus; rami stigmatici graciles, 2, punicei. Semen non vidi, probaliter verticale.

HOLOTYPUS: N. T. Burbidge: CANB 12218: South Australia. Yudnapinna Stn., 11.IX.1946. (Out of 100 fruiting perianths examined 46 had 3 well-developed spines, 36 had 3 spines and 1 rudimentary and 18 had 4 well-developed spines.).— [Isotype: AD, fragm.]

Undershrub, spreading, almost glabrous; branchlets many; ribs slender. Leaves terete, 5-11 mm long, ca. 1 mm wide, acute, spreading; base flat, thin, wider at base; juvenile pilose. Fruiting perianth ± cylindrical, ca. 2½ mm long, ca. 2 mm wide, glabrous; summit concave; ribs longitudinal, several, horizontal one. Spines 3-4, unequal, acicular, glabrous, usually ± horizontal; one up to 12 mm long; 2-3 opposite, close together at base, 1-11 mm long; one erect, short or rudimentary. Limb erect, 1-1½ mm long, coriaceous, broad, ciliate. Base ± ovate, oblique, slightly hollowed. Style slightly lanate in upper part; stigmatic branches slender, 2, pink. Seed not seen, probably vertical.

NEW SOUTH WALES. N. C. Beadle: SYD: Lake Yantara. (The spines in this specimen are usually 5 and more erect than in the type specimen.)

41. **Bassia tricuspis** (FvM.)Anderson, Proc.Linn.Soc.N.S.Wales 48(1923)835; 59 (1934)272; Black, Fl.S.Austral. (1924)193; ed.2, (1948)304,fig.399.— *Anisacantha tricuspis* FvM., Trans.Viet.Inst. (1855)133; FvM., Hook.J.Bot.Kew Misc. 8(1856)204; FvM., Rep.Babb.Exped. (1859)20.— *Chenolea tricuspis* (FvM.)FvM., Fragm. 10(1876)92.— *Sclerolaena tricuspis* (FvM.)Ulbrich, Pflfam. ed.2, 16c(1934)534.— *Bassia divaricata* [non (R.Br.)FvM.] FvM., Ic.Austral.Salsol.Pl. 8(1891), t.77.

NEW SOUTH WALES. F. Mueller: MEL (*Holotype*): Murray River.— Anonym.: NE (one spine very short): Trida Woolshed.— N. C. Beadle: SYD: Lake Cargelligo.— E. Betche: NSW 57398: Paroo River.— id.: NSW 57397: Warrego River.— J. Brough: SYD: Sidonia-Hay.— P. D. Carter: NSW 61412: 11 miles N. Pilliga.— id.: NSW 57409: Near Pilliga.— D. J. Campbell: NSW 57408: Coonamble.— N. C. Forde: NSW 57401: Tiree Stn.— D. L. W. Henderson 369: NSW: Gundabooka.— Johnson and Constable: NSW 48535: Mourna Stn.— L. W. McLennan: NSW 5312: Boggabilla.— H. Nicholas: NSW 57400: Gravesend.— C. W. Rhodes: NSW 57399: Narrabri.

QUEENSLAND. G. H. Allen 288: CANB: 58 miles W. Charleville.— S. T. Blake 6851: NSW: Barcaldine-Lochnagar.— id. 6674: AD, NSW: Isisford-Emmet.— id. 11733: AD: Dynevor.— id. 10431: AD: Yelarbon.— id. 10673: AD: Noondoo.— Lau: NSW 57406: Darling Downs.— J. Mann: NSW: Chinchilla (with 4 spines).— R. Roe: NE: Gilruth Plains.— id.: CANB 3371: Moonie Riv.— C. T. White: NSW 57404: Tower Hill.

SOUTH AUSTRALIA. E. C. Black: AD 96309210: Renmark.— C. M. Eardley: ADW 2373: ibid.— Hj. Eichler 14908: AD: Manmum.— E. H. Ising: AD 96131146: Taveday.— H. Mincham 11: AD: Lyndhurst.

VICTORIA. A. C. Beauglehole 5261: A.C.B.: Sandalong Park, near Mildura.— Willis and Beauglehole 5262, 5263: A.C.B.: Kulkyne and Chalka Creek.

42. **Bassia andersonii** Ising, Trans.Roy.Soc.S.Austral. 57(1933)185; Black, Fl.S. Austral. ed.2, (1948)304,fig.397; Chippendale, Trans.Roy.Soc.S.Austral. 82 (1959)327.

Additional descriptive notes: Limb erect, prominent, coriaceous; fruiting perianths deciduous or easily detached; leaves sometimes narrow linear; spines sometimes 4.

NORTHERN TERRITORY. C. E. F. Allen 575: NSW: Ryans Well.— G. Chippendale 405: NT: Tobermory.— id. 622: NSW: Angas Downs.— id. 8051: NSW: Burt Plain.— id. 6482: AD: Near Macdonald Downs.— id. 2957: NSW: Manners Creek St.— G. Chippendale and L. Johnson 3942: NT: 29 miles W. of Andado Stn.— E. H. Ising: AD 96132115,

96132017: Macdonald Downs.— M. Lazarides 5938: CANB, NT, AD: 12 miles W. of Huckitta Stn.— id. 5947: CANB: Huckitta Stn.— R. A. Perry 1823: CANB, NT: 35 miles E. of Borroloola Stn.— id. 1599: CANB: 30 miles SSE of Brunette Downs.— D. E. Symon 40: ADW: Mt. Riddock Stn.

QUEENSLAND. S. T. Blake 6469: NSW: Boulia.— id. 8094: AD: Normanton.— id. 10010: AD: Elderslie.— id. 11459: AD: Kalkadoon.— id. 11710: AD: Cunnamulla.— id. 12205: AD: Birdsville.— id. 12364: AD: Marion Downs.— id. 12512: AD: Normanton.— R. L. Crocker: AD 96130038: 40 miles N.W. of Birdsville.— id.: AD 96130037: Birdsville.— J. G. Davies: CANB 3390: Central South.— R. Roe: NE 000438: Cunnamulla.— C. T. White 11706: AD: ibid.

SOUTH AUSTRALIA. J. B. Cleland: AD 96132113: Abminga.— id: AD 96132112: AD 96309269: Pedirka.— id.: AD 95820047: Cordillo Downs.— E. H. Ising 2887: AD (*holotype*): Pedirka.— id.: AD 96132119: Abminga.— id.: AD 96132117: Snake Gully, 16 miles S. of Pedirka.

43. **Bassia aellenii** Ising, sp.nov.— Fig. 16.

Suffrutex procumbens; rami leviter costati, tomentosi; ramuli erecti. Folia anguste lanceolata, 8-16 mm longa, ca. 2 mm lata, ± acuta, pubescentia, congregata; basis coangustatur, marginibus membranaceis. Flores axillares solitarii. Stamina 5. Perianthium in fructu urceolatum, ca. 2 mm longum et latum, parce induratum, glabrum; costae nunnullae, longitudinales, debiles. Spinae 3, erectae, ca. 1 mm longae, ± aequales, obtusae, basi lata, glabra. Limbus brevissimus, ciliatus; lobi 5, obtusi. Basis ± circularis, leviter obliqua, leviter cavuta. Stylus hirsutus; rami stigmatici 2, in parte inferiore crasse, rubidi. Semen non vidi.

HOLOTYPUS: Hj. Eichler 14188: AD 95819005: South Australia. Corny Point, Yorke Peninsula, X.1957.— [Isotype: P. Aellen (Basel).]

Undershrub, procumbent; branches slightly ribbed, tomentose; branchlets erect. Leaves narrow-lanceolate, 8-16 mm long, ca. 2 mm wide, ± acute, pubescent, crowded; base narrowed, margins membranous. Flowers solitary in axil. Stamens 5. Fruiting perianth urceolate, ca. 2 mm long and wide, not much hardened, glabrous; ribs several, longitudinal, weak. Spines 3, erect, ca. 1 mm long, ± equal, obtuse, broad-based, glabrous. Limb erect, very short, ciliate; lobes 5, obtuse. Base ± circular, slightly oblique, slightly hollowed. Style hirsute; stigmatic branches 2, thick in lower part, dark red. Seed not seen, probably horizontal.

Nearest to *B. urceolata* Ising which has leaves terete, 4-6 mm long; spines 5; style glabrous.

This species is named in honour of Dr. P. Aellen, Basel (Switzerland), who has specialized in Chenopodiaceae, Atriplex and Chenopodium in particular.

44. **Bassia drummondii** (Benth.)FvM., Cens. 1(1882)30; Anderson, Proc.Linn.Soc. N.S.Wales 48(1923)336; Gardner, En.Pl.Austral.Occid. (1930)38; Blackall, W.Austral.Wildfl. 1(1954)152.— *Anisacantha drummondii* Benth., Fl. Austral. 5(1870)199.— *Sclerolaena drummondii* (Benth.)Domin, Bibl.Bot. 89(1921)624; Ulbrich, Pflfam. ed.2, 16c(1934)533.

WESTERN AUSTRALIA. N. T. Burbidge: BRI: Kalgoorlie.— W. D. Campbell: PERTH: Boulder.— J. Drummond: MEL (*?isotype*): W. Austral.— W. V. Fitzgerald: NSW 57466: Kalgoorlie.— R. Helms: PERTH: Coolgardie.— N. Knieps: PERTH: Sandstone.

44b. *Bassia drummondii* var. **hispida** (Moore)Anderson, Proc.Linn.Soc.N.S.Wales 48(1923)336.— *Anisacantha hispida* Moore, J.Linn.Soc. 45(1920)190.

WESTERN AUSTRALIA. N. T. Burbidge 2586, 1897: CANB: Kalgoorlie.— Dr. Cole 1/7: PERTH: West of Mullewa.— M. Cronin: PERTH: Blackwood River-Lake Letroy.— W. V. Fitzgerald: NSW 57465: Kanowna. J. H. Maiden: NSW 57435: Kalgoorlie.— J. E. C. Maryon: NSW (*isotype*), MEL: Mulline.— N. S. Marr: PERTH: Morowa.— K. C. Tiller: PERTH: Kurrawang.

45. **Bassia filiformis** Ising, sp.nov.— Fig. 14.

Suffrutex, villosus, ± erectus, ramosulosus. Folia oblanceolata 4-10 mm longa, tenuia, ± obtusa. Flores axillares, solitarii. Perianthium in fructu cylindratum, ca. 1·5 mm longum et latum, vix duriusculum; facies anteria cum 2-3 costis longitudinalibus. Spinae 4 (interdum 3), 1-5·5 mm longae, plerumque inaequales, subtiliter aciculares, debiles, rectae, divergentes, dispositione regulari, glabrae (basi exclusa). Limbus erectus minutus. Basis ± ovata, obliqua, nec cavata. Stylus glaber vel fere glaber. Semen non vidi.

Holotypus: R. Roe; CANB 3357; Queensland, "Warrie", Nindigully.

Undershrub, villous, ± erect; branches many. Leaves oblanceolate, 4-10 mm long, thin, ± obtuse. Flowers solitary in axil. Fruiting perianth cylindrical, ca. 1½ mm long and wide, not much hardened; anterior face with 2-3 longitudinal ribs. Spines 4 (sometimes 3), 1-5½ mm long, usually unequal, finely acicular, weak, straight, divergent, evenly spaced, glabrous except at base. Limb erect, very small. Base ± ovate, oblique, not hollowed. Style glabrous or almost so. Seed not seen.

New South Wales. K. R. Green; NSW 61594: Wycombe Stn., 18 miles N. Coonamble.

This species is nearest to *B. eurotioides* which has 3-6 finer, much weaker longer spines; perianth with very long villous hairs.

The specific epithet refers to the fine, weak spines.

46. **Bassia ramsayae** Willis, Vict.Nat. 73(1957)152.— Fig. 22.

Victoria. E. Ramsay: MEL (*holotype*): Meridian Road near Benetook, N.W. Victoria.— id.: NSW 61411: Sandalong near Mildura.

47. **Bassia forrestiana** FvM., Fragm. 12(1882)12; FvM., Ic.Austral.Salsol.Pl. 8 (1891)75; Anderson, Proc.Linn.Soc.N.S.Wales 48(1923)342.— *Sclerolaena forrestiana* (FvM.)Domin, Bibl.Bot. 89(1921)623-4; Ulbrich, Pflfam. ed.2, 16c(1934)533.

Western Australia. J. Forrest: MEL (*holotype*): Gascoyne River, 1882.

48. **Bassia minuta** Ising, sp.nov.— Fig. 6.

Suffrutex; rami tomentosi; ramuli dense foliati fructiferique. Folia ± lanceolata, 4-7 mm longa, acuta, curvata, densa, patula, ± villosa. Perianthium in fructu obconicum, compressum, ca. 1·5 mm longum, ca. 1·5 mm latum villosum; apex planus; omnis facei 1-2 costiis longitudinalibus ornati. Spinae 4, inaequales, rubri, subulatae; pubescentes, 2 oppositis ½-1 mm longis, ± horizontalibus, 2 brevioribus ad basim contiguis. Limbus erectus, brevissimus, jugiformis. Basis circularis, obliqua, parva, nec cavata. Stylus glaber; rami stigmatici 2, punicei. Semen verticale; radicula superior.

Holotypus: S. T. Blake 12373; BRI 028612; Queensland. Near Boulia, low stony ridge with scattered Acacia spp., etc., 24.VII.1936. "Subglaucous annual to 6 inches with tufted stems and ascending branches."— [Isotype: AD 96134037.]

Undershrub; branches tomentose; branchlets with dense leaves and fruits. Leaves ± lanceolate, 4-7 mm long, acute, curved, dense, spreading, ± villous. Fruiting perianth obconic, compressed, ca. 1½ mm long, ca. 1½ mm wide, villous; summit flat; ribs longitudinal, 1-2 on each face. Spines 4, unequal, red, subulate; pubescent, 2 opposite ½-1 mm long ± horizontal; 2 close together at base,

shorter. Limb erect, very short, ridge-like. Base circular, oblique, small, not hollowed. Style glabrous; stigmatic branches 2, pink. Seed vertical; radicle superior.

QUEENSLAND. S. T. Blake 15967; AD; "Yelvertoff", about 40 miles east of Camooweal on stony ridge in Eucalyptus brevifolia, Triodia community. Alt. 342 m. "Hoary tiny annual", 15 VI.1946.

NOTE. This species is similar to *B. lanicuspis*, which has linear leaves, all spines acicular (usually 3), and cylindrical limb. It also resembles *B. glabra* which is a glabrous plant with semiterete leaves, 2 spines, and hollowed base.

The specific epithet refers to the very small size of the fruiting perianths.

49. **Bassia cucullata** Ising, sp.nov.— Fig. 11.

Herba glabra; caulis et rami crassi subtilissime striati. Folia teretia vel anguste linearia, 8-20 mm longa, ca. 1 mm lata, acuta, glauca, leviter rugosa, irregulariter flexa, ad basim latiora; in axilla pilosa. Flores axillares solitarii. Perianthium in fructu cylindricum, ca. 1·5 mm longum, ca. 2·5 mm latum, in ramo firme adfixum. Spinae 4, inaequales, aciculares, 2 longissimis ad 20 mm longis, insolite rectis sursum diversis, 2 brevioribus 1-4 mm longis, recurvis vel erectis, in basi contiguis. Limbus erectus ca. 1·5 mm longus, cucullatus, ciliatus, trans culmen perianthii extendit; ± coriaceus, intra lanatus. Basis ± circularis, plerumque obliqua, nec cavata, saepe expansa. Stylus lanatus, longus, in basi crassus; rami stigmatici 2, rubri. Semen obliquum horizontale; radicula superior; utriculus ovarii lanatus.

HOLOTYPUS: S. T. Blake 11376; AD 96204106; Queensland. Tranby, 142°25'E., 22°40'S., on rugged sandstone ridges, 550-700 ft., with Triodia with or without lancewood. Bushy, rather spreading to 2 feet diam., 1 ft. high; leaves sub-glaucous; fruit sometimes reddish, 8.V.1936.

Plant glabrous; stem and branches thick, slightly striate. Leaves terete to narrow linear, 8-20 mm long, ca. 1 mm wide, acute, glaucous, finely rugose, irregularly bent, wider at base; hairs in axil. Flowers solitary in axil. Fruiting perianth cylindrical, ca. 1½ mm long, ca. 2½ wide, firmly attached to branch. Spines 4, unequal, acicular; 2 longest up to 20 mm long, usually straight, diverging upwards; 2 shorter 1-4 mm long, recurved or erect, close together at base. Limb erect, ca. 1½ mm long, cucullate, ciliate, extending across summit of perianth, ± coriaceous, lanate inside. Base ± circular, usually oblique, not hollowed, often expanded. Style lanate, long, thick at base; stigmatic branches 2, red. Seed obliquely horizontal; radicle superior; ovary cell lanate.

QUEENSLAND. S. T. Blake 6497: NSW 57373: Woodstock, west of Winton. Very common on stony Gidgee country. Green bush up to 2 ft., 29.VI.1934.— id. 6498: NSW 57372. Woodstock, west of Winton; very common on stony Gidgee country. More or less spreading, rather pale green, reputed to be eaten by stock, 29.VI.1934.— B. Cameron 31: BRI: called by pastoralists "Gidgee prickly Saltbush". Good feed. It dies out at about 2 or 3 years old and grows up from seed. It is a round bunch-like Roley Poley and the stems turn hard. It is very hardy and stands dry weather. IX.1934.

The specific epithet illustrates the limb which is prominent and hard. It does not appear to have any close ally in this genus.

50. **Bassia recurvicuspis** Fitz., Journ.W.Austral.Nat.Hist.Soc. 1(May1904)32; Gardner, En.Pl.Austral.Occid. (1931)38; Blackall, W.Austral.Wildfl. 1(1953) 152.— *Bassia litoralis* Diels, Bot.Jahrb. 35(Dec.1904)186,fig.24,A-C.— *Sclerolaena recurvicuspis* (Fitzg.)Domin, Bibl.Bot. 89(1921)623.— *Sclerobassia litoralis* (Diels)Ulbrich, Pflfam. ed.2, 16c(1934)539,fig.201,A-C.

WESTERN AUSTRALIA. W. V. Fitzgerald: PERTH (*holotype*), NSW; Nanning.— A. W. Humphries: PERTH; Wooleen Lake and Boolardy.— N. H. Speck 1079: AD, CANB; Milmra

51. **Bassia blakei** Ising, sp.nov.— Fig. 2.

Herba ramosissima, glabra; rami ± erecti, subtilissime striati. Folia linearia, 4-14 mm longa, ½-1 mm lata, obtusa, irregulariter flexa; basis latior; margines membranacei; axillae pubescentes. Flores axillares solitarii. Perianthium in fructu urceolatum, ca. 3-4 mm longum, ca. 1·5 mm latum, glabrum, muris tenuibus; costae ca. 10, longitudinales; facies posterior plana; facies anterior convexa. Spinae 4, aciculares, glabres; 2 divergentes ca. 5·5 mm longae, ± rectae; 1 recurva ca. 3 mm longa; 1 ± erecta, ca. 1 mm longa; 2 spinae breviores ad basim contiguae. Limbus incurvus, brevis, ciliatus. Basis obliqua, ovata, concava, aliquantum dilata. Stylus glaber vel fere glaber, basi flexa vel convoluta; rami stigmatici 2, punicei. Semen verticale; radicula superior.

HOLOTYPUS: S. T. Blake 12345: AD 96134035: Queensland. Breadalbane, north of Bedourie.— [Isotype: BRI.]

Plant much branched, glabrous; branches ± erect, slightly striate. Leaves linear, 4-14 mm long, ½-1 mm wide, obtuse, irregularly bent; base wider; margins membranous; axils pubescent. Flowers solitary in axils. Fruiting perianth urceolate, ca. 3-4 mm long, ca. 1½ mm wide, glabrous, walls thin; ribs ca. 10, longitudinal; posterior face flat; anterior face convex. Spines 4, acicular, glabrous; 2 divergent ca. 5½ mm long, ± straight; one recurved ca. 3 mm long; one ± erect, ca. 1 mm long; the 2 shorter ones close together at base. Limb incurved, short, ciliate. Base oblique, ovate, hollowed, somewhat dilated. Style glabrous or almost so, bent or coiled at base; stigmatic branches 2, pink. Seed vertical; radicle superior.

NOTE. *B. blakei* is nearest to *B. tuberculata* Anders. which has curved, acute leaves, cylindrical fruiting perianth and straight style.

This new species is named in honour of Dr. S. T. Blake, Queensland Herbarium, Brisbane.

52. **Bassia divaricata** (R.Br.)FvM., Cens. 1(1882)30; Fragm. 12(1882)13; FvM., Ic. Austral.Salsol.Pl. 8(1891),t.77; Black, Trans.Roy.Soc.S.Austral. 42(1918)171; Black, Fl.S.Austral. (1924)194; ed.2, (1948)304,fig.396; Anderson, Proc.Linn. Soc.N.S.Wales 48(1923)334; Chippendale, Trans.Roy.Soc.S.Austral. 82 (1959)327.— *Anisacantha divaricata* R.Br., Prod. 1(1810)410; Moq. in DC., Prod. 13/2(1849)122; Benth., Fl.Austral. 5(1870)200 p.p.— *Anisacantha erinacea* Moq. in DC., Prod. 13/2(1849)122.— *A. erinacea* var. *longicuspis* FvM., Fragm. 7(1869)14 ["Stokes Range" (specimen not seen)].— *Sclerolaena divaricata* (R.Br.)Domin, Bibl.Bot. 89(1921)624; Ulbrich, Pflzfam. ed.2. 16c(1934)533.

NEW SOUTH WALES. Brough and Beadle: SYD: Broken Hill-Fowlers Gap.— D. M. Dinning: NE: ibid.— C. K. Ingram 6558: Ingr.: Bourke.— id. 9813: Nyngan-Brewarrina.— E. H. Ising: AD96131145: 50 miles N.E. Broken Hill.— A. Morris 2050: ADW: Horse Lake.— id. 78: AD, ADW: Broken Hill.— Pidgeon and Vickery: SYD: ibid.— J. A. Thompson 128: NE: Wilcannia.

NORTHERN TERRITORY. N. T. Burbidge: CANB 18193: Tanami.— G. Chippendale 3931: CANB, NSW: 13 miles E. Finke.— id. 8051: NT: Burt Plain.— J. B. Cleland: AD 96019109: Glen Helen.— id.: AD 96019108: Hanns Rge.-Prowses Gap.— id.: AD 96019107: 50 miles N. Ayers Rock.— id.: AD 96019110: 15 miles W. Liddles Hill, Angus Downs. This specimen differs from *B. divaricata* in having 4-6 spines, two of them often joined together at the base and borne on a horizontal lobe at the summit of the perianth. A very short spine is usually present at the base of one of the longer ones.— E. H. Ising: AD 96131150: Rodinga.— id.: AD 96131149: 25 miles N.E. Alice Springs.— id.: AD 96131159, 60: Macdonald Downs.— M. Lazarides 5895: AD, CANB: Lucy Creek Stn.— id. 5855: AD, CANB: Wauchope.— id. 5759: AD, CANB: Deep Well.— E. Reichenbach: AD 96131020: Rodinga.— R. Swinbourne 332: AD, NT: Alice Springs.— id. 19: Ingr.: ibid.— id. 493: NT: 10 miles W. Yuendumu.

QUEENSLAND. S. T. Blake 12372, 12375: AD: Boulia.— id. 11375: AD: Tranby.— S. L. Everist 3209: CANB: Ardmore.— id. 3947: CANB: Cunnamulla.

South Australia. R. Brown: BM (*holotype*): Inlet XII, South Coast Spencers Gulf, 1802.— G. H. Clarke: ADW 3200: Anacoora.— J. B. Cleland: AD 96140089: Woomera.— id.: AD 95820067: Mt. Chambers.— id.: AD 95820060: 25 miles N.W. Oodnadatta.— id.: AD 95820058: Parachilna.— id.: AD Tinga Tingana.— R. L. Crocker: ADW 23016: Yudnapinna.— J. G. Davies: ADW 3089: ibid.— Hj. Eichler 12443: AD: Koonamore.— id. 12547: AD: Chambers Gorge, Flinders Range.— N. Forde 357: CANB: Emu.— F. M. Hilton 477, 849: ADW: Yudnapinna.— id. 1409: ADW: Lyndhurst-Avondale.— id. 1463: ADW: Beltana.— E. H. Ising: AD 96220027, 28, 29, 30, 31, 32: Evelyn Downs.— id.: AD 96131158: Mooloolloo Stn.— id.: AD 96131156: Callane.— id.: AD 96131148: Abminga.— id.: AD 96131147: Stirling North.— id.: ADW 11560: Mt. Barry Stn.— M. Koch: PERTH: Mt. Lyndhurst.— H. Mincham 12: AD: Lyndhurst.— B. J. Murray 192: AD: Arcoona.— id. 443: AD: Carrieweerloo.— — T. B. Paltridge: CANB 97833, AD: Koonamore.— P. A. Perry: CANB 18303: Iron Knob.— R. Schodde 1115: AD: Koonamore.— D. E. Symon: ADW 11466: Ellery Creek.— id. 1025A. NE: Andamooka-Stuarts Range.— P. C. Wilson 79; AD: Pt. Augusta-Whyalla.

Western Australia. N. T. Burbidge 23: PERTH: Glenorn.— W. D. Campbell: PERTH: Boulder.— J. S. Johnston: PERTH: Leonora.— A. S. George 5575: PERTH: Brockman Ck., Wonguwol Stn.— id. 4499: PERTH: 15 miles E. of Laverton.— id. 3983: PERTH: Windulda, Laverton-Warburton Rd.— E. Merrall: MEL: Parkers Range.— N. H. Speck 890: CANB: Meekatharra.— id. 733: CANB: Nanuine.— id. 371: CANB: Berringarra.

Note. This species shows some variation in the collections, chiefly in the perianth and spines. The holotype has an oblong perianth and 4 spines, the shortest spine straight and often diverging upwards. Some specimens examined have a turbinate or obconic perianth about as long as wide; spines may be 3 only or 3 with a 4th rudimentary or very short. Sometimes the short spine is horizontally curved across the posterior face of the perianth. The limb, however, appears to be constantly bent inwards (incurved) and definitely not erect.

53. **Bassia longicuspis** FvM., Ic.Austral.Salsol.Pl. 8(1891),t.74; FvM., Vict.Nat. 9(1893)187; Black, Trans.Roy.Soc.S.Austral. 39(1915)823, 828; 41(1917)43, 351; Black, Fl.S.Austral. (1924)194; ed.2, (1948)303,fig.394; Anderson, Proc. Linn. Soc.N.S.Wales 48(1923)333; Chippendale, Trans.Roy.Soc.S.Austral. 82(1959)327.— *Austrobassia longicuspis* (FvM.) Ulbrich, Pflfam. ed.2, 16c (1934)532.

New South Wales. B. Kennedy: MEL (*syntype*): Darling River.— A. Morris 691: ADW: Menindie Road.— B. R. Paterson: NE: Fowlers Gap.— J. A. Thompson 127: NE: Byrnedale, W. Darling.

Northern Territory. H. Kempe s.n.: MEL (*lectotype*), NSW: Charlotte Waters.

Queensland. J. Bancroft: AD 96309302: Longreach.— S. T. Blake 11902: AD: Eromanga.— id. 6693: AD, NSW: Bilbah Downs.— S. L. Everist 3561: CANB: Whynot. L. S. Smith 6080: BRI: Whynot Stn., Quilpie.

South Australia. S. T. Blake 16921: CANB: Hookina. J. B. Cleland: AD 95820066, 96309301: Pedirka.— R. L. Crocker: ADW 4573: Flinders Range.— Hj. Eichler 12993: AD: Aroona Dam, Flinders Range.— E. H. Ising: AD 96131088-9: Pedirka.— R. A. Perry 5536: CANB, NSW, NT: Near De Rose Hill Stn.— J. P. Richards: MEL (*syntype*): Beltana.— D. Wotherspoon: Ingr. 10105: Flinders Range-Lake Eyre.— R. Tate: AD 96130021: Mt. Parry.

54. **Bassia tetracuspis** White, Roy.Soc.Queensl. 55(1944)76.

Queensland. S. T. Blake 5674: NSW: Morven.— id. 5863: NSW: Pallardo.— id. 7591: AD, BRI: ibid.— E. Bowman: MEL: Westwood.— S. L. Everist 1738: BRI 010644 (*holotype*), AD: The Oaks, 20 miles W. Tara.— id. 2508: CANB: 10 miles E. Emerald.— id. 5806: AD, BRI: Cypress Downs.— Hartmann: MEL: Toowoomba.— C. E. Hubbard 5041: NSW: Wandoon.— L. A. S. Johnson: NSW 57414. Jondaryan.— Leichhardt and Bunce: MEL: Subtropical Eastern Austral.— J. Mann: NSW 57415: Chinchilla.— F. Mueller: MEL: Suttors River.— P. A. O'Shanasy: MEL: Fitzroy River.— C. T. White 11305: BRI: Hannaford.— id.: BRI: Wyaga.

55. **Bassia hostilis** Diels, Bot.Jahrb. 35(1904)185.— *Sclerolaena hostilis* (Diels) Domin, Bibl. Bot. 89(1921)624; Ulbrich, Nat.Pflfam. ed.2, 16c(1934)533.

Western Australia. C. A. Gardner 6298: PERTH (*neotype*): Mt. Herbert Tableland, 15.X.1941. [The holotype (and isotypes, if any) cannot be traced. It is known that Diels' specimens were deposited in Berlin, Germany. Most of them were destroyed in wartime by a fire. It was, therefore, necessary to select a specimen as neotype.]— N. T. Burbidge 878: PERTH; Warralong H.S. id. 1209: PERTH: Between Mt. Edgar Stn. and Marble Bar.— id. 1536: PERTH: De Grey River Dist.— J. Forrest: MEL: Sherlock and Yule Rivers, between Roebourne and Pt. Hedland, 1878. A. S. George 3481: PERTH: Mundabullangana Stn.

Note: Anderson [Proc.Linn.Soc.N.S.Wales 48(1923)353] mentions that he had seen no specimen of *B. hostilis*, "but," he says, "I am unable to separate it from *B. divaricata* (R.Br.) Ew.M., the features of both species apparently agreeing in every particular." The fruiting perianths are different; both have 4 spines, yet *B. divaricata* has sometimes only 3.— C. A. Gardner [Enum.Aust.Occid. (1930)38] places *B. hostilis* as a synonym of *B. divaricata* which indicates that he had not seen at that time an authentic specimen of *B. hostilis*. He collected a specimen of this latter species later and determined it correctly.

56. **Bassia eremaea** Ising, sp.nov.— Fig. 18.— *B. spinosa* Ewart and Dav., Fl.N.Terr. (1917)95,t.12,fig.1-3 (*nom. illeg.*, Intern. Code Bot. Nomencl. (1961)52, Art. 71); Anderson, Proc.Linn.Soc.N.S.Wales 48(1923)350; Chippendale, Trans.Roy.Soc.S.Austral. 83(1960)199.

Suffrutex, omino cum pilis verticillatis densissime vestitis; caules et rami teretes, costati. Folia oblanceolata, 5-22 mm longa, obtusa, crassa; axilla pilosa. Perianthium in fructu ± cylindratum, ca. 2 mm longum, ca. 2 mm latum; costae ca. 8, longitudinales; apex obliquus; persistens. Spinae 5, 3 ± subulatae ad basim conjunctae, spina centrali erecta, ad 6 mm longa, spinis lateralibus divergentibus, ca. 3 mm longis; 2 spinae 1-2½ mm longae, recurvatae vel rectae. Limbus erectus, ca. 1 mm longus, lobis 4, obtusis, dense pilosus. Basis expansa, nec cavata, ± circularis; margo incrassatus cum 2 tuberculis prominentibus, umbonatis; caulem amplexit. Stylus prope glaber; rami stigmatici 2, rubri. Semen verticale; radicula superior.

Holotypes: E, Reichenbach: AD 96335001: Bundooma, N.Terr.: 27.II.1953. - [Isotypes: AD 96335002 (Fig. 18).]

Undershrub, very densely clothed with verticillate hairs on whole plant; stems and branches terete, ribbed. Leaves oblanceolate, 5-22 mm long, obtuse, thick, hairs in axil. Fruiting perianth, = cylindrical, ca. 2 mm long, ca. 2 mm wide; ribs ca. 8, longitudinal; summit oblique; very difficult to detach. Spines 5; 3 of which = subulate, joined together at base, central one erect, up to 6 mm long, others diverging ca. 3 mm long; 2 others 1-2½ mm long, recurved or straight. Limb erect, ca. 1 mm long, lobes 4, obtuse, densely hairy. Base spreading, not hollowed, ± circular; margin with rib and 2 prominent dome-like tubercles; stem clasping. Style almost glabrous; stigmatic branches 2, red. Seed vertical; radicle superior.

Northern Territory. G. F. Hill 346: MEL (*holotype* of *B. spinosa* Ewart and Dav.; monstrous material), AD: Lander Creek. J. B. Cleland: AD 96140087: 25 miles S. Alice Springs.— id.: AD 96132021: Haasts Bluff. M. Lazarides 6183: CANB, NT: Angas Downs Stn.— D. J. Nelson 102: NSW: Mt. Wedge.— B. A. Perry 3232: CANB, NT: Alice Springs.— R. Swinbourne 16: Ingr.: Temple Bar Creek, 12 miles S. Alice Springs.— id. 208: Ingr.: near Alice Springs.— id. 8342: NT: Alice Springs.— id. 466: NT, Temple Bar Creek.— id. 487: AD, NT: Alice Springs.— id. 331: AD, NT: ibid.— id.: NT 9030, AD: ibid.— R. E. Winkworth 262: CANB, NT: 15 miles S.W. Alice Springs.— id. 383: CANB, NT: East Mt. Wedge.— id. 317: NT: 25 miles W. Haasts Bluff.— A. J. Ward: NSW: Alice Springs.

South Australia. J. B. Cleland: AD 95914013: North end of Munn Ranges.— T. R. N. Lothian 1645: AD: Simpson Desert.

Western Australia. F. L. Hill 408: AD: Hermite, Monte Bello Is. ibid.: CANB 29006: Hermite, Monte Bello Is., 12.XI.1953.— N. H. Speck 979: CANB, PERTH: 10 miles south of Berringarra, Eremaean Prov.

NOTE. The original description, in part, of *B. spinosa* Ewart and Day, is "fruiting perianths connate into a hard mass of about ½" diam." I have examined isotype material (AD) and cut sections of the "hard mass" and found in it several perianths and irregular tunnelling in which was an empty case or shell of the vacated insect. This is proof that the "hard mass" is a monstrous formation, an insect gall. Chippendale [Trans.Roy.Soc.S.Austral. 83(1960)199] confirms this. *B. spinosa* Ewart and Davies was thus described from a monstrosity. The name, though validly published, must be rejected [Intern. Code Bot. Nomencl. ed. 1961, Art. 71]. I have, therefore, described this species from normal material (based on a new type specimen).

The epithet of the name *B. eremaea* is descriptive of the type of country in which the species occurs.

57. **Bassia clelandii** Ising, sp.nov.— Fig. 10.

Suffrutex; rami leviter costati, dense tomentosi. Folia caulis linearí lanceolata, ad 8 mm longa, ca. 1·5 mm lata, tenuia, obtusa, mucronata, dense hirsuta; folia florum ± ovata, ca. 2·5 mm longa, ca. 1 mm lata, tenuia, dense hirsuta. Flores axillares, solitarii. Stamina 5; filamenta membranaecea, nec latiora in parte inferiore. Perianthium in fructu ± oblongum, 2-lobum, ad basim unilateraliter gibbosum, ca. 3 mm longum, ca. 1·5 mm latum; facies ± planantur, cum 2-3 costis debilibus longitudinalibus. Spinae 5, 1-1·5 mm longae, simplices, recurvae, hirsutae, in lobis duobus recurvis productae; bases crassae, contiguae. Limbus erectus, ca. 1 mm longus, chartaceus, hirsutus. Basis ± ovata, leviter obliqua, leviter cavata. Stylus fere glaber; rami stigmatici 2, punicei. Semen verticale; radicula superior.

HOLOTYPUS: J. B. Cleland: AD 96317117: Northern Territory. 44 miles west of Erldunda, 1.VI.1935.

Undershrub; branches finely ribbed, densely tomentose. Leaves: stem, linear-lanceolate, up to 8 mm long, ca. 1½ mm wide, thin, obtuse, mucronate, densely hirsute; floral, ± ovate, ca. 2½ mm long, ca. 1 mm wide, thin, densely hirsute. Flowers solitary in axil. Stamens 5; filaments membranous, not widened in lower part. Fruiting perianth ± oblong, 2-lobed, unilaterally gibbous at base, ca. 3 mm long, ca. 1½ mm wide; faces ± flattened with 2-3 weak longitudinal ribs. Spines 5, 1-1½ mm long, simple, recurved, hirsute, produced on 2 recurved lobes; bases thick, close together. Limb erect, ca. 1 mm long, chartaceous, hirsute. Base ± ovate, slightly oblique, slightly hollowed. Style almost glabrous; stigmatic branches 2, pink. Seed vertical; radicle superior.

NORTHERN TERRITORY. R. Swinbourne 30: Inger, NT 9046: 7 miles S. Mt. Wedge Stn.

QUEENSLAND. R. L. Crocker: NSW 55252: Kalidhwarry Stn., ca. 70 miles N.W. Birdsville.

WESTERN AUSTRALIA. B. H. Kuchel 276: AD; Lake Christopher, 60 miles N.W. Giles – D. E. Symon 2342: AD, ADW: West end of Hopkins Lake, S. of Sir Frederick Range.

This species is unlike all others in the perianth being divided at the summit into 2 lobes which bear the spines.

Named in honour of Prof. Sir John B. Cleland, Adelaide.

58. **Bassia blackiana** Ising, Trans.Roy.Soc.S.Austral. 57(1933)91-2,fig.1-3; Black, l.c. 58(1934)176; Black, Fl.S.Austral. ed.2, (1948)307,fig.415; Ising, Trans. RoyalSoc.S.Austral. 78(1955)112.

NEW SOUTH WALES. L. A. S. Johnson 547/102: NSW 18850: Wilcannia (first record for New South Wales).

QUEENSLAND. S. T. Blake 11969: AD, BRI: Mt. Howitt Stn., 80 miles W. Eromanga (first record for Queensland).

SOUTH AUSTRALIA. E. H. Ising 2670: AD (holotype); ADW, MEL, NSW: Oodnadatta.— id. 3583: AD, ADW: Condiments, 45 miles S. Oodnadatta.— id.: AD 96230178, 96230182 to 96230190: Evelyn Downs.— id.: AD 96230048, 96230180-1: 20 miles E. Evelyn Downs.— id.: AD: 30 miles S.W. Oodnadatta.— J. B. Cleland: AD 96309284: 22 miles W. Oodnadatta.

