



QUEENSLAND HERBARIUM  
DEPARTMENT OF PRIMARY INDUSTRIES  
BRISBANE

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Genera Allied to *Mesembryanthemum* (Aizoaceae).

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**A REVISION OF *CARPOBROTUS* AND *SARCOZONA* IN  
AUSTRALIA, GENERA ALLIED TO *MESEMBRYANTHEMUM*  
(AIZOACEAE)**

By S. T. BLAKE

Queensland Herbarium, Brisbane

**SUMMARY**

*Carpobrotus* N. E. Br. and *Sarcozona* J. M. Black are distinguished from other genera segregated from *Mesembryanthemum* by having fleshy indehiscent fruits and partly axile as well as parietal placentation. *C. glaucescens* (Haw.) Schwantes, *C. virescens* (Haw.) Schwantes (*C. abbreviatus* (Haw.) Schwantes), *C. rossii* (Haw.) Schwantes and *C. modestus* sp. nov. are indigenous. In the past these have been identified with *C. aequilaterus* (Haw.) N. E. Br. (*Mesembryanthemum aequilaterum* Haw., *M. aequilaterale* Willd.), but this name rightly belongs to a species from Chile, California and Mexico naturalized in Australia and of which *C. disparilis* N. E. Br. and *C. chilensis* (Mol.) N. E. Br. are synonyms. *C. edulis* (L.) L. Bolus from South Africa is also naturalized.

The taxa were discriminated from the study of living plants. Distinguishing characters not hitherto used were found in the dots on the sepals, streaks on petals and filaments, number of petals and stamens, length of anthers, shape of calyx-tube, shape of seeds, pattern of branching, and leaf-index. Neotypes were chosen for Haworth's names.

*Sarcozona* is an endemic genus of two species including *S. bicarinata* sp. nov.

**INTRODUCTION**

The genus *Mesembryanthemum* as generally understood up to the 1920's comprised a large number of species of succulent mostly South African plants varying greatly between themselves in habit, flower and fruit. Early workers had recognized a number of more or less distinct groups distinguished chiefly on habit, shape and surface of the leaf, and colour of the flower. Towards the end of the first quarter of this century N. E. Brown undertook a critical study of the fruits and found a number of distinct types; variation in habit and placentation were often correlated with the difference of fruit and Brown began describing many new genera. He was immediately followed by Schwantes in Germany and Mrs. Bolus in South Africa, though each used the name *Mesembryanthemum* for a different genus.

The family to which these genera belong has been called Ficoidaceae, Aizoaceae, Tetragoniaceae and Mesembryanthemaceae, the last mentioned name being used by those who would treat the genera formerly included under *Mesembryanthemum* as a family distinct from the one including *Aizoon*, *Sesuvium* and other genera. But the name Ficoidaceae is based on *Ficoides*, a pre-Linnaean name for *Carpobrotus* included by Linnaeus and later authors under *Mesembryanthemum* so there is no justification for the use of the name Mesembryanthemaceae on taxonomic grounds. It is widely accepted that *Aizoon* and *Mesembryanthemum* sens. lat. are sufficiently alike to be referred to the same family; the correct name of this then becomes a matter of nomenclature, and this has been settled by the conservation of Aizoaceae (ICBN 1961, App. II).

Brown typified *Mesembryanthemum* on *M. umbellatum* L. but because of a mistake in his key to the segregated genera (later corrected by Brown himself) Schwantes rejected this typification, selected *M. tenuifolium* L. as the type of *Mesembryanthemum* and described a new genus *Ruschia* to include *M. umbellatum* and related species. Brown then described *Lampranthus* to which he referred *M. tenuifolium* but chose *M. multiradiatum* Jacq. as type of the genus. Bolus also rejected Brown's typification of *Mesembryanthemum* and selected *M. nodiflorum*, a species included by Brown in *Cryophytum* N. E. Br. of which *M. aitonis* L. is the type. Schwantes then accepted this interpretation and followed Brown in the use of *Lampranthus*. It has now been shown that *Gasoul* Adans. is congeneric with *Cryophytum* so that the latter is a later synonym.

Although Brown's typification is in accord with the International Code of Botanical Nomenclature and the reasons given for its rejection are not, Schwantes in his later work, Bolus, Jacobsen and others in various works continued to use *Mesembryanthemum* for *Gasoul* (*Cryophytum*) and *Ruschia* for *M. umbellatum* and allied species. Some authors have used *Cryophytum*, *Ruschia* and *Lampranthus*, avoiding the use of *Mesembryanthemum* altogether, probably regarding it as a *nomen confusum* (Art. 69). The variant spelling *Mesembrianthemum* also has been used. Further discussion of these confusions is outside the scope of this paper.

In recent classifications two groups of genera have been recognized within the old concept of *Mesembryanthemum*, one with axile placentation and united petals, and the other with parietal or basal placentation and entirely free petals. *Carpobrotus* has been referred to the latter group but treated as a distinct taxon (tribe or subtribe) because of its fleshy indehiscent fruits so different from the prevailing capsular fruit dehiscing when wet. Nobody appears to have noticed that in *Carpobrotus* the placentas are not only parietal but also extend about half way up the axis (Fig. 1 A: f). *Sarcozona* has a similar placentation but this genus seems not to have been known to recent workers in the family. The genus *Faucaria* also has a somewhat similar placentation but is otherwise very different.

Brown published a key to the Australian species of *Carpobrotus* in 1928 and difficulties met with in using this led to the study reported in this paper. Among the genera with capsular fruits *Disphyma* N. E. Br. is represented in



Australia by a single native species whose leaves vary greatly in shape and size with changes in the aridity of the environment. The Australian plants have usually been treated as conspecific with those from New Zealand for which the correct name is *D. australe* (Ait.) J. M. Black, but an account of this and naturalized species of other genera with capsular fruits is outside the scope of this paper.

The genera represented in Australia may be distinguished by the following key based on floral and vegetative characters. The very important characters in the fruit have been ignored to some extent because fruits of some species have not been found on wild-growing plants here.

**KEY TO GENERA ALLIED TO MESEMBRYANTHEMUM GROWING WILD  
IN AUSTRALIA**

Placentation axile; petals  $\pm$  united at base; calyx-tube  $\pm$  produced above the ovary:

Plants with persistent, flat  $\pm$  petiolate leaves:

Plants covered with glistening papillae; upper leaves alternate; styles 5; capsule-valves with approximate, sharp-edged expanding keels and membranous wings

*Gasoul*

Plants not papillose; all leaves opposite; styles 4; capsule-valves without wings; expanding keels lip-like, toothed

*Aptenia*

Plants with early deciduous, slender, linear-terete, opposite leaves and thick  $\pm$  moniliform branches; styles 4-5; capsule-valves with pocket-like wings; expanding keels closely approximated

*Psilocaulon*

Placentation parietal or basal or also partly axile; petals free or nearly so; calyx-tube not produced above the ovary:

Plants annual, hairy; leaves petiolate, flat; styles 12-20; flowers yellow

*Carpanthea*

Plants perennial, glabrous; leaves sessile, terete to  $\pm$  triquetrous; styles 4-12; flowers often purple:

Sepals 5, rarely 6, about equidistant, no 2 opposite; calyx-tube terete; fruit capsular, opening when wet; leaves less than 4 mm thick or not acutely triquetrous:

Leaves with glistening papillae (styles about as long as stamens)

*Drosanthemum*

Leaves without glistening papillae:

Leaves long decurrent; stamens and staminodes appressed in a "cone" or "tube" around the styles which are longer than this cone

*Mesembryanthemum (Ruschia)*

Leaves not decurrent and only shortly connate; styles shorter than stamens:

Placental tubercle usually well developed, bifid; leaves convex rather than angled on the back; flowering branches with very short internodes but often long pedicels

*Disphyma*

Placental tubercle small or absent but not bifid; leaves  $\pm$  triquetrous, the dorsal angle evident; flowering branches with conspicuous internodes

*Lampranthus*

Sepals 5 or 4, 2 of them  $\pm$  opposite and commonly much the longest; calyx-tube commonly 2-ribbed; fruit fleshy, indehiscent; leaves more than 4 mm wide and thick, acutely triquetrous:

Styles 6 or more; stems elongated and creeping

*Carpobrotus*

Styles 4-5; stems not much elongated,  $\pm$  oblique, reiterately branched

*Sarcosoma*

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For chromosome count: Dr. B. A. Barlow, then of the University of Queensland, Brisbane, now at Flinders University of South Australia, Bedford Park.