59. **Bassia albolanata** Ising, sp.nov.— Fig. 9.

Suffrutex; rami densissime albo-lanati, subtilissime costati. Folia linearia 7-18 mm longa, ca. 1 mm lata, tenuia, plana, acuta, villosa, denique prope glabra. Flores 2 axillares. Stamina 5. Perianthium in fructu depresso-hemisphaericum, ca. 2·5 mm diam., ca. 1 mm longum, albo-lanatum; apex ± planus; costae ca. 5, longitudinales, rubidae. Spinae, 5 raro 4 vel 6, 1·5-4 mm longae, subulatae, horizontales, inaequales, rubidae, albo-lanatae, uno spina plerumque ad apicem dentato et obtuso. Limbus fere absens; lobi 5, lati. Basis minuta, circularis, non cavata. Stylus lanatus, crassus; rami stigmatici 2, rubidi. Utriculus ad apicem lanatus. Semen horizontale; radicula lateralis.

Holotypus: J. B. Cleland: AD 95820121: South Australia. Between Mungeranie and Cowarie, 17.IX.1956.— [Isotype: NSW.]

Undershrub; branches very densely white lanate, finely ribbed. Leaves linear 7-18 mm long, ca. 1 mm wide, thin, flat, acute, villous, becoming almost glabrous. Flowers 2 in axils. Stamens 5. Fruiting perianth depressed – hemispherical, ca. 2½ mm dia., ca. 1 mm long, white lanate; summit ± flat; ribs ca. 5, longitudinal, dark red. Spines 5, rarely 4 or 6, 1½-4 mm long, subulate, horizontal, unequal, dark red, white lanate; one usually obtuse and toothed at apex. Limb almost absent; lobes 5 broad. Base very small, circular, not hollowed. Style lanate, thick; stigmatic branches 2, dark red. Utricle lanate at summit. Seed horizontal; radical lateral.

Note. *B. alholanata* is near to *B. chippendalei* Ising which has less dense indumentum, solitary flowers, obconic fruiting perianth, acicular spines, and the style with a globular lanate mass in upper part.

The specific epithet describes the indumentum of the plant.

60. **Bassia astrocarpa** FvM., Fragm. 12(1882)12; FvM., Second Cens. (1889)51; FvM., Ic.Austral.Salsol.Pl. 7(1891),t.65; Anderson, Proc.Linn.Soc.N.S.Wales 48(1923)320; Gardner, En.Pl.Austral.Occid. (1931)38.— *B. astracantha* FvM., Cens. 1(1882)140 (*orth.mut.*).— [*Chenolea astrocarpa* FvM., Fragm. 12(1882)12 *pro syn.*].— *Sclerolaena astrocarpa* (FvM.)Domin, Bibl.Bot. 89(1921)624; Ulbrich, Pflfam.ed.2, 16c(1934)533.

Western Australia. N. T. Burbidge 620: PERTH: Port Hedland (sometimes 2 perianths in the axil).— id. 1379: PERTH: Anna Plains Stn.— id. 1308: PERTH. Nalgi Stn., 80 mile Beach (spines very short and obtuse).— id. 5807: CANB: Cowrie Creek, S Pt Hedland.— Mrs. Crouch: MEL (*holotype*), PERTH: Nicol Bay, 1876.— W. V. Fitzgerald 115: PERTH: Broome.— id. 96: PERTH: Port Hedland.— id.: PERTH: Goodygoody.— A. S. George 3425: PERTH: Mundabullangana Station.— A. Morrison: PERTH: Onslow.

61. **Bassia densiflora** Fitzg., Journ.W.Austral.Nat.Hist.Soc. 1(May 1904)31; Anderson, Proc.Linn.Soc.N.S.Wales 48(1923)325; Gardner, En.Pl.Austral. Occid. (1920)38; Blackall, W.Austral.Wildfl. 1(1954)153.

Western Australia. W. E. Blackall 364: PERTH: Leonora.— N. T. Burbidge 71: PERTH: Glenorn.— J. B. Cleland: NSW 20528: Mullewa.— W. V. Fitzgerald: NSW 55949 (*lectotype*): Gwalia, XI.1903.— id.,: NSW 55950: Nannine.— C. A. Gardner 6193: PERTH: Wandagee, Minilya River.— A. S. George 5511: PERTH: 14 miles E. of Carnegie H.S.— M. Koch: NSW 57303: Cowcowing.— D. D. MacKinnontz: PERTH: Leonora.— J. H. Maiden: NSW 57302: Laverton.— id.: NSW 20529: Cue.— N. H. Speck 690: CANB: Mileura H.S.

62. **Bassia chippendalei** Ising, sp.nov.— Fig. 8.

Caules et rami cinereo-tomentosi, graciles. Folia ± linearia, 5-10 mm longa, 1-2 mm lata, basi et apice coangustatur, dense pubescentia. Flores axillares solitarii. Perianthium in fructu ± obconicum, ca. 2·5 mm longum, dense albo-villosum. Spinae 5 rectae, aciculares

divergentes, debiles, in parte inferiore villosae; 3 spinae 2-3 mm longae, 2 breviores ad basim contiguae. Limbus brevis, erectus; lobae obtusae, membranaceae, dense pubescentes. Basis oblonga, ± obliqua, leviter expansa, leviter cavata. Stylus in parte inferiore glaber, parte superiore dense albo-lanatus in massa sphaerica; rami stigmatici 3, stylo longiores, rubidi. Semen horizontale; radicula lateralis.

HOLOTYPUS: G. Chippendale 4210: AD 96314181: Northern Territory. 39 miles S.E. of Granites, "grey perennial herb 1'; common in desert loamy soil".— [Isotype: NT.]

Stems and branches grey tomentose, slender. Leaves ± linear, 5-10 mm long, 1-2 mm wide, narrowed at base and summit, obtuse, densely pubescent. Flowers solitary in axil. Fruiting perianth ± obconic, ca. 2½ mm long, densely white villous. Spines 5, straight, acicular, divergent, weak, villous in lower part, three 2-3 mm long, 2 shorter and close together at base. Limb short, erect; lobes obtuse, membranous, densely pubescent. Base oblong, ± oblique, slightly expanded, slightly hollow. Style glabrous in lower part; densely lanate in a white spherical mass in upper part; stigmatic branches 3 longer than style, dark red. Seed horizontal, radicle lateral.

NOTE. *B. chippendalei* resembles *B. alboLanata* Ising which has 2 flowers in axil, one spine obtuse and toothed, perianth ribbed and hemispherical, style lanate all over.

Named in honour of the discoverer, Mr. C. M. Chippendale, Botanist, Animal Industry Branch, Northern Territory Administration, Alice Springs, N.T.

63. **Bassia ramulosa** White, Roy.Soc.Queensland 55(1944)76.— Figs. 19 and 21.

QUEENSLAND. Bassingthwaite and Cole 6: BRI (*holotype*), NSW 60286: Banchory, 42 miles W. Clermont.— C. H. Allen A292: BRI, CANB: Mt. Morris, 75 miles N.W. Charleville.— S. T. Blake 9982: AD, BRI: Milray Stn., S. Pentland.— S. L. Everist 2131: BRI: BRI, NSW 60287: Blendon, 53 miles N. Blackall.— F. Mueller: MEL: Sutton River.

64. **Bassia obconica** Ising, sp.nov.— Figs. 20 and 27.

Suffrutex; rami dense tomentosi; costae graciles. Folia linearia; 5-13 mm longa, ca. 1 mm lata, tenuia, obtusa; in basi angustiore; villosa vel pilosa. Perianthium in fructu obconicum, ca. 2 mm longum; ca. 8 costae longitudinales; aliquot costarum ex spinis decurrentium; apex ± concavus; pilosum. Spinae 5, inaequales, late divergentes, aciculares, rectae, parte superiore glabrae; 3 longissimae 6-9 mm longae; 2 brevissimae ad basim contiguae, 1·5-3 mm longae, cum costa decurrenti. Limbus rectus, ca. 0·5 mm longus, chartaceus, ciliatus. Basis oblonga, obliqua, nec cavata. Stylus glaber; rami stigmatici 2-3, punicei. Semen horizontale; radicula superior.

HOLOTYPUS: C. A. Gardner 6044-5: PERTH: Western Australia, 30-60 miles E. of Carnarvon, 20.IX.1941, "diffuse, leaves grey-green, fruits pale yellow; lower part of sandhills". (The label indicating the locality shows the number 6044; however, the plant specimen has a label with the number 6045 tagged on.)

Undershrub; branches dense, tomentose; ribs slender. Leaves linear, 5-13 mm long, ca. 1 mm wide, thin, obtuse, narrowed at base; villous to pilose. Fruiting perianth obconic, ca. 2 mm long; ribs longitudinal, ca. 8, some decurrent from spines; summit ± concave; pilose. Spines 5, unequal, widely diverging, acicular, straight, glabrous in upper part: 3 longest 6-9 mm long; 2 shortest close together at base, 1½-3 mm long, with decurrent rib. Limb erect, ca. ½ mm long, chartaceous, ciliate. Base oblong, oblique, not hollowed. Style glabrous; stigmatic branches 2-3, pink. Seed horizontal; radicle superior.

WESTERN AUSTRALIA. G. R. Meadly: PERTH: 55 miles E. of Carnarvon, 10.VII.1937

The specific epithet is given in allusion to the shape of the fruiting perianth.

65. **Bassia quinquecuspis** (FvM.)FvM., Cens. 1(1882)30; Cens. 2(1889)50; FvM., Ic.Austral.Salsol.Pl. 8(1891),t.76; Anderson, Proc.Linn.Soc.N.S.Wales 48 (1923)341; Black, Fl.S.Austral. (1924)194; ed.2, (1948)305,fig.406; Ising, Trans.Roy.Soc.S.Austral. 59(1934)216; Black, l.c. 59(1935)256; Chippendale, l.c. 83(1961)100.— *Anisacantha quinquecuspis* FvM., Trans.Viet.Inst. (1855)134; FvM., Hook.J.Bot.KewMisc. 8(1856)204.— *Chenolea quinquecuspis* (FvM.)FvM., Fragm. 10(1876)91.— *Anisacantha muricata* Moq., Chenop.Monogr.Enum. (1840)84 [non *B. muricata* (L.)Aschers.]; Moq. in DC., Prod. 13/2(1849)122; Benth., Fl.Austral. 5(1870)199.— *Sclerolaena muricata* (Moq.)Domin, Bibl.Bot. 89(1921)623; Ulbrich, Pflfam. ed.2, 16c (1934)533.

New South Wales. J. B. Cleland; AD 96138049: Narrabri.— id.: AD 96247290: Menindie.— A. Cunningham; MEL: Liverpool Plains.—C. K. Ingram 9853: Ingr.: Bourke.— id. 6479: Ingr: Mullengudgery.— E. H. Ising: AD 96018137: Broken Hill.— Leichhardt: MEL: Colroy Creek.— C. Moore: MEL: Liverpool Plains.— A. Morris 2052: ADW: Horse Lake.— F. Mueller: MEL (*holotype*): Near the junction of the Darling and Murray Rivers, XII.1853.— E. K. Winterhalder: NE: Mullengudgery.

Northern Territory. Johnson and Chippendale: NT 3940: New Crown Stn.

Queensland. W. Barton: MEL (var. *major* FvM. *nom.nud.*): Armadillo.— S. T. Blake 6598: AD: Longreach.— id. 5576: AD: Cunnamulla.— id. 6530: NSW: Winton.— id. 12085: AD: Windorah.— id. 8027: AD: Minerva.— id. 7782: AD: Rockhampton.— id. 10475: AD: Goondiwindi.— R. L. Crocker: NSW: E. Andado, Simpson Desert Exped.— W. MacGillivray: ADW: Blackall.— C. T. White 13058: CANB: Laidley.— id.: NSW 60249: Wallumbilla.— id.: AD 96142087: Muttaburra.

South Australia. J. B. Cleland: AD 96312118: Pandie Pandie.— R. L. Crocker: AD: Diamantina River.— id.: AD 96130142: Andrewilla W. H., 75 km S. Birdsville.— Hj. Eichler 14907: AD: Mannum.— id. 13832: AD: Renmark.— M. Koch: AD 96130139: Mt. Lyndhurst.— Tapp and Robertson 7351: ADW: Murray Bridge.

Victoria. H. I. Aston 538: AD: Murphy's Lake, Kerang.— E. Green: MEL: Sunbury.

65b. *Bassia quinquecuspis* var. **lanata** Ising, var.nov.

Rami lanati. Folia linearia vel anguste oblanceolata, 6-12 mm longa, ca. 1 mm lata, obtusa, lanata. Perianthium in fructu lanatum. Spinae 5, in parte inferiore sparse villosae.

Holotypus: R. A. Perry 5353: CANB 73390: Northern Territory. 24 miles south of Barrow Creek Township; 3.IX.1955; flooded depression, possibly saline; "greyish plant 1 ft. high".— [Isotypes: NSW 60264, N.T.]

Branches lanate. Leaves linear to narrow oblanceolate, 6-12 mm long, ca. 1 mm wide, obtuse, lanate. Fruiting perianth lanate. Spines 5, sparsely villous in lower part.

Northern Territory. G. Chippendale 4778: AD: Boomerang W.H., Lander River, 42 miles N.W. Willowera H.S.— Chippendale and Johnson 3981: NT: 25 miles N. of Kulgera.— R. Swinbourne 492: NT: 12 miles S. of Stuart Bluff Range.— id. 9032: AD, NT: E. of Alice Springs.— id. 21: Ingr.: ibid.— id. 14: Ingh.: 70 miles S.E. Ynendumu.

Western Australia. W. E. Blackall 839: PERTH: Yandil.— C. F. Brockway: PERTH: Sturt Meadows Stn.— N. T. Burbidge 81, 232: PERTH: Glenorn.— N. H. Speck 1442. AD, CANB: 36 miles W. Yelma, Eremaen Prov.— D. E. Symon 2326: AD, ADW: West end of Hopkins Lake, south of Sir Frederick Range.

65c. *Bassia quinquecuspis* var. **semiglabra** Ising, var.nov.

Rami tomentosi. Folia superiora ± obovata, 2·5-5 mm longa, ca. 2 mm lata, ± obtusa, super glabra, infra villosa, ad basim attenuata, tenuia; inferiora ± oblanceolata ca. 10 mm longa, ca. 2 mm lata, obtusa, super glabra, infra sparse pubescentia, ad basim attenuata tenuia; omnia folia subtiliter rugosa, colore fusco plumbi.

HOLOTYPUS: H. I. Aston 277: MEL: New South Wales. 20 miles north-west of Jerilderie, 28.III.1959. "Shrub 4 ft. high x 3 ft. wide, common on open-forest-saltbush plain."— [Isotype: AD 95927087.]

Branches tomentose. Leaves: upper, ± obovate, 2½-5 mm long, ca. 2 mm wide, ± obtuse, glabrous above, villous below, tapering to base, thin; lower, ± oblanceolate, ca. 10 mm long, ca. 2 mm wide, obtuse, glabrous above, sparsely pubescent below, tapering to base, thin; all leaves finely rugose, dark lead colour.

NEW SOUTH WALES. L. Abraham: NSW 60256: Cobar.— J. M. Black: AD 96142083: Coonamble.— N. C. Beadle: SYD: Condobolin.— Beadle and Tupper: SYD: ibid.— J. B. Cleland: AD 96138046: Warren.— C. K. Ingram 8336: Ingr.: Forbes.— id. 3247: Ingr.: Bathurst.— E. H. Ising 2164: AD, NSW 60277: Gunningbland.— id. 2086: NSW 60278: Bogan Gate.— H. Lynch: BRI, NSW 60289: Bathurst.— McBarron: SYD: Henty.— McClymont: NE: Moree.— T. W. Mills: NSW 60280: Forbes.— E. Officer: NSW 60261. Wanganella.— J. O'Reilly: NSW 60254: Boggabri.— Shire Clerk: NSW 60281: Bourke Shire.— F. Sulman: NSW 60263: Cutharoo.— J. W. Vickery: SYD: Moree.— E. H. Zeck: NSW 60251: Ashley.

QUEENSLAND. S. T. Blake 10430: AD: Yelarbon.— id. 10886: AD: Roma.— id. 10638: AD: Noondoo.— id. 10529: AD: Kildonan.— S. L. Everist 763: BRI: Noondoo Stn.— J. Mann: BRI: Chinchilla.— E. Middleton: BRI: Texas.— Reid: BRI: Mitmenan.— R. Roe: BRI: Nindigully.— C. T. White: AD, BRI: Dalby.

VICTORIA. H. B. Williamson: NSW 60269: Mildura.— id.: MEL: Bendigo.

65d. *Bassia quinquecuspis* var. **villosa** (Benth.)Black, Trans.Roy.Soc.S.Austral. 39(1915)828: Ewart and Tovey, Proc.Roy.Soc.Vict., n.s., 32(1920)191; Anderson, Proc.Linn.Soc.N.S.Wales 48(1923)341; Black, Fl.S.Austral. (1924) 194; ed.2 (1948)305; Chippendale, Trans.Roy.Soc.S.Austral. 84(1961)100.— *Anisacantha gracilicuspis* FvM., Fragm. 2(1861)170.— *Anisacantha muricata* var. *villosa* Benth., Fl.Austral. 5(1870)199.— *Sclerolaena muricata* var. *villosa* (Benth.)Ulbrich, Pflfam.ed.2, 16c(1934)533.

NEW SOUTH WALES. E. Breakwell: NSW 60252: Gurley.— J. Bruckner: MEL: Darling and Lachlan Rivers.— E. Cheel: NSW 60267: Merriwa.— E. F. Constable: NSW 5197. Hay-Balranald.— A. B. Costin: NSW 60290: Cooma.— A. Cunningham 381: BM: Molles Plains.— id.: MEL: Liverpool Plains.— H. Doust: NSW 60276: Camden.— O.D.E.: SYD: Flemington-Homebush Bay.— J. W. Hicks: NSW 60282: Young.— C. K. Ingram: Ingr.: Booligal.— id. 9796: Ingr.: Warren.— E. H. Ising 2159: NSW: Bogan Gate.— L. A. S. Johnson: NSW 60258: 15 miles W. Hilston.— Johnson and Constable: NSW 48554: Booligal.— E. J. McBarron 4419: NSW: Mulwala.— C. Moore: NSW 60253: Namoi River.— id. 644: CANB: Trangie.— A. Morris 1500: ADW, NSW: Moulamein.— E. Officer: NSW 60260, 60268, MEL: Yara (Wanganella).— J. T. Waterhouse: SYD: Collarenebri.— H. A. Webb: NSW 60288: Bathurst.— W. M. Willoughby 51, 93: CANB: Deniliquin

NORTHERN TERRITORY. J. B. Cleland: AD 96142091: Maryvale.— Kempe 281: MEL Finke River.

QUEENSLAND. S. T. Blake 5164: BRI: Toowoomba-Drayton.— id. 5391: BRI: Charleville.— id. 7930: AD: Minerva.— E. Bowman: MEL: E. Australia.— S. L. Everist 271: BRI: Northampton Downs.— id. 818, 823: BRI: Noondoo Stn., Dirranbandi.— Holland and Cranck 16: CANB: Mungindi.— C. E. Hubbard 5646: BRI: Toolburra-Rose Hill.— F. Mueller: MEL (*holotype*), AD (fragm.): McKenzie Downs.— P. A. O'Shanesy: MEL: Springsure.— N. H. Shaw 318: CANB: Comet-Dingo.— W. E. Wehl: BRI: Surat.— C. T White: BRI: Dalby.— id. 13058: BRI: Laidley.

SOUTH AUSTRALIA. C. H. Clarke: ADW, AD: Parafield, Abattoirs.— J. B. Cleland. AD 96033044: Wellington-Meningie.— N. Lohmeyer: ADW: Pinnaroo.— R. Schodde 798: AD: Morgan.— D. E. Symon 398: ADW: Abattoirs.

Victoria.- H. I. Aston 524: AD, MEL: Kow Swamp, Gunbower.— A. C. Beauglehole 979: A.C.B.: Kulkyne.— R. A. Black: MEL: Echuca.— J. G. Luehmann: MEL: Swan Hill.— J. Minchin: MEL: Kerang.— E. T. Muir: A.C.B. 5257: Dimboola.— R. M. Reader: AD, MEL: Borong.— F. Robbins: A.C.B. 5267: Rochester.— E. J. Semmens: MEL: Sedgwick.— P. St.John: MEL: Jeparit.— J. Vickery: NSW 1978: Euston-Mildura. id.: NSW 2022: Echuca.— H. B. Williamson: MEL: Bendigo.— Willis and Beauglehole: A.C.B. 5256: Chalka Creek.

66. **Bassia birchii** (FvM.)FvM., Cens. 1(1880)30; FvM., Ic.Austral.Salsol.Pl. 8 (1891),t.72; Black, Trans.Roy.Soc.S.Austral. 39(1915)828; 40(1916)60; Black, Fl.S.Austral. (1924)191 p.p.; ed.2 (1948)306,fig.412; Anderson, Proc. Linn.Soc.N.S.Wales 48(1923)344; Chippendale, Trans.Roy.Soc.S.Austral. 82 (1959)327.— *Anisacantha birchii* FvM., Fragm. 8(1874)163.— *Sclerolaena birchii* (FvM.) Domin, Bibl.Bot. 89(1921)623.— *Sclerolaena muricata* var. *birchii* (FvM)Ulbrich, Pflfam. ed.2, 16c(1934)533.

New South Wales. E. F. Constable: NSW 16428: Dubbo-Bent.— J. W. Green 2345: NE: 14 miles W. Warialda.— C. K. Ingram 4471: Ingr.: Narrabri.— id. 6525: Ingr.: Boorindal.— A. Morris 1284: ADW: Thorndale.— J. W. Sutherland: NSW 61500: Natromine.— R. Tupper: SYD: Condobolin.

Northern Territory. G. Chippendale 680: ADW: Ayers Rock.— id. 814: CANB, NT: 12 miles E. Stokes Yard.— id. 6381: AD, NT: Lake Amadeus.— J. B. Cleland: AD 96019150 spines with reflexed barbs: Hamilton Downs.— M. Lazarides 5992: AD, CANB, NT: 25 miles SSW. Napperby Stn.

Queensland. C. W. Birch: MEL (*holotype*), BRI: Bowen Downs, 1874.— S. T. Blake 6599: AD: Longreach.— id. 7572: AD: Dulacca.— id. 8028: AD: Minerva. - id. 8086: AD: Blair Athol.— id. 10719: AD: Narine.— id. 10912: AD: Morven.— id. 11570: AD: Prairie.— R. Carolin 639: SYD: Tambo.— W. R. Coates: AD 96309259: Miles.— G. R. Gillespie: AD, CANB 3356: Dirranbandi.— Holland and Gnanck 1235: CANB: Gilruth Plains.— W. T. Jones: CANB 36860: Goodiwindi. - C. T. White: AD 96309258: Barcaldine.

South Australia. F. Humphris: ADW 5133: Jamestown.

67. **Bassia costata** Anderson, Proc.Linn.Soc.N.S.Wales 48(1923)347,t.36,fig.D-G; Black, Fl.S.Austral. (1924)191; ed.2, (1948)307,fig.414; Chippendale, Trans. Roy.Soc.S.Austral. 82(1959)327.— *Austrobassia costata* (Anders.)Ulbrich, Pflfam. ed.2, 16c(1934)532.

Northern Territory. Burbidge and Gray 4195: CANB: Undoolya Gap.— G. Chippendale 3079: NSW, NT: 15 miles E. Woodgreen.— id. 1361: NSW 61542, NT: Kulgera.— id. 7488: NSW, NE, NT: Alice Springs.— id. 8997: AD, NT: 18 miles N. Alice Springs.— id. 3224: NT: 18 miles W. Delmore Downs.— id. 3694: AD, NT: Ammaroo.— J. B. Cleland: NSW: Burt Well.— id.: AD 96019115: ibid.— id.: AD 96019114: Mt. Hay.— id.: AD 96019112: Mt. Doreen.— id.: AD 96019111: Macdonald Downs.— G. F. Hill: NSW (*lectotype*), MEL: 60 miles N.E. Camp 2 (Lander River).- D. J. Nelson 44: AD: Alice Springs.— R. A. Perry 3219: CANB, NT: Alice Springs.— id. 5354: CANB, NT: 24 miles S. Barrow Creek.— N. Sim: AD 96138034: Napperby.— R. Swinbourne 26: Ingr.: Mt. Doreen.— id. 140: Ingr.: Near Ammaroo Stn.— id. 8, 73: Ingr.: Alice Springs.— id. 341: AD, NT: ibid.— D. E. Symon 69: ADW: 36 Miles E. Hermannsburg.

South Australia. A. S. George 5215: PERTH: 16 miles E. of Mt. Davies.— S. A. White: AD 96309208: Glen Ferdinand, Musgrave Range.

Western Australia. C. A. Gardner 11629: PERTH, N.T.: Hamilton Downs.— A. S. George 3947: PERTH: Elder Creek, Warburton Mission.— A. Morrison: PERTH: Nanntarra.— N. H. Speck 636: PERTH: 20 miles S.E. Belele.

68. **Bassia convexula** Anderson, Proc.Linn.Soc.N.S.Wales 48(1923)346,t.36,fig. A-C; l.c. 59(1934)272; Black, Fl.S.Austral. (1924)191, (1929)684; ed.2, (1948)306,fig.413; Ising, Trans.Roy.Soc.S.Austral. 82(1959)327.— *Austrobassia convexula* (Anders.)Ulbrich, Pflfam. ed.2, 16c(1934)532.— *Bassia echinopsila* [non (FvM.)FvM., Cens. 1(1882)30]FvM., Ic.Austral.Salsol.Pl. 7(1891),t.69 p.p.— *B. birchii* [non (FvM.)FvM., Cens. 1(1882)30]FvM., et Tate, Trans.Roy.Soc.S.Austral. 16(1896)346.

New South Wales. E. Betche: NSW (*lectotype*): Warrego River, IX.1885.— id.: NSW: Warrego-Paroo Rivers, VIII.1900.— id.: NSW: Girilambone.— C. K. Ingram: NE: Coolabah.— A. Morris 548: NSW 20514: Broken Hill. id. 232: NSW 2653/20: ibid.— R. Swinbourne 6627: Ingr.: Byrrock.— id. 9899: Ingr.: Mt. Oxley.

Northern Territory. G. Chippendale 1361: CANB: Kulgera.— id. 3088: NT: Elkedra W.H.— id. 1107: AD, NT: 40 miles E. Harts Rge. P.S.— id. 2888: NT: Mt. Olga.— id. 221: NT: Tobermory.— id. 7415: AD, NT: Illara Creek.— id. 2536: AD, NT: Harper Sp. - id. 3461: AD, NT: Harts Range.— J. B. Cleland: AD 96019035: Deep Well.— id.: AD 96018153: Yuendumu.— id.: G. R. Cramer: ADW 10045: Hermannsburg.— R. L. Crocker: AD 96130034: 75 km N.W. Birdsville.— E. H. Ising 2704. AD: Horseshoe Bend.— id.: AD 96132093: Macdonald Downs.— Johnson and Chippendale 3939: CANB, NT: 30 miles E. New Crown.— M. Lazarides 5793: AD, CANB, NT: Aileron.— R. A. Perry 5495: CANB, NT: Mt. Cavanagh Stn.— R. Swinbourne 494: NT: Mt. Doreen.— D. E. Symon. ADW 11658: 30 miles E. Ayers Rock.— R. E. Winkworth 650: CANB, NT: 70 miles E. Ringwood Stn.

Queensland. G. H. Allen 336: NE: Riversdale, St. George.— id. 412: CANB: Cunnamulla.— S. T. Blake 6089: AD: Pentland.— id. 12090: AD: Windorah.— id. 10901: AD: Morven.— M. S. Clemens: AD 96243265: Jericho.— S. L. Everist 3120: CANB: Dingwall.— id. 2754: CANB: Boatman Stn.— id. 5766: AD, BRI: Thylungra. - Holland and Cranck 201: CANB: Bolton-Cunnamulla.— R. Roe 135, 349: CANB: Gilruth Plains.— C. T. White 11710: CANB: Nebine Creek.

South Australia. E. C. Black: AD 96207105: Granite Downs.— N. T. Burbidge: CANB 12828: W. Hawker.— J. B. Cleland: AD 95820209: Evarard Range.— id.: AD 96132096: Tomkinson Range.— E. H. Ising: AD 96226023-4-5, AD 11542: Evelyn Downs.— R. H. Kuchel 344: AD: Piltadi R.H., Mann Range.— T. R. N. Lothian 2012: AD: North Flinders Range.— T. B. Paltridge: CANB 3365: Koonamore. Miss Staer: AD 96309273: Oodnadatta.— D. E. Symon 2611: AD, ADW: Piltadi Creek, Mann Range.— P. G. Wilson 2529: AD: Piltadi R.H., Mann Range.

Western Australia. C. Chippendale 4546: AD, NT: Giles.— J. B. Cleland: AD 96131058: W. Rawlinson Range.— A. S. George 5309: PERTH: 28 miles N. of Warburton Mission.— id. 3994: PERTH: 24 miles E. of Windulda.— id. 4668: PERTH: Beegul, Laverton-Warburton Rd.— R. Helms: AD 96138022, PERTH: Great Victoria Desert.

69. **Bassia tubata** Anderson, Proc.Linn.Soc.N.S.Wales 48(1923)339,t.35,figs.A-C.

New South Wales. E. Breakwell: NSW (*lectotype*), AD: Coonamble.— R. McDonald: NSW: Coonamble.

Queensland. S. T. Blake 10474: AD: Goodiwindi.

70. **Bassia intricata** Anderson, Proc.Linn.Soc.N.S.Wales 48(1923)340,t.35,fig.D-F; Black, Fl.S.Austral. (1924)193, (1929)684; ed.2 (1948)305, fig. 405; Ising, Trans.Roy.Soc.S.Austral. 57(1933)93; 58(1934)216; Chippendale, Trans.Roy. Soc.S.Austral. 82(1959)327.— *Austrobassia intricata* (Anders.)Ulbrich, Pflfam. ed.2, 16c(1934)532.

New South Wales. M. Collins: NSW (*lectotype*); Corona, Barrier Ranges.— N. C. Beadle: SYD: 50 miles N. Wentworth.— P. N. and N. C. Beadle: SYD: Wanaaring-Bourke.— id.: SYD: 40 miles W. Wilcannia.— E. Betche: NSW 61439: Warrego River.— J. B. Cleland: AD 96247293: Mourna.— C. H. Collier: NSW 61438: Milparinka.— D. L. W. Henderson:

NSW 20440; Quandong.— C. K. Ingram 6560: Ingr.: Bourke.— E. H. Ising: AD 96131153; 30 miles N.E. Broken Hill.— L. A. S. Johnson: NSW 48511: Balranald-Hatfield.— Johnson and Constable: NSW 39988: Mt. Poole-Theldarpa.— id.: NSW 39984, NT: Winnathee Stn.— id.: NSW 61437: Mt. Poole Stn.— A. Morris 2291: ADW: Pine Creek.— T. G. B. Osborn: SYD, CANB: Broken Hill.— R. Roe 573: NE: Brewarrina.— J. A. Thompson 28: NE: N.W. Booligal.— E. K. Winterholder: NE: Wilparinka.— T. M. Whaite 1245: NSW: Booligal.

Northern Territory. G. Chippendale 2825: NT, NSW 61447: 21 miles N. Andado.— id. 2728: AD, CANB, NT: N. Maryvale.— id. 9148: AD, NT: 29 miles N. Alice Springs.— id. 4948: AD, NT: Hale River.— Chippendale and Johnson 3941: NSW, NT: 29 miles W. Andado.— R. L. Crocker: AD 96129043: 110 km N.N.W. Birdsville.— id.: AD 96129062: 125 km N.W. Birdsville.— E. H. Ising: AD 96131148, 9, 51, 4: Macdonald Stn.— M. Lazarides 6107: CANB, NSW, NT: Henbury Stn.— R. Swinbourne 24: Ingr., Yamba Stn.— id. 443: AD, NT: McGrath Creek.

Queensland. S. T. Blake 11746: AD: Dynever Lakes.— id. 11836: AD: Nockatunga.— id. 11973: AD: Mt. Howitt.

South Australia. H. G. Andrewartha 8310: ADW: Purple Downs.— J. B. Cleland: AD 95820051: Etadunna.— id.: AD 95820052: Woomera.— id.: AD 95820056: Carawecna-Lake Crossing.— id.: AD 95820053: 20 miles W. Oodnadatta.— id.: AD 95820054: Mungeranie.— id.: AD 96309347: Oodnadatta.— id.: AD 96309344. Mt. Norwest.— id.: AD 96247292: Brachina. R. L. Crocker: AD 96129046: 175 km S.S.W. Birdsville.— id.: AD 96129045: 65 km S. Birdsville.— id.: AD 96129047: Lake Letty.— H. M. Douglas: ADW 23017: Yudnapinna.— C. Gross: AD 96018075: Whittata. F. M. Hilton 1467: ADW: Beltana.— E. H. Ising: ADW 11559: Evelyn Downs.— id. 2671-2: AD: Macumba. id. 2663: AD: Wanginnna.— id. 2874, 2883, 2895: AD, AD 96131150: Pedirka.— id.: AD 96309346: Cordillo Downs.— id.: AD 96314180: Mt. Barry Stn.— M. Koch 115 p.p. NSW: Mt. Lyndhurst.— id. 367: NSW: ibid.— E. E. Lord: AD 96207163: Oodnadatta.— A. Morris 635: ADW, NSW: Pinnacles-Cockburn-Mutooroo.— id.: AD 96309345, NSW 61446: Boulcoomatta.— B. J. Murray 103: AD: Arcoona.— L. Reese: AD 96131119, 20, 23: Minnie Downs.— B. Spencer: NSW 61442: Lake Eyre.— J. G. O. Tepper 236: AD: Lake Eyre.— R. Tate: AD 96129042: Warburton River and Mt. Norwest.

Note. For *B. intricata* var. *hirsuta* Black see chapter "Insufficiently Known Taxa", No. 83.

71. **Bassia johnsonii** Ising, sp.nov.— Fig. 1.

Suffrutex, dense intricatus, glaber vel fere glaber. Rami ± costati. Folia teretia, compressa, 3-10 mm longa, ca. 1 mm lata, obtusa; basis leviter angustatur, axilla pilosa. Perianthium in fructu cylindratum, ca. 2 mm longum, apice convexo, ad basim affixum, glabrum. Spinae 5, 3 longissimis 3-7 mm longae, late separatae, 2 ad basim contiguae 2-4 mm longae; aciculares, rectae vel curvatae, ± horizontales. Limbus incurvus, brevissimus, ciliatus. Basis oblonga, leviter obliqua, nec cavata. Stylus glaber; rami stigmatici 2, rubri. Semen horizontale; radicula superior.

Holotypus: G. Chippendale and L. A. S. Johnson NT 3940; NSW 60238: 36·2 miles E. of New Crown H.S., 12.X.1957; "Dwarf shrub to 1 ft. Common in red sandy flat." [Isotypes: AD, CANB, MEL.]

Undershrub, densely intricate, glabrous or almost so. Branches ± ribbed. Leaves terete, compressed, 3-10 mm long, ca. 1 mm wide, obtuse; base slightly narrowed; hairs in axil. Fruiting perianth cylindrical, ca. 2 mm long, summit convex, basally attached; glabrous. Spines 5, 3 longest 3-7 mm long, widely separated, 2 close together at base 2-4 mm long; acicular, straight or curved, ± horizontal. Limb incurved, very short, ciliate. Base ± oblong, slightly oblique, not hollowed. Style glabrous; stigmatic branches 2, red. Seed horizontal; radicle superior.

Northern Territory. G. Chippendale 4676: NT: 4 miles N. of Connor's Well, 22.VII. 1958. Herbaceous, 1 ft., rare, in deep red sand.— id. 4651: CANB, NSW 60239, NT: 26 miles E. Armstrong River.— J. B. Cleland: AD 96309275: Maryvale.— id.: AD 96019179: Middleton Ponds.— id.: AD 96120004: Mt. Wedge Stn.— R. L. Crocker: AD 96130141, NSW 60241: E. Andado Stn.— A. S. George 5115: PERTH: 22 miles W. of Victory Downs H.S.— E. H. Ising: AD 96312117: Bundooma.— R. H. Kuchel: AD 96242151: 200 miles

W. Kulgera.— M. Lazarides 6082: AD, BRI, CANB, NT, NSW 60240: 35 miles E. Napperby Stn. E. Reichenbach: AD 96030102: Bundooma.— R. Swinbourne: Ingr.: S. Mt. Wedge Stn.— id.: NT 9401: S. Mt. Wedge Stn.

Queensland. S. T. Blake 12051: AD: Hammond Downs.

South Australia. F. C. Black: AD 96207106: 20 miles N. Everard Range.— N. Forde 410: CANB: 12 miles S. Emu.— E. H. Ising 2885, 2892-3: AD: Pedirka.

Western Australia. A. S. George 4934: PERTH: Near Giles Ck. E. of Giles Met. Stn.— D. E. Symon 2361: AD, ADW: 10 miles S. of west end of Hopkins Lake.

Named in honour of Mr. L. A. S. Johnson, National Herbarium of N.S. Wales, Sydney.

72. **Bassia calcarata** Ising, sp.nov.— Fig. 25.

Suffrutex; rami costati, pilosi. Folia ± teretia, 6-14 mm longa, ad 1 mm lata, obtusa, hirsuta, tenuiter rugosa; basis latior, tenuis; axilla cum pilis ornata. Flores axillares solitarii. Perianthium in fructu oblongum, ca. 2·5 mm longum, ca. 2 mm latum, pilosum; costae ca. 8, longitudinales, sulcis alternatae; apex leviter concavus. Spinae 6, plerumque 1-2 mm longae, verticales vel horizontales, rectae vel recurvae, pungentes, glabrae; plerumque 2 spinae ad basin contiguae, divergents. Limbus erectus, ca. 1 mm longus, chartaceus, ciliatus. Basis ± circularis, obliqua, leviter cavata; plerumque cum calcaribus duobus ornatis. Stylus glaber, rami stigmatici 2, pinnicei. Semen verticale; radicula superior.

Holotypus: E. H. Ising: AD 96226146: South Australia. Oodnadatta, 20.VIII.1955.

Undershrub; branches ribbed, pilose. Leaves ± terete, 6-14 mm long, ca. 1 mm wide or less, obtuse, hirsute, finely rugose; base widened, thin; hairs in axil. Flowers solitary in axil. Fruiting perianth oblong, ca. 2½ mm long, ca. 2 mm wide, pilose; ribs ca. 8, longitudinal, alternating with grooves; summit slightly concave. Spines 6, usually 1-2 mm long, vertical to horizontal, straight to recurved, pungent, glabrous; usually 2 close together at base, divergent. Limb erect, ca. 1 mm long, chartaceous, ciliate. Base ± circular, oblique, slightly hollowed; spurs usually present, 2. Style glabrous; stigmatic branches 2, pink. Seed vertical; radicle superior.