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### METHOD

The study was based on plants grown with the help of my wife in our home garden from 1952 onwards. Thanks to the help of the many friends mentioned above, plants have been grown from about forty localities in Australia south from the Tropic of Capricorn, from Norfolk Island and California and living plants have been examined from nearly one hundred localities. Material was described as received and if in flower or fruit was usually photographed natural size, and part preserved as herbarium specimens. The remainder was grown in the open, either in sand or in the natural sandy podzolised soil. In the majority of cases such plants flowered and fruited. For convenience, all flowering and fruiting material collected in one season of the one clone has been given the same collection number; material collected in different seasons received separate numbers with references to other collections from the same plants. In this way, I have been able to compare plants from many diverse localities growing under similar conditions and from observations on the same plants from year to year to assess any modification caused by change of environment. All plants could not be kept for the duration of the study, for a well grown plant occupies a considerable space; the whole of some plants were preserved as specimens and others died, but enough has been grown to show that, except in extreme conditions of shade, wet soil or drought the taxa that I have learned to recognize and which I treat as

species are fairly consistent in their vegetative characters. Shade tends to cause elongation of leaves and drought a shortening of all parts; the damper and shadier the situation, the greener (less glaucous) the plants become. The length of the pedicel varies to some extent in all and long pedicels tend to be associated with a more gradual narrowing of the base of the calyx-tube, otherwise each species has a characteristic shape of the calyx-tube.

When plants flowered or fruited in Brisbane, flowering pieces were taken and photographed, commonly with sections of leaves, often of ovary and sometimes of longitudinal section of flowers. Material was described in detail, and then exposed to formalin for 24 hours or longer when most of it was pressed and dried as herbarium specimens. Exposure to formalin was obtained by one of the following methods:

- (1) Immersion in about 5 per cent formalin in water
- (2) Enclosure in a plastic bag with a small quantity of commercial formalin
- (3) Placing in folder, sprinkling with formalin and wrapping in plastic or paper.

Before fruits were exposed to formalin, several seeds were removed, washed and dried separately. In many cases, flowering and fruiting material was preserved in jars in 5 per cent formalin. A few plants persisted through most of the investigation but several died after two or three years and many others in 1960 and 1962.

Herbarium specimens are difficult to prepare even with artificial heat, and leaves, flowers and fruits are usually much deformed. It was only in the later stages that herbarium material from most of the Australian herbaria was studied. Most of the earlier collections are fragmentary, but by using water with a detergent and an artist's brush it was found possible to soften the flower sufficiently to examine the number, shape and dimensions of petals, filaments, anthers, staminal hairs and styles. It was commonly not possible to be sure of the exact shape of the calyx-tube, nor has it been found possible to restore the leaves to their living form, but details of the margin can be observed without soaking.

### TERMINOLOGY

Mostly as a matter of convenience I have referred to the parts of the flower as calyx-tube, sepals, petals and stamens. In some genera the petals and stamens pass into one another in appearance; however to call petals "staminodes" on theoretical grounds ignores the sharp differences from the fertile stamens found in *Carpobrotus* and many other genera and also makes difficult the description of a third group of organs found in some genera between petals and stamens which have commonly been called "staminodes" in taxonomic works. The free parts of the pistil have been called styles by some and stigmas by others. I have used "style" because the parts are free or nearly so and receptive (stigmatic) only along the inner side.

## REFERENCES TO LITERATURE

References have been restricted to those pertinent to the discussion; most of them have been cited in the usual way with the synonymy of the genus.

## CITATION OF SPECIMENS

Specimens cited fall into four categories and are distinguished as follows:

- (1) Specimens seen only as herbarium material; indicated by the abbreviation for the herbarium in parentheses after the collector's name.
- (2) Material received alive from the collector; marked (v.) if sterile and (v.fl.), (v.fr.), or (v.fl.fr.) if received in flower or fruit or both; if fertile, at least part of it was prepared for the herbarium (BRI).
- (3) Material cultivated in Brisbane; shown by my collection number and date in parentheses following the name of the original collector. Specimens of all these in BRI, and duplicates of many in course of distribution.
- (4) Plants represented in two or more of the above categories; e.g. pieces of *Wilson* 1761 (AD; v.fl. Apr.–June 1961, *Blake* 21513) were received in flower, from some of which herbarium specimens were prepared, others were grown from which *Blake* 21513 was taken, and the collector prepared herbarium specimens at the time of collecting which I saw later in herb. Adelaide.

## Tribe CARPOBROTEAE

Sepals free to the top of the ovary (2 much different from the others). Petals free. Stamens  $\pm$  effuse. Styles elongated, free or nearly so, stigmatic along the upper inner surface. Ovary entirely inferior. Placentation parietal and also axile. Fruit fleshy, indehiscent, with as many cells as styles. Seeds very many, with rounded edges. Small or creeping shrubs with  $\pm$  conspicuous internodes and triquetrous  $\pm$  equilateral to compressed glabrous narrow leaves, connate at base with small flat or convex not shining epidermal cells. Two genera, distinguished as follows:

*Carpobrotus*: Styles and ovary-cells 6–15; stigmas  $\pm$  plumose; seeds smooth or finely reticulate; epidermal cells of leaves flat or nearly flat on top, the surface of the leaf smooth; stems creeping with  $\pm$  differentiated flowering branches, the leaf-scars short, not collar-like; flowers free from the upper leaves.

*Sarcozona*: Styles and ovary-cells 4–5; stigmas papillose rather than plumose; seeds verrucose at least in part; epidermal cells of leaves  $\pm$  convex on top; surface of larger sepals and often of the leaves verrucose from the prominent ideoblasts; stems erect or oblique or finally prostrate but not creeping, reiterately branched, all branches potentially flower-bearing at about the same time; leaf-scars relatively large and collar-like; flowers commonly partly enclosed by the enlarged much connate bases of the topmost pair of leaves.

**Carpobrotus**

**Carpobrotus** N. E. Br. Gardn. Chron. 78: 433 (1925) in clavi, in Phillips, Gen. S. Afr. Pl. 249 (1926), J. Bot. 66: 322–4 (1928); Schwantes, Gartenflora 77: 68–9 (1928); J. M. Black, Trans. & Proc. Roy. Soc. S. Aust. 56: 40 (1932); Jacobsen, Handb. Sukk. Pfl. 3: 1195–9 (1955), Handb. Succ. Pl. 3: 1002–6 (1959).

*Ficoides* Hermann Fl. Lugd.-Bat. 244, t. 245 (1690); *nomen invalidum*.

*Mesembryanthemum* L. sect. *Triquetra* Haw. Rev. Pl. Succ. 135 (1821).

*Mesembryanthemum* L. sect. *Acinaciformia* Salm-Dyck, Obs. Bot. 20 (1820); Haw. Rev. Pl. Succ. 118 (1821); DC. Prodr. 3: 428–9 (1820).

*Mesembryanthemum* L. sect. *Decumbentia* Salm-Dyck in Link, Hort. Berol. 2: 51 (1822).

*Mesembryanthemum* spp., Haw. Obs. *Mesembryanthemum* 390–4 (1794), Misc. Nat. 76–7 (1803), Syn. Pl. Succ. 233–7 (1812), Rev. Pl. Succ. 118–21 (1821), Phil. Mag. 68: 329–30 (1826); Salm-Dyck, Monogr. *Aloes et Mesembryanthemi*, tt. div. (1836–49); Benth. Fl. Aust. 3: 324 (1867).