Anisacantha echinopsila [non FvM.]FvM., Fragm. 7(1869)14 (*nom. illeg.*) as to Balandool River and Darling River specimens [excluding Bogan River specimen (not seen) and Suttor River specimen which is *Bassia anisacanthoides* (FvM.)Anders.]; Benth., Fl.Austral. 5(1870)201 as to descr. [excluding Desert of Suttor specimen].— *Chenolea echinopsila* [non (FvM.)FvM.] FvM., Fragm. 10(1876)92 as to descr. [specimens cited not seen]; FvM., Icon.Austral.Salsol.Pl 7(1891),t.69 Fig. 6 4th and 5th drawings, Fig. 7 right hand drawing; Anderson, Proc.Linn.Soc.N.S.Wales 48(1923)338; Black, Fl.S.Austral. (1929)684; ed.2 (1948)305, Fig. 404 right hand drawing.

New South Wales. B, Ament: NSW: Nyngan.— L. Abraham: NSW: Louth.— N. C. Headle: SYD: Brewarrina.— E. Betche: NSW, MEL: Warrego River.— id. 114: MEL, NSW: Near Bourke.— J. L. Boorman: NSW: Burren Junc.— N. T. Burbidge: CANB: Bourke-Brewarrina.— N. A. Burges: SYD: Tibooburra.— Carron: NSW: Namoi River.— A. and D. Carson: MEL: Namoi River.— E. F. Constable: NSW: Bourke.— M. J. Collins: SYD: Paroo River.— W. Collins: NSW: Monculta.— T. Cotter: MEL: Cumiaroo, Hungerford, Paran.— G. S. Couch: NSW: Tibooburra.— J. Dallachy: MEL: Darling River Desert — O.D.E.: SYD: Flemington-Homebush Bay.— A. V. Giblin: SYD: Gerongra Stn.— Glenfield Vet. Res. Stn.: NSW: Moree.— D. L. W. Henderson 361: NSW: Lower Trans. Darling.— id.: NSW: Willotia Stn.— Henry: MEL, NSW: Warrego River.— C. K. Ingram 6559: Ingr.: Bourke.— id.: Ingr.: Louth. id. 0898: Ingr.: Mt. Oxley.— Johnson and Constable. NSW 39812: Winnathee Stn.— L. A. S. Johnson: NSW: Lake Menindee.— H. W. Looker: MEL: Balandool River.— J. H. Maiden: NSW: Bourke.— Maiden and Boorman: NSW: Nyngan.— A. W. Mullen: NSW: Quantambone, Brewarrina. - A. Morris 1058: ADW, NSW: Wilcannia.— Miss Salmon: NSW: Cutharoo.— J. S. Webb: NSW: Culgoa River.— A. Wurfel: MEL: Upper Darling River.

Northern Territory. Johnson and Chippendale 3928: CANB, NT: 13 miles E. Finke.— M. Lazarides 5946: AD, NT: Huckitta Stn.— R. Swinbourne 2: Ingr.: 32 miles N. Alice Springs.— id. 442: AD, NT: McGrath Creek.

QUEENSLAND. S. T. Blake 5332: NSW: Charleville.— id. 6504: AD, NSW: Woodstock.— id. 5915: NSW: Dalby.— id. 6563: AD, NSW: Darr.— id. 6531: NSW: Winton.— id. 6695: NSW: Bilbah Downs.— id. 6590-7: NSW: Longreach.— id. 6471: NSW: Boulia.— id. 5565: AD, NSW: Cunnamulla.— id. 6664: NSW: Isisford.— id. 10547: AD: Noondoo.— E. Bowman: MEL: Crocodile Creek; this specimen is labelled by F. Mueller "Anisacantha echinopsila FvM. var." It has sometimes the young shoots villous and this is possibly the "var." meant by him. The original diagnosis by Mueller (Trans.Phil.Inst.Viet. 2(1858)76) describes the plant as "glabrous". There are hairy forms of this species as noted by Anderson [Proc.Linn.Soc.N.S.Wales 48(1923)339].— id.: MEL: McKenzie River, 1871.— C. L. Davies: CANB 3575: Noondoo.— id.: CANB 3377; C.S. Queensland.— S. L. Everist 6257: BRI 6267, AD: Thylungra.— H. Flecker 6659: AD: Longreach.— W. D. Francis: NSW: Blackwater.— Holland and Gnauck 1073: CANB: Near Mungindi.— Hubbard and Winders 6240: BRI: Curragh Stn.— S. Johnson: MEL: Gilbert-Cape River.— K. Kennedy: NSW: Longreach.— G. Luehmann: MEL: N.E. Queensland.— R. S. Moore: MEL: Buloo River. F. Mueller: NSW: Rockhampton.— O'Shanesy: MEL, NSW: Rockhampton. R. Roe, C.H.A. 721: CANB, NE: Gilruth Plains.— id. CANB 3376, 3378: Warrie, Moonie River.— id.: CANB 3579: Warrie, Nindigully.— id. 320-1: CANB: Gilruth Plains.— Spencer: MEL: Yappunya.— D. Stibbard: BRI: Barcaldine.— W. Willoughby: CANB 3405: Balogna.

SOUTH AUSTRALIA. E. H. Ising: AD 96229454, ADW: Oodnadatta.— id. 2886: AD: Pedirka. id. 2667: AD: Neales River, Oodnadatta.— L. Reese: AD 96140126, 96301019: Minnie Downs.

73. **Bassia murrayae** Ising, sp.nov.— Fig. 24.— *B. echinopsila* [non (FvM.) FvM.] Black, Fl.S.Austral. ed.2(1948)305,fig.404 left-hand drawing.

Rami pilosi. Folia semiteretia, 5-10 mm longa, ± acuta, pilosa, curvata; pars inferior plana, latior, marginibus membranaceis; in axilla pilosa. Perianthium in fructu ± urceolatum, ca. 3 mm longum, ca. 2 mm latum, glabrum; costae ca. 10, longitudinales; apex concavus. Spinae 6, 1-2 mm longae, lanceolatae, ± acutae, erectae, tenues, 2-4 in paribus versus basem conjunctae. Limbus erectus, brevissimus, ciliatus. Basis plerumque circularis, obliqua, leviter cavata. Stylus glaber; rami stigmatici 2. Semen non vidi, probabiliter horizontale.

HOLOTYPUS: B. J. Murray: AD 96301020: South Australia. Arcoona, west of Lake Torrens, IX.1927 (Herb. J. M. Black).

Branches pilose. Leaves semiterete, 5-10 mm long, ± acute, pilose, curved; lower part flat, widened, margins membranous; pilose in axil. Fruiting perianth ± urceolate, ca. 3 mm long, ca. 2 mm broad, glabrous; ribs ca. 10, longitudinal; summit concave. Spines 6, 1-2 mm long, lanceolate, ± acute, erect, thin, 1-2 pairs united towards base. Limb erect, very short, ciliate. Base usually circular, oblique, slightly hollowed. Style glabrous; stigmatic branches 2. Seed not seen, probably horizontal.

The species is nearest to *B. calcarata* in which both Black and Anderson referred this plant. *B. calcarata*, however, has an oblong fruiting perianth constricted in the middle, all ribs prominent; spines acicular, some spreading, 2 close together at base; base with 2 spreading spurs.

This species is named in honour of the late Miss B. J. Murray, who collected the species in a district of which she investigated the flora and vegetation thoroughly.

74. **Bassia anisacanthoides** (FvM.)Anderson, Proc.Linn.Soc.N.S.Wales 48(1923) 330; White, Roy.Soc.Queensl. 60(1944)78.— *Echinopsilon anisacanthoides* FvM., Trans.Phil.Inst.Viet. 2(1858)76.— *Anisacantha brevicuspis* FvM., Fragm. 4(1864)150; FvM., Fragm. 7(1869)14.— *Anisacantha echinopsila* FvM., Fragm. 7(1869)14. *nom. illeg.* based on *Echinopsilon anisacanthoides* excluding specimens Balandool, Bogan and Darling Rivers; Benth., Fl. Austral. 5(1870)201 excl. descr. but incl. Desert of Suttor; Bailey, Queensl. Fl. 4(1901)1260 excl. descr., and Crocodile Creek and Rockhampton; FvM., Ic.Austral.Salsol.Pl. 7(1891),t.69, probably Fig. 2 and left-hand drawing of Fig. 6; Bailey, Compr.Cat.Queensl.Pl. (1913)409.— *Threlkeldia brevicuspis*

(FvM.)FvM. ex Benth., Fl.Austral. 5(1870)198; Bailey, Queensl.Fl. 4(1901) 1260; Bailey, Compr.Cat.Queensl.Pl. (1913)409.— *Chenolea echinopsila* (FvM.)FvM., Fragm. 10(1876)92 excl. descr. (specimen not seen).— *Bassia echinopsila* (FvM.)FvM., Cens. (1882)30 p.p.; FvM., Fragm. 12(Dec.1882) 13 (specimen not seen), FvM., Key Viet.Pl. 2(1885)16.— *Bassia brevicuspis* (FvM.)FvM., Cens. (1882)30; FvM., Second Cens. (1889)52; FvM., Ic. Austral.Salsol.Pl. 7(1891),t.67 (excluding 4th fig. No. 7); Maid. and Betche, Cens.N.S.WalesPl. (1916)69.— *Sclerolaena anisacanthoides* (FvM)Domin, Bibl.Bot. 89(1921)624; Ulbrich in Engler and Prantl, Nat.Pflfam. ed.2, 16c (1934)533.— *Coilocarpus brevicuspis* (FvM.)Domin, Bibl.Bot. 89(1921) 625 [vide FvM., Fragm. 8(1873)38].

New South Wales. N. C. Beadle: SYD: Broken Hill.— R. W. Condon: NSW 53386-7: Condobolin.— C. W. E. Moore 351: CANB: Trangie.— A. Morris 717: AD, ADW, BRI, NSW 53143.— J. T. Waterhouse: SYD: Collarenibri.

Queensland. W. Barton: NSW 53393: Armadilla.— Bassingthwaite and Cole 11: BRI 024753: Darr.— C. W. Birch: MEL: Thomson River.— S. T. Blake 6694: AD, BRI: Emmet, Bilbah Downs.— id. 11469: AD: Frensham.— id. 10718: AD: Dirranbandi.— id. 11972: AD: Mt. Howitt.— id. 5567: AD, BRI: Cunnamulla.— id. 11674: AD: Richmond.— id. 10476: AD: Goondiwindi.— id. 7575: AD: Dalacca.— id. 6640: BRI, NSW 53389: Longreach-Arillulah.— id. 6933: NSW 53390: Minerva.— id. 6260: AD, BRI, NSW 53391: Hughenden.— id. 6564: AD, BRI, NSW 53392: Darr.— id. 6487: BRI: East of Boulia. Bowman: MEL: Peak Downs.— (E.?) Bowman 267: MEL (*holotype*) of *Anisacantha brevicuspis* (FvM.): Cape River.— M. S. Clemens: BRI: Jericho.— K. Domin: PR: Flinders River, Hughenden and between Longreach and Winton.— S. L. Everist 757: BRI: Noondoo Stn., Dirranbandi.— id. 1304: BRI: Athol.— id. 2022: BRI: Malvern Hills.— id. 1233: BRI: Blackall.— id. 6255: BRI, AD: Thylungra.— N. C. Ford 524: NSW 53388: Tiree Stn.— Hubbard and Winders 7255: BRI: Bundoran.— W. MacGillivray: ADW (Herb. A. Morris): Blackall.— F. Mueller: MEL (*holotype*): Suttor River. R. Roe: CANB 3347: Warrie, Nindigully.— id.: CANB 3348: Balagna, Moonie River.— F. Spencer: MEL: Thargomindah.— C. T. White: BRI: Quilpie.— id.: BRI, NSW 53395: Tower Hill.— id.: BRI, NSW 53394: Dalby.— id.: BRI: Wallumbilla.

Note. I have examined Domin's specimens which he quoted when he described the genus *Coilocarpus*. They agree in all details with *B. anisacanthoides*, the type specimen of which I also investigated. *Coilocarpus* is based on *Anisacantha brevicuspis* FvM., a taxonomic synonym of *B. anisacanthoides* (FvM)Anderson. The two superposed cavities of the fruit are apparently the main "diagnostic" features of Domin's genus, a characteristic of all the species of *Bassia* with the deeply hollowed base of the fruiting perianth.

The lower cavity of the fruiting perianth is the larger when the ovary is fertile; it then has a large basal opening to be seen when detached from the stem. If the fruiting perianth is infertile the lower cavity is much smaller or absent and it has no basal opening. The upper cavity contains the seed.

75. Bassia urceolata Ising, sp.nov.— Fig. 12.

Rami graciles, glabri. Folia linearia, 4-6 mm longa, ca. 1 mm lata, obtusa, tenuia, glabra, ad basim angustiora. Perianthium in fructu urceolatum, ca. 2 mm longum latumque, leviter indurata, glabrum; 5 alae obtusae prominentes longitudinales ab spinis decurrentes, plerumque una costa debilis alis alternatis. Spinae 6, 0·5-1·5 mm longae, obtusae, crassae, rectae, glabrae, duobus contiguis super appendicem erectam. Limbus erectus, brevis, chartaceus, ciliatus. Basis ± circularis, obliqua, profunde cavata, leviter dilata. Stylus glaber, rami stigmatici 2, rubri. Semen horizontale; radicula superior.

Holotypus: R. E. Winkworth 382: NT: Northern Territory. 10 miles east of Mt. Wedge H.S., I.VII.1954; "small shrub, 6 inches tall, fleshy leaves; associated with Atriplex on drainage flats along mountain range"

Branches slender, glabrous. Leaves linear, 4-6 mm long, ca. 1 mm wide, obtuse, thin, glabrous, narrowed at base. Fruiting perianth urceolate, ca. 2 mm long and wide, slightly hardened, glabrous; 5 obtuse prominent longitudinal

wings decurrent from the spines, usually one weak rib alternating with wings. Spines 6, ½-1½ mm long, obtuse, thick, erect, glabrous, 2 close together on an erect appendage. Limb erect, short, chartaceous, ciliate. Base ± circular, oblique, deeply hollowed, slightly dilated. Style glabrous; stigmatic branches 2, red. Seed horizontal; radicle superior.

NORTHERN TERRITORY. R. Swinbourne: NT 9047: 9 miles east of Mt. Wedge H.S., 18.X.1961: "approximately 5 inches high straggling succulent herb, on very saline soil with Arthrocnemum sp."— Chippendale and Johnson: NT 3984, AD: 25·8 miles north of Kulgera: 11.X.1957: succulent green herb 6 to 9 inches; fruit green; rare; in red clayey soil.

76. **Bassia microcarpa** Anderson, Proc.Linn.Soc.N.S.Wales 48(1923)348.

WESTERN AUSTRALIA. A. McGregor: NSW 20515 (*holotype*): Poison Creek via Leonora.

77. **Bassia clavata** Ising, sp.nov.— Fig. 17.

Rami tomentosi. Folia clavata, 1·5-2·5 mm longa, obtusa, hispida, subtiliter rugosa; basis coangustior, tenuis. Flores axillares solitarii. Perianthium in fructu ± turbinatum, ca. 2 mm longum, ca. 2·5 mm latum, pubescens; apex planus; costa ab spinis duobus brevissimibus decurrens, tenuis. Spinae 6, aciculares, glabrae, divergentes; 4 longissimae, 3-5 mm longae; 2 brevissimae 1-1·5 mm longae, ad basim contiguae. Limbus minimus, erectus. Basis ± circularis, ca. 1 mm diam., leviter cavata. Stylus pilosus; rami stigmatici 2, rubri. Semen horizontale; radicula lateralis.

HOLOTYPUS: For Ranger Day: PERTH; W.A., Southern Cross. August, 1902.

Branches tomentose. Leaves clavate, 1½-2½ mm long, obtuse, hispid, finely rugose; base narrowed, thin. Flowers solitary in axil. Fruiting perianth ± turbinate, ca. 2 mm long, ca. 2½ mm wide, pubescent; summit flat; rib, decurrent from 2 shortest spines, slender. Spines 6, acicular, glabrous, divergent; 4 longest 3-5 mm long; 2 shortest 1-1½ mm long, close together at base. Limb very small, erect. Base ± circular, ca. 1 mm dia., slightly hollowed. Style pilose; stigmatic branches 2, red. Seed horizontal; radicle ± lateral.

B. clavata is similar to *B. parviflora* Anderson which has horizontal, shorter spines, linear-clavate longer (to 12 mm) leaves, slender branchlets, and glabrous style; and to *B. concexula* Anderson which has villous, linear-clavate (5-10 mm long) leaves, ± globular to turbinate perianth, convex at summit, 5, rarely 6, spines, and glabrous style.

The specific epithet refers to the shape of the leaves.

78. **Bassia parviflora** Anderson, Proc.Linn.Soc.N.S.Wales 48(1923)347,t.36,fig. H-L; Black, Fl.S.Austral. (1924)191; ed.2 (1948)306,fig.410; *Austrobassia parviflora* (Anders.)Ulbrich, Pflfam. ed.2, 16c(1934)532.

NEW SOUTH WALES. J. Minchin: NSW: Darling and Murray Rivers junction.— F. Mueller: NSW: Darling River, Victorian Expedition.— Tucker: NSW: Lachlan River.

QUEENSLAND. S. T. Blake 10794: BRI: Miltonise Stn., St. George.— C. H. Allen 336: CANB: St. George.

SOUTH AUSTRALIA. J. M. Black: AD 96216278: Minnipa.— id.: AD 96216282: Malbooma.— Hj. Eichler 13743: AD: Monash.— N. Forde 441: CANB: 16 miles S. Emu.— D. W. Gonde: ADW 4917: Malbooma.— E. H. Ising 1275: AD, ADW: Ooldea.— D. E. Symon 1069: NE: Coober Pedy.— P. G. Wilson 537: AD: Gawler Range.

VICTORIA. A. C. Beauglehole 981, 3249: A.C.B.: Kulkyne Nat. Park.— H. B. Williamson: AD 96216284: Onyen.— id.: AD 96216280: Murrayville.

WESTERN AUSTRALIA. Young: MEL (*lectotype*), NSW: Victoria Springs.— A. S. George 4102: PERTH: 22 miles S.E. of Windulda.— id. 5540: PERTH: 2 miles E. of Carnegie H.S., spines wide and flat downwards.— R. Helms: AD 96138050: Victoria Desert.— Anonym: NSW: Doodlakine.

79. **Bassia cornishiana** FvM., Austral.Chem.Drugg. (1885), repr.(orig.n.v.); FvM., Bot. Centralbl. 26(1886)228; Black, Trans.Roy.Soc.S.Austral. 39(1915)828 in obs.; Anderson, Proc.Linn.Soc.N.S.Wales 48(1923)343; Black, Fl.S.Austral. ed.2 (1948)306,fig.411; Chippendale, Trans.Roy.Soc.S.Austral. 82(1959) 327.— [*Chenolea cornishiana* FvM., Bot.Centralbl. 26(1886)228 *pro. syn.* FvM., Trans.Roy.Soc.S.Austral. 9(1887)213 *nom.nud.*].— *Bassia birchii* [non (FvM.)FvM., Cens. 1(1882)30] Black. Fl.S.Austral. (1924)191 p.p.

Northern Territory. G. Chippendale 680: NSW, NT: Ayers Rock.— id. 2091: NSW, NT: Hamilton Downs.— id. 1106: AD, CANB, NT: 40 miles E. Harts Range.— id. 2496: NT: Ooratipra H.S.— id. 305: AD, CANB, NT: Argadargunda H.S.— id. 2969: NT: 38 miles S.W. Tobermory.— id. 5595: AD, NT: Tanami.— id. 5682: AD, NT: 53 miles N.E. Tanami.— id. 7019: AD, NT: 21 miles N.E. Banka Banka.— id. 3695: AD, NT: 25 miles E. Woodgreen. - J. B. Cleland: AD 96019155: Mt. Doreen. id.: AD 96019172, NSW 61485; Finke.— id.: AD 96019153: Thomsons R.H.— id.: AD 96019152: Mt. Eclipse.— id.: AD 96019157: 50 miles N.E. Ayers Rock.— id.: AD 96019171: Yuendumu.— id.: AD 96019147: Mt. Liebig.— G. R. Cramer: ADW 10046: Hermannsburg.— Horn Expedition. NSW: Ilpilla.— M. Lazarides 5789: AD, CANB, NT: Aileron.— T. R. N. Lothian 284: AD: Narwietoona.— C. J. Mulhearn 885: NT: Banka Stn.— D. J. Nelson 63! AD: 21 miles W. Tobermory.— R. A. Perry 543: CANB, NT: Tennant Creek.— R. Swinbourne 6: Ingr.: Burt Plain.— D. E. Symon 72: ADW: Henbury-Curtin Sp.— id.: AD W11580: Mt. Olga.— R. E. Winkworth 310: CANB, NT: Derwood H.S.

Queensland. S. T. Blake 5478: NSW: Earlstoun.— id. 17930: CANB: Barclay Downs.— id. 12036: AD: Keeroongooloo.— id. 12089: AD: Windorah.— id. 12563: AD: Wyaaba.— id. 11884: AD: Mt. Margaret Stn.— id. 12400: AD: Dajarra.— W. H. Cornish: MEL (*holotype*), AD 96309236: Near Field River and boundary of Queensl. and S.Austral.— S. L. Everist 3889: CANB: E. Windorah.— M. Lazarides 4384: CANB, NSW, NT: Mt. Isa.— R. A. Perry 4041: CANB, NT: Dajarra.

Western Australia. F. M. Bennett 222: PERTH: Carnegie Stn. - id. 43: PERTH: Wongawal.— J. B. Cleland: AD 96131055: S. Rawlinson Range.— A. S. George 977: PERTH: 92 miles N. Mundiwindi.— id. 3530: PERTH: Millstream Station.— id. 4794: PERTH: Cavanagh Range.— A. Stewart: PERTH: Roy Hill.

Insufficiently Known Taxa

80. *Bassia* sp. aff. *B. brachyptera* (FvM.)Anders.—E. M. Packe: NSW 55255: Sandalong Golf Links, ca. 1½ miles east of Mildura, Victoria, 29.IX.1949.— The only specimen I have so far seen is a branch ca. 9 cm long with several short branchlets and a few flowers and perianths. This specimen has branches and leaves sparsely pubescent; leaves 5-8 mm long; spines straight, one more obtuse and longer than the others; base shallow, areole thin. Although the differences between this specimen and *B. brachyptera* are fairly well marked it seems better to wait for more material before describing it as a new species.

81. *Bassia* sp. aff. *B. glabra* (FvM.)FvM.—F. Mueller collected material at Sturts Creek, N. Terr. (near W. Austral. border) in 1856. Part of the material was named *Bassia glabra* and part *Kentropsis glabra*β *longicuspis* by Mueller, but the latter was not published. However, t.66 figs. 1 and 6, Ic.Austral.Salsol.Pl. 7(1891), illustrates this 'variety', but as no other material is available it is advisable to delay publication as a new species for the time being.

82. *Anisacantha kentropsidea* FvM., Trans.Vict.Inst. 1(1855)133.—This name was tentatively placed as a synonym of *B. diacantha* (Nees)FvM. in Ising, Trans.Roy.Soc.S.Austral. 84(1961)91. As no type specimen could be located, the application of this name remains doubtful.

83. *Bassia introcata* var. *hirsuta* Black, Fl.S.Austral. (1924)194. "Branches and leaves tomentose. Everard Range." I have searched for this specimen, but have not found it in any Australian Herbarium. It is not recorded in the second edition of Black's Flora.

84. *Bassia micrantha* (Benth.)FvM., Cens. (1882)30. – *Enchylaena ? micrantha* Benth., Fl.Austral. 5(1870)181.—I have not yet seen the type specimen which is probably at Kew (K) and, therefore, am unable to make any comment. Cf. Anderson, Proc.Linn.Soc.N.S.Wales 48(1923)348. [sphalm. *B. micranthera* (Benth.)FvM.]

85. *Kentropsis lanata* Moq., Chenop.Enum. (1840)83; Moq. in DC., Prod. 13/2(1849)138.— This is placed as a synonym under *Bassia bicornis* (Lindl.) FvM. [*Sclerolaena bicornis* Lindl.] in Bentham, Fl.Austral. 5(1870)195. I have not yet seen the type specimen ["In Nova-Hollandiâ (Cunningh.). Salsola ? mollis Cunningh. in herb. . . . (v.s. in h.Mus.Paris.et Hook.)"] and consider its position, therefore, as doubtful.

86. *Sclerolaena coriacea* Moq. in DC., Prod. 13/2(1849)123.—The only specimen cited by Moquin is "In Novae Hollandiae ins.sterilibus (h.Mus.Paris!)." In his description he says . . . "calyce fructifero mutico . . ." Having no spines, this specimen apparently is not a *Bassia*, but as yet I have not seen the specimen. Bentham, Fl.Austral. 5(1870)194, referring to this specimen says that it was unknown to him and doubted if it was a true congener as it had no spines. Anderson, Proc.Linn.Soc.U.S.Wales 48(1923)354, also mentions Bentham's reference.

Species to be Excluded

87. *Bassia carnosa* (Moq.)FvM., Cens. (1882)30,
= **Kochia carnosa** (Moq.)Anderson, Proc.Linn.Soc.N.S.Wales 48(1923)353.

88. *Bassia enchylaenoides* (FvM.)FvM., Cens. 1(1882)30,
= **Duriala villosa** (FvM.)Ulbrich, Pflfam. ed.2, 16c(1934)537.

89. *Bassia inchoata* Black, Trans.Roy.Soc.S.Austral 38(1914)463,t.38,fig.1-4,
= **Threlkeldia inchoata** (Black)Black, Fl.S.Austral. (1924)203.

90. *Bassia lanuginosa* White, Queensl.Agric.Journ., n.s. 15(1921)216,t.24,
= **Kochia carnosa** (Moq.)Anderson, Proc.Linn.Soc.N.S.Wales 48(1923)353.

91. *Bassia longifolia* Fitzg., Journ.W.Austral.Nat.Hist.Soc. 1(1904)32,
= **Kochia fimbriolata** FvM., Fragm. 9(1875)75.

92. *Bassia salsuginosa* (FvM.)FvM., Cens. 1(1882)30,
= **Threlkeldia salsuginosa** (FvM.)Benth., Fl.Austral. 5(1870)197.

93. *Bassia tricornis* (Benth.)FvM., Cens. 1(1882)30,
= **Malacocera tricornis** (Benth.)Anderson, Proc.Linn.Soc.N.S.Wales 51 (1926)382,t.25.

94. *Bassia walkeri* White, Proc.Roy.Soc.Queensl. 55(1944)77,t.1V,
= **Cyrilwhitea walkeri** (White)Ising, Trans.Roy.Soc.S.Austral. 88(1964) pp. 61-2.

ACKNOWLEDGMENTS

My thanks are hereby expressed to the curators of various State Herbaria and to the owners of several private Herbaria, as recorded in the beginning of this paper, for the loan of material; to Mr. L. Dutkiewicz for preparing drawings; to Mr. P. G. Wilson for the Latin translations; and to Dr. Hj. Eichler for facilities provided for the work at the State Herbarium of South Australia and for his valuable help and encouragement.

INDEX TO NAMES

(Bold designates new taxa, new combinations or new names; italics indicate synonyms; numbers refer to species)

TWO NEW SPECIES OF AUSTRALIAN FROGS OF THE HYLID GENUS *NYCTIMYSTES*

BY MICHAEL J. TYLER

Summary

The Hylid frog genus *Nyctimystes* is reported from Australia for the first time. Two new species are described from montane rainforest in north-eastern Queensland, and it is suggested that the distribution of Australian *Nyctimystes* will prove to be confined to similar environments within that area.

TWO NEW SPECIES OF AUSTRALIAN FROGS OF THE HYLID GENUS *NYCTIMYSTES*

By Michael J. Tyler*

[Read 11 June 1964]

SUMMARY

The Hylid frog genus *Nyctimystes* is reported from Australia for the first time. Two new species are described from montane rainforest in north-eastern Queensland, and it is suggested that the distribution of Australian *Nyctimystes* will prove to be confined to similar environments within that area.

INTRODUCTION

Within the Australian zoogeographical region the frog family Hylidae is represented by two genera: *Hyla* and *Nyctimystes*. *Nyctimystes* (as re-defined by Zweifel, 1958) may be distinguished from *Hyla* by the presence of a palpebral venation and the shape of the constricted pupil (a vertical slit in *Nyctimystes* as opposed to a horizontal slit in *Hyla*). *Hyla* is widespread throughout Australia and New Guinea, whereas *Nyctimystes* is believed to be confined to New Guinea.

In 1956, Mr. William Hosmer collected a small, conspicuously coloured Hylid frog in north-eastern Queensland which subsequently proved to be a *Nyctimystes* species.

A second specimen of *Nyctimystes* from north-eastern Queensland was recently found by the author amongst a collection of unidentified Australian Hylids received on loan from the Naturhistorisches Museum of Vienna. Comparison of this specimen with the one taken by Hosmer reveals that they are distinct species, each of which is new to science.

Nyctimystes hosmeri new species

Holotype—American Museum of Natural History No. 65538, a male from Tully Falls, Cape York Peninsula, Queensland, Australia, collected by Mr. William Hosmer on April 22, 1956.

Description of Holotype—The vomerine teeth are in two small, almost circular series which are widely separated from one another and situated beneath the posterior borders of the choanae. The tongue is half as wide as the mouth, cordiform in shape, its posterior border free and very slightly indented. The head is slightly longer than broad (head length 11·8 mm; head breadth 11·4 mm). The snout is rounded when viewed from above, and rounded in profile with an obscure canthus rostralis and oblique loreal region. The nostrils are inconspicuous and separated from one another by a distance which is slightly less than the distance between naris and eye; eye to naris 3·4 mm; internarial span 3·2 mm. The eye is prominent with a horizontal diameter of 4·7 mm; the pupil is almost completely dilated and nicked medially on its superior and inferior borders. The tympanum is small, 1·4 mm diameter, and indistinct and separated from the eye by a distance equal to its own diameter.

The distance between the snout and the vent is 33·5 mm.

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The fingers are long and slender with small terminal discs, and are approximately one-half webbed. The fourth finger is slightly longer than the second, but does not quite reach the disc of the third; the disc on the third finger covers approximately two-thirds of the tympanum. There is a rudiment of a pollex which projects slightly

The toes are almost fully webbed, the webbing on the fourth toe reaching the base of the penultimate phalanx and continuing to the disc as a fringe. The toe discs are smaller than the finger discs; the disc on the fourth toe covers slightly more than one-half of the tympanum. There is a narrow inner but no outer metatarsal tubercle. The legs are rather long; the tibia length is 18·8 mm and the ratio of tibia length to snout to vent length is 0·561. When the hindleg is adpressed the heel reaches well beyond the tip of the snout; when the limbs are laid along the sides the knee and elbow overlap considerably; when the hindlegs are bent at right angles to the axis of the body the heels overlap slightly.

The skin covering the dorsal surfaces of the head and body is smooth except in those small areas marked with cream where it is granular. The lateral surfaces are slightly granular, and the throat, chest, abdomen and lower femur coarsely granular. There is a weakly defined supratympanic fold, but no trace of a skinfold across the chest.

The dorsal surfaces of the head, body and limbs are dark brown. On the head and body are several roughly circular, asymmetrically arranged, large cream

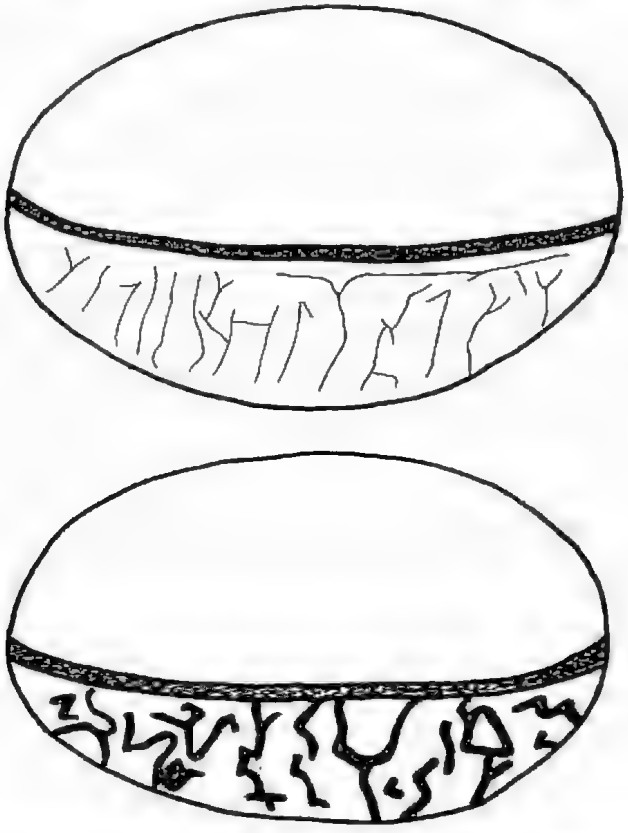

Fig. 1. Palpebral Venations. Top: *Nyctimystes vestigea*; bottom: *N. hosmeri*.

spots. Each of these spots has a black centre. On the tibiae are traces of irregular banding or marbling of pale brown. The lower surfaces of the limbs are a dull yellowish-brown; the posterior surfaces of the thighs are dark brown and there are traces of pearl in the groin.

The palpebral venation consists of pearl-coloured veins distributed in the form of a reticulum, with a tendency for most of the longer veins to be orientated in the vertical plane.

Collector's Notes—The specimen was found on a leaf of a tree during the daytime. Its colour in life was described as light green above with conspicuous white, black-centred, spots; below yellowish-white; anal region darker. Taken at an altitude of 2,670 feet above sea-level.

Comparison with other Species—The unusual colouration and the long slender digits with their very small discs will distinguish *N. hosmeri* from the sixteen other species known at the present time. Two species (*N. humeralis* (Boulenger) and *N. foricula* Tyler) share with *hosmeri* a similar dorsal colour, but these species lack the distinctive markings exhibited by *hosmeri*. *Nyctimystes humeralis* is an extemely large species in which the males may attain a length of up to 100 mm., and are characterised by the presence of a sharp projecting spike on the interior face of the humerus. The palpebral venation of *foricula* consists of extremely broad, oblique, black veins permitting light to enter via narrow slits. In *hosmeri* the veins are extremely broad and form an irregular, pearl-coloured network.

Nyctimystes vestigia new species

Holotype—Naturhistorisches Museum, Vienna, No. 17187, a female from Mount Bartle Frere, Cape York Peninsula, Queensland, Australia, collected February, 1897. Collector unknown.

Description of Holotype—The vomerine teeth are on two large, triangular elevations fused in the midline and lying beneath the small, oval choanae. The tongue is one-third as wide as the mouth and cordiform in shape, its posterior border free and very slightly indented. The head is large, flattened and broader than long (head breadth 18·3 mm; head length 17·9 mm). The snout is large, rounded when viewed from above, and strongly rounded in profile. The canthus rostralis is straight and inconspicuous; the loreal region is concave and oblique, the upper lip flaring out strongly below it. The nostrils are prominent and separated from one another by a distance which is slightly less than the distance between eye and naris; eye to naris distance 5·0 mm; internarial span 4·6 mm. The eye is large and prominent, its horizontal diameter 5·8 mm; the pupil is dilated and nicked medially on its superior and inferior borders. The tympanum is small with a diameter of 1·8 mm, and indistinct, only a portion of the tympanic annulus being visible; the tympanum is separated from the eye by a distance which is nearly equal to the diameter of the tympanum.

The distance between the snout and the vent is 53·2 mm.

The fingers are broadly fringed and two-thirds webbed, the webbing on the outer finger reaching slightly above the subarticular tubercle at the base of the penultimate phalanx; fourth finger longer than second, nearly reaching disc of third, which covers about two-thirds of the tympanic area. The first finger is almost completely opposed to the fourth. The finger discs do not project laterally beyond the fringes.

The toes are fully webbed and the disc of the fourth toe covers slightly more than two-thirds of the tympanic area. There is a distinct, narrow, oval inner but no outer metatarsal tubercle. The legs are rather long with a tibia

length of 28·7 mm. and a tibia length to snout to vent length ratio of 0·539. When the hindleg is adpressed the heel reaches beyond the tip of the snout, when the limbs are laid along the sides the knee and elbow overlap slightly; when the hindlegs are bent at right angles to one another the heels overlap slightly.

The skin covering the dorsal surfaces of the head and body is minutely glandular. The lateral surfaces of the body are slightly granular, and the throat, chest, abdomen and lower femur coarsely granular. There is a wide patagium extending from the back of the upper arm to the side of the body, a supratympanic fold hiding the upper portion of the tympanum and a disrupted dermal ridge along the outer edge of the forearm.

The dorsal surfaces of the head, body and limbs are light brown with indistinct creamish-brown markings as follows: a poorly defined patch beneath the canthus rostralis, and irregular mottling on the coccygeal region, thigh, tibia, foot, forearm and hand. The posterior surfaces of the thighs are very dark brown. The lower surfaces of the body and limbs are cream; the palmar and plantar surfaces are pale brown, and the anterior surface of the thigh a pale slate colour.

The palpebral venation consists of a few fine, slightly disrupted, largely vertical veins.

Comparison with Other Species—The presence of extensively webbed fingers, apposable first finger and the form of the palpebral venation distinguish *N. vestigea* from *N. hosmeri* and all other *Nyctimystes* species known at the present time. The finger webbing of *N. perimetri* Zweifel is almost as extensive as that of *vestigea* but, in addition to the differences in the position of the first finger and the form of the palpebral venation (a pattern of oblique to almost vertical lines with a few horizontal connections in *perimetri*), *perimetri* exhibits a triangular dermal appendage on the heel and a distinct tympanum, and there is little likelihood of confusing the two species.

DISCUSSION

The eighteen Papuan *Nyctimystes* species known at the present time are confined to areas of subtropical rainforest. There are only two records of specimens being found at altitudes of less than 1,000 feet above sea-level, and in fact the vast majority have not been taken below 3,500 feet. As the *N. hosmeri* holotype was collected at an altitude of over 2,500 feet at Tully Falls and it is possible that the *vestigea* holotype could have been taken at a similar elevation on Mt. Bartle Frere, it seems reasonable to predict that the distribution of *Nyctimystes* in Australia will prove to be restricted to montane rainforest. Such a distribution pattern would provide a parallel to that of the Australian species of the predominantly Papuan Microhylid genera *Cophixalus* and *Sphenophryne* reported by Zweifel (1962).