(*Abryanthemum* Neck.; Rothm. Notizbl. Bot. Gart. Berlin 15: 413 (1941). Necker's names are not generic names; see ICBN Art. 20, note (2)).

Calyx-tube adnate to ovary and not produced above it, semiglobose, subcylindrical, turbinate or pyriform, 2-edged; sepals 4–5, two of them triquetrous and resembling the leaves, the others with scarious or membranous margins, with or without dorsal leaf-like green points. Petals free, usually very numerous in up to 5 series, linear or somewhat spathulate, the tip entire or variously denticulate. Stamens in up to 9 series, usually numerous or very numerous, the inner series  $\pm$  horizontal, the outer ones at first erect then converging over the stigmas; filaments except sometimes those of the outermost, densely bearded towards the base with usually many-celled white hairs; anthers linear-oblong. Nectary low, annular. Ovary entirely inferior, 6–15-celled; placentas parietal and axile extending throughout the length of the wall of the cell and about half-way up the central axis, with very many ovules in several series erect or pendulous from the up-curved or down-curved ends of  $\pm$  horizontal filiform funicles. Styles 6–15, free or nearly so, subulate-lanceolate, fimbriate and stigmatic along the upper inner face, convex on the lower face, at first erect, later spreading, passing down a depression in the top of the ovary. Fruit fleshy with as many cells as stigmas, indehiscent,  $\pm$  resembling the calyx-tube in shape, 2-costulate, crowned by at least the two longest calyx-lobes which commonly become coloured. Seeds very numerous, brown, imbedded in mucilage, with the hilum against the radicle,  $\pm$  obovate or obliquely so, compressed with rounded edges, finely striate or reticulate to smooth with small epidermal cells quadrate or nearly so with the surface flat to depressed, or  $\pm$  convex or also somewhat elongated over the radicle.—Prostrate shrubs with several long, branched, trailing, succulent at length woody stems rooting at the nodes with  $\pm$  elongated internodes and  $\pm$  distinct, ascending or erect, simple

or branched, 2–15-noded flowering branches with often short internodes; flowering branches branching from one or more nodes, in some species these branchlets not growing out until flowering is over. Leaves very succulent, opposite, sessile, shortly connate at the base by as much as their thickness, not decurrent along the stem, acutely triquetrous, about as thick as or thicker than wide, glabrous, smooth or nearly so except for the sometimes scabrous-crenulate keel and margins, finely pellucid-dotted, those of each pair similar and similar to those of other pairs except as to size, all with a thickened  $\pm$  semicircular callus at the base on the upper surface; first pair of each branch usually with eccentric keel. Flowers solitary, terminal, usually large, purple or light purple, rarely yellow, opening during the day for several successive days, subsessile to conspicuously pedicellate above the last pair of leaves which are sometimes markedly smaller than those below but which can carry shoots in their axils, or in some African species more extensively connate and bract-like. Larger sepals opposite or almost so, slightly constricted at base with one side wider than the other, their keels passing into the ribs on the calyx-tube; membranous parts of the other sepals with dark reddish or brown dots at least towards the herbaceous part, the limb of the innermost with the keel uppermost, the limb often very small. Petals for the greater part purple, rarely yellow, sometimes paler or (in the indigenous Australian species) pure white at the base, in the dry state streaked with raised longitudinal whitish and dark coloured lines, those of the intermediate series the longest, those of the innermost often few and much smaller. Filaments pink or yellowish in the upper part, white towards base, sometimes streaked in the dry state like the petals, those of the intermediate series the longest, these and sometimes others often with some stouter parallel-sided or clavellate non-septate hairs in the beards which are otherwise (except in *C. modestus*) made up of very slender moniliform septate hairs; anthers yellow; pollen yellow. Ovary green on top and there flat, convex or “descending convex” with the higher part adjacent to the insertion of the stamens and a convex downward slope to the centre, truly concave in some African species; styles at first erect, then lengthening and spreading, green; cells much higher than wide, gently narrowed downwards; funicles long, nearly horizontal, alternately upcurved and down-curved; ovules and seeds about 60–100 in each cell. Fruits yellowish or more usually dull purple at maturity. Epidermal cells of vegetative parts flat on top (slightly convex in *C. modestus*), those of the stem square or transversely shortly oblong. Chromosomes:  $n = 9$ .

Type: *Carpobrotus edulis* (L.) L. Bolus (*Mesembryanthemum edule* L.).

Species about 20–25, chiefly South African, one of them (*C. edulis*) naturalized in Australia, Europe and America, four indigenous to Australia (one of them also in Norfolk Island) and one in Chile naturalized in California and Australia.

One species is found mainly inland commonly in mallee scrub or heath, the others on coastal dunes or cliffs rarely extending inland. Some have been planted for the stabilization of soil and for ornamental purposes. They are easily grown from cuttings and pieces remain fresh and viable for a considerable time if kept dry or well ventilated.

Conditions for setting of fruit have not been fully investigated, but fruits have followed flowers that opened when no other flower of any species was open; it appears that these must have been either self-pollinated or else they behaved apomictically. Most of the species have been seen to produce flowers with abortive anthers devoid of pollen; in some seasons all or almost all the flowers of a plant behave thus. Almost every open or opening flower examined had thrips among the stamens, apparently feeding on the pollen; during their movements these insects must certainly transfer pollen to the stigmas. Honey bees visit the flowers of cultivated plants.

Pollen from all species from at least two collections each has been examined for fertility, or rather the stainability by aceto-carmines or lactophenol and cotton blue. The stainability was usually high, 80 per cent to 100 per cent (usually at least 90 per cent), but in a few plants believed to be hybrids on morphological grounds, the percentage was 60 per cent to 70 per cent or lower. There is no evidence that hybrids are commonly formed. Two examples were found in Western Australia of a hybrid between the native *C. virescens* and the naturalized *C. edulis*. *C. juritzii* (L. Bolus) L. Bolus, described from the coast of Natal and now becoming common in cultivation in Brisbane is evidently of hybrid origin.

#### HISTORICAL

From the time of its publication by Haworth (1794) the name *Mesembryanthemum aequilaterum*, usually in the form *M. aequilaterale*, has been commonly used for the creeping plants of the coastal dunes of the southern half of Australia. J. M. Black (1932) used the combination *Carpobrotus aequilateralis* (Haw.) J. M. Black and this has been followed to some extent.

Haworth was a grower of succulent plants and was one of the pioneers in their taxonomy. Later he described *M. glaucescens*, *M. virescens*, and *M. abbreviatum* from the Australian mainland and *M. rossii* from Tasmania. All names were based on living plants growing in England; the original descriptions of *M. aequilaterum*, *M. abbreviatum* and *M. rossii* were based on plants that had not flowered but an account of the flower of the first was published later. The descriptions are brief and no specimens seem to have been preserved. Salm-Dyck was another early student of succulent plants and he published descriptions and figures of many species described by Haworth, including *M. aequilaterum*, *M. abbreviatum*, *M. rossii* and *M. virescens*, all represented by flowering pieces. It is reasonable to suppose that he would have received some of his plants directly from Haworth.

Bentham (1867) referred all the native Australian plants as well as those from California and Chile to *M. aequilaterale*, quoting *M. glaucescens*, *M. virescens*, *M. rossii*, *M. abbreviatum* and also *M. praecox* F. Muell. as synonyms; *M. praecox* was described from plants collected by Mueller in South Australia.