ACKNOWLEDGMENTS

I wish to record my thanks to Dr. J. Eisèlt of the Naturhistorisches Museum, Vienna, and Mr. William Hosmer and Dr. Richard G. Zweifel of the American Museum of Natural History, New York, for permitting me to examine the specimens reported in this paper.

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Top *Nyctimystes vestigea* Holotype; bottom *N. hosmeri* Holotype.
N.B. The white patches on the knees of *N. hosmeri* Holotype are strings and not markings.

A DESCRIPTION OF A NEW MALLEE SPECIES OF EUCALYPTUS FROM CENTRAL AUSTRALIA

BY MICHAEL J. TYLER

Summary

Arbor, multi-stirpibus, 3-4(-7)m altar, ad basim cortice rugosa et persistent!, sursum levi et griseo. Folia adulta alterna, petiolata, pallido subflavida virida, sub-nitida, coriacea; petiolus 9-12 mm longus; lamina oblonga, apice longe acuminato, basi in petiolum sensim contracta, 7-11 cm longa, 1-1-8 cm lata. Inflorescentia; umbellae axillares; pedunculus brevis, robustus, 4-8 mm longus, cum 5-7 (-10) gemmis. Gemmae leves, cylindrico-pyriformae; operculum toro equum, late vel obtuso conicurn, 8-10 mm longum (pedicel10 2-4 mm longo incluso), 3-4 mm latum. Pedunculus in fructu robustus, compressus, brevis, 4-8 mm longus. Capsulae breviter sed distincte pedicellatae (in speciminibus cupuliformibus) vel sensim attenuatae (in speciminibus subsessilibus sub-pyriformibus), 7 mm longae et latae. Valvae manifeste exsertae, breviter subulatae, plerumque 3; discus convexus, ca. 2 mm latus. Anthera oblongo-reniforma, loculis manifeste separatis, sub-versatilis filamenta ad basim connectivi indistincti inserta, glande terminali parva, loculis poris magnis dehiscentibus.

A DESCRIPTION OF A NEW MALLEE SPECIES OF EUCALYPTUS FROM CENTRAL AUSTRALIA

By C. D. Boomsma*

[Read 13 August 1964]

Eucalyptus mannensis nov. sp.

Arbor, multi-stirpibus, 3-4(-7)m alta, ad basim cortice rugosa et persistenti, sursum levi et griseo. Folia adulta alterna, petiolata, pallido subflavida virida, sub-nitida, coriacea; petiolus 9-12 mm longus; lamina oblonga, apice longe acuminato, basi in petiolum sensim contracta, 7-11 cm longa, 1-1·8 cm lata. Inflorescentia; umbellae axillares; pedunculus brevis, robustus, 4-8 mm longus, cum 5-7(-10) gemmis. Gemmae leves, cylindrico-pyriformae; operculum toro equum, late vel obtuso conicum, 8-10 mm longum (pedicello 2-4 mm longo incluso), 3-4 mm latum. Pedunculus in fructu robustus, compressus, brevis, 4-8 mm longus. Capsulae breviter sed distincte pedicellatae (in speciminibus cupuliformibus) vel sensim attenuatae (in speciminibus subsessilibus sub-pyriformibus), 7 mm longae et latae. Valvae manifeste exsertae, breviter subulatae, plerumque 3; discus convexus, ca. 2 m[illegible]tus. Anthera oblongo-reniforma, loculis manifeste separatis, sub-versatilis filamenta ad basim connectivi indistincti inserta, glande terminali parva, loculis poris magnis dehiscentibus.

Holotypus—Northern Territory, 20·3 miles north of Angas Downs Head Station, 15.x.1957, G. Chippendale and L. Johnson 3986 (AD 95951147). Isotypes in N.T., N.S.W., Canb., Bri., Melb., N.E.K., Perth.

It is a mallee in habit, 3-4(7m) high with rough bark at the base, smooth and grey in colour above. *Cotyledons* deeply bifid, *seedling leaves* at three months of age number 8 pairs, the first pair being sessile, the others shortly but distinctly pedicellate, narrow-lanceolate 3 cm x ·8 cm. *Mature foliage* pale yellowish green when dried, to sub-glossy dark green when fresh; thick enough to be rigid when dried, well spaced along branchlets, alternate, tapering at the apex to a long acuminate point and at the base gradually into the petiole which is sometimes twisted.

Venation obscure in dried material; central vein furrowed on upper surface, intramarginal nearly coinciding with leaf margin, lateral veins pinnate for 35-50 pairs. Petiole 9-12 mm long, mature lamina oblong to oblong-lanceolate, rarely narrow-lanceolate 7-11 cm long, 1-1·8 cm wide.

Inflorescence; umbels axillary of 5-7 (-10) spaced buds; peduncle short, robust, 4-7 (-8) mm long generally shorter than the capsule.

Buds smooth, cylindrico-pyriform, operculum equal to torus, broadly or obtusely conical, rarely hemispherical, 8-10 mm x 3-4 mm including the pedicel which is 2-4 mm long. Anthers oblong-reniform, typical of the Platyantherae (Blakely), cells distinctly separated, sub-versatile, filament inserted at the base of the indistinct connective, terminal gland small, visible from the front, dehiscence by large circular pores.

Capsules from shortly but distinctly pedicellate in cupular shaped specimens to gradually tapering in sub-sessile sub-pyriform specimens, 5-7 x 5-7 mm. Valves obviously exsert, shortly subulate but fragile and often only the bases remain attached, usually three, disc raised to almost domed, about 2 mm wide, equal to half the radius of the capsule.

Distribution—Widespread in the far north-west of South Australia, north-

* Department of Woods and Forests, Adelaide.

wards into Northern Territory, and probably westwards into the adjoining mountain ranges in Western Australia.

South Australia, Mann Ranges, 1955, J. Johnson, AD 96 340 086, dup. Woods and Forests Dept., Herb. Of the 29 specimens examined those showing extremes of characters include a long peduncle of 8 mm (18 miles north of Curtin Springs, N.T., N. Forde 182), a hemispherical operculum (22 miles north of Angas Downs, N.T., Winkworth 53) and narrow-lanceolate foliage (4 miles south of Palmer River, N.T., N.T. 12064).

This species is typically found on reddish sand dunes associated with well-recognised drought resistant species, such as *Triodia basedowii*, *T. pungens*, and *Cassia nemophila*. In the easier conditions of the ranges it is found associated with Eucalypts, *E. oleosa*, *E. gamophylla* or *E. oxymitra*; and occasionally *E. terminalis* (J. Johnson, personal communication).

Its position would seem to be in the series Subulatae (Blakely) because of its longish, fragile subulate valves; but the broad, flat to raised disc to the capsule separates it from the broad conical operculum forms of *E. oleosa* which appears to be nearest to *E. mannensis*.

ACKNOWLEDGMENTS

My thanks are due to the Director of the Botanic Garden for the successful raising of a seedling, and to the Keeper of the State Herbarium for technical assistance with the text, not the least being the Latin translation carried out by Mr. P. Wilson.

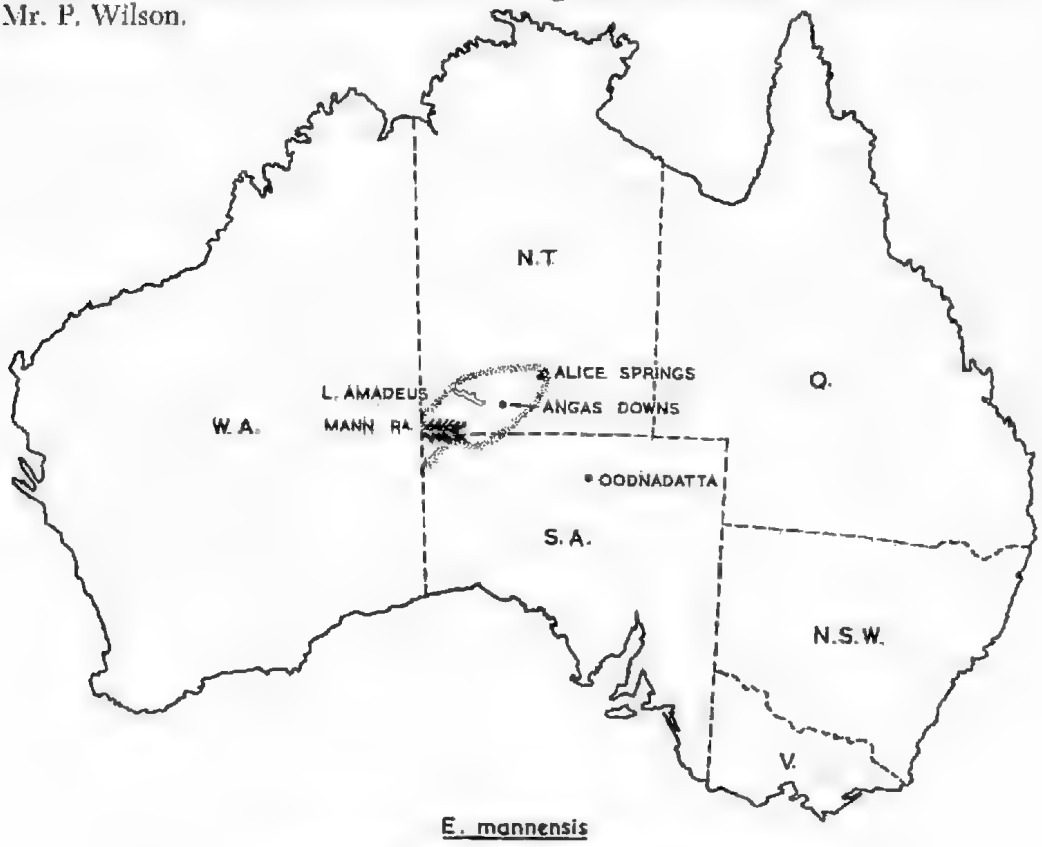

Fig. 1. Map of Australia showing the reported occurrence as at April, 1964.

A typical occurrence of *Eucalyptus mannensis* nov. sp. on sand dunes just north of Mt. Lindsay in the far N.W. of South Australia. Herb specimen ADW 25129.

Photos by courtesy of D. Symon, Waite Agricultural Research Institute

A DESCRIPTION OF A NEW MALLEE SPECIES OF EUCALYPTUS FROM CENTRAL AUSTRALIA

BY MICHAEL J. TYLER

Summary

Arbor, multi-stirpibus, 3-4(-7)m altar, ad basim cortice rugosa et persistent!, sursum levi et griseo. Folia adulta alterna, petiolata, pallido subflavida virida, sub-nitida, coriacea; petiolus 9-12 mm longus; lamina oblonga, apice longe acuminato, basi in petiolum sensim contracta, 7-11 cm longa, 1-1-8 cm lata. Inflorescentia; umbellae axillares; pedunculus brevis, robustus, 4-8 mm longus, cum 5-7 (-10) gemmis. Gemmae leves, cylindrico-pyriformae; operculum toro equum, late vel obtuso conicurn, 8-10 mm longum (pedicel10 2-4 mm longo incluso), 3-4 mm latum. Pedunculus in fructu robustus, compressus, brevis, 4-8 mm longus. Capsulae breviter sed distincte pedicellatae (in speciminibus cupuliformibus) vel sensim attenuatae (in speciminibus subsessilibus sub-pyriformibus), 7 mm longae et latae. Valvae manifeste exsertae, breviter subulatae, plerumque 3; discus convexus, ca. 2 mm latus. Anthera oblongo-reniforma, loculis manifeste separatis, sub-versatilis filamenta ad basim connectivi indistincti inserta, glande terminali parva, loculis poris magnis dehiscentibus.

PERMIAN-JURASSIC HISTORY OF THE WESTERN GREAT ARTESIAN BASIN

By H. Wopfner*

[Read 13 August 1964]

SUMMARY

The Late Palaeozoic and the Mesozoic history of the western portion of the Great Artesian Basin was characterised by periods of short-lived intercratonic sedimentation which were separated by extensive intervals of erosion. The periods of sedimentation were the Lower Permian and the Upper Jurassic-Lower Cretaceous.

The Lower Permian sequence, comprising in ascending order, glacigene, marine and freshwater deposits, obtained their greatest thickness in deep, north-west to north-north-west trending troughs of apparently pre-Permian origin. The upper Jurassic deposits consist substantially of terrestrial beds but become freshwater in origin towards the deeper (eastern) portion of the basin. The presence of Middle Jurassic freshwater strata is predicted beneath the area of Lake Eyre. The western boundary of Middle Jurassic deposition is formed by a north-north-west to north-west trending hinge zone, situated along the western shore of Lake Eyre and termed the Lake Eyre lineament.

The interval between the Permian and the Middle to Upper Jurassic was a period of erosion which, in conjunction with (?) pre-Middle Jurassic uplifts in the area west of Lake Eyre, led to severe truncation of the Lower Permian sediments and older rocks. As truncation approached near-peneplain conditions, lateral transport gradually decreased and a strongly kaolinised, deep weathering profile developed. Lateral transport was apparently eastward and led to the deposition of the kaolinitic-Middle Jurassic sandstones (Walloon and older equivalents) in the depressed areas east of the Lake Eyre lineament.

The process of peneplanation was terminated by the Lower Cretaceous transgression

INTRODUCTION

Recent investigations of the Western Great Artesian Basin by the South Australian Geological Survey have revealed some interesting aspects of the pre-Cretaceous history of this portion of the basin. In addition, data became available from recent exploration by the French Petroleum Company of Australia and some of this information has been incorporated.

The purpose of this paper is to summarize available information and to try to answer a few of the many questions regarding the geological events controlling the present distribution of the Lower Permian and Jurassic sediments.

THE AREA

The area dealt with in this paper comprises the western portion of the Great Artesian Basin, approximately between 134° and 138° east longitude.

Monotonous plains and low table lands form the characteristic features of most of the area. The monotony of the topography is only interrupted by the Peake and Denison Ranges and the Stuart Range.

The Peake and Denison Ranges consist of a NNW trending chain of rugged Upper Proterozoic hills which rise to a maximum elevation of 1,350 feet above

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sea-level. As a morphological feature, these ranges are not older than Upper Tertiary, as indicated by steeply dipping Mid-Tertiary duricrust, dragged along the faults which led to the present elevation of the ranges.

The Stuart Range consists of low, slightly west dipping cuestas formed by Cretaceous and Tertiary strata.

Purely on the development of the Mesozoic sequence, the western Great Artesian Basin can be subdivided into a stable, western "shelf"-area and a negative, eastern basin-area. The stable area is characterised by thin Mesozoic deposition whilst several thousand feet of Mesozoic sediments were laid down in the negative basin area. The boundary between these two areas is formed by a NW to NNW trending zone of faulting and monoclining situated approximately along the western shore of Lake Eyre. For convenience this zone is referred to as the Lake Eyre Lineament. Faulting affecting Cretaceous strata can be observed on outcrops at the lower reaches of the Neales River, about two to six miles east of the Lake Eyre shore. The latest movements are not older than Upper Tertiary, similar to the movements which took place on the eastern margin of the Peake and Denison Ranges. However, syn-Mesozoic movements must have taken place so as to affect the deepening of the eastern basin area. This is indicated by some seismic evidence, as shown in Fig. 3.

The importance of the Lake Eyre Lineament as a line of demarcation for pre-Mesozoic rocks is problematical.

STRATIGRAPHY

Pre-Permian

The oldest known rocks in the area are granites, hornblende-granites, adamellites and gneisses. They are part of the Australian shield and are Archean or Lower Proterozoic in age. They are widely exposed along the south-west margin of the Great Artesian Basin and form the basement inlier of Mt. Woods (see Figs. 1 and 4). These rocks were also encountered in Lake Phillipson bore, below 3,140 feet.

East of Mt. Woods, the ancient shield-rocks are overlain by unmetamorphosed sediments of Upper Proterozoic age. They are comparatively thin and undisturbed in the vicinity of the shield but increase in thickness towards the east. More than 30,000 feet of unmetamorphosed but moderately folded Upper Proterozoic sediments of the Adelaide System (Willouran to Sturtian Series), are exposed at the inlier which forms the Peake and Denison Ranges (Reyner, 1955). The Upper Proterozoic succession exposed at the Peake and Denison Ranges consists largely of clastic sediments with minor carbonate developments. Basic volcanics (Douglas Creek Volcanics) are associated with the oldest of these sediments (Willouran Series).

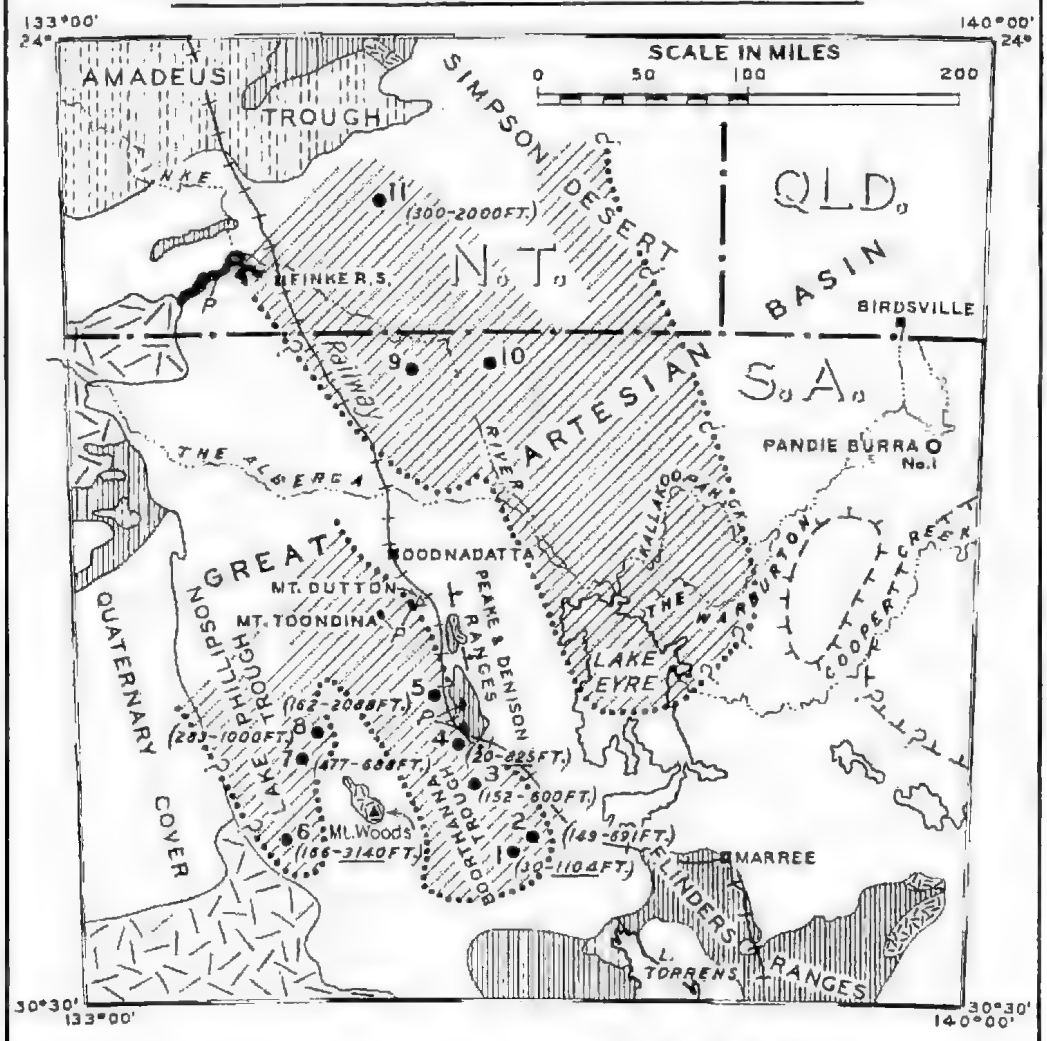
Lower Proterozoic schists, gneisses, migatites and basic meta-sediments occur on the north-eastern side of the Peake and Denison Ranges. The same sediments apparently also underly the area between the ranges and the western shore of

Fig. 1. Geological map of Western Great Artesian Basin showing Permian outcrop and approximate outline of Permian subcrop. Bores containing proved Permian sediments are numbered: 1-11. 1, Coorie Appa; 2, Margaret Creek; 3, Marpoo; 4, Anna Creek; 5, Boorthanna; 6, Lake Phillipson; 7, Stuart Range No. 1; 8, Stuart Range No. 2; 9, FPCA Witcherrie No. 1; 10, FPCA Purni No. 10. 1, 11, Malcolms. Figures in brackets behind the number of the bore show upper and lower boundaries of Permian beds below ground level. Last figure underlined indicates depth of Permian-pre-Permian contact. Last figure not underlined indicates total depth at which bore bottomed in Permian.

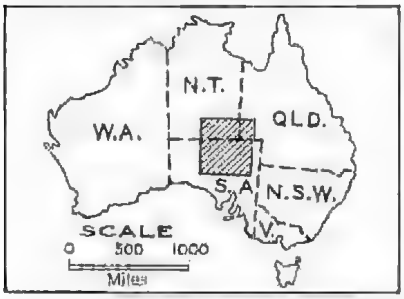
MAP OF WESTERN GREAT ARTESIAN BASIN

SHOWING

MAJOR GEOLOGICAL UNITS



LOCALITY PLAN



LEGEND

- Permian outcrop
- Approximate outline of Permian subcrop
- Approx. outline of eastern Permian basin (Dullingari-Gidgealpa region)
- Domal upwarp along Birdsville track
- Lower Paleozoic (Cambrian to Devonian)
- Upper Proterozoic
- Archean & Lower Proterozoic
- (30-1104FT.) Bores containing proved Permian

Del. B.T. 64-507 H. Wopfner S.A. Dept. of Mines

Lake Eyre, where they occasionally protrude through the younger sediments to form small, isolated inliers like Lagoon Hill, Mt. Charles, and Springhill.

The nature of the pre-Permian rocks beneath Lake Eyre is unknown but it is generally thought that Upper Proterozoic to Lower Palaeozoic sediments underly this portion of the basin.

Permian

Permian sedimentation was initiated by ubiquitous deposition of glacigene material, ranging from basal tills to fluvio-glacial and glacio-marine sediments higher up the sequence. These glacial sediments are of Lowermost Permian to perhaps Uppermost Carboniferous age and they rest unconformably on any of the older rocks described previously. The glacigene deposits consist of pebble to boulder beds with generally textureless clayey or sandy matrix (Plate 1, Fig. 1). Outcrops of these beds along the Peake and Denison Ranges exhibit a great abundance of soled, striated and sometimes fluted pebbles (see Plate 1, Fig. 2). They are dominantly locally derived from the underlying Upper Proterozoic sediments and commonly facetted and striated cobbles or boulders consisting of well-consolidated Sturtian Tillite (Adelaide System) can be observed. Some outcrops show indistinct, sometimes distorted bedding of the sandy matrix, indicating deposition under fluvio-glacial environment.

The Lower Permian glacial sediments are widely distributed along the western flank of the Peake and Denison Ranges. The same beds were also encountered at the base of the Permian sequence in the Lake Phillipson, Coorie Appa, Margaret Creek and Anna Creek bores (Ludbrook, 1961). They are further known from Yellow Cliff near Finke, from where, in fact, the first Central Australian occurrence of Permian glacials was described (Tate, 1898). Tillites of assumed Permian age and containing plentiful striated, soled and fluted pebbles and boulders also occur in the Field River area (N.T.) on the northern margin of the Great Artesian Basin. They rest unconformably on Upper Proterozoic sediments and should not be confused with the Upper Proterozoic "Field River Glacials" or overlying clastics of Mesozoic age.

There can be little doubt as to the true glacial nature of these basal Permian beds. They show all the criteria one can expect to observe on a tillite except glacial pavements. Furthermore, their age is identical with occurrences in southern South Australia where at several localities Lower Permian boulder tills rest on well-preserved glacial pavements (e.g. Inman Valley) (Campana and Wilson, 1955; Horwitz, 1960).

The basal glacigene horizon is followed by a few hundred feet of lower Sakmarian marine calcarenites and shale. This horizon has not been recognised in outcrop, but was proved in several bores, e.g. Lake Phillipson, Boorthanna and Coorie Appa (Ludbrook, 1961).

The marine horizon is overlain by a thick fresh-water sequence of Upper Sakmarian to Lower Artinskian age (Balme, 1957; Ludbrook, 1961). It consists of bituminous shale, carbonaceous siltstone and sandstone and is concluded by widespread deposition of coal. This unit is known from many bores along the westernmost Artesian Basin and its existence has been proved as far north as Malcolm's Bore, about 100 miles NE of Finke (Balme, 1959). The only known outcrop is at Mt. Toondina where I. B. Freytag (1963) discovered glossopteris and other Permian plant remains in a distorted and steeply dipping siltstone, shale and coal-sequence (Plate 1, Fig. 3).

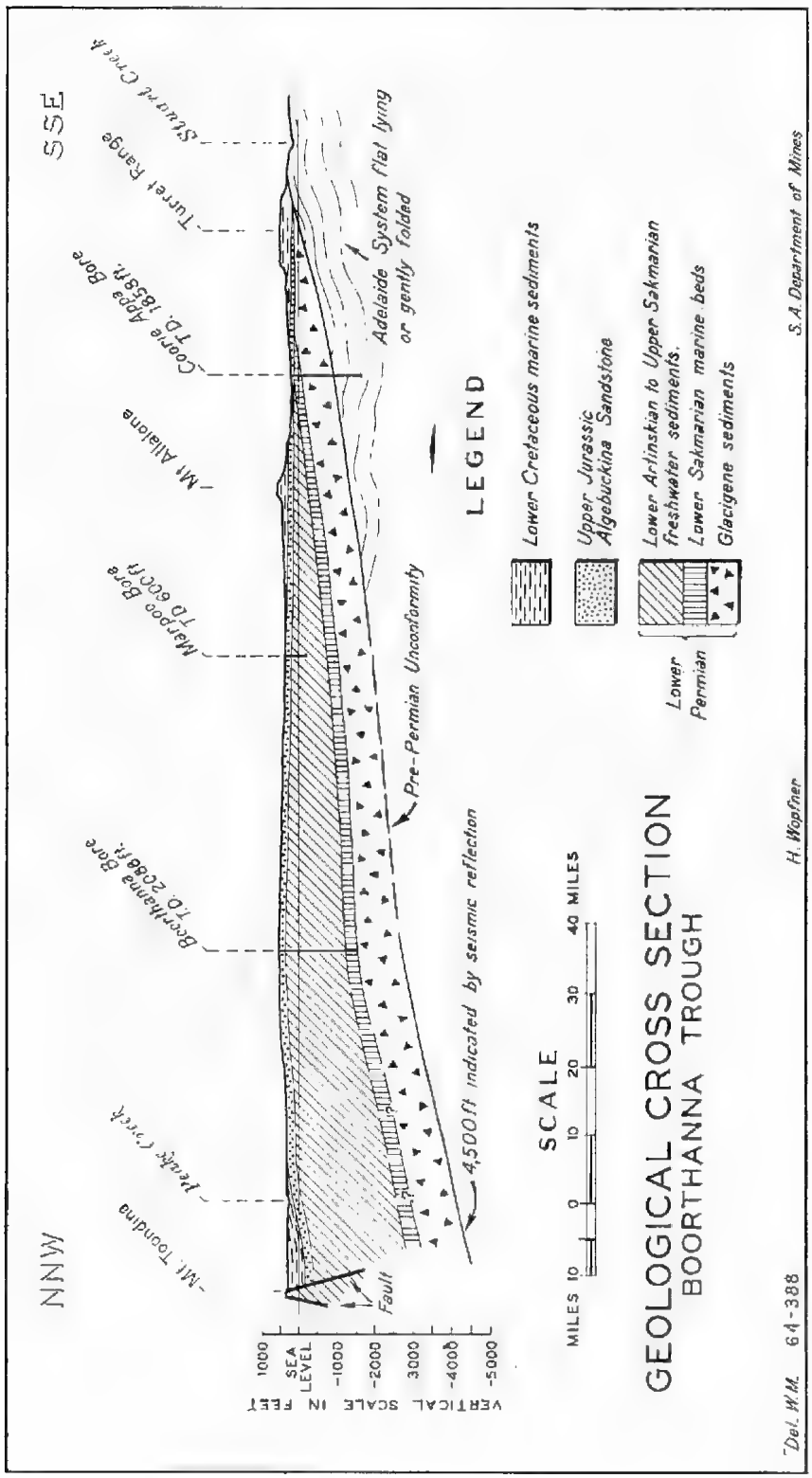


Fig. 2. Longitudinal geological section through Boorthanna trough from Coorie Appa to Mt. Toondina, showing north plunge of the trough and truncation of Permian sediments prior to the deposition of the Algebuckina Sandstone. Lower Cretaceous transgressional sandstones are not separated from the underlying Algebuckina Sandstone.

The freshwater sequence appears to overlap the marine horizon (Rochow, 1963). Considerable thinning of the freshwater sequence takes place across structural highs, which demonstrates the existence of a pre- and/or syn-Permian topography.

No Upper Permian strata have been recorded from the area and it is assumed that the deposition of the Artinskian freshwater and coal beds concluded the Permian sedimentation.

Present day distribution of the Lower Permian is the result of the interplay of several factors, viz. pre- and syn-Permian topography and structure, post-Permian uplift and tilting of the southern portion of the area and pre-Upper Jurassic truncation.

Two areas of major Permian distribution occur on the western side of the Peake and Denison Ranges: the Boorthanna trough situated between the Proterozoic ranges and the Archean of Mt. Woods, and the Lake Phillipson trough, WSW of Mt. Woods (Fig. 1).

The Boorthanna trough is fault bounded on its eastern side but onlaps onto the Archean of Mt. Woods on its western limit and onto Proterozoic to the south. Its axis trends NNW and shows a marked plunge to the north (Fig. 2), caused by post-Permian uplift of its southern portion. Aeromagnetics and recent seismic reflection surveys carried out by the S.A. Department of Mines show a maximum depth to the pre-Permian unconformity of about 4,500 feet in the vicinity of Mt. Toondina (pers. com. B. A. Milton and K. R. Seedsman).

Little is known about the Lake Phillipson trough and its configuration is still somewhat problematic. The Lower Permian encountered in the Stuart Range bores Nos. 1 and 2 probably belong to the same trough. A shallow interconnection between the Lake Phillipson trough and the Boorthanna trough in the vicinity of Mt. Willoughby is indicated by sparce seismic evidence (see Fig. 1).

No Permian sediments are known from the area between the Peake and Denison Ranges and Lake Eyre. Except for a few shallow water bores which penetrate only the Mesozoic sequence to the top of the Algebuckina Sandstone, there is little subsurface information available from this area.

A seismic reflection survey, comprising two-mile correlation shooting and intermittent continuous profiling was carried out by the S.A. Department of Mines between Mt. Dutton and the northern shore of Lake Eyre (see Fig. 3). Between Mt. Dutton and shot point D.K. 28, the survey shows a thin Mesozoic sequence (Algebuckina Sandstone and younger) resting directly on a shallow high velocity layer, representing Proterozoic or Archean basement.

East of shot point D.K. 28, however, considerable and rapid deepening of the "basement" reflector is observed. As shown in Fig. 3, the deepening of the basement is effected by a series of faults and flexures affecting both Mesozoic and pre-Mesozoic rocks. These faults are part of the Lake Eyre Lineament and a NW to NNW trend of these faults is indicated. In conjunction with the deepening of the basement, however, additional seismic reflectors appear below the horizon of the Algebuckina Sandstone ("C") and the "Basement" ("Z"). These intermediate reflectors, designated P_1 and P_2, are considered to represent Lower Permian sediments.

In Fig. 1, the western limit of Permian reflectors is connected to the area of Permian outcrop near Finke and this line is considered the western limit of Lower Permian subcrop within the Lake Eyre Basin. This line has recently been substantiated by two more seismic traverses and by the French Petroleum

Company's oil exploration wells, Witcherrie No. 1 and Purni No. 1, which both encountered Lower Permian sediments underneath the Mesozoic sequence.

The eastern and southern boundaries of Lower Permian distribution, as shown on Figs. 1 and 4, may be regarded as conjectural. However, seismic data obtained by the S.A. Department of Mines along the Birdsville track show that Permian sediments are absent over this upwarped region. Furthermore, it will be noted on Fig. 4 that no Permian was encountered in the Delhi-Santos Well Pandieburra No. 1.

Correlation between the Lower Permian of the western Great Artesian Basin and the Permian encountered by recent petroleum exploration work in the Innamincka-Gidgealpa area is still uncertain and beyond the scope of this paper. The discussion of this problem cannot be attempted until reliable datings of this eastern Permian sequence are available. From the sparse information on hand it appears that this sequence may extend well into the Upper Permian.

Jurassic-Cretaceous

Within the western Great Artesian Basin, the oldest Mesozoic sediments can be expected in the deeper parts of the basin, i.e. east of the Lake Eyre Lineament. The reader will recall the pronounced deepening of the basement east of shot point D.K. 28, along the Mt. Dutton-Lake Eyre seismic line. Together with this deepening of the basement and the appearance of Permian reflectors, one also observes a marked increase of the interval "P"-"C" (Fig. 3). This thickening of the post-Permian section beyond the normally experienced thickness of the Upper Jurassic sequence is thought to be due to the presence of Middle Jurassic sediments (Walloon equivalents and older), similar to the known Middle Jurassic succession as revealed by recent drilling as far west as 139°25′ east longitude (Delhi-Santos Pandieburra No. 1). Sediments of Middle Jurassic age were also encountered in F.P.C.A. Purni No. 1 well. Unfortunately, however, it is not known whether the Middle Jurassic sediments overlap or onlap the Lower Permian.

West of the Lake Eyre Lineament, Middle Jurassic sediments are absent and the oldest Mesozoic rock known from outcrop as well as from subsurface information is the Algebuckina Sandstone. It forms the basal stratigraphic unit of the Mesozoic sequence in the westernmost portion of the Great Artesian Basin.

The Algebuckina Sandstone rests unconformably on either Permian, Proterozoic or Archean rocks (Figs. 2 and 4), which are invariably and intensely kaolinised beneath the contact (Plate 2, Figs. 1 and 2). This feature is particularly evident on feldspar-rich metamorphics such as gneiss or schist in which quartz remained the only unaltered constituent.

The basal beds of the Algebuckina Sandstone consist of white, coarse and cross-bedded, kaolinitic sandstones and lenticular pebble conglomerates. The dominant constituents of the conglomerates are pebbles of milky quartz of an average size of two to five inches diameter. Pebbles of quartzite, tourmaline quartzite and acid igneous rocks occur as accessories. The pebbles are generally well rounded but dreikanters and case hardened, hollowed and pitted pebbles are common. The basal conglomerates also contain residual gold deposits (Brown, 1894). These characteristics in conjunction with the strong kaolinisation of the underlying rocks indicate that the basal Algebuckina Sandstone was formed on a deep weathering profile under terrestrial and fluviatile conditions. The basal terrestrial-fluviatile deposits are followed by clean, coarse- to medium-

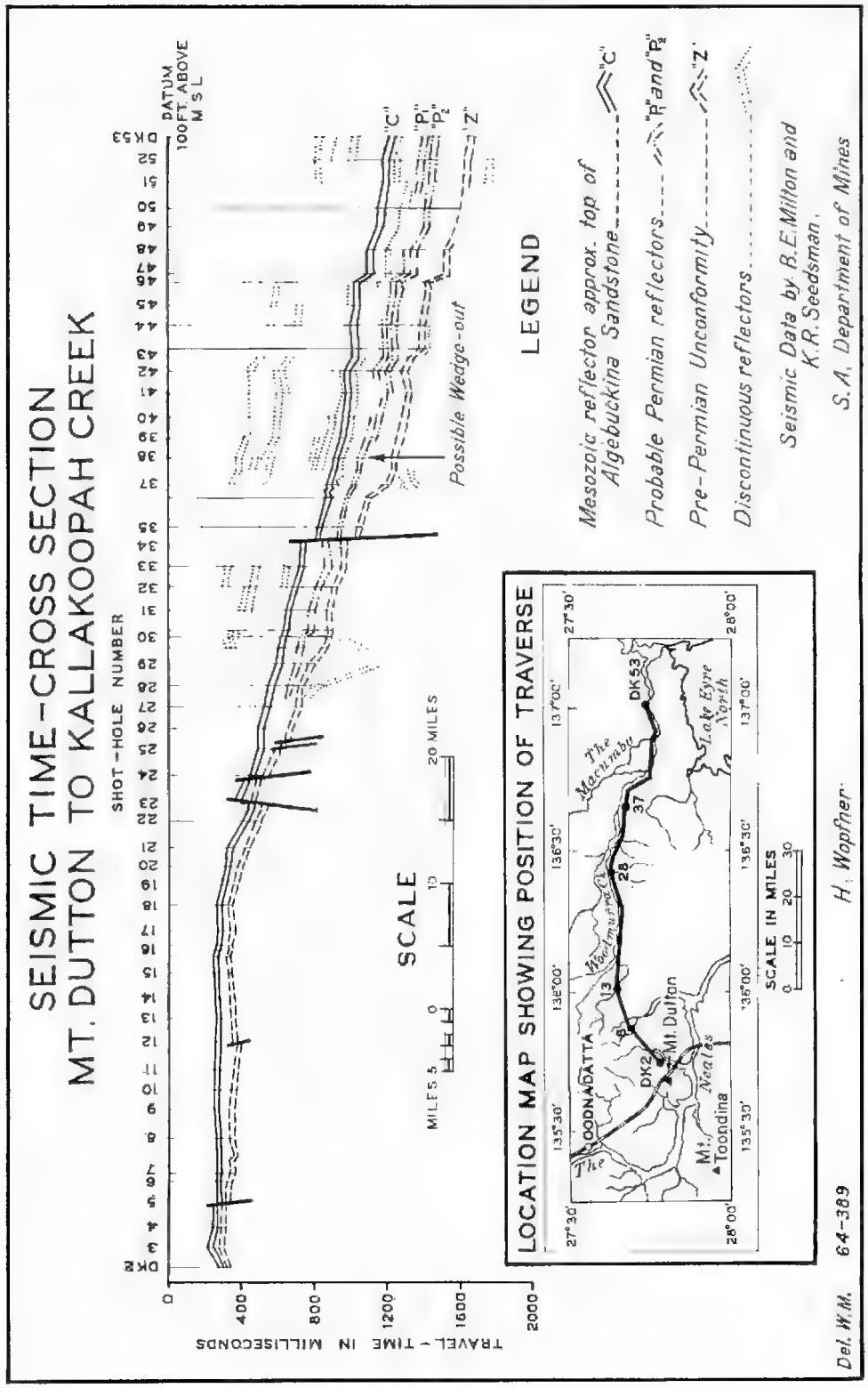


Fig. 3. Seismic time-cross section from Mt. Dutton to Kallakoopah Creek showing deepening of the Mesozoic reflector "C" and appearance of probably Permian reflectors P_1, and P_2 to the east of shot point 28.

grained lacustrine sandstones, containing well-preserved plant fossils of Upper Jurassic to Lower Cretaceous age (Wopfner and Heath, 1963).

The Algebuckina Sandstone is considered to be an equivalent of the Upper Jurassic formations of the Blythesdale Group.

The maximum thickness of the Algebuckina Sandstone measured on outcrops along the Peake and Denison Ranges is about 120 feet. However, the thickness increases to the north (186 feet in Santos Oodnadatta No. 1 well) and to the east, particularly across the Lake Eyre Lineament.

The Algebuckina Sandstone forms a nearly continuous blanket, shrouding most older rocks of the western Great Artesian Basin. Its cover is interrupted only where basement inliers break the surface (Fig. 4).

In the northern and eastern portion of the western Great Artesian Basin, a transition zone leads from the non-marine Algebuckina Sandstone to the Lower Cretaceous marine shale sequence. In the southern parts, however, a coarse, transgressional facies is developed which commonly overlaps the non-marine sequence. (Due to the small vertical scale, this sandstone is not separately shown on cross-sections Figs. 2 and 4.)

GEOLOGICAL HISTORY

From the evidence presented in the previous part of this paper, the following sequence of geological events can be deduced:

1. Deterioration of climatic conditions and lowering of the mean temperature in the Uppermost Carboniferous led to extensive glaciation, covering a stable and mature land surface of pre-Permian origin. To what extent and in what manner this surface was controlled by geological structure is a question which still needs clarifying.

2. The scouring action of the glaciers superimposed a distinctive glacial topography onto this pre-Permian landscape which led to the development of well-defined Permian troughs. At the same time, widespread deposition of moraines and other forms of glacial debris took place.

3. On the retreat of the ice-cover the sea advanced and the Lower Sakmarian horizon was deposited. Glacial components were incorporated by means of reworking and ice drift, whilst fluvio-glacial sediments were laid down in the wake of the retreating glaciers.

4. Marginal uplift, perhaps induced by crustal rebound following the removal of large parts of the ice cover, disrupted the connection with the open sea in Upper Sakmarian time. A continuing and excess influx of freshwater flushed out the remaining basin and subsequent sedimentation occurred in a substable, intracratonic freshwater basin or basins. As the troughs filled up with sediments they became decidedly shallow and swampy, so forming the environment in which the Lower Artinskian carbonaceous sequence was deposited.

5. The succession of events in the Lower Permian, viz. glaciation — marine incursion — freshwater deposition and swamp environment, is surprisingly similar to the sequence of Quaternary events in northern Europe. One might speculate therefore whether the Lower Permian succession was not similarly controlled by isostatic adjustments and fluctuations of sea-level.

6. The interval between the Artinskian and the Upper Jurassic, covering some 80 to 90 million years, was essentially a period of erosion, denudation and

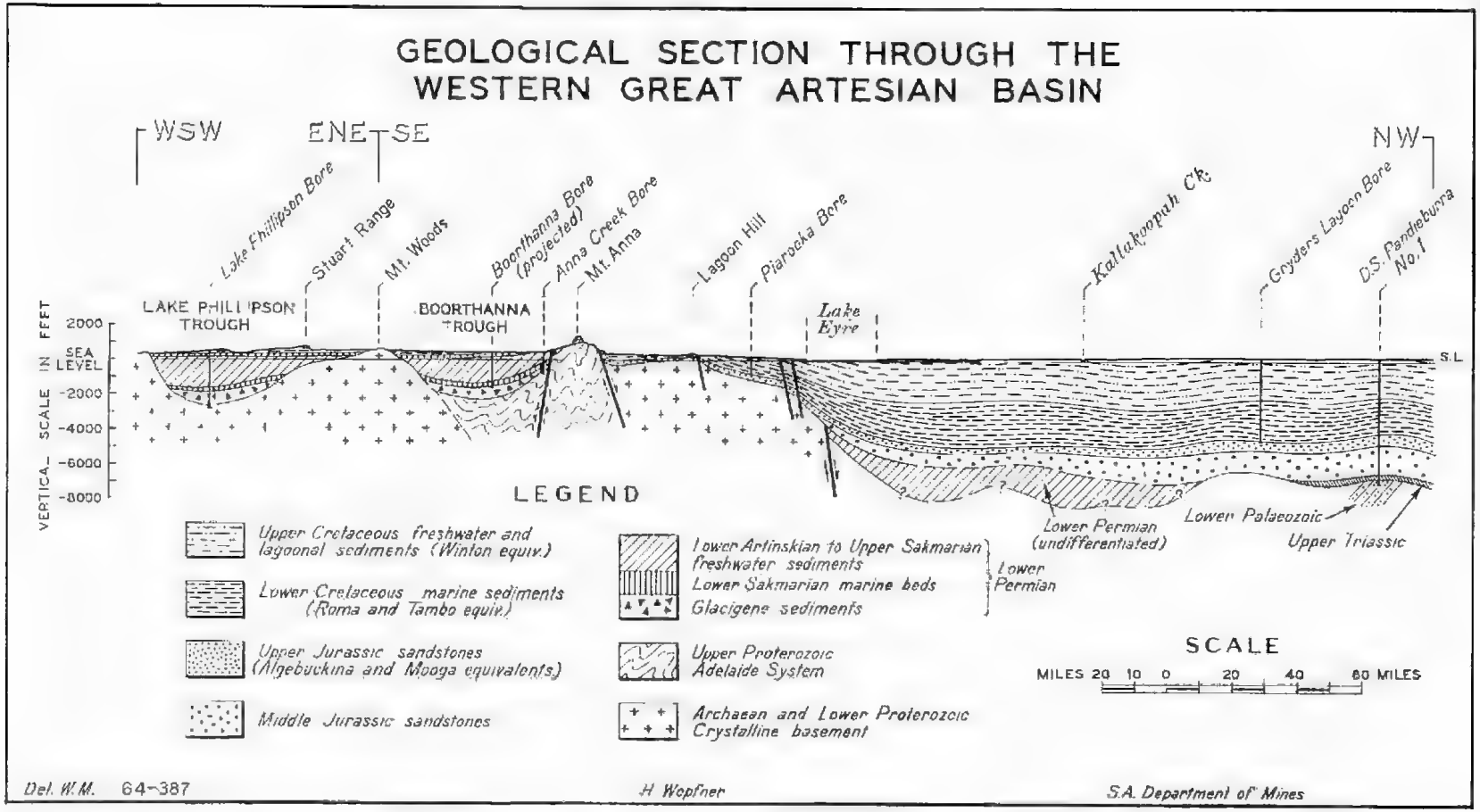


Fig. 4. East-west section through Western Great Artesian Basin between D.S. Pandieburra No. 1 and Lake Phillipson bore, showing Lake Phillipson and Boorthanna troughs and assumed Permian and Middle Jurassic sediments underneath the Lake Eyre Region.

peneplanation. As the surface reached the stage of a near peneplain, deep weathering profiles developed.

7. These processes were only briefly disturbed by minor uplifts and faulting which affected the area between the western margins of the Peake and Denison Ranges and the Lake Eyre Lineament. Positive movements also took place in the Margaret Creek area and, following Upper Triassic sedimentation, also in the northern Flinders Ranges. These positive movements were responsible for the north-tilting of the Lower Permian troughs (Fig. 2). The dating of these movements is obscure. Evidence from the Leigh Creek region in the northern Flinders Ranges suggests a post-Triassic age (Parkin, 1953). Furthermore, it is thought that the positive movements west of the Lake Eyre Lineament were compensated by down warping east thereof, thus conceding the deposition of Middle Jurassic sediments. Indeed, the uplifted western regions would have furnished the source for the highly kaolinitic clastic material of the Middle Jurassic deposits. If this reasoning is correct, the movements have to be placed in the upper Lower Jurassic. It would further mean that the Lake Eyre Lineament approximates the Middle Jurassic shore line.

8. West of the Lake Eyre Lineament, however, terrestrial conditions prevailed and the country underwent extensive peneplanation, whilst the uplifted portions were eroded and truncated and substantial portions of the Permian sections were stripped, particularly in the southern parts of the area (see Fig. 2). Soon, however, the uplifted portions were reduced to a near peneplain again. Rudiments of palaeosoils and ferruginisation of the Permian sediments at the contact with the Algebuckina Sandstone (Heath, 1963) as well as the intensive kaolinisation of older rocks at the same contact bear witness to prolonged exposure to weathering.

9. The overlying basal units of the Algebuckina Sandstone also indicate the existence of a Jurassic peneplain. The combination of the basal conglomerate itself, consisting of the most resistant materials only, the presence of dreikanters, the abundance of case-hardened, hollowed and pitted pebbles and the enrichment of alluvial gold are together characteristics of a terrestrial residual deposit developed by prolonged weathering under peneplain conditions. The comparatively small amount of debris which was laterally removed was transported east and deposited in the shallow Middle Jurassic freshwater basin which existed east of the Lake Eyre Lineament.

10. Slight subsidence in the Uppermost Jurassic led to partial inundation of this peneplain and the deposition of the plant bearing freshwater sandstone.

11. The Lower Cretaceous marine transgression finally covered the whole of this ancient peneplain. Pronounced subsidence to the east of the Lake Eyre Lineament resulted in the development of a thick Cretaceous marine sequence. The area west of the lineament, however, remained shallow and comparatively stable throughout the existence of the Cretaceous sea.

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EXPLANATION OF PLATES

PLATE 1

Fig. 1. Lower Permian glacigene sediments containing striated and fluted cobbles in unsorted kaolinitic sandy matrix. Outcrop on west flank of Peake and Denison Ranges, 4·5 miles NNE of Warrina. (*Author's photograph*)

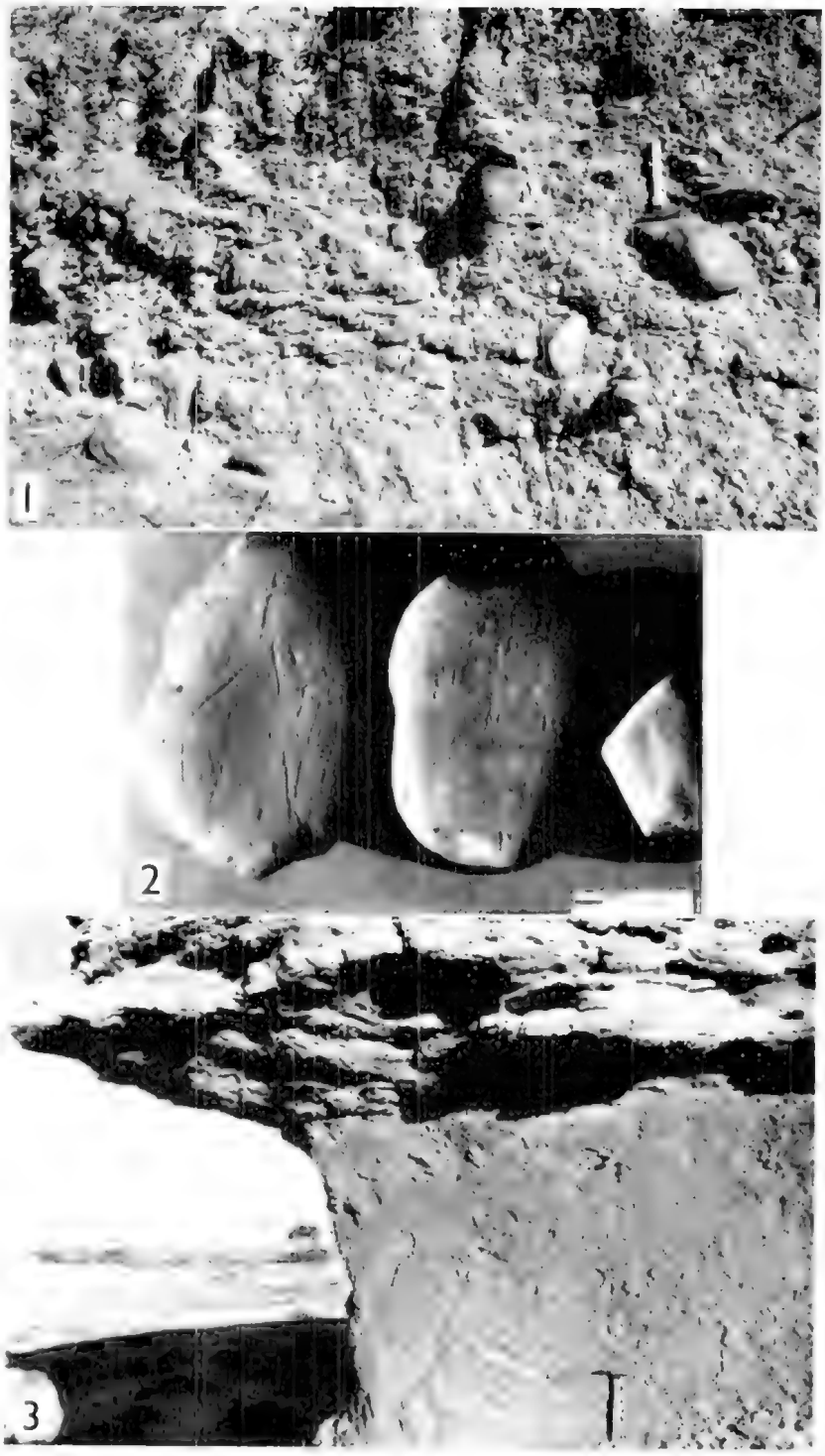
Fig. 2. Striated and soled pebbles from west flank of Mt. Dutton and from outcrop shown in Fig. 5. (*Author's photograph*)

Fig. 3. Steeply dipping Artinskian fresh-water sediments at Mt. Toondina. The Permian is capped by flat-lying Pleistocene limestone. (*Photograph G. R. Heath*)

PLATE 2

Fig. 1. Unconformity between steeply dipping (?) Lower Proterozoic gneiss (Pl) and Algebuckina Sandstone, west of Algebuckina Hill. Feldspars and micas of the gneiss are completely kaolinised, only quartz remaining unaltered. The intense kaolinisation is the result of a pre-Upper Jurassic deep weathering profile. (*Author's photograph*)

Fig. 2. Contact between Lower Permian pebbly shale and Algebuckina Sandstone west of Mt. Dutton. The dark bands below the contact (arrow) are ferruginised zones in the Permian sediments. The shales below are slightly kaolinised. (*Author's photograph*)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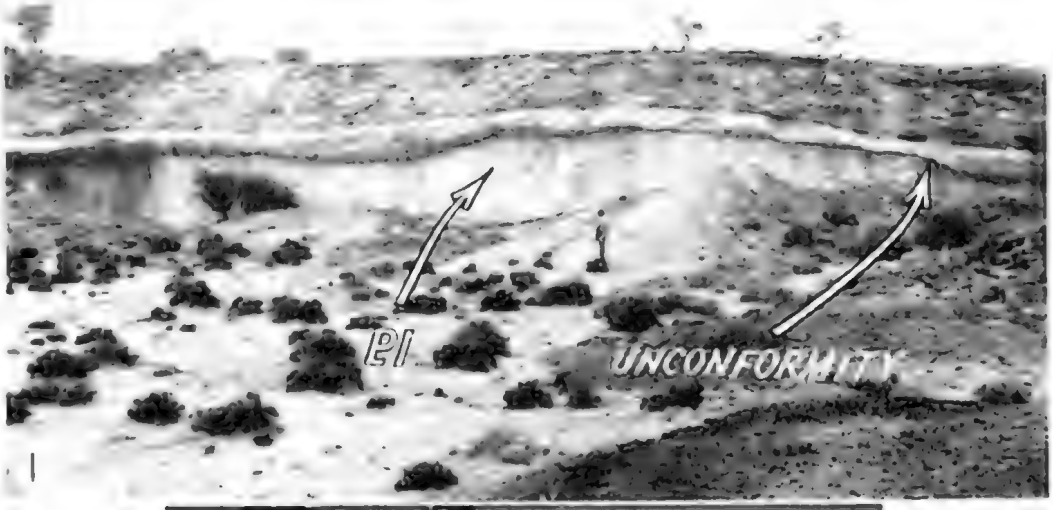
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LOWER CAMBRIALN STRATIGRAPHY OF THE FLINDERS RANGES'

BY C. R. DALGARNO

Summary

The distribution and relationships of Lower Cambrian units in the Flinders Ranges are illustrated by a panel diagram and sketch maps.

A new rock name, Hawker Group, is introduced for six formations of Lower Cambrian age which represent a phase of marine transgression following the deposition of the Pound Quartzite. An archaeocyathid biostrome development associated with graben faulting above the Oraparinna Diapir is noted.

The Billy Creek Formation is considered to lie disconformably on the Hawker Group in several areas and to represent a widespread phase of uppermost Lower Cambrian marine regression. A thin but persistent tuffaceous unit occurs in the lower half of this formation.

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By C. R. Dalgarno†

[Read 13 August 1964]

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The distribution and relationships of Lower Cambrian units in the Flinders Ranges are illustrated by a panel diagram and sketch maps.

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INTRODUCTION

The early records of Cambrian sequences in the Flinders Ranges are those of Howchin (1922, 1925), in which he described the Bunkers Range and Wilson sections, and Mawson (1937, 1938, 1939), who recorded two sections at Nepabunna and the Parachilna, Ten Mile Creek and Balcoracana sections. Segnit (1939) gave a description of the Mt. Scott Range and exposures near Andamooka to the west of Lake Torrens.

The only detailed biostratigraphic study has been carried out by Daily (1956). From the Flinders Ranges he discussed the Wilson-Quorn, Mt. Scott and Ten Mile Creek sections. His paper gives a comprehensive historical summary of studies on the Cambrian System in South Australia; it provides the basis for the subdivision and nomenclature of the sequence, and it demonstrates the biostratigraphic significance of his twelve faunal assemblages.

Regional mapping of Cambrian exposures of the northern Flinders Ranges was largely completed by the Geological Survey by 1953. Subsequently, Horwitz (1962b) mapped the sheet Arrowie and completed Cadnia using the work of R. Grasso (unpub. M.Sc. Thesis, Univ. of Adelaide). Webb and Von der Borch (1962) have mapped the Cambrian synclines of the Wilson and Quorn areas in the southern Flinders Ranges.

Sections measured during 1956 by R. B. Wilson (unpub.) for Santos Petroleum were the first Cambrian traverses at Brachina and Bunyeroo on the western flank of the central Flinders Ranges. B. Daily (pers. comm.) identified from fossils collected, the three important limestone units of the Lower and Middle Cambrian. In 1959, Daily (unpub.) recognised the Wirrealpa Limestone in the Mernmerna syncline and he subsequently tabulated the rock units and the faunal assemblages present in that locality.

B. P. Webb (unpub.) compiled a sketch section of the Lower Cambrian sequence east of Reaphook Hill after a brief reconnaissance traverse in 1961 of the hitherto unknown Cambrian exposure.

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† Geological Survey of South Australia.

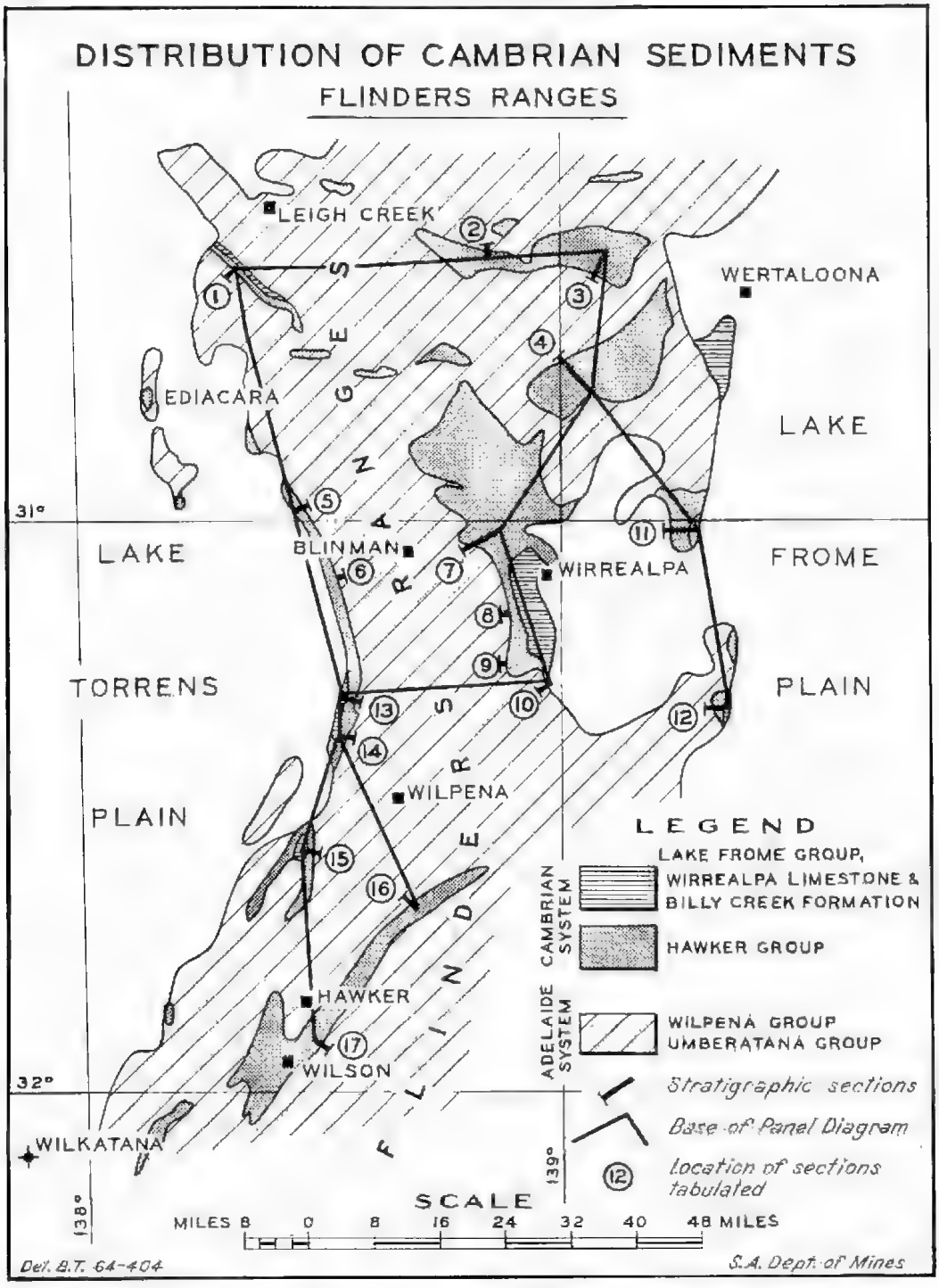

Fig. 1. Distribution of Cambrian Sediments, Flinders Ranges. 1. Mt. Scott. 2. Angepena. 3. Nepabunna. 4. Arrowie. 5. East of Nilpena R.S. 6. Parachilna. 7. Point Well. 8. Balcoracana Creek. 9. Ten Mile Creek. 10. Two miles south of Ten Mile Creek. 11. Mt. Frome. 12. Reaphook. 13, Brachina. 14. Bunyeroo. 15, Mernmerna, 16, Chace Range. 17. Wilson area.

The Wirrealpa Limestone was recognised west of Wertaloona H.S. by R. P. Coats; and brachiopods and trilobite fragments collected by J. E. Johnson and the author from this limestone during 1960, were identified by B. Daily as referable to his faunal assemblage ten. The sequence extending to the south was found to be a fairly complete development of the Lake Frome Group. East of Mt. Frome, a further area of exposure of the Lower Cambrian sequence and Wirrealpa Limestone has been mapped (Dalgarno and Johnson, 1963).

The present paper gives the general relations, distribution and approximate thicknesses of the formations employed during mapping of the central Flinders Ranges together with details of the mapping in some of the areas which have proved critical to the understanding of the relationships of the units. The thicknesses given are approximate, having been scaled from aerial photographs at a scale of 60 chains per inch.

STRATIGRAPHY

The Cambrian sequence in the Flinders Ranges follows with general structural conformity the Pound Quartzite, the uppermost formation of the Wilpena Group (Dalgarno and Johnson, in Thomson *et al.*, 1964). The Cambrian beds

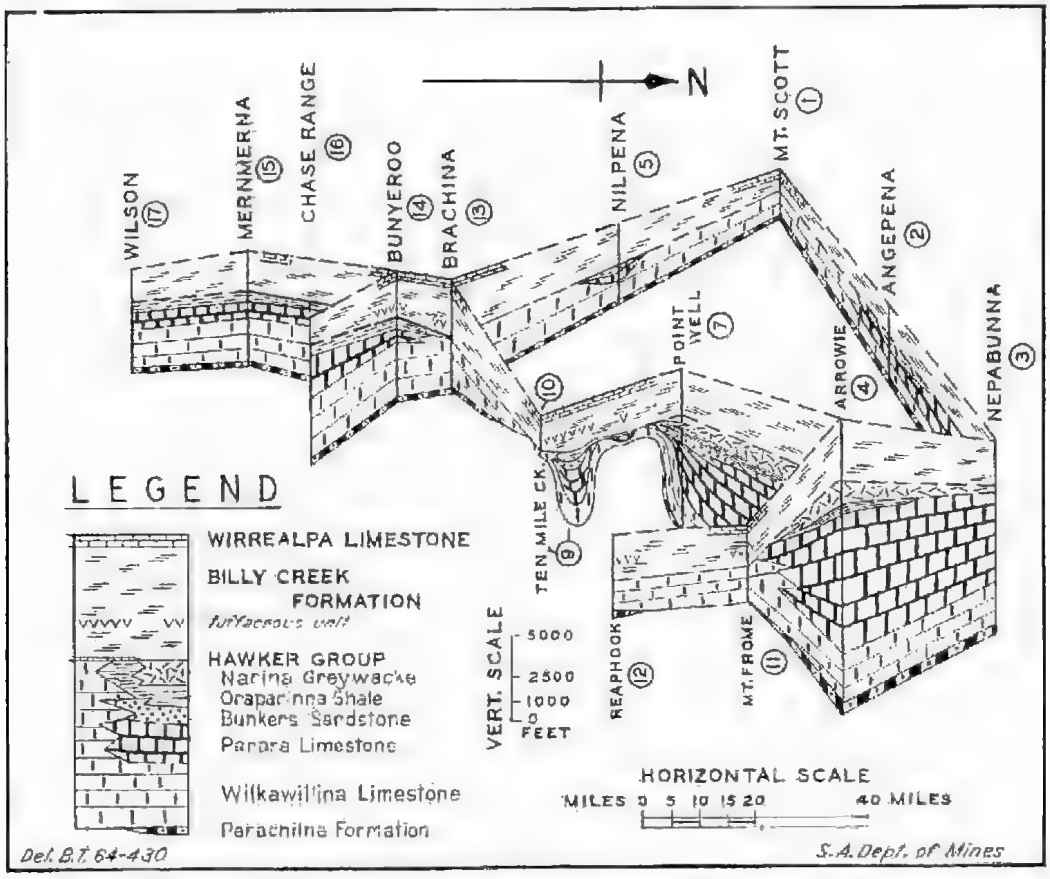

Fig. 2. Panel diagram of Lower Cambrian sediments, Flinders Ranges. Isomorphic base. Datum line of diagram shown on Fig. 1. Broken lines indicate units not exposed.

occupy broad synclines with moderate dips. Faulting is relatively common and oblique structures with displacements of a few hundred feet often show influence over the facies and thickness of the Cambrian sediments. Major faults may have displacements of the order of several thousand feet and these often bear close relationships to diapiric structures (Webb, 1958; Coats, 1964). These intrusive bodies occur along fairly well defined trends particularly in the central Flinders Ranges, and there is clear evidence from the facies and thickness of the Adelaide and Cambrian Systems that the cores were actively rising and eroded during deposition.

The most significant feature of the Lower Cambrian Series in the Flinders Ranges is the basinal structure described by Horwitz (1962a) in the Arrowie area. A thickness of 12,000-14,000 ft. of Lower Cambrian sediments has been measured in this region (Fig. 1: 4). This contrasts with the more normal thickness of approximately 2,000 ft. in the stable shelf zones (Fig. 1: 1, 6, 8, 11, 12, 13).

CLASSIFICATION OF THE CAMBRIAN SEQUENCE, FLINDERS RANGES

TABLE 1

CAMBRIAN SYSTEM	Middle Cambrian Series	LAKE FROME GROUP Grindstone Range Sandstone Unnamed sandstone Balcoracana Formation Moodlatana Formation
		WIRREALPA LIMESTONE, AROONA CREEK LIMESTONE
		— BILLY CREEK FORMATION
	Lower Cambrian Series	HAWKER GROUP (new name) Narina Greywacke (new name) Oraparinna Shale Bunkers Sandstone Parara Limestone Ajax Limestone Wilkawillina Limestone Parachilna Formation
ADELAIDE SYSTEM	Marinoan Series	WILPENA GROUP Pound Quartzite, etc.

HAWKER GROUP (*new name*)

The mapping of Lower Cambrian formations in the central Flinders Ranges indicates a natural grouping of the units proposed by Daily (1956) from the Lake Frome region. The Parara Limestone, Bunkers Sandstone and Oraparinna Shale and also the Narina Greywacke (new name) are closely related and in one locality all but the last unit change laterally to the facies of the Wilkawillina Limestone (see Fig. 3, point b).

The Hawker Group is defined comprising the seven formations listed above. There is a distinct mappable contact at the top of the Pound Quartzite which forms the boundary between the Wilpena and Hawker Groups; and the unit overlying the Hawker Group, the Billy Creek Formation, has a sharply defined base in all areas. Locally, the Billy Creek Formation may be disconformable on the underlying units.

The geographic name for the Group is taken from the township of Hawker (31°53′S., 138°25′E.).

A representative section for the Hawker Group is Ten Mile Creek south of Wirrealpa (Fig. 3, XY), which is the type area of Daily's units (Daily, 1956). The Parachilna Formation and Narina Greywacke are not developed. Sections which are convenient for examination and which show important units of the Hawker Group occur at Bunyeroo Gorge (Fig. 4), along the east flank of the Wilson syncline a few miles north or south of the old town, in the Mernmerna syncline near the abandoned rail cottages and east of the Big Hill on the Blinman-Wirrealpa Road. Also the track north-west from the bore near Old Wirrealpa provides an instructive section of the upper units.

Howchin (1925) described the Cambrian exposures in the vicinity of Wilson and used the term "Wilson Series" although no definition was given. His sequence as shown in his sections (Howchin, 1925, Fig. 6, p. 19) was incorrect. Thus his unit A is variously the Bunyeroo Formation (Thomson *et al.*, 1964) of the Wilpena Group and the Oraparinna Shale. Although four formations of the Hawker Group are now recognized in this area, the name "Wilson" is not adopted. For cartographic reasons it is desirable to have distinctive initial letters for the Group names; thus Wilpena Group, Hawker Group. Furthermore, the name Wilson's Bluff Limestone (Singleton, 1954) is in common use in Tertiary stratigraphic nomenclature.

The Hawker Group represents almost the entire Lower Cambrian Series in the Flinders Ranges. Glaessner (1963) has discussed the concept of the base of the Cambrian and he states that there is commonly an interval where dating is uncertain and that this should be indicated in map legends. However, in the Flinders Ranges the base of the Parachilna Formation has been adopted as the top of the Adelaide System (Thomson *et al.*, 1964), and the Parachilna Formation is arbitrarily assigned to the Cambrian, although the first recognizable Lower Cambrian fossils appear in the Ajax and Wilkawillina Limestones. The base of the Middle Cambrian is considered to fall somewhere within the Billy Creek Formation (Daily, op. cit.).

Parachilna Formation (Glossary, Thomson *et al.*, 1964).

Type Section—South side of Parachilna Creek 200 yards downstream from the point where the road from Parachilna to Blinman first enters the creek. The unit corresponds to the "passage beds" of Mawson (1938), viz. units 28-38. Thickness: 220 ft. It comprises white argillaceous sandstone with scattered pebbles at the base, overlain by 30 ft. of ferruginous weathering sandstone with

vertical burrows. This bed forms a prominent marker both in the Ranges and at Ediacara (Nixon, 1963). The remainder of the Formation comprises sandy units and calcareous silts and shales with minor oolitic limestones. The upper limit is marked by the appearance of dominant carbonates. In the Parachilna section the top of the Formation corresponds to the base of Mawson's unit 39, comprising 918 ft. of massive, flaggy and oolitic limestones. This unit is referred to the lower (unnamed) member of the Wilkawillina Limestone.

In the Mt. Scott Range, Segnit (1939) described the Parachilna Formation (his unit Ela) as a light grey, calcareous shale 180 ft. in thickness, lying disconformably on the Pound Quartzite, the hollows at its base being filled with arenaceous material.

In the Nepabunna area, Mawson (1937) did not differentiate the beds with worm burrows from the Pound Quartzite, but a mappable contact is clear here as also at Angepena and in the Arrowie syncline to the south. The Formation reaches its maximum thickness of approximately 1,200 ft. in this area. The unit diminishes to zero south of Wirrealpa. At Mt. Frome there is a thickness of 15 ft. and further south quartz-pebble conglomerates occur in the unit east of Reaphook Hill. Here burrows penetrate into the top of the Pound Quartzite but none originate within this formation, suggesting hiatus before deposition of the Parachilna Formation.

At Brachina and Bunyeroo, the Formation does not exceed 80 ft., although thicknesses of several hundred feet occur in the region about Wilson. Worm burrows and evidence of worm activity remain a consistent feature of the sandstones. Thomson (1962) has recognized the characteristic lithology and worm burrows of the Parachilna Formation in the Wilkatana Bore where the Pound Quartzite is not distinguished.

The burrows have previously been designated *Scolithus* by the author (Dalgarno, 1962) although some examples of U-shaped burrows were known. A critical examination on the suggestion of M. F. Glaessner has revealed that the burrows are better referred to *Diplocraterion* as the single burrows exposed in vertical section frequently have a paired shaft on the bedding surface, indicating the U-form of the burrow.

Wilkawillina Limestone (Daily, 1956).

South of its type section, Wilkawillina Gorge (Ten Mile Creek), the formation lies with inferred disconformity on the lower (unnamed), reddish member of the Pound Quartzite (Fig. 3, a). The upper, more resistant member, is absent along the Bunkers Range northward as far as the Blinman-Wirrealpa Road, but to the south of Ten Mile Creek in the vicinity of point e (Fig. 3), it exceeds 1,000 ft. in thickness. Mawson (1939, p. 345) stated that there was no sign of unconformity, but that there was some evidence of an overlap at the base of the Cambrian limestone in Wilkawillina Gorge. This is supported by the observation by J. E. Johnson (pers. comm.) at point e, Fig. 3, of faunal assemblage two of Daily, which occurs at the top of the Wilkawillina Limestone in its type section, lying directly on the upper member of the Pound Quartzite.

The name Wilkawillina Limestone is used in a broad way in this paper for the Lower Cambrian limestones in the Flinders Ranges, other than in the Mt. Scott area, which either occur stratigraphically below the Parara Limestone or

represent continued deposition of thick-bedded *Archaeocyatha* limestones. There is considerable variation in lithology but essentially two members may be recognized. The lower is poorly fossiliferous with arenaceous and shaley bands, the limestones being relatively thinly bedded, dolomitic and frequently oolitic. Algal-rich units are notable in the Brachina, Mernmerna and Chase Range areas near the top of this sequence. The upper member is best developed in the stable shelf zone of the central Flinders Ranges and comprises relatively pure and light coloured fossiliferous limestones in very thick beds. In the basinal areas south of Mernmerna and north of Wirrealpa, mottled blue-grey massive and thick-bedded limestones may be developed at the top.

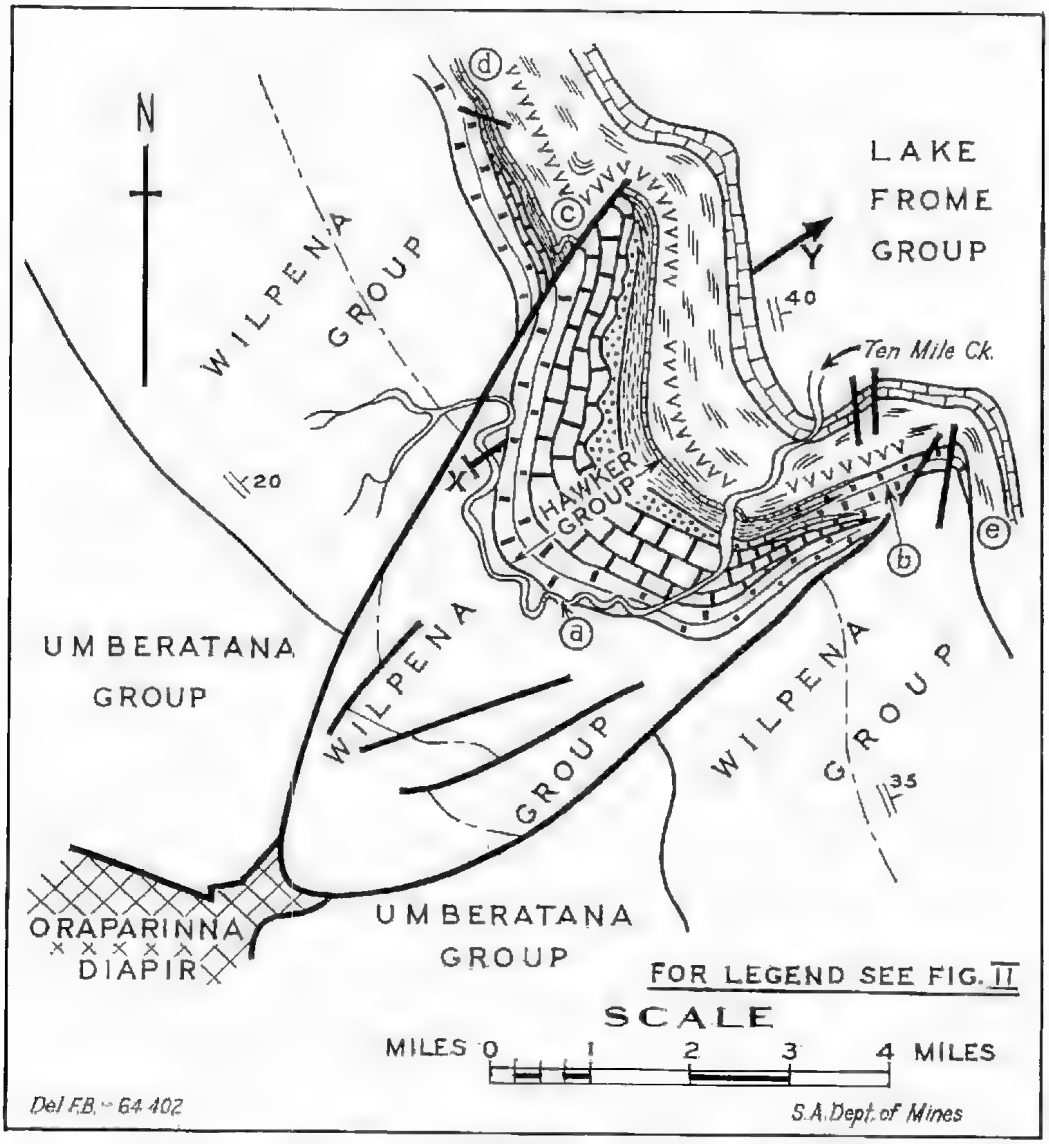

Fig. 3. Graben and Cambrian biostrome development, Ten Mile Creek area. XY is the Ten Mile Creek section of Daily (1956).