In a brief paper consisting of a large number of new transfers to recently described genera without any comment, Schwantes (1928) transferred nine names to *Carpobrotus*. A few months later, without having seen Schwantes's paper,



N. E. Brown published an annotated list of the species of *Carpobrotus* with full synonymy making afresh a number of transfers just made by Schwantes and presented a key to the Australian species, stating that there was a drawing of *M. aequilaterum* and *M. abbreviatum* at Kew and that *M. abbreviatum* was based on plants raised from seed collected by A. Cunningham at King George Sound. He regarded this and *M. virescens* as synonyms of *C. glaucescens*, stated that he saw no material to match Haworth's drawing of *M. aequilaterum* but that Salm-Dyck's plate agreed well with it. He noted that Salm-Dyck's figure and description of *M. virescens* did not accord with Haworth's description and based *Carpobrotus disparilis* N. E. Br. on that account although he saw no specimen to match it; he assumed it referred to an Australian plant. It seems that he referred all the specimens he saw to *C. glaucescens* and *C. rossii*. *Carpobrotus pulleinei* J. M. Black was described in 1932, but on the suggestion of N. E. Brown a new genus—*Sarcozona* J. M. Black—was described from it in 1934.

Jacobsen (1955, 1959) gave an uncritical account of the genus with brief descriptions of most of the species mentioned, adapted from the original descriptions; no descriptions were given of any Australian forms and the synonymy was copied from N. E. Brown.

As my study progressed, four undoubtedly indigenous taxa were recognized, one on the east coast, one on the south-western coast, one from the coasts of South Australia, Tasmania and western Victoria, and an inland species first recognized from South Australia and Victoria. The yellow-flowered *C. edulis* is naturalized. It seemed reasonable on historical grounds that the coastal species were known to Haworth and that the inland species was not; none could be reconciled with *C. aequilaterus*.

#### NOMENCLATURE

As the recognition of taxa grew the problem of nomenclature had to be solved. No specimens have been found of the plants described by Haworth or Salm-Dyck and the application of Haworth's names has been determined from his and Salm-Dyck's descriptions, drawings and plates; some of Salm-Dyck's accounts were very likely based on plant material received directly or indirectly from Haworth. I have therefore selected neotypes from Salm-Dyck's plates or material collected at or near the probable wild source of Haworth's plants.

Haworth described *M. virescens* and *M. glaucescens* in the same work, stating that they were introduced about 1804; he described the former as having pedicellate flowers with a tetragonous ovary and four sepals and he remarked that the latter scarcely differed, except in having nearly sessile larger flowers with five sepals, paler petals, larger and more glaucous leaves and stouter stem. These differences are among those distinguishing the eastern species from the south-western species except that, on the whole there is little difference in stoutness of stem. In his MS, R. Brown gave a detailed description of plants he collected at King George Sound, mentioning a pedicellate flower with a tetragonous ovary and four sepals. These features were also described and figured by Salm-Dyck for *M. abbreviatum*,

originally described by Haworth from a sterile plant raised at Kew from seed collected by A. Cunningham at King George Sound, according to Haworth's note on the drawing cited by N. E. Brown. The other parts of the accounts of *M. virescens* by Haworth and of *M. abbreviatum* by Haworth and Salm-Dyck accord with plants of the south-western taxon and Haworth's different accounts of *M. glaucescens* agree with plants of the eastern taxon, so I have accepted *C. virescens* (Haw.) Schwantes and *C. glaucescens* (Haw.) Schwantes as the correct names of these taxa.

*M. rossii* was based on a plant said to have been raised from seed from Tasmania in 1820 that had not flowered. Salm-Dyck's account and plate do not disagree with Haworth's brief account and agree well with Tasmanian plants except for the very acute petals of the plate which look more like those of the inland species described below as *C. modestus*; however the size of the flower, the shape of the calyx-tube and numerous petals and stamens are not those of *C. modestus*.