The areas in which archaeocyathids are best developed are the Wilkawillina Gorge and immediately to the south, the Brachina area and parts of the Mt. Scott-Ajax region.

A mile to the south of its type section, the Wilkawillina Limestone facies inter-tongues with the Parara Limestone, Bunkers Sandstone and Oraparinna Shale (assemblage nine) so that the upper boundary of the formation is markedly time transgressive, varying between faunal assemblages nine and two within a few miles. The name Ajax Limestone (Daily, 1956) is applied to the equivalents of the Wilkawillina Limestone (this paper) in the Mt. Scott Range area.

Parara Limestone

The name Parara Limestone was extended from Yorke Peninsula by Daily (1956). In the Ten Mile Creek section the formation comprises flaggy limestones and dark calcareous shales. In the central Flinders Ranges it is lithologically distinct from the underlying massive limestone and the contact is normally quite sharp. In the basinal areas, such as about Hawker and Arrowie, a shale unit is common at the base. New nomenclature may be necessary later for notable calcareous and carbonaceous shale units within the formation in the northern areas. The most common fossils are fragmented trilobites and archaeocyathids.

The unit is discontinuous in the central Flinders Ranges, being absent from the Mt. Frome, Reaphook, Brachina and Mt. Scott areas. Daily (op.cit.) records faunal assemblages three and four, typical of the Parara Limestone, from the Ajax Limestone at Mt. Scott, but the Parara facies is not developed. A similar situation may apply in the other areas; thus at Reaphook faunal assemblage two apparently occurs in the middle part of the Wilkawillina Limestone, whereas it occurs at the top at Ten Mile Creek.

Near Balcoracana Creek the Parara Limestone is lenticular and does not exceed 200 ft. in thickness, but north of the Wirrealpa Diapir and in the Arrowie area, it reaches 5,000 ft. North of Bunyeroo Creek, the formation wedges out against a fault which controlled deposition (Fig. 4, point a).

Bunkers Sandstone (Daily, 1956).

This formation attains its thickest development (600 ft.) in its type section north of Ten Mile Creek. It wedges out within a few miles to the north and south and is lenticular between the type area and Point Well. It does not exceed 150 ft. in thickness in these occurrences and there are no other developments of the formation in the Flinders Ranges. It was recorded from Reaphook (Dalgarno and Johnson, 1963) but subsequent work has shown that the sandstone overlying the Wilkawillina Limestone in that area represents the lower part of the Billy Creek Formation.

In certain areas the Bunkers Sandstone interdigitates with the Parara Limestone and Oraparinna Shale, e.g. Fig. 3, c.

Oraparinna Shale (Daily, 1956)

The Oraparinna Shale is a green, very thinly bedded silty shale which normally breaks with a conchoidal fracture. Immediately north of its type section, the Oraparinna Shale rests on the Parara Limestone (Fig. 3, c) and

it appears to transgress this unit on to the Wilkawillina Limestone in the vicinity of point d (Fig. 3). In the occurrences about Hawker the formation has an apparent transitional contact with the underlying Parara Limestone. North of Bunyeroo the Oraparinna Shale overlaps the Parara Limestone on to the Wilkawillina Limestone (Fig. 4, b) and then thins to zero. It occurs above shaley Parara Limestone in a local area east of Nilpena Siding but neither facies is developed in the Mt. Scott section nor to the north of Brachina Creek.

The Oraparinna Shale is not developed in the Mt. Frome and Reaphook areas and it is missing for a distance of approximately two miles along the Bunkers Range in the vicinity of Balcoracana Creek. It is also absent immediately north of Wirrealpa H.S., but it is present further west, both north and south of the Wirrealpa Diapir, where it is interbedded with more silty units. In this region it apparently interdigitates with the Narina Greywacke. The Oraparinna Shale carries trilobites together with brachiopods and small archaeocyathids.

Narina Greywacke (new name)

Geographic feature: Narina Head Station (30°56′20″S., 138°53′40″E.).

Type section: Adjacent to the track from Mulga View H.S. to Irish Well, Arrowie 1:63,360 sheet, viz., 30°48′30″S., 139°01′20″E. to 30°49′00″S., 139°01′45″E. The formation corresponds to unit (f) in Horwitz's (1962b) tabulation of the Cambrian sequence. It comprises interbedded grey silts and greenish greywacke sandstones with minor calcareous units. The formation is truncated by a fault at its upper limit in the type section. In the only other important exposure near Point Well the top of the unit has been removed by erosion so that nowhere is its relationship to the Billy Creek Formation observed. The contact with the underlying Oraparinna Shale is transitional. A minimum thickness of 4,500 ft. is given for the unit on the Arrowie Sheet (Horwitz, op.cit.); however, Fig. 2 shows only 2,000 ft.

R. P. Coats (pers. comm.) has mapped near Angepena a tuffaceous unit similar in lithology to the Narina Greywacke.

Billy Creek Formation

In the central Flinders Ranges there is an important marker bed above the Oraparinna Shale which is notable as a ridge former. It comprises a unit of flaggy and finely laminated, buff-weathering dolomitic limestone approximately 10 ft. in thickness and it is commonly underlain by a thin, brown, fossiliferous limestone which was chosen by Dalgarno and Johnson (1962; 1963, section 3) as the base of the Billy Creek Formation.

In the vicinity of Ten Mile Creek the dolomite follows rubbly limestones at the top of the Oraparinna Shale and it has been mapped to within a quarter mile of Balcoracana Creek. B. Daily and K. Pocock (pers. comm.) have recently observed the unit immediately north of Balcoracana Creek and below it is a thin development of Oraparinna Shale. However, one mile beyond this both units are considered to be absent and the marker dolomite is not known beyond this area. East of Ten Mile Creek this unit occur above massive *Archaeocyatha* limestones which represent a tongue from a biostromal development (Fig. 3, b).

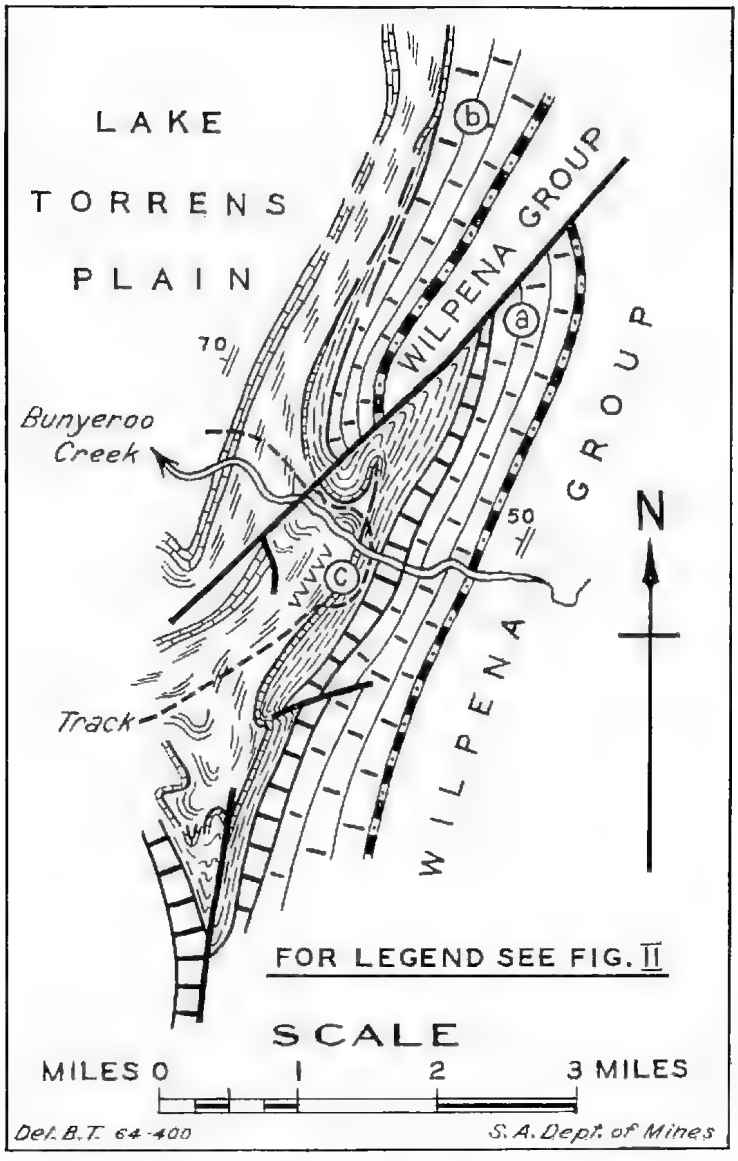

Fig. 4. Cambrian sequence near Bunyeroo Gorge.

On the western side of the Range the laminated dolomite and fossiliferous bed are known north of Brachina lying directly on the Wilkawillina Limestone. They are prominent at Bunyeroo (Fig. 4, c) and in the small syncline to the south. The same marker beds occur above the Oraparinna Shale in the Mernmerna area and also in the keel of the syncline four miles north-east of Wilson.

The Billy Creek Formation is dominantly red-brown micaceous shale with a lower member comprising alternating red and grey-green silts with minor sandy bands and thin dolomitic beds. This is separated from the upper portion of the Formation in the Ten Mile Creek-Balcoracana area by a fairly persistent dolomite associated with three tuffaceous units. The latter are a characteristic

salmon pink colour and were first collected by B. P. Thomson from Brachina and Ten Mile Creeks. Subsequently tuffaceous units have been found at Bunyeroo, Wirrealpa and along the entire length of the Bunkers Range to south of the type section, where they occur in Mawson's units 41-43 (Mawson, 1939). They occur also at Reaphook and Mt. Frome, but are not known in the Billy Creek Formation at Mt. Scott.

The uppermost units of the Billy Creek Formation are red-brown micaceous sandstones very similar in character to the Moodlatana Formation. The Billy Creek Formation as a whole is considered to represent an entirely different phase of deposition from the Hawker Group and shows close affinities to the Lake Frome Group. It is known only in the areas of relatively thin Lower Cambrian sedimentation, but it is inferred to represent a phase of general regression with minor marine fluctuations.

It is probable that the Billy Creek Formation is disconformable on the Ajax Limestone at Mt. Scott where faunal assemblages six to nine are absent (Daily, 1956). North of Brachina Creek the basal dolomitic unit of the Billy Creek Formation lies directly on the Wilkawillina Limestone facies so that a similar relationship may exist here, although biostratigraphic information is lacking. South of Ten Mile Creek the Formation onlaps on to the Wilkawillina Limestone (see below) and may actually be in contact with the Pound Quartzite below alluvial cover. East of Reaphook Hill a prominent sandy unit occurs low in the Billy Creek Formation, but this is not a basal unit, as sandy limestones at the top of the Wilkawillina Limestone are overlain with a sharp contact by red silts in the intervening valley. Facies changes do occur along strike in the basal beds of the Billy Creek Formation, particularly on the north side of a small oblique fault. A disconformity of small importance is inferred but faunal studies have not been done.

Just to the south of Balcoracana Creek halite casts occur at the top of a 6 ft. calcareous sandstone above the basal dolomitic unit of the Billy Creek Formation, indicating emergence during the early part of its deposition. Halite casts and raindrop impressions have been noted throughout the formation and trilobites are rare. No other marine forms have been reported.

A suite of trilobites was collected by J. E. Johnson and the author from approximately 25 ft. below the lowest of three tuffaceous bands in the lower part of the Billy Creek Formation near Balcoracana Creek. They are at present being described by K. Pocock and B. Daily of the University of Adelaide.

Wirrealpa Limestone (Daily, 1956)

The Wirrealpa Limestone is known in all areas, with the exception of Reaphook, in which the Billy Creek Formation occurs. It thus forms a useful datum for discussion of the Cambrian in the Flinders Ranges. Its thickness on the western side of the range is approximately 300 ft., whereas in the Ten Mile Creek-Wirrealpa region, it is 350-400 ft. thick. The lithology of the unit varies little, there being a fairly persistent massive dolomitic unit at the base which contains siderite and flecks of galena. Commonly a few feet above this, in thin-bedded limestones, is a persistent bed containing broken fragments and spines of *Redlichia*. Brachiopods and *Girvanella* are abundant higher in the unit in more shaley and rubbly limestones.

The unit occurs west of Wertaloona H.S. where it has a facies similar to the Aroona Creek Limestone (Daily, op.cit.) on the opposite side of the Ranges. The sequence here is faulted at the base against the Adelaide System, but red beds referable to the Billy Creek Formation do occur. This is the only evidence of the persistence of these two formations in the deeper basin area.

Lake Frome Group (Daily, 1956)

The Moodlatana Formation overlies the Aroona Creek Limestone at Mt. Scott and the Wirrealpa Limestone at Brachina and Bunyeroo and in the Wirrealpa area. It also outcrops east of Mt. Frome and south-west of Wertaloona. In all areas the contact is conformable and apparently represents a return to deltaic conditions similar to those of the top of the Billy Creek Formation. Two cherty, petroliferous-smelling dolomitic limestones near the base of the unit are persistent marker beds on the western side of the Ranges.

Conditions appear to have been uniform across the present Ranges during deposition of the Balcoracana Formation which is a repetitively bedded unit of thin dolomitic limestones and red-green micaceous silts, probably representing enclosed basin conditions. This unit together with the overlying terrestrial-deltaic sandstone (unnamed) is known in only three areas, viz., north of Bunyeroo Creek to Commodore on the west side of the Range, in the Grindstone Range area and south-west of Wertaloona. The Grindstone Range Sandstone, of deltaic character, is known only in the latter two areas.

The entire sequence from the base of the Billy Creek Formation through to the Grindstone Range Sandstone, totalling 12,000 ft., appears to show no significant break in deposition. Daily (op.cit.) considers the Lake Frome Group to be contained within the Middle Cambrian.

DISCUSSION

Ten Mile Creek Locality

Mapping of the Ten Mile Creek area showed that the structural setting of Daily's standard section is a graben developed above the Oraparinna diapir. The structure is related to diapiric uplift which took place during deposition of the upper Marinoan and Lower Cambrian. Reference to Fig. 3 shows the relative displacement of the Umberatana Group (Coats in Thomson *et al.*, 1964), Wilpena Group, Hawker Group and the Middle Cambrian Wirrealpa Limestone.

In detail, the upper member of the Pound Quartzite is absent within the graben and for more than five miles to the north, although it is very strongly represented to the south of the point b. The Parachilna Formation is absent from the whole region so that the Wilkawillina Limestone rests disconformably on the Pound Quartzite.

For the Hawker Group, the thickness in the central part of the graben is 4,100 ft., whereas at point d, the unit is approximately 1,500 ft. and at point e, only 200 ft. Here the basal limestones appear to represent faunal assemblage two of Daily so that the lower part of the Wilkawillina Limestone is absent. The significant feature of the mapping is the interdigitation of the units of the Hawker Group at points b, c and d. See Fig. 3 and Plate I, Figs. 1 and 2.

The development of Wilkawillina Limestone at point b constitutes a biostrome controlled by the actively subsiding fault bounding the graben. The entire structure and the processes which interfinger with the basinal facies are comprised of richly fossiliferous bedded archaeocyathid limestones similar to the Wilkawillina Limestone in its type section. No detailed study has been made of the faunas or rock types, but the preliminary mapping shows that the biostrome persisted throughout much of the Lower Cambrian as a localized area where growth of carbonate secreting organisms, notably *Archaeocyatha*, flourished.

The Billy Creek Formation is 3,300 ft. in thickness in the graben and to the north (Mawson, 1939, units 39-46); however, the formation is reduced near point e to approximately 1,800 ft. Here the upper part of the Formation (viz. Mawson's units 44-46) appear to transgress the Wilkawillina Limestone, but it is not seen in contact with the Pound Quartzite as the red shales do not outcrop south of point e. The basal marker bed of the Billy Creek Formation is not known east of the point b and the three tuffaceous beds and associated dolomite are not present beyond the major fault.

Bunyeroo Region

The features of the Hawker Group illustrated by Fig. 4 are the restriction of the Parara Limestone facies to the zone south of the fault (point a) and the tongue of Oraparinna Shale which extends northward to point b. The upper part of the Wilkawillina Limestone about point b and further north in the vicinity of Brachina Gorge is extremely rich in archaeocyathids. Southward, nearer the fault, brachiopods become very abundant. In Bunyeroo Gorge archaeocyathids are relatively less common and brachiopods and trilobite fragments are the important fossils at the top of the unit. The faunal assemblages have not been determined for the sections north and south of the fault so that two interpretations are possible.

1. *Archaeocyatha* were abundant north of the fault (point b) prior to the development of the Parara Limestone and Oraparinna Shale, but then deposition ceased in this area until the basal member of the Billy Creek Formation (Fig. 3, e) was deposited.

2. The lateral equivalents of the Parara Limestone and Oraparinna Shale are represented north of the fault by a slowly accumulated biostromal archaeocyathid development.

This situation exemplifies the problem of interpreting geological events without the evidence provided by fossils, which in this area, are abundant but unstudied.

GEOLOGICAL HISTORY

Conditions in the Adelaide Geosyncline during deposition of the upper part of the Wilpena Group (late Marinoan) appear to have been generally marine, with thinly-bedded silts and marls deposited. Prior to the Cambrian, rejuvenated erosion and marine regression resulted in widespread deltaic and shallow marine conditions over the area of the present Ranges (Pound Quartzite) and on the Stuart Shelf to the west of Lake Torrens broad areas were covered by clastics of the Tent Hill Formation.

A fairly clearly defined sedimentary change related to renewed transgression occurred at the base of the Hawker Group. A littoral or shallow marine sandstone with scattered pebbles at the base and abundant vertical burrows was deposited over a wide area (Parachilna Formation). This development is absent from the southern part of the Bunkers Range and the Cambrian limestones lie disconformably on the lower member of the Pound Quartzite. On the shelf area near Andamooka, Segnit (1939) described transgressive relationships at the base of the carbonates.

Over the greater part of the area discussed the Cambrian carbonate followed transitionally the arenaceous units. Dolomitic limestones were developed on the stable shelf in the main transgressive phase and oolitic and algal beds were common. In the middle part of the Lower Cambrian clean limestones and archaeocyathid biostromes were widespread but were less well developed in the basinal zone to the north-east.

Subsidence adjacent to minor faults resulted in limited thicknesses of thin-bedded limestones on the stable shelf (Parara Limestone) but limestones of the same character accumulated to thicknesses as great as 5,000 ft. in the unstable zones. Adjacent to the hinge line above the Wirrealpa Diapir (Fig. 2, 7) these basinal limestones interdigitated with sandy units (Bunkers Sandstone).

In the upper part of the Lower Cambrian green silts and shales (Oraparinna Shale) overlapped the thin developments of Parara Limestone in the central Flinders Ranges on to the clean shelf limestones. Deposition may have ceased locally in the western and central provinces, but clean biostromal limestones continued to form slowly in local areas, e.g. south of Ten Mile Creek and possibly near Brachina.

Close to the hinge line at the Wirrealpa Diapir silty interbeds developed in the shales and more rapid deposition occurred immediately to the north. A clastic unit several thousand feet in thickness (Narina Greywacke) was deposited in the main basin area during an interval of non-deposition over much of the central Flinders Ranges.

Following deposition of the Hawker Group, the red argillites of the Billy Creek Formation appear to represent a mud flat environment with occasional incursions of the sea, indicating regression with large supplies of fine terrigenous clastics. Very small scale oscillation ripple marks, halite pseudomorphs and raindrop impressions are environmental indicators. The last phase of deposition in this unit is more arenaceous with cross-bedding, suggesting a deltaic environment. Thin tuffaceous bands in the lower part of the Formation may be related to vulcanism in the province to the east.

Shallow marine transgression over a broad stable shelf resulted in the Middle Cambrian Wirrealpa and Aroona Creek Limestones, which were clearly continuous over much of the northern and central Flinders Ranges. The basal unit may have been a chemical precipitate of an enclosed basin but the trilobite breccias, brachiopod-rich bands and rubbly limestones of the upper part of the unit in the central areas, suggest open, shallow water environments.

The Middle Cambrian marine beds and the underlying Billy Creek Formation have generally been removed by erosion from the areas of thicker deposition but both units are considered to have been widely distributed.

The environment of deposition of the Lake Frome Group alternated between deltaic, enclosed basin and terrestrial conditions and these must be regarded as the final phases of deposition in the Adelaide Geosyncline. The Lake Frome Group is known in only four areas, but it is clear that the lower units at least extended without lithological change across the present Flinders Ranges.

The broad folding and final movements of the larger faults of the Flinders Ranges are presumed to have taken place in the late Cambrian and Ordovician. There is no evidence of diapirism within the Ranges later than the upper Lower Cambrian, the only evidence of later movements being provided by the infolded Triassic coal basins.

The present topography of the Ranges is regarded as due to broad arching during the Tertiary and Quaternary which has resulted in the young dissected gravels of the Range margins and the shallow dipping duricrusted sands which dip under the Lake Frome and Torrens Plains in the latitude of Blinman.

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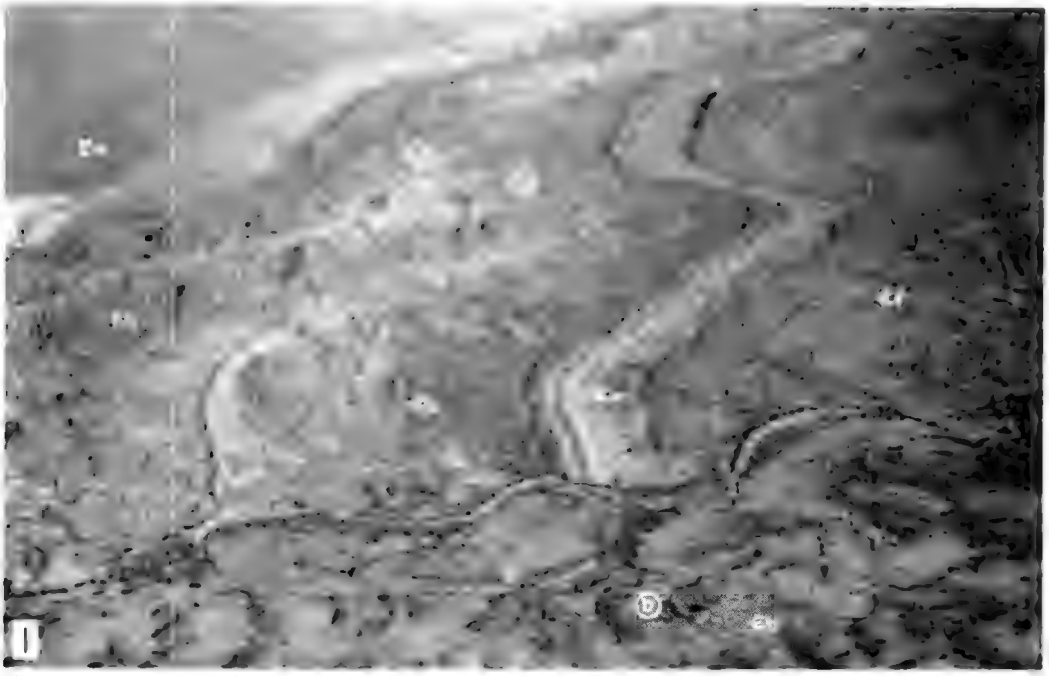

Fig. 1. A. View north over Ten Mile Creek and the Bunkers Range. Points b, c and d refer to Fig. 3. Photo H. Wopfner. Pw Wilpena Group, Ch Hawker Group, Cb Billy Creek Formation, Cw Wirrealpa Limestone, Cf Lake Frome Group.

Fig. 2. B. View south over the zone of interfingering of the formations of the graben with the *Archaeocyatha* biostrome at point b (Fig. 3 and above). Pw Wilpena Group, Chw Wilkawillina Lst., Chp Parara Lst., Chb Bunkers Ss., Cho Oraparinna Shale, Cb Billy Creek Formation.

THE LARVAE OF AUSTRALIAN *CYBISTER* SPP. CURT., *HOMOEODYTES* SPP. REG. AND *HYDERODES SHUCKARDI* HOPE. (COLEOPTERA : DYTISCIDAE.)

BY C. H. S. WATTS

Summary

The larval stages of Cybister tripunctatus (Oliv.), C. godeffroyi Weh., *Homoeodytes atratus* (Fab.) and *Hyderodes shuckardi.* Hope are described. The larvae of Homoeodytes scutellaris (Germ.) are redescribed in greater detail than in the original description.

Descriptions of all instars except the first of H. atratus are included.

THE LARVAE OF AUSTRALIAN *CYBISTER* spp. Curt., *HOMOEODYTES* spp. Reg. AND *HYDERODES SHUCKARDI* Hope. (COLEOPTERA : DYTISCIDAE.)

By C. H. S. Watts*

(*Communicated by I. M. Thomas*)

[Read 13 August 1964]

SUMMARY

The larval stages of *Cybister tripunctatus* (Oliv.); *C. godeffroyi* Wch., *Homoeodytes atratus* (Fab.) and *Hyderodes shuckardi* Hope are described. The larvae of *Homoeodytes scutellaris* (Germ.) are redescribed in greater detail than in the original description.

Descriptions of all instars except the first of *H. atratus* are included.

During a recent trip through Eastern and Northern Australia, I collected several large Dytiscid larvae belonging to the Cybisterini. Among them were two specimens of a *Homoeodytes* Reg. other than *H. scutellaris* (Germ.) the larva of which is known (Watts, 1963). As *H. atratus* (Fab.) is the only other species of this genus in Australia and an adult specimen was taken at the same time as the larvae, it seems certain that these larvae belong to *H. atratus*. The collection also contained larvae of two species of *Cybister* Curt., one of which, *C. tripunctatus* (Oliv.) was identified by breeding out the adult. Larvae of the other species have been assigned to *C. godeffroyi* Wch., the only other *Cybister*, other than the following, recorded from Australia. Blackburn, in 1888, described a *Cybister* under the name of *C. granulatus*. I have seen the co-type and specimens identified by Blackburn in the S.A. Museum and consider that they represent the more granulated forms of *C. tripunctatus*, there being an unbroken gradient from smooth to rough elytra in this species. In addition, the larvae in question are much larger than those of *C. tripunctatus* which is the same size as *C. granulatus*.

Xambeu (1904) described a larva from Madagascar under the name of *C. tripunctatus*. The description of the colour does not match that of Australian specimens and the fact that the size of the larva he described was a great deal larger than the true *C. tripunctatus* (length 80 mm as against 57 mm) indicates that he was mistaken in assigning his larva (which he did not rear) to this species.

In September, 1962, I visited a pool in a slowly flowing creek at Williamstown, S.A., and found it to contain a large number of Dytiscini larvae. Several of the larger larvae were bred out and proved, as expected, to belong to *Hyderodes shuckardi*† Hope. A month later I made a trip to the same pool in an attempt to collect adults. However, no specimens of any stage were found. As it was hardly likely that all the larvae present one month earlier had pupated, many being first instars, it seems likely that the whole population had been

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† Dr. H. Bertrand has pointed out to me the existence of a previous description of the 3rd instar of *H. shuckardi* cf. Bertrand, 1932.

destroyed in the meantime. Further trips also produced no specimens, nor had I taken the species there on numerous previous occasions stretching back over two years.

This paper contains descriptions of the larvae of the above four species as well as a redescription of those of *H. scutellaris* made desirable by the discovery of the larvae of closely related species. *Hyderodes* Hope is endemic to Australia: *H. shuckardi* is found in S.E. Australia, Tasmania (Sharp, 1882) and S.W. Australia (Regimbart, 1908), although the latter reference might in reality be to *H. crassus* Sharp. Two other species, *H. crassus* and *H. collaris* Sharp, have been described from N.W. Australia, but are very rare in collections. *C. godeffroyi* occurs in the wetter areas of N. Australia; *C. tripunctatus* occurs through most of Australia apart from the more southern areas, having outside Australia a wide distribution through S.E. Asia, India, Africa and occasionally S. Europe. *H. scutellaris* is common in southern Australia including Tasmania; *H. atratus* is more tropical in distribution, occurring in the coastal regions of Queensland and northern Australia. The only other species of the genus *H. hookeri* (Wh.) occurs, together with the introduced *H. scutellaris*, in New Zealand.

In identifying the larvae of *Cybister* and *Homoeodytes* it is helpful to know the instars of the specimens involved. A good clue to this is the relative lengths of the third and fourth joints of the labial palpi: in the 3rd instar the fourth joint is the smaller, in the 2nd instar it is either a little longer or roughly equal to the third joint, and in the 1st instar the fourth is the greater. Furthermore, 1st instar larvae can be separated from older instars by the lack of a row of setae behind the ocular area and also by the lack of ventral spines on the posterior adbominal segments present in older instars, although often few in 2nd instar larvae.

In my key to the larvae of Australian Dytiscids (Watts, 1963) *Hyderodes* is not included. It will run to *Hydaticus* Leach from which it can be distinguished by the lack of a ligula and the presence of swimming hairs on the cerci.

Cybister tripunctatus (Oliv.)

3rd Instar Larvae

Chitinous areas testaceous, spotted with black, tips of antennae darker. Terga with H-shaped darker markings one on either side of the middle. Dorsal membranous areas with small blotches of dark grey. Underside pale grey, in some specimens dotted with dark grey, especially on more posterior segments. Pale medial stripes down dorsal surface of abdomen present in some specimens. This colour pattern is not well developed in all specimens.

Head nearly as wide as long with a well-marked neck region, dorsal sutures straight, meeting just in front of centre. Front of clypeus trilobed: the two lateral lobes wide with outer edges slightly convex especially near the sides,

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Line indicates 1 mm. (1) Head of 2nd instar *Homoeodytes scutellaris*. (2) Ditto, *H. atratus*. (3) Ditto, *Hyderodes shuckardi*. (4) Clypeus, 1st instar *Cybister godeffroyi*. (5) Ditto, 1st form of 2nd instar. (6) Ditto, 2nd form. (7) Ditto, 3rd instar. (8) Clypeus, 1st instar *C. tripunctatus*. (9) Ditto, 2nd instar. (10) Ditto, 3rd instar. (11) Clypeus, 2nd instar *H. atratus*. (12) Tip of last abdominal segment 2nd instar, *H. scutellaris* (ventral). (13) Ditto, *C. tripunctatus*. (14) Dorsal view last abdominal segment, *Hyderodes shuckardi* (swimming hairs omitted). (15) Tarsal claw of fore leg of 3rd instar, *H. shuckardi*. (16) Labium, 3rd instar, *H. shuckardi*. (17) Antenna, 3rd instar, *H. shuckardi*. (18) *H. shuckardi*, maxilla. (19) Mandible, 3rd instar, *C. tripunctatus*. (20) Ditto, *H. scutellaris*.

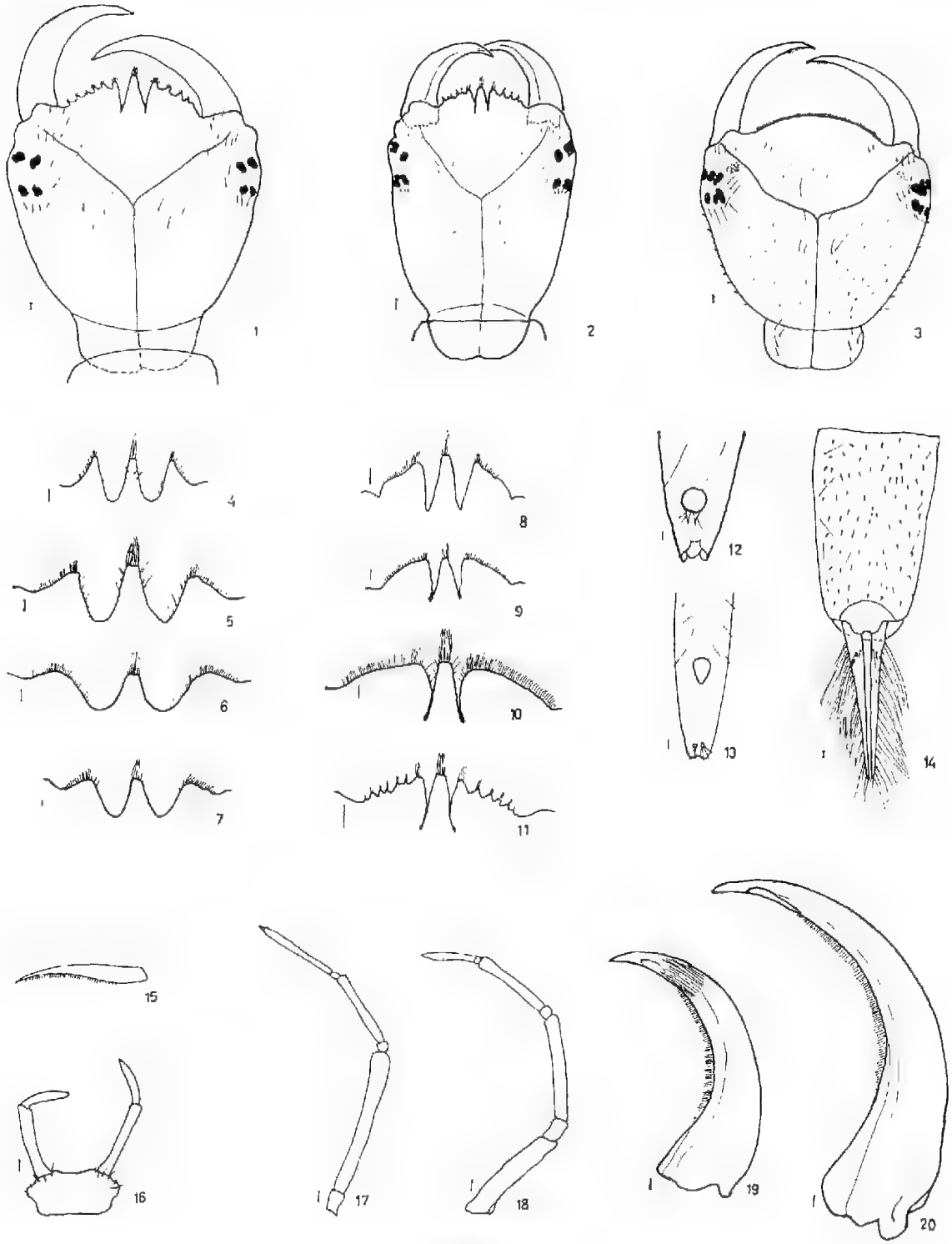

PLATE 1

inner edges convex and for the most part touching the sides of the middle lobe which is in the form of a narrow triangle, truncate at the top, which projects slightly in front of the lateral lobes. The front edges of these and the top of the middle lobe are fringed with short setae, those of the middle lobe nearly twice the length of the others. There are a few stouter setae along the front of the inner edges of the lateral lobes where they do not touch the middle lobe.

Mandibles rather stout, outer and inner edges evenly curved, top quarter dark and devoid of setae. Just below this mandible girdled with dense long setae which cover a good half of apical quarter. There is a rather thick row of small setae along the inner edge of the middle two quarters of the mandible. Rest of mandible bare.

Antennae, maxillae and labial palpi as in Figs. 47, 23, 35.

Labrum strongly bilobed, front much wider than back and with a small but prominent ligula.

Prothorax 2·3 times the length of the mesothorax which is a little longer than the metathorax.

Abdominal segments 7 and 8 with swimming hairs. Segment 8 narrowing towards apex, its ventral surface with scattered long setae and numerous short spines loosely grouped around the base. Segment 7 parallel-sided and about half the length of the 8th, its ventral surface with many very short spines and a few long setae. Circi reduced to small lobes, each with four long setae and placed close to the tip of the segment.

Legs with two rows of long swimming hairs on posterior face; claws simple, very nearly equal in length, the inner one a fraction shorter.

Length 51-57 mm, head capsule 5·3-5·6 mm L., 4·3-4·6 mm W.

2nd Instar Larvae

Colour as in 3rd instar, but dorsal colour pattern less distinct and in some non-existent.

Front of head wider than back with well marked neck region: clypeus as in 3rd instar but with wedge-shaped notches between middle and lateral lobes with acute angles of about 20 degrees. Middle and lateral lobes only touch for a short distance at the bottom of the notches, or, as in a few specimens are completely separate in which case the bottoms of the notches curve slightly outwards. Front of middle lobe only slightly in front of foremost parts of lateral lobes. The few stout setae on the inner edges of the lateral lobes are placed further back than in the 3rd instar.

Mandibles, labrum and ligula as in 3rd instar.

Antennae, maxillae and labial palpi as in figures. There is a variation in the relative lengths of some joints between different specimens but these differences are not great.

Prothorax 2·6 times as long as the mesothorax which is slightly longer than the metathorax.

Abdominal segments and legs as in 3rd instar.

Length, 31-34 mm, head capsule, 3·3-3·4 mm L., 2·5-2·6 mm W.

1st Instar Larvae

Very pale with little or no colour pattern.

Head much narrower at back than front. Lobes of clypeus project further forward than in older instars, notches between lobes slightly wider than in 2nd instar, lateral and middle lobes do not touch. Setae along the outer edge of lateral lobes stouter and sparser than in older instars. Front of middle lobe only a little in front of foremost parts of the lateral lobes.

Top quarter of mandible curved inwards more sharply than rest.

Antennae, maxillae and labial palpi as in Figs. 45, 21, 33.

Labrum and ligula as in older instars.

Prothorax twice the length of the mesothorax, which is about the same length as the metathorax.

Abdominal segment 7 narrow, segment 8 narrow and parallel-sided for most of its length. Both segments lack the ventral spines of older instars.

Legs relatively longer than in older instars and with swimming hairs not as well developed, claws equal.

Length, 19-22 mm, head capsule, 2·0-2·3 mm L., 1·5-1·6 mm W.

Larvae collected from a temporary billabong, Home Hill, Q., April, 1963; a grassy temporary pool, Malanda, Q., April, 1963; a swamp, Townsville, Q., April, 1963; a temporary pool, Darwin, N.T., May, 1963.

Cybister godeffroyi Wehncke

3rd Instar Larvae

Chitinous parts testaceous, top quarter of mandibles black, membranous areas paler, conspicuous pale stripe down centre of dorsal surface behind head bordered with dark stripes on pro meso and metanotum and terga, dark lines on terga double in some cases. Body covered to varying degrees with small rings of darker colour. Underside paler. Antero-lateral angles of head marginally black in one specimen.

Head a little longer than wide with well marked neck region, dorsal sutures straight, meeting just forward of centre.

Mandibles as in *C. tripunctatus* but with top quarter curving inwards to a slightly greater degree than the rest of the mandible. Front of clypeus trilobed, two lateral lobes with short, slightly convex outer edges and longer, very slightly concave inner edges. Middle lobe narrowly triangular and separated from lateral lobes by wide V-shaped notches rounded at the bottoms. Posterior edges of all three lobes in line. Outer edges of lateral lobes and truncate top of middle lobe with thick stout setae, those of the middle lobe about twice the length of the others. There are a few setae on the inner edges of the lateral lobes.

Antennae, maxillae and labial palpi as in Figs. 50, 32, 26.

Labrum strongly bilobed, front much wider than back and with a small but prominent ligula.

Prothorax about twice the length of the mesothorax which is about the same length as the metathorax. Anterior half of prothorax parallel-sided, posterior half widening towards back.

Abdominal segments 7 and 8 with swimming hairs. Segment 8 narrow, parallel-sided for most of its length but narrowing at tip, its ventral surface with scattered long setae and short spines which are restricted to the basal portion. Segment 7 widest at anterior end and about two-thirds the length of the 8th, its ventral surface with scattered stout spines and long setae. Circi squarish, very small, each with four long setae and placed close to the tip of the last segment.

Legs relatively short, with swimming hairs; claws simple and of a very nearly equal length—the posterior claws of front tarsi a little shorter than anterior ones.

Length, 72-85 mm, head capsule 7·8 mm L., 6·1-7·0 mm W.

The second of my two specimens has the lateral lobes of the clypeus more rounded and the base of the middle lobe wider than the one described above, giving a shallower and more rounded outline to the notches. The setae on the anterior edges of the lateral lobes continue down the inner edges gradually becoming sparser towards the base of the notch.

2nd Instar Larvae.

Colour as in 3rd instar, but with pattern less distinct.

Head as in 3rd instar, mandibles with the tip more noticeably narrower than the rest. Clypeus with lateral lobes triangular, their bases about twice the width of the base of the middle lobe, each lobe with a truncate tip which bears a dense tuft of setae. Setae on middle lobe twice the length of those on the others. Outer edges of lateral lobes with a relatively sparse row of setae, their inner edges with a few setae. Notches between lobes rounded at bottom.

Antennae, maxillae and labial palpi as in Figs. 49, 31, 25.

Labrum and ligula as in 3rd instar.

Prothorax shaped as in 3rd instar, about twice the length of the mesothorax which is a little longer than the metathorax.

Segment 7 of the abdomen a little over half the length of segment 8. Ventral surfaces of these segments with numerous long setae but few, if any, spines.

Legs as in 3rd instar.

Length, 42 mm L., head capsule, 5·0 mm L., 3·7 mm W. (from one specimen only).

Again the clypeus of my two specimens differ, the second form has the clypeus similar to the second form of the 3rd instar.

1st Instar Larvae

Head more elongate. Mandibles with top quarter more strongly curved inwards and much narrower than rest and with inner edge of central portion

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Line indicates ·1 mm. (21) Maxilla, 1st instar *Cybister tripunctatus*. (22) Ditto, 2nd instar (23) Ditto, 3rd instar. (24) Labial palpus, 1st instar *C. godeffroyi*. (25) Ditto, 2nd instar. (26) Ditto, 3rd instar. (27) Maxilla, 1st instar *H. scutellaris*. (28) Ditto, 2nd instar. (29) Ditto, 3rd instar. (30) Maxilla, 1st instar *C. godeffroyi*. (31) Ditto, 2nd instar. (32) Ditto, 3rd instar. (33) Labial palpus, 1st instar *C. tripunctatus*. (34) Ditto, 2nd instar. (35) Ditto, 3rd instar. (36) Labial palpus, 2nd instar *H. atratus*. (37) Antenna, 1st instar *H. scutellaris*. (38) Ditto, 2nd instar. (39) Ditto, 3rd instar. (40) Labial palpus, 1st instar *H. scutellaris*. (41) Ditto, 2nd instar. (42) Ditto, 3rd instar. (43) Antenna, 2nd instar *H. atratus*. (44) Ditto, maxilla. (45) Antenna, 1st instar *C. tripunctatus*. (46) Ditto, 2nd instar. (47) Ditto, 3rd instar. (48) Antenna, 1st instar *C. godeffroyi*. (49) Ditto, 2nd instar. (50) Ditto, 3rd instar.

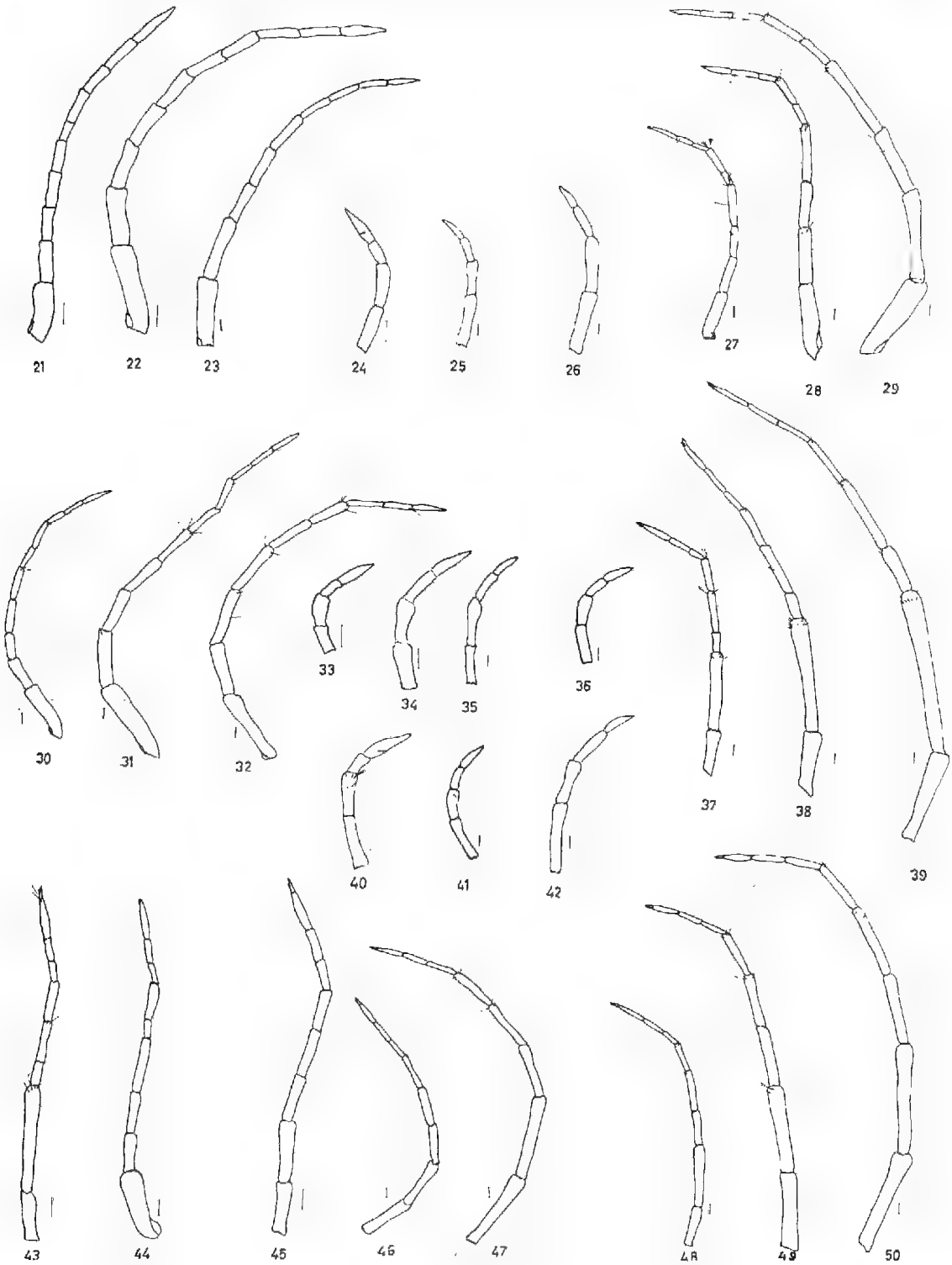
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PLATE 2

a little sinuate. Clypeus with all lobes triangular, lateral lobes wider than central lobe and with their inner edges much longer than their outer. Fronts of all lobes truncate and bearing thick tufts of setae, those on the central lobe about twice the length of the others. Outer edges of lateral lobes with a sparse row of setae, inner edges with a few small fine setae.

Antennae, maxillae and labial palpi as in Figs. 48, 30, 24.

Labrum and ligula as in older instars.

Prothorax shaped as in older instars, twice the length of the mesothorax which is a little longer than the metathorax.

Abdominal segment 8 about twice the length of segment 7, both lacking ventral spines. Cerci as in older instars.

Legs relatively longer than in older instars and with sparser swimming hairs.

Length, 29 mm, head capsule 2·5-2·6 mm L., 2·3-2·4 mm W.

Larvae (two 3rd, two 2nd and several 1st instars) collected from swamps at Home Hill and Townsville, Q., April, 1963.

Larvae of this species are best separated from those of *C. tripunctatus* by their larger size and the different shape of the clypeus after having first determined the instars by means of characters mentioned in the introduction.

Homocodytes Reg.

The dentate lateral lobes of the clypeus effectively separate *Homocodytes* from the Australian *Cybister*. However, Bertrand (1922) has illustrated a supposedly *Cybister* larva from Madagascar that has the lateral lobes slightly dentate, but not to the same extent as in *Homocodytes*. The cerci are not as reduced, although those of *H. atratus* approach those of *Cybister* and they are placed much farther forward than in *Cybister*. The neck is short and is sunk into the prothorax, whereas in *Cybister* it is longer and is not covered by the prothorax. The mandibles lack the apical girdle of setae found in *Cybister*. (In a previous paper (Watts, 1963) before I had seen specimens of *Cybister* I gave as a distinguishing character the length of the ligula which in fact does not differ much between the genera.)

Redescription of H. scutellaris (Hope).

3rd Instar Larvae

Body grey-brown, head and thorax reddish-brown, black stripes on either side of body, especially noticeable on the thorax.

Head roundish, as long as wide with a short neck region which is covered by prothorax. Dorsal sutures straight and meeting in centre of head. Clypeus trilobed, lateral lobes strongly dentate. Number of teeth variable, from 13 to 18 and often asymmetrically arranged. Lateral lobes well separate from the narrow triangular-shaped middle lobe. Tips of teeth and top of middle lobe with long setae. Mandibles slender and evenly curved with very short setae along inner edge except for basal and apical quarters.

Antennae, maxillae and labial palpi as in Figs. 39, 29, 42.

Labium bilobed, front much wider than back, with a small ligula.

Prothorax 2·6 times the length of the mesothorax, which is about the same length as the metathorax. Anterior half of prothorax parallel-sided, posterior half widening towards back.

Abdominal segments 7 and 8 with swimming hairs, segment 7 with sides roughly parallel, its ventral surface with numerous small spines and some long setae. Segment 8 tapering towards apex and a little less than twice length of segment 7, its ventral surface with scattered long setae and a large number of short spines together with some long fine setae near its base. (The ventral spines are very small and are often missing; however, the integument near their point of attachment is darkly pigmented in a roughly oval shape which serves to indicate the position of the spines and also the longer setae.) Cerci very small, narrowly conical in shape with four setae near their tips and placed a little nearer anus than tip of segment.

Legs with two rows of swimming hairs on posterior face; claws simple, approximately equal in length.

Length 45-55 mm, head capsule 5·0-5·7 mm L., 6·0-6·3 mm W.

2nd Instar Larvae

Colour as in 3rd instar but dorsal pattern much less marked. Head and clypeus as in 3rd instar except that the clypeus has fewer teeth. Mandibles as in 3rd instar, but with apical quarter much narrower than the rest.

Antennae, maxillae and labial palpi as in Figs. 38, 28, 41.

Labium and ligula as in 3rd instar.

Prothorax shaped as in 3rd instar, 3·2 times the length of the mesothorax which is a little longer than the metathorax.

Abdominal segments 7 and 8 as in 3rd instar except that the ventral spines are a little longer.

Legs as in 3rd instar.

Length, 30-34 mm, head capsule 4·1-4·2 mm L., 3·6-3·7 mm W.

1st Instar Larvae

Pale, almost without markings.

Head more triangular in shape than in older instars. Row of prominent setae behind the ocular area present in older instars absent. Mandibles and clypeus as in 2nd instar.

Antennae, maxillae and labial palpi as in Figs. 37, 27, 40.

Prothorax shaped as in older instars, about twice as long as the mesothorax which is about the same length as the metathorax.

Abdominal segments 7 and 8 as in older instars except that they lack ventral spines and have the cerci placed relatively nearer the anus.

Legs, labrum and ligula as in older instars.

Length, 23-24 mm, head capsule 2·3-2·6 mm L., 2·3-2·4 mm W.

Larvae collected from a weedy creek, Canberra, January, 1961; a weedy pool, Melbourne, December, 1961 Lake Boga, Vic., January, 1961; and a swamp, Mannum, S.A., September, 1961.

H. atratus (Fab.)

3rd Instar Larva

Testaceous; terga and dorsal surface of head and thorax covered with darker dots and small blotches. Rest of dorsal surface with an extensive dark latticework giving it a dark brown appearance. Sides of thorax and abdomen lighter in colour. Ventral surface pale grey.

Head nearly rectangular being only a little narrower at base, neck short and sunk into prothorax. Anterior dorsal sutures slightly curved and meeting straight medial suture a little in front of centre of head. Clypeus trilobed, lateral lobes dentate, each tooth with a tuft of setae at its tip. (The number of teeth in *H. scutellaris* is very variable and the same is probably true of this species, my one specimen of this instar having four on the right lobe and six on the left.) Middle lobe narrowly triangular in shape with lateral lobes touching it along its basal half. Row of large setae behind ocular area. Mandibles stout, top quarter more strongly curved inwards than the rest, central portion of inner edge straight. The mandibles of the specimen are abraded of most setae.

Antennae and maxillary palpi missing. Maxillary stipes long and without galea. Labium moderately bilobed with a small cone-shaped ligula. Labial palpi with last joints missing, relative lengths of others $1 > 2 > 3$.

Prothorax a little less than three times the length of the mesothorax which is a little longer than the metathorax. Anterior half of prothorax narrow and cylindrical, posterior half widening towards middle.

Abdominal segments 7 and 8 with swimming hairs. Segment 7 narrower at back than front and with its ventral surface sparsely covered with small spines and longer setae (see note under *H. scutellaris*). Segment 8 about twice the length of segment 7, tapering towards apex, its ventral surface with scattered long setae, especially along the sides, and numerous small spines near the base. Cerci reduced to small, widely triangular knobs with a few long setae and placed half-way between anus and end of segment.

Legs with two rows of swimming hairs on posterior face; claws simple, approximately equal in length.

Length, 35 mm, head capsule 3·8 mm L., 2·5 mm W.

2nd Instar Larva

Paler than 3rd instar, with dark latticework absent in my one specimen.

Head as in 3rd instar with neck region within prothorax, clypeus with inner edges of lateral lobes touching edges of middle lobe for a little less than half its length. Specimen has seven teeth on left lobe, six on right lobe, with both lobes having two very small teeth, with a few setae, at their lateral edges. Mandibles as in 3rd instar with all but their apical quarter with fine setae along the inner edge.

Antennae, maxillae and labial palpi as in Figs. 43, 44, 36.

Labrum and ligula as in 3rd instar.

Prothorax shaped as in 3rd instar, about twice the length of the mesothorax which is a little longer than metathorax.

Abdominal segment 7 a little more than half the length of segment 8 and more or less parallel-sided; otherwise these two segments as in 3rd instar.

Legs as in 3rd instar.

Length 29 mm, head capsule 2·4 mm L., 1·7 mm W.

1st instar larva as yet unknown.

Two specimens collected from a temporary billabong at Home Hill, Q., April, 1963.

Larvae of this species can be separated from those of *H. scutellaris* by their more reduced cerci, their narrow elongated head and the fact that the lateral lobes of the clypeus touch the middle lobe. There is a possibility that I have assigned these two specimens to the wrong instars: they may prove to be the 1st and 2nd instars.

Hyderodes Hope

This genus is most closely related to *Dytiscus* L. of the Northern Hemisphere, the two forming a well-marked tribe, the larvae characterised by their entire clypeus, cerci and abdominal segments 7 and 8 with swimming hairs, and the lack of a ligula. The larvae of *Hyderodes* differ from those of *Dytiscus* most noticeably in the following characters: *Hyderodes* has temporal spines (except in the 1st instar), spines on the ventral surface of the head, two rows of short spines along the bottom edge of claws and has no row of long setae on the inner edge of the cerci. (In many species of *Dytiscus* the number of setae on the inner edge of the cerci are reduced to only two apical ones in 1st instar larvae.)

H. shuckardi Hope

3rd Instar Larvae

Testaceous, chitinous areas with numerous small black dots, integument greyish without spots.

Head as wide as long, anterior dorsal sutures curved and meeting straight medial suture in front of middle of head. Front of clypeus complete, with a thick row of short blunt setae along front edge. A greatly pigmented area on dorsal surface, twice the size of an ocellus, just inwards from ocular area. Temporal spines present, stout spines on underside of head. Mandibles slender and curved but with middle portion of inner edge rather straight. Sparse row of setae along this straight portion set a little back from edge on dorsal surface and a thick row of very stout setae along inner edge of mandible except for basal quarter. These setae are often abraded to varying degrees.

Antennae, maxillae and labial palpi as in Figs. 17, 18, 16.

Labrum squat, expanded slightly laterally.

Prothorax a little over twice the length of the mesothorax which is slightly longer than the metathorax.

Abdominal segments 7 and 8 with swimming hairs, segment 8 narrower than 7 but only a little longer. Fine setae along sides of all segments, short spines and long fine setae on ventral surface of abdominal segments 4, 5, 6, 7 and 8, spines more numerous and larger on last two. Cerci stout, about length of second last abdominal segment, fringed with long setae on outer edges and with three long setae on dorsal surface close to the base and two long setae on ventral surface close to the tip. Last abdominal segment slightly produced dorsally behind the cerci.

Legs with swimming hairs, claws unequal, posterior one a little shorter, both with two rows of spines on ventral surface.

Length 30-36 mm, head capsule 5·0-5·5 mm. L., 4·4-5·0 mm W.

2nd Instar Larvae

As in the 3rd instar except that the prothorax is a little less than twice the length of the mesothorax and the spines on the ventral surface of the abdomen are absent but for a few on the last two segments.

Length 22-26 mm, head capsule 3·7-4·0 mm L., 3·1-3·2 mm W.

1st Instar Larvae

Head quite strongly triangular with neck only slightly marked off and lacking temporal spines. Clypeus as in older instars, mandibles with setae only on apical quarter.

Relative lengths of segments of antennae as follows: $1 > 3 > 2 \gg 4$; of maxillary palpi $2 > 3 = 4 \gg 1$, of labial palpi $1 > 2$ which has a roughened ventral surface.

Prothorax shaped as in 3rd instar, about twice the length of the mesothorax which is about the length of the metathorax.

Claws on legs not or only slightly unequal.

Abdominal segment 8 about 1·3 times the length of segment 7. Cerci a little shorter than last abdominal segment. Ventral surfaces of abdominal segments without spines but with long setae that tend to form transverse bands, last segment with only two setae placed near its apex.

Length 14-16 mm, head capsule 2·2-2·5 mm L., 1·7-2·1 mm W.

Larvae collected from a weedy pool, Williamstown, S.A., September, 1962.

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TWO TRICHOSTRONGYLE NEMATODES FROM A MARMOSET

BY PATRICA M. MAWSON

Summary

A number of worms were taken from the small intestine of *Callithrix jucchus,* recently imported (from the Antwerp Zoo) for the Adelaide Zoological Gardens. They were collected and fixed in the Institute of Medical and Veterinary Science (Adelaide) and given to me through the courtesy of Alan W. Banks of that Institute. Mr. Banks noted that in life "the largest worms were red and more or less straight, the smaller ones coiled". The species have been identified us *Molineus elegans* Travassos (the larger) and *Longistriata dubia* Travassos (the coiled), both new records for the marmoset. Travassos noted (1937, p. 77) that these two species occurred together in the common type host, *Saimiri sciurea.*

TWO TRICHOSTRONGYLE NEMATODES FROM A MARMOSET

By Patricia M. Mawson*

[Read 13 August 1964]

SUMMARY

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Molineus elegans Travassos

Fig. 1.

Host and Locality.—Callithrix jacchus, Adelaide Zoological Gardens.

The measurements and appearance of the specimens from the marmoset agree generally with the description of the types, although the position of the cervical groove and the excretory pore, and of the cervical papillae, are more posterior compared to that of the nerve ring and to the length of the oesophagus. The arrangement of these resembles more that in *M. torulosus* (Molin). It is, however, distinguished from *M. torulosus* by the barbed inner branches of the spicules, the longer externo-dorsal ray, the presence of a patch of fine hooks on the inner surface of the lateral lobes of the bursa, and the shorter ovejectors.

Measurements are given in Table 1.

TABLE 1.

Measurements of *Molienus elegans* and *Longistriata dubia* from a marmoset

	Molineus elegans		*Longistriata dubia*	
	♂	♀	♂	♀
Length (mm)	4·0-5·5	4·4-6·9	2·7-2·8	2·9-3·5
Oesophagus (μ)	355-380	370-420	300-340	300-400
Anterior end—nerve ring (μ)	180-210	170-210	180	160-180
—cerv. pap. (μ)	220-240	240-270	250	250-280
—excr. pore (μ)	210-260	210-250	250	250-280
Length ceph. inflation (μ)	50-60	55-70	55-60	50-60
Spicules (μ)	110-130	—	180-190	—
Gubernaculum (μ)	60-70	- -	?20	—
Vulva—posterior end body (μ)	—	0·9-1·2	-	170-250
Tail (sans spike) (μ)	—	80-90	—	60-100
Tail spike (μ)	—	10-15	—	—
Eggs (μ)		45-50 x 25-30	—	70-80 x 40

* University of Adelaide.

Longistriata (*Brevispiculoides*) *dubia* (Travassos)

Fig. 2-5.

Host and Locality.—*Callithrix jacchus*, Adelaide Zoological Gardens.

Longistriata dubia closely resembles *L. argentina* Freitas, Lent and Almeida. The latter has been recorded once, from a rodent, *Holochilus balnearum* (F, L, A 1937, p. 198), the former five times, three records from primates (Travassos, 1921, p. 367, from *Saimiri sciurea*; 1937, p. 329, from *Alouta caraya*; *Cameron*, 1923, p. 71, from *Saimiri sciurea*) and twice from a lagomorph, *Romerolagus diazi* (Bravo Hollis, 1950, p. 114; Aguillar, 1958, p. 45). A proper comparison of the descriptions given by these authors is impossible, as the positions of nerve ring, excretory pore and cervical papillae are not given in all cases. Moreover, I have unfortunately been unable to consult Aguillar's paper. The spicule tips

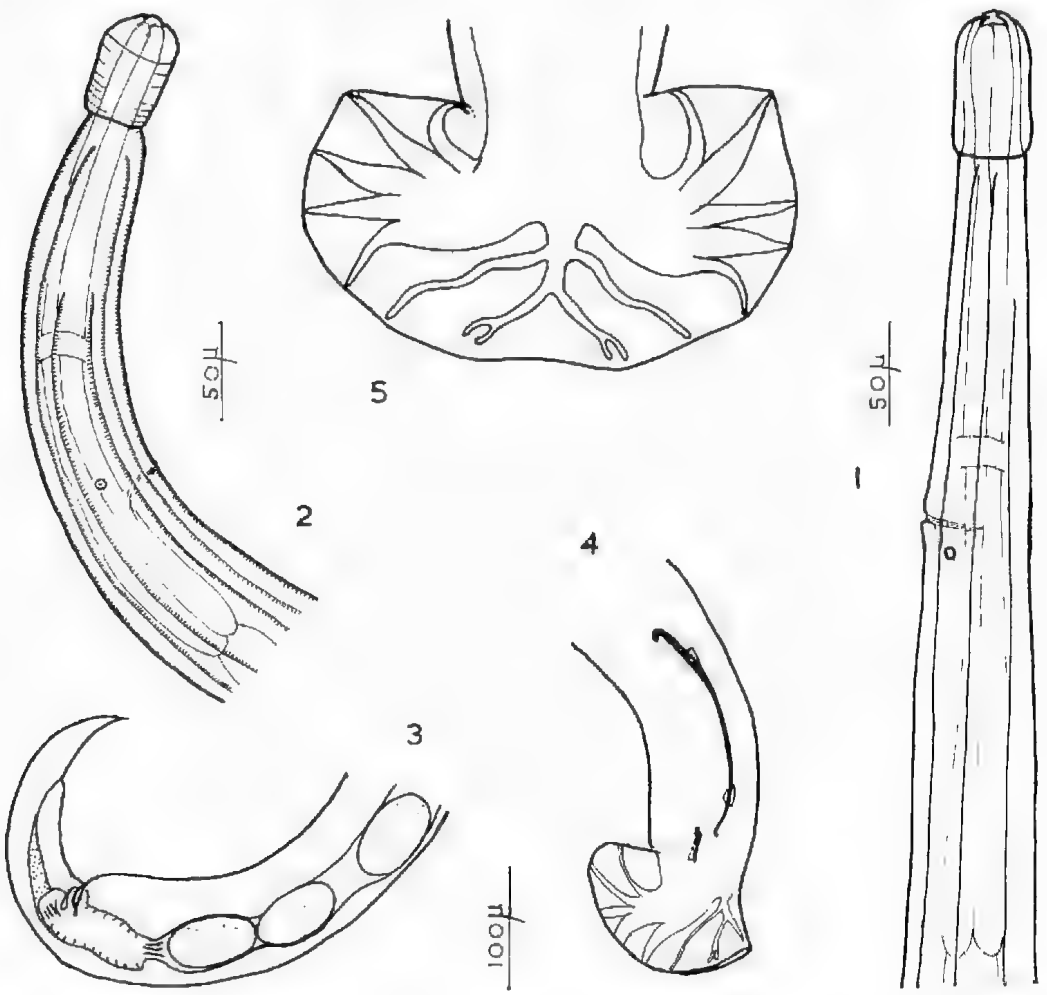

Fig. 1, *Molineus elegans*, oesophageal region. Figs. 2-5. *Longistriata dubia*: 2, oesophageal region; 3, *L. dubia*, tail of female; 4, *L. dubia*, posterior end of male; 5, *L. dubia*, bursa opened out. 1, 2, and 5 to same scale; 3 and 4 to same scale.

are described by Travassos as enlarged and enclosed in a membrane, but are shown by other authors as simple. *L. dubia* of Bravo Hollis is shown with the excretory pore in what seems to be a groove around the body. In the specimens now identified as *L. dubia* no such groove is present. The spicules each end in a tiny hook which in lateral view gives a swollen appearance to the tips. In some male specimens a very lightly chitinised gubernaculum and telamon, absent in *L. dubia*, are visible, as figured for *L. argentina*.

The tail of the female ends in a sharp point, whereas those figured in all records quoted above are rather rounded; the sub-cuticular tissue, however, shows subterminal knobs as figured by Travassos. The eggs are larger in relation to the body width than in other descriptions, but it has been noticed that in *Longistriata* spp. the posterior end of the female enlarges with age.

It is considered that the specimens from the marmoset belong to *L. dubia*. Whether *L. argentina* should be considered a synonym of *L. dubia*, and, if not, whether the specimens identified by Bravo Hollis and by Aguillar belong to *L. dubia* or to *L. argentina*, can only be ascertained by re-examination of the material in question.

Measurements of the specimens from the marmoset are given in Table 1.

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THE PROCESS OF FERTILIZATION IN THE SPINY LOBSTER *JASIJS LALANDEI* (EL MILNE-EDWARDS)

BY D. R. FIELDER

Summary

The mechanism of copulation in Jams lalandei (H. Milne-Edwards) is discussed by comparing the reproductive organs with those of Panulirus cygnus (George). The structure of the fifth pereiopods and thoracic sterna of the female 1. lalandei indicate;; that the deposition of external spermatophores is unlikely. The male genital apertures of 1. lalandei are also not well adapted for depositing external spermatophores as they are in P. cygnus. The introduction of internal therefore the alternative.

An hypothesis is put forward, describing a potential intromittent organ in male J. lalandei to support the assumption of internal fertilization.

THE PROCESS OF FERTILIZATION IN THE SPINY LOBSTER *JASUS LALANDEI* (H. Milne-Edwards)

By D. R. Fielder*

(Communicated by I. M. Thomas)

[Read 13 August 1964]

SUMMARY

The mechanism of copulation in *Jasus lalandei* (H. Milne-Edwards) is discussed by comparing the reproductive organs with those of *Panulirus cygnus* (George). The structure of the fifth pereiopods and thoracic sterna of the female *J. lalandei* indicates that the deposition of external spermatophores is unlikely. The male genital apertures of *J. lalandei* are also not well adapted for depositing external spermatophores as they are in *P. cygnus*. The introduction of internal spermatophores is therefore the alternative.

An hypothesis is put forward, describing a potential intromittent organ in male *J. lalandei* to support the assumption of internal fertilization.

INTRODUCTION

The mechanism of fertilization has been described for several species of *Panulirus; Panulirus interruptus* (Randall), Allen (1916), Lindberg (1955); *Panulirus penicillatus* (Oliver), Matthews (1951); *Panulirus cygnus* (George); Sheard (1949), George (1957); *Panulirus argus* (Latreille), Walton Smith (1959). In each case fertilization occurs in the same manner. The male deposits a putty-like spermatophore on the sternum of the female, posterior to the genital apertures, some time before the eggs are released. The spermatophore, initially soft and light in colour, hardens and turns black. Eggs are said to be fertilized externally by sperm released from the spermatophore by the chela of the fifth legs of the female. However, the method of copulation has not been verified, nor is it known with certainty at what stage of moult copulation occurs.

Von Bonde (1936) described the act of mating for *Jasus lalandei* (H. Milne-Edwards) from observations made on captive animals. He found that the male turns a newly moulted female on her back so that their sterna are closely apposed. His conclusion that fertilization is internal is based on the following statement, that "the spermatophores are extruded and appear to make their way through the female genital apertures and so into the oviducts where fertilization takes place at their upper ends". Since no mention is made of actually finding spermatophores in the oviducts or failing to find them externally it must be taken that the above statement is an assumption.

Initial observation of external genitalia during this present investigation indicated that internal fertilization was difficult mechanically due to their relative positions and difference in size between the sexes. Copulation was not observed during observation of captive animals over three years, precluding direct description. The problem was therefore approached indirectly by comparing the external genitalia of *P. cygnus* from which the process of fertilization is known, with those of *J. lalandei*. From this comparison it was hoped that an hypothesis for the method of fertilization, based on more than assumption, could be erected.

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The Female

(a) *The Fifth Walking Leg*:—The fifth walking legs of *P. cygnus* and *J. lalandei* are compared in Fig. 1. In *P. cygnus* a short, stout arm projects laterally from the base of the dactylopodite, which is capable of closing against a stout extension of the propodite. The dactylopodite therefore forms a strong chela capable of pinching as well as scratching. This chela is used to break the spermatophore and then gouge it open to release sperm. In *J. lalandei* the dactylopodite has no lateral arm and is similar to those of the other walking legs. A spine projects from the distal end of the propodite, which is apposed to the dactylopodite forming a chela. The spine of the propodite is much smaller than the dactylopodite and is attached by a thick membrane of chitin. The chela is therefore not very strong as the spine of the propodite does not form a solid base to the dactylopodite. Such a chela is not suited for pinching or breaking and is probably used to comb and clean the ovigerous setae of the pleopods.

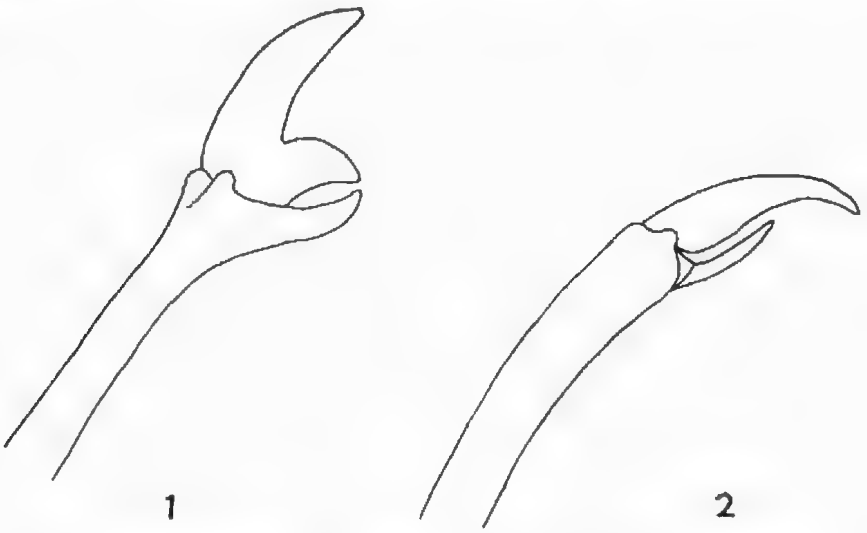

Fig. 1. The fifth chelate pereiopods of (1) *P. cygnus* and (2) *J. lalandei*.

(b) *The Last Two Thoracic Sterna*:—The last two thoracic sterna of *P. cygnus* have a smooth hairless area, presumably for the reception of spermatophores. This area is covered by tufts of short hairs in *J. lalandei* indicating that deposition of an external spermatophore is unlikely.

(c) *The Genital Apertures*:—Both species have similar genital apertures. The rim of the aperture is raised and circular in shape. The actual opening is situated on the inner side and extends as a crescent-like slit around half of the circumference. The remaining area inside the rim is filled with a chitinous membrane, which can be inverted to form a circular opening. This membrane is quite soft and easily inverted in *J. lalandei*, but is inverted with difficulty in *P. cygnus*. The diameter of apertures in mature animals is 2 to 3 mm in *J. lalandei* and 3 to 4 mm in *P. cygnus*.

The Male

The Genital Apertures (Fig. 2):—The genital aperture of *P. cygnus* has the form of an oval saucer. The actual opening to the vas deferens is slit-like and situated on the inner side of the saucer. The remaining area inside the saucer is filled with a chitinous membrane in the form of a loosely coiled tube ending in a spine. The spine is free and the tube is capable of erection. Normally, the tube is coiled so that the spine effectively closes the aperture. The tube is muscular and is probably capable of autonomous movement. Its probable function is to direct the placement of the spermatophore. Movement of the fifth legs moves the aperture in an arc, accounting in part for the bilateral symmetry of the spermatophore. Apertures of mature animals may be more than 13 mm in diameter.

The genital aperture of *J. lalandei* is much smaller than that of *P. cygnus*, being as small as 3 mm in diameter at first maturity. The shape is similar to the female aperture, the actual opening extending in an arc around the inner rim. The chitinous membrane filling the remaining area is folded and shaped to form a tongue-like flap, which normally closes the opening. It is unlikely that such an aperture could extrude a spermatophore similar to that of *P. cygnus*.

It can be seen from comparison of external genitalia that the chelate fifth legs of female *J. lalandei* are poorly adapted to break open external spermatophores. In fact, it is unlikely that external spermatophores could be attached successfully to the sterna of female *J. lalandei*. The soft nature of the female aperture in *J. lalandei* also indicates the possibility of introducing a spermatophore internally.

The large male genital apertures in *P. cygnus* would allow large quantities of spermatophoric material to be extruded. Their construction also allows the spermatophore to be directed over a relatively large area reducing its thickness. A thin spermatophore would be gouged more efficiently than a thick one, with better release of sperm. It is doubtful whether the smaller size of the male genital aperture in *J. lalandei* would allow the large amount of material necessary to form an external spermatophore to be extruded.

Most aspects of the external anatomy of *J. lalandei* indicate poor adaptation for external fertilization. If fertilization is internal, the absence of a long intromittent organ and the small size of the apertures introduces the problem of how males can locate the female aperture for efficient transfer of spermatophores. In an attempt to answer this question, a detailed examination of the male genital aperture was made.

It has been stated that the tongue-like flap of the male genital aperture normally closes the aperture. However, this flap is capable of erection and may project more than 5 mm in large males. This observation introduced the possibility that the flap of male genital apertures could be used to locate female apertures. The validity of this suggestion appeared to lie in the mechanism of erection. The fact that most flaps were observed in the distended condition during breeding seasons indicated they were connected functionally with copulation.

The structure of the male genital aperture was therefore studied from transverse sections. Several male genital apertures were excised with some underlying muscle and a short length of vas deferens, and fixed in Gilson's fluid. The acetic acid of this fixative decalcified the skeleton, which was softened

further with 8 per cent phenol in 75 per cent methyl alcohol. After embedding in paraffin wax, m.p. 58°C., serial transverse sections 15μ thick were cut. Sections were stained with Delafield's haematoxylin (Harris modification) and eosin.