As stated above, no Australian plant had been found to agree with Haworth's account of *Mesembryanthemum aequilaterum*. The original description (with epithet spelt *equilaterum*) was based on a plant or plants without flowers growing at "Mr. Lee's" (a nurseryman). Later, (1803), under the name *M. aequilaterale* (an alteration by Willdenow) he gave another description based on a plant he had grown and brought into flower after much labour ("Flores tandem produxi post multum laborem"). The important characters from these two accounts are: Long slender trailing and rooting branches; green leaves compressed-triangular to equilaterally triangular especially at the base, with smooth non-cartilaginous margins and smooth sides, 2–3½ in. long, "scarce to be called connate"; large, intensely red, pedunculate flowers, peduncles scarcely an inch long, angular, thickened upwards; 5 unequal sepals incurved at tips; linear, rather broad, emarginate, intensely red petals rose-coloured at base; red filaments; 6 subulate, erect, short styles. Of its origin he wrote in 1794 "I have been told, it is a native of the country about Botany Bay" and in 1803 "habitat in Nova Hollandia" and to this was added later (Haworth 1812) his statement that it was introduced in 1791 and that he had seen flowers once only. As stated by N. E. Brown (1928), there is a drawing at Kew and Salm-Dyck's figure (Salm-Dyck 1836, fasc. 1, fig. 19) represents the same species which Salm-Dyck evidently had growing, very likely received from Haworth. Salm-Dyck's account agrees with Haworth's except that he described the leaves as connate, the petals as rich purple and somewhat rose, yellow filaments, and also that the leaves (2–3 in. long) were scarcely 3 lines wide at the base and somewhat attenuate, and the calyx-tube was compressed turbinate. From the figure the stem was 2–3 mm thick and the leaves 4–6 mm wide or thick, shortly connate for less than their thickness, gradually acute in side view, longer sepals about as long as the petals which are 18–20 mm long. He stated it was the most slender member of the group and that Joseph Banks brought it from New Holland in 1791. All the Australian species are stouter plants with white bases to the petals as described for other species by both Haworth and Salm-Dyck; the leaves are much less acute in side view and the styles are

usually 7–10 although 6 styles have been noted very early in the season on *C. rossii* and *C. modestus*. As to its extreme slenderness and narrow leaves *M. aequilaterum* approaches *Carpobrotus modestus* described below, but the latter is definitely coarser, has leaves mostly thicker than wide, much less acute in side view, much smaller flowers with small sepals and smaller fewer acute petals conspicuously white at the base. Ignoring the number of styles and even the colour of the petals there is still no Australian plant to match the figure. The two Australian species that I have identified with *M. virescens* and *M. glaucescens* have  $\pm$  denticulate petals  $\pm$  obtuse in outline but otherwise there is no close resemblance.

Haworth (1812) also mentioned a variety of *M. aequilaterale* which was somewhat more robust and flowered more freely with ten styles and a very red pulpy fig-shaped fruit introduced (to England) about 1801. Salm-Dyck, loc. cit., mentioned var. *decagynum* with slightly more robust branches and leaves but stated that although long grown by him it had not flowered; he evidently referred to Haworth's plant with ten styles. Later (1849, fasc. 5, fig. 16), he described and figured *M. aequilaterale* var. *chiloense* Salm-Dyck (*M. chiloense* Hort.), which he queried as coming from the island of Chiloe, more robust than *M. aequilaterale* with suberect, subrigid branches and ten styles; it was quite different from *M. aequilaterale* var. *decagynum* Haw. and could be a distinct species. The branches in the figure are 2.5–5 mm thick, the leaves are up to 8 mm thick sometimes less acute in profile, and the calyx-tube is more oblong,  $\pm$  abruptly narrowed to the pedicel. The petals appear to be fully coloured almost to the base (the lowermost 1 mm or less appears to be pale).

Salm-Dyck (1836, fasc. 1, fig. 20) also described and figured a plant or plants that he had identified with *M. virescens*. Brown stated that this figure did not accord with Haworth's account and based a new name *C. disparilis* N. E. Br. on it although he saw no specimen that matched it. But there are inconsistencies within Salm-Dyck's account suggesting that he had more than one plant in mind or was trying to reconcile his plant(s) with Haworth's accounts. In his diagnosis he wrote "flore . . . decagyno" and quoted Haworth's diagnosis . . . "Stylis octo" but in the description he gave "styli 12–14 . . . Capsula 12–14 locularis"; the figure shows about thirteen styles. This also has very slender stems (about 2–3 mm diam.), narrow leaves, some