The flap had no muscle-attachment, eliminating the possibility of erection through contraction of muscles. The underlying tissues contained large blood spaces, suggesting the flap was distended by an increase in blood-pressure. It has been suggested by Von Bonde (1936), that mating occurs a few weeks following moulting by the male. Since increase in size at moult is caused primarily by an increase in tissue-fluid it is possible that erection of the flap is a consequence of moulting. Von Bonde also stated that the female moulted a few hours prior to mating. At this stage the skeleton is very soft and the

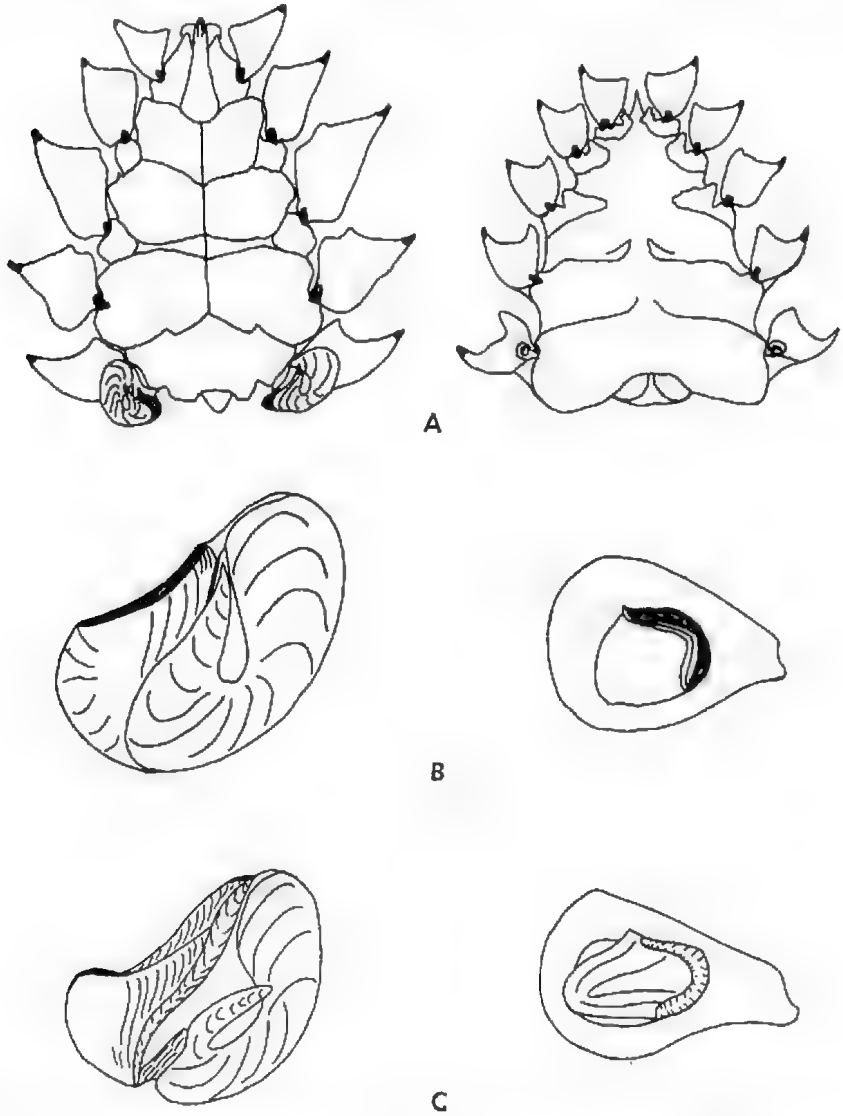

Fig. 2. The male genital apertures of *P. cygnus* and *J. lalandei*. A. Genital atria *in situ*. B. Genital flaps closed. C. Genital flaps open.

chitinous membrane of the female aperture would be inverted easily. This would therefore be the best time for the male to locate the female apertures and maintain its position by insertion of the genital flaps.

Examination of the oviduct failed to reveal a dilatation or sac that could be used as a seminal vesicle. Without such a vesicle it was difficult to see how fertilization could occur in the oviduct. Even allowing for stretching of the oviduct it would be much smaller than the corresponding vas deferens and it is doubtful whether it could hold the same amount of spermatophoric material. It was also difficult to see how sufficient of the spermatophore was retained to fertilize all eggs after ovulation had begun.

It has been stated previously (Fielder, 1964) that the oviduct is lined with high columnar epithelium, which is folded to form villi. In many cases adjacent villi formed sac-like channels. Apart from secreting a lubricating fluid or contributing to the egg-shell, it is difficult to see the significance of villi in the oviduct. One other possible function of villi would be to retain sperm, which would fertilize the eggs as they passed down the oviduct. This could occur only if some of the matrix of the spermatophore was removed and sperm concentrated between the villi of the oviduct. A final comparison was made between the structure of the sperm-mass and vas deferens of *J. lalandei* and *P. penicillatus*. The purpose of this comparison was to determine whether the spermatophore of *J. lalandei* was more likely to be deposited externally or internally. The vas deferens of each species has been described earlier, *J. lalandei* (Fielder, 1964) and *P. penicillatus* (Matthews, 1951). The glands of the proximal vas deferens of *P. penicillatus* secrete a crystalline material, which surrounds the sperm-mass. This walled sperm-mass continues into the large distal portion of the vas deferens. Here it becomes convoluted and embedded in a matrix secreted by a large glandular "typhlosole". Sections through the distal vas deferens show sperm concentrated into a strand contained within the granular spermatophoric wall, the whole embedded in a non-cellular matrix.

The proximal vas deferens of *J. lalandei* does not secrete a granular wall around the sperm-mass, but appears to initiate secretion of a fluid matrix. A distinct strand of sperm is therefore not formed. The resultant spermatophore appearing in the distal vas deferens consists of clumps of sperm embedded in the fluid matrix. A very thin crystalline wall appears to surround the matrix.

Matthews (1951) described the spermatophoric mass of *P. penicillatus* as being putty-like on extrusion. At a similar stage the spermatophoric mass of *J. lalandei* is a sticky, jelly-like mass, which remains discreet in sea-water. It is reasonably fluid and could possibly be introduced into the oviduct. Absence of a crystalline wall around the sperm-mass would allow release of sperm on disintegration of the matrix. Such disintegration of the matrix in the oviduct would allow sperm to be stored between the villi in the oviduct until needed.

It appears on morphological grounds then, that Von Bonde's assumption was correct and that fertilization in *J. lalandei* is internal. Observations of captive animals also indicated that moulting of the female is a prerequisite for mating. Four females moulted between August and October. Although males were present, mating was never observed. In each case, however, the female died within two weeks of moulting without appreciable hardening of the exoskeleton. Post-mortem examination showed that the ovaries were ripe. No sperm were detected in the oviduct or in the ovary. No external spermatophore had been deposited. It must therefore be assumed that mating had not occurred.

The fact that the four animals died without spawning may indicate that mating is a necessary stimulus for spawning and failure to spawn may prove fatal. Lindberg (1955) states that: "It is not known whether eggs will be extruded in the absence of a sperm case, or without mating activity, but it is perhaps significant that only fertilized eggs attach to the swimmerets. The presence, in females not bearing sperm cases, of ripe ovaries late in the breeding season may indicate, in fact, that egg extrusion does not occur in the absence of mating."

DISCUSSION

In the absence of critical observation of mating and extrusion of eggs, three factors appear necessary for successful spawning. These are (1) moulting precedes mating, (2) spermatophores are introduced in the oviducts where fertilization occurs, (3) mating is probably a prerequisite of spawning.

It is unlikely that both genital apertures of the male and female would often coincide during mating. It is also unlikely that eggs are extruded from one genital aperture only. If fertilization does occur in the oviduct, sperm must be present in both oviducts if fertilization is to be complete. Further work is required to determine whether a male is able to control extrusion of spermatophores or whether some sperm is lost by release from both apertures when one does not coincide with a female aperture.

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Dr. R. W. George, Western Australian Museum, supplied specimens of *Panuliris cygnus* for comparison.

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THE IDEINTITY AND ORIGIN OF VARIETIES OF OXALIS PES-CAPRAE L. NATURALIZED IN AUSTRALIA

BY D. R. FIELDER

Summary

A brief account of the distribution of the tristylic species Oxalis pes-caprae L. as a weed is given. Variation within the species is discussed. The widespread weedy variety is described as a short-styled pentaploid *(5%* = 35) clone, other varieties being tetraploid (4% = 28). An account of the history of the short-styled pentaploid variety and the tetraploid varieties in Australia is presented.

THE IDENTITY AND ORIGIN OF VARIETIES OF *OXALIS PES-CAPRAE* L. NATURALIZED IN AUSTRALIA

By P. W. Michael[1]

[Read 13 August 1964]

SUMMARY

A brief account of the distribution of the tristylic species *Oxalis pes-caprae* L. as a weed is given. Variation within the species is discussed. The widespread weedy variety is described as a short-styled pentaploid ($5x = 35$) clone, other varieties being tetraploid ($4x = 28$). An account of the history of the short-styled pentaploid variety and the tetraploid varieties in Australia is presented.

I. INTRODUCTION

Oxalis pes-caprae L., syn. *O. cernua* Thunb.[2] is a serious bulbous weed over thousands of acres in the agricultural areas of South Australia. It is a strong competitor in crops and pastures and a well-known poisonous plant, oxalic acid poisoning in sheep feeding on soursob (*O. pes-caprae*) being first recorded by Bull (1929). It is abundant also in home gardens, vineyards and orchards.

Although it occurs in all Australian States, paddock-size infestations are uncommon, except in South Australia. The most important infestations, outside South Australia, are in the vineyard and orchard areas of Western Australia and in part of the cereal belt of Victoria.

O. pes-caprae occurs as a weed in many other parts of the world, most notably throughout the western coastal regions of the Mediterranean and in the Cape Province of South Africa. Its overall Mediterranean distribution is mentioned by Rikli (1946) and particular references to it as a weed are given by Hildebrand (1884) for Sicily, Morris (1895) for the Canary Islands, Ducellier (1914) and Chevalier (1940) for Algeria, Knoche (1922) for the Balearic Islands, Borg (1927) for Malta and neighbouring islands and by Chabrolin (1934) for Tunisia. Hildebrand (1884) first drew attention to its potentiality as a weed.

It seems certain that *O. pes-caprae* is a native of South Africa (Salter, 1944). Thunberg (1781) noted that it was abundant at the Cape, both in and outside gardens. Later published records in South Africa are uncommon, however, and do not give a satisfactory picture of its significance as a weed. Its major status as a weed in the Cape Province of South Africa was noted by Hughes.[3]

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[1] C.S.I.R.O., Division of Plant Industry, Canberra, A.C.T.

[2] Rappa (1911) recognized that, on grounds of priority, *Oxalis pes-caprae* L. was the valid name of the species, but he preferred to retain the name *O. cernua* Thunb., which had become so widely accepted. Salter (1939) re-established the original name *O. pes-caprae* L.

[3] All references in the text to current observations on *O. pes-caprae* in South Africa are due to Dr. R. D. Hughes, Department of Zoology, Australian National University, who visited South Africa in 1961.

II. VARIATION WITHIN THE SPECIES

Salter (1944) has described *O. pes-caprae* as a variable species in South Africa. Similarly in Australia, different combinations of a number of characters of both flowers and leaflets make for considerable variation. The more important of these characters are:

(i) Sepals – presence or absence of purple markings on upper and/or lower portion; presence or absence of orange or purple apical calli.

(ii) Petals – varying size; varying shades of yellow; reddish or whitish tinge on underside; presence or absence of red mark on distal edge.

(iii) Leaflets – acute or obtuse angle at base; presence or absence of purple markings as flecks, basal crescent and/or line (Fig. 1); reddish or pale green apical mark; reddish or green petiolules.

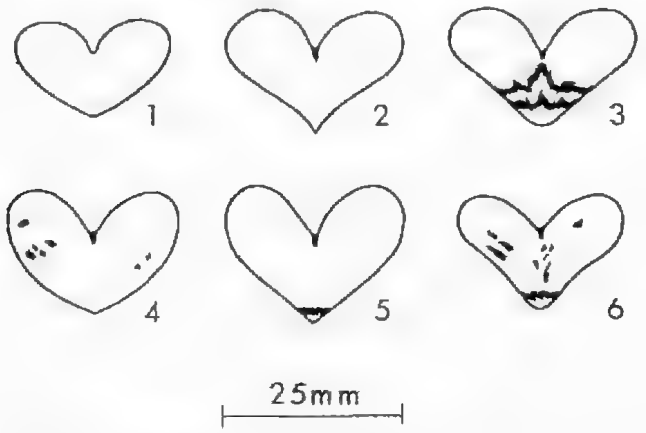

Fig. 1. Variation in leaflets of *Oxalis pes-caprae*. 1. No purple or red markings, obtuse basal angle; 2. red apical mark, acute basal angle; 3. purple basal crescent and line; 4. purple flecks (pentaploid variety, Albany, W.A.); 5. purple basal line (tetraploid variety, Albany, W.A.); 6. purple flecks and basal line (apparent hybrid between (4) and (5), Albany, W.A.).

Double-flowered varieties have long been known in South Africa (Marloth, 1908) and in the Mediterranean regions (Viviani, 1824; Ball, 1878; Morris, 1895; Rappa, 1911; Borg, 1927; Chevalier, 1940), but are rare in Australia.

The flowers of *O. pes-caprae* are tristylic. They are described as short-, mid- and long-styled according to the position of the stigma, whether it is below, between or above the two levels of anthers, respectively (Fig. 2). Fruitful crossing is possible only between plants of different style length (Hildebrand, 1887; Salter, 1944).

Infestations in South Australia and eastern Australia are primarily of a single apparently stable variety, other varieties being uncommon. In Western Australia clonal infestations of a number of varieties including that widespread in South and eastern Australia are quite common. In South Africa variation within the species is more striking although isolated colonies of one variety are reported (Salter, 1944). The principal Australian variety is quite uncommon in South Africa but appears similar to the common Mediterranean form as de-

scribed by Viviani (1824), Willkomm and Lange (1880), Hildebrand (1884), Henslow (1891), Rappa (1911) and Borg (1927).

The widespread Australian and Mediterranean weed is a short-styled variety with large bright sulphur-yellow flowers and orange apical calli on its sepals. Its leaflets are flecked with purple, often with a poorly defined basal purplish crescent. An excellent reproduction of this variety is presented by Loddiges (1826b). It has been shown to be pentaploid ($5_X = 35$) by Vignoli (1937) for Mediterranean material, by Oram (1956) for South Australian material, and by Franklin (pers. comm., 1962) for material collected in Western Australia by the author and in the immediate neighbourhood of Cape Town by Hughes. As far as is known, the pentaploid variety exists in only the short-styled form.

Other varieties, however, have been shown to be tetraploid ($4_X = 28$) by Marks (1956) for South African material supplied by Salter and by Oram (1956) and others at the Genetics Department, University of Adelaide, for South Australian material. These tetraploid varieties freely produce seed provided that different style-length forms are present.

In Australia, natural hybridization between the pentaploid clone and tetraploid varieties of different style length is uncommon. At Albany, Western Australia, in a mixed population of the pentaploid variety and a tetraploid variety with highly coloured sepals and small reddish-tinged flowers, a few plants with obviously intermediate characters were found. Leaflets of both the supposed parent varieties and intermediates are shown in Fig. 1. Phenotypic intermediates have also been observed at Roseworthy Agricultural College, South Australia.

In Australia, leaflets flecked with purple are quite uncommon in varieties other than the pentaploid clone. This flecked character, which is retained in drying is of great value in the identification of this clone, both in the field and in herbarium specimens. But, where mixtures of varieties occur, identification of short-styled plants with flecked leaflets must be made with caution until cytological confirmation is possible or comparative pollen measurements can be made.

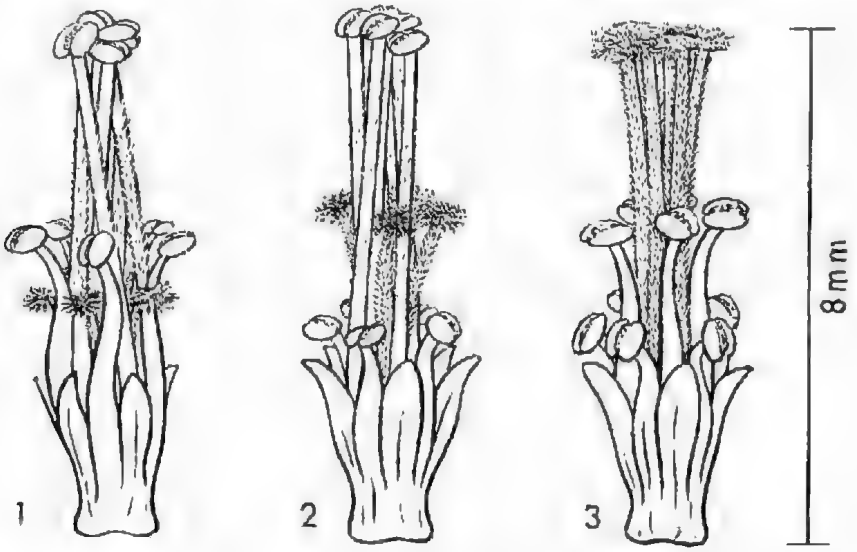

Fig. 2. The three style-length forms of flowers of *Oxalis pes-caprae*. 1 short-styled; 2. mid-styled; 3. long-styled.

The mean size of pollen grains taken from anthers borne on the longer filaments of the pentaploid variety is appreciably greater than that of grains taken from anthers borne on the longer filaments of short- and mid-styled forms of the tetraploid varieties. A comparison between pollen size of South African and Australian pentaploid material on the one hand and tetraploid material on the other is presented in Fig. 3.

III. HISTORY

(1) *The Pentaploid Variety*

One of the earliest references to *O. pes-caprae* in Australia (under the name of *O. cernua*) is in "Catalogue of Plants Cultivated in, and for Sale at the Hackney Nursery, Adelaide, 1845" in "The Adelaide Observer" on the 3rd May, 1845. The Hackney Nursery was established about 1841 by John Bailey, who had been previously employed by Loddiges, nurserymen, at Hackney, London. It is most probable that the plants sold by Bailey were the forerunners of the weed now widespread in South Australia. *O. pes-caprae*, under the name of *O. cernua*, was listed in the catalogue of the Adelaide Botanic Garden in 1859 (Francis, 1859). Schomburgk (1879) first recorded it as a weed in gardens and in wheat crops. Clarke (1934), in a short account of the history of the plant in South Australia, concluded that it probably escaped from cultivation in the early eighteen sixties.

It is probable also that early introductions of this clone to Western Australia came at least partly through the medium of Loddiges. It is known that James Drummond, who arrived in Western Australia in 1829, corresponded with and collected Western Australian plants for them. On his old property, "Hawthornden", near Toodyay settled in 1839, the pentaploid variety of *O. pes-caprae* can still be seen growing around old fruit-trees and ornamentals and has spread downstream to Toodyay where it is abundant. Helms (1897) recorded *O. pes-caprae* under the name of *O. cernua*, as a weed in Western Australia, the earliest specimen in the State Herbarium, Western Australia, being a variety which appears to be the pentaploid clone collected by him in 1895.

Infestations in eastern Australia almost certainly originated from horticultural material. *O. pes-caprae*, under the name of *O. cernua*, was included in the catalogue of plants grown by Sir William Macarthur at Camden, New South Wales, in 1843 (Anon., 1843). Macarthur's list of *Oxalis* species bears a strong resemblance to Loddiges' collection as featured in "The Botanical Cabinet" (Loddiges, 1818-1833), or as listed in their catalogues (for example, Loddiges, 1826a). It was also included in the catalogues of plants grown in the Sydney Botanic Garden in 1857 (Anon., 1857), in the Royal Society's Gardens in Hobart in 1865 (Abbott, 1865) and in the Queensland Botanic Gardens in 1875 (Hill, 1875). Ewart (1907) recorded it as widely spread in Victoria. It must have escaped from cultivation many years earlier, the earliest specimen in the National Herbarium of Victoria being one which appears to be the pentaploid clone, a garden escape, collected in 1885. Although the first Australian record of the naturalization of *Oxalis pes-caprae* (*O. cernua*) given by Spicer (1878) is for Tasmania, the weed is now quite insignificant in that State.

Woolls (1880) recorded *O. pes-caprae*, under the name of *O. cernua*, as being naturalized around Sydney. The pentaploid clone is now common enough in coastal towns of southern New South Wales and in towns of the South-West Slopes and the Riverina. It has rarely become a weed problem outside gardens and cemeteries.

Naturalization of the weed did not take place until much later in Queensland. It was not recorded by Bailey (1909) and, indeed, it is not common in Queensland even now. Its present distribution is given by Everist (1959).

(ii) *The Tetraploid Varieties*

The earliest Australian specimen (in the National Herbarium of New South Wales) of one of these varieties was collected in the Domain, Sydney, about 1902. A mid-styled variety from Western Australia is pictured in Carne and Gardner (1927).

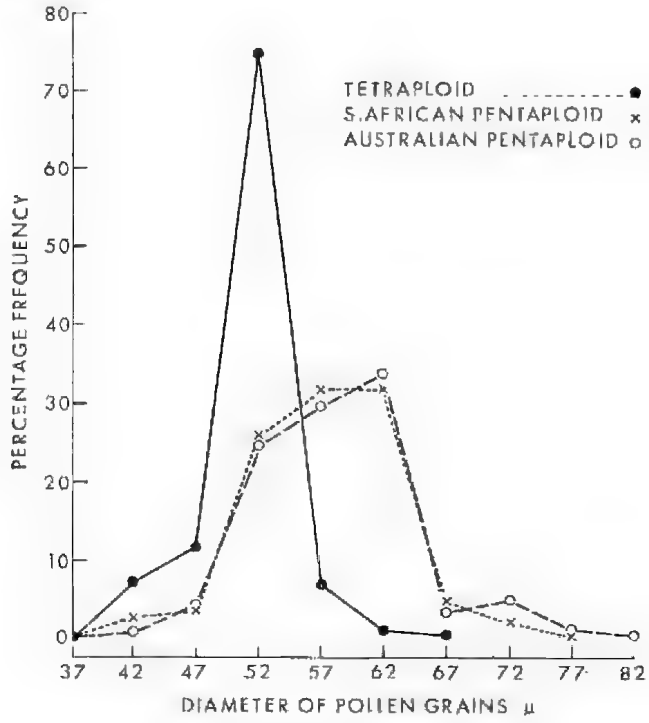

Fig. 3. Frequency distribution of size of pollen grains of tetraploid and pentaploid varieties of *Oxalis pes-caprae.*

The history of these varieties, which are most prevalent in Western Australia, is probably one of independent direct importation, both intentional, for ornamental purposes, and accidental, with vines, from South Africa. Clones of different varieties occur in neighbouring vineyards in the Swan Valley, near Perth, and, for example, in the old settlements of Bunbury, New Norcia and Albany. In Albany, the pentaploid clone is abundant also. Infestations at York in the Avon Valley are of a variety quite distinct from the pentaploid clone present in the neighbouring town of Northam.

Although, in general, these varieties occur clonally in Western Australia—that is, only one style-length form is present—there are many areas in which small populations of mixed varieties occur. Similar mixed populations occur in

South Australia and New South Wales. In such situations, where different style-length forms are present, seed is freely produced.

A mid-styled variety with highly coloured sepals and reddish-backed petals has been found in small patches, here and there, throughout a large part of Victoria. This distribution suggests either that it was sold as an ornamental, or that it was a common contaminant of nursery stock. Indeed, the latter method of spread of this and other species of *Oxalis* is quite prevalent today.

IV. ACKNOWLEDGMENTS

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RECORDS OF NORTHERN TERRITORY PLANTS

BY G. M. CHIPPENDALE

Summary

New or interesting records are given of plant species in the Northern Territory, including some naturalised species and some newly introduced weeds. Modifications to a previous Check List of Central Australian Plants are also included.

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By G. M. Chippendale[a]

[Read 13 August 1964]

SUMMARY

New or interesting records are given of plant species in the Northern Territory, including some naturalised species and some newly introduced weeds. Modifications to a previous Check List of Central Australian Plants are also included.

INTRODUCTION

The present paper is a successor, covering a wider area, to previous papers (Chippendale, 1960, 1961, 1963) which referred only to Central Australia. Collections of plants have extended with greater emphasis on the northern areas of the Northern Territory, and new records are being found. It is, as yet, premature to compile a Check List for the whole of the Northern Territory, but it seems better to discuss all records for the Territory at one time.

Aspidiaceae

Polystichum proliferum (R.Br.) Presl. Reedy Rock Hole, George Gill Range, D. W. Madden, May, 1962 (NT10572).

A new record for Central Australia. Tindale (1961) mentions this species as occurring "mainly at high altitudes . . . in rain forests or wet sclerophyll forests". This present record emphasises the refugial nature of the George Gill Range, and is further evidence of the wetter conditions in Pleistocene time.

Marsileaceae

Marsilea crenata Presl. Fogg Dam area, 40 miles south-east Darwin, G. Chippendale, 18.5.1959 (NT6191). Landerandera Waterhole, Argadargada, D. Nelson, 20.6.1962 (NT9073).

Second and third collections in the Northern Territory, and a new record for Central Australia.

Gramineae

Aristida ramosa R.Br. is deleted from the Check List for Central Australia (Chippendale, 1959) as the record was based on a specimen which has now been redetermined as *A. strigosa* (Henr.) S. T. Blake. 14 miles south-west Jay Creek Settlement, R. E. Winkworth, 27.2.1954 (Herb. Aust. REW30).

Dichanthium annulatum (Forsk.) Stapf. is deleted from the Check List for Central Australia, as the record was based on a specimen which has been redetermined as *Bothriochloa intermedia* (R.Br.) A. Camus (Dashwood Creek, Narwietooma, C. A. Gardner 11621, 12.3.1953).

Echinochloa colonum (L.) Link. James River crossing on Barkly Highway, R. A. Perry, 2.5.1948 (Herb. Aust. RAP709).

A new record for Central Australia. This replaces the record of *E. turneriana* Domin which was based on the wrongly identified specimen quoted above.

Enneapogon glaber N. T. Burbidge. 80 miles west The Granites, A. J. Mahood, 8.4.1962 (NT8772).

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A new record for Central Australia.

Enneapogon pubescens (Domin) N. T. Burbidge is deleted from the Check List for Central Australia, as the record was based on a specimen which has been redetermined as *E. oblongus* N. T. Burbidge. Palm Valley, M. Lazarides, 15.5.1955 (Herb. Aust. ML5293).

Eragrostis australasica (Steud.) C. E. Hubbard, and *E. concinna* (R.Br.) Steud. are deleted from the Check List, as the records were based on a mention by Black (1943), but no specimens have been found to support the reference.

Iseilema windersii C. E. Hubbard is deleted from the Check List, as the specimen on which the record was based has been redetermined as *I. membranaceum* (Lindl.) Domin. 35 miles west-south-west of Tobermorey Station, M. Lazarides, 9.5.1955 (Herb. Aust. ML5249).

Pseudoraphis spinescens (R.Br.) J. Vickery. 1·9 miles east Wycliffe Creek crossing, Stuart Highway, D. Nelson, 30.4.1963 (NT10295).

A new record for Central Australia.

Schizachyrium obliqueberbe (Hack.) A. Camus. 5 miles south of Ti Tree, R. A. Perry, 8.4.1962 (NT8639).

A new record for Central Australia.

Xerochloa laniflora Benth. 80 miles west of The Granites, A. J. Mahood, 7.4.1962 (NT8699).

A new record for Central Australia.

Loranthaceae

Amyema miraculosa (Miq.) Tiegh. 13 miles south-west of Angas Downs, C. Chippendale, 14.9.1956 (NT2927). 22 miles south of George Gill Range, C. Chippendale, 27.6.1959 (NT6323). South-east corner of Lake Amadeus, C. Chippendale, 29.6.1959 (NT6373).

A new record for Central Australia.

Chenopodiaceae

Arthrocnemum halocnemoides Nees var. *pergranulatum* J. M. Black. South-east corner of Lake Amadeus, C. Chippendale, 29.6.1959 (NT6376).

A new record for Central Australia.

Bassia bicornis (Lindl.) F. Muell. var. *horrida* (Domin) C. T. White. Tobermorey, C. Chippendale, 10.9.1954 (NT234).

A new record for Central Australia.

Bassia decurrens J. M. Black. Alice Springs, R. Swinbourne, 27.5.1962 (NT9031). 29 miles east-south-east of Alice Springs, D. Nelson, 7.6.1963 (NT10488).

A new record for Central Australia.

Bassia limbata J. M. Black. Heavitree Gap, Alice Springs, R. Swinbourne, 7.9.1962 (NT9286).

A new record for Central Australia.

Bassia obliquicuspis R. H. Anderson. Yambah Station, R. Swinbourne, 23.11.1961 (NT9405).

New record for Central Australia.

Bassia uniflora (R.Br.) F. Muell. Delete from Check List, as all records are *B. diacantha* (Nees) F. Muell.

Chenopodium pumilio R.Br. 36 miles north of Alice Springs, D. Nelson, 30.3.1962 (NT8630).

A new record for Central Australia.

Kochia sedifolia F. Muell. Carmichael Crag area, George Gill Range, D. W. Madden, May, 1962 (NT10369). 4 miles east of McGrath Flat Dam, P. Walter, 12.6.1963 (NT10476).

This species was observed and recorded by Tate (1896), but no specimen had been found in herbaria at the time of the Check List. These recent records confirm the occurrence of the species which can now be added to the list for Central Australia. It is noteworthy that Madden's specimen was from the same locality as Tate's observed record.

Amaranthaceae

Ptilotus aervoides (F. Muell.) F. Muell. 32 miles north of Alice Springs, G. Chippendale, 5.9.1960 (NT7370).

A new record for Central Australia.

Ptilotus aristatus Benl. 54 miles north-west of Alice Springs, G. Chippendale, 3.5.1962 (NT8799).

This species was described by Benl (1961) from a specimen at Charlotte Waters, and the above specimen is the second record of this species for Central Australia.

Ptilotus decipiens (Benth.) C. A. Gardn. (syn. *P. hoodii* F. Muell.). 25 miles south-west of Napperby Station, M. Lazarides, 16.9.1956 (Herb. Aust. ML5993) is a recent record of this species, previously known in Central Australia only by specimens of Giles at Mt. Olga, and Tate at Mt. Gillen.

P. decipiens replaces *P. hoodii* in the Check List.

Aizoaceae

Trianthema rhynchocalyptra F. Muell. Delete from Check List, as record was redetermined as *Bergia perennis* (F. Muell.) F. Muell. ex Benth.

Nymphaeaceae

Nymphaea gigantea Hook. var. *violacea* (Lehm.) Conard. 1·9 miles east of Wycliffe Creek crossing, Stuart Highway, D. Nelson, 30.4.1963 (NT10291). Both blue and white forms were collected.

A new record for Central Australia.

Capparidaceae

Capparis loranthifolia Lindl. 18 miles west of Delmore Downs Station, G. Chippendale, 18.12.1956 (NT3220). 18 miles south-east of Murray Downs Station, R. Winkworth, 30.7.1954 (Herb. Aust. REW531).

A new record for Central Australia.

Leguminosae

Aeschynomene americana L. Beatrice Hills, 40 miles south-east of Darwin, G. Chippendale, 23.3.1961 (NT7960).

A native of tropical America, but apparently naturalised in estuarine clay grassland.

Indigofera trita L.f. 2 miles west of Avon Downs, G. Chippendale, 20.6.1960 (NT7261).

A new record for Central Australia.

Vigna lanceolata Benth. var. *latifolia* C. T. White. 12 miles north-north-east of McDonald Downs Station, R. Perry, 12.3.1953 (Herb. Aust. RAP3416), Aileron Lagoon, G. Chippendale, 14.12.1954 (NT736). Yuendemu, M. Meggitt, January, 1955 (NT3245). Ooraminna, G. Chippendale, 4.7.1955 (NT3324).

This variety replaces the record of *V. lanceolata* in the Check List.

Zornia albiflora Mohlenbrock. 1 mile south of Elkedra Station, G. Chippendale, 22.10.1956 (NT3104 Isotype). 13-8 miles north-west of Mt. Doreen Station, G. Chippendale, 1.5.1958 (NT4198). 40 miles north of Wauchope, M. Lazarides, 26.8.1956 (Herb. Aust. ML5845).

This replaces Z. *diphylla* Pers. in the Check List.

EUPHORBIACEAE

Euphorbia hoophthona C. A. Gardn. 6 miles south-west of Woodgreen Station, D. Nelson, 20.10.1961 (NT8495). 70 miles north of Alice Springs, R. Swinbourne, 1.8.1962 (NT9221). 13 miles east of Woodgreen Station, D. Nelson, 12.9.1962 (NT9416). 14 miles west of Ammaroo Station, D. Nelson, 25.7.1963 (NT10568). 36 miles north of Alice Springs, D. Nelson, 22.6.1962 (NT9091). 15 miles north-north-east of Barrow Creek, M. Lazarides, 24.8.1956 (Herb. Aust. ML5822).

A new record for Central Australia.

Micrococca mercurialis (L.) Benth. Darwin (as garden weed), H. S. McKee, 12.2.1961 (Herb. Aust. McKee 8403).

First record of this introduced species in the Northern Territory, possibly first record for Australia.

Phyllanthus maderaspatanus L. var. *angustifolius* Benth. 60 miles west of The Granites, A. J. Mahood, 30.3.1962 (NT8719).

A new record for Central Australia.

MALVACEAE

Hibiscus brachysiphonius F. Muell. 12 miles north of Alice Springs, D. Nelson, 8.3.1962 (NT9107). 33 miles north of Alice Springs, G. Chippendale, 28.9.1962 (NT9397, NT9384).

Mentioned by Black (1952) and Cleland (unpublished list) as occurring in Central Australia, but no specimens could be traced. This species can now be added to the Check List.

Malachra fasciata Jacq. Fogg Dam, 40 miles south-east of Darwin, G. Chippendale, 18.5.1959 (NT6182). 4 miles east of Koolpinyah Station, J. Heaton, 29.6.1961 (NT8058).

A native of Venezuela, but apparently naturalised in some Pandanus swamps near Darwin.

STERCULIACEAE

Pentapetes phoenicea L. Humpty Doo, J. Roka, 20.5.1953.

A native of tropical Asia, recorded as a weed in rice crops.

MYRTACEAE

Eucalyptus cyanoclada Blakely. 51·3 miles north-east of Bectaloo Station, G. Chippendale, 10.3.1959 (NT5489). Warlock Ponds, L. Beens, 7.12.1962 (NT9836).

Two additional records of a rarely collected species.

Eucalyptus nesophila Blakely. 9 miles south-east of Raffles Bay, G. Chippendale, 18.7.1961 (NT8185).

First mainland record, as Blake (1953) states the species was known only from Melville and Bathurst Islands.

Eucalyptus websteriana Maiden. Standley Chasm, J. Frith, 18.9.1955 (Herb. Aust. JF4160). Standley Chasm, N. Forde, 17.10.1957 (Forde, 939). Mt. Sonder, R. W. Burbury, 26.7.1963 (NT10571).

Blakely (1955) mentions a specimen on Mt. Sonder as *E. orbifolia*, but following recent collections, this record is now changed and this present species is a new record for Central Australia.

ONAGRACEAE

Jussieua linifolia Vahl. 40 miles south-east of Darwin, G. Chippendale, 23.3.1961 (NT7929).

Probably the second record of this tropical weed in Australia, being recorded from North Queensland, and apparently naturalised on the estuarine plains near Darwin.

PRIMULACEAE

Samolus valerandi L. Finke River bed, Glen Helen, G. Chippendale, 4.2.1955 (NT784). 30 miles south of Glen Helen, D. Fietz, 1.8.1959 (NT6419). Simpsons Gap, H. S. McKee, February, 1961 (Herb. Aust. McKee 8648).

This replaces *S. repens* Pers. var. nov. in the Check List.

CONVOLVULACEAE

Bonamia linearis (R.Br.) Hall. f. 40 miles north-west The Granites, A. J. Mahood, 29.3.1962 (NT8735).

A new record for Central Australia.

Bonamia media R.Br. 31·6 miles north-west Mt. Patricia, G. Chippendale, 5.5.1958 (NT4295).

A new record for Central Australia.

BORAGINACEAE

Heliotropium conocarpum F. Muell. ex Benth. 15·1 miles north-east Wave Hill Station, G. Chippendale, 16.4.1959 (NT5779).

Only collection since Mueller's type specimen from Sturt Creek.

SOLANACEAE

Solanum pugiunculiferum C. T. White, Elsey Station, G. A. Letts, 27.10.1961 (NT8507).

First definite record in the Northern Territory, although White (1942) mentions a collection at Settlement Creek which flows from the Northern Territory into Queensland.

SCROPHULARIACEAE

Peplidium muelleri Benth. 13 miles north-east Utopia Station, D. Nelson, 20.6.1962 (NT9080).

First definite record for species in Central Australia, although mentioned by Black (1957), but apparently unsupported by specimens.

RUBIACEAE

Knoxia stricta Gaertn. 39 miles south of Darwin, G. Chippendale, 18.3.1961 (NT7764). 5 miles south-west Grove Hill, G. Chippendale, 17.3.1961 (NT7675). Darwin district, H. S. McKee, 11.2.1961 (Herb. Aust. McKee 8380).

Mentioned by Ewart and Davies (1917) as "Recorded from North Australia", but now definitely collected.

COMPOSITAE

Centipeda cunninghamii (DC.) A.Br. et Aschers. 30 miles north-west Willowra Station, G. Chippendale, 30.7.1958 (NT4746). 15 miles north-west Aileron, R. Swinbourne, 2.8.1962 (NT9233).

New record for Central Australia.

Chthonocephalus pseudevax Steetz. Ayers Rock, J. B. Cleland, 28.6.1961 (NT8506).

New record for Central Australia.

INTRODUCED WEEDS

The following species have been recorded in Alice Springs within the last few years, either in gardens, in cultivation areas, near railway lines, or in areas where hay imported from interstate has been used for feeding cattle. None of these species has become established away from the mentioned areas.

Adonis aestivalis L. (NT9338)
Amaranthus viridis L. (NT10617)
Anagallis femina Mill. (NT9331)
Capsella bursa-pastoris (L.) Moench. (NT9294, NT9335)
Carrichtera annua (L.) Prantl (NT9300, NT9332)
Cenchrus echinatus L. (NT3277)
Cerastium aff. *glomeratum* Thuill. (NT9321)
Chenopodium murale L. (NT10575)
Cryptostemma calendula (L.) Druce (NT9287, NT9299, NT9323)
Apium leptophyllum (Pers.) F. Muell. (NT10577)
Eragrostis cilianensis (All.) Lutati (NT8692)
Erodium botrys (Cav.) Bertol. (NT10596)
Erodium cicutarium (L.) L'Her. (NT9327)
Glaucium corniculatum (L.) Curtis (NT8509, NT8523)
Hordeum leporinum Link (NT3044, NT9411, NT10607)
Hypochaeris glabra L. (NT10625)
Lactuca scariola L. (NT7457, NT10619)
Lithospermum arvense L. (NT9329)
Lolium rigidum Gaud. (NT9334)
Lycium ferocissimum Miers (NT8372, NT8373)
Medicago denticulata Willd. (NT9418)
Medicago hispida Gaertn. (NT9322)
Medicago reticulata Benth. (NT9320)
Medicago truncatula Gaertn. (NT9297)
Oxalis corymbosa DC. (NT10578)
Oxalis pes-caprae L. (NT10586)
Papaver hybridum L. (NT9289, NT9290, NT9534, NT9295, NT9296, NT9333, NT9337)
Polycarpon tetraphyllum (L.) Nathorst (NT6529)
Rhynchelytrum repens (Willd.) Hubbard (NT10576)
Sisymbrium irio L. (NT9288, NT9293)
Sisymbrium orientale L. (NT9291, NT9324)
Urtica urens L. (NT9298)
Vicia calcarata Desf. (NT3212, NT9330)

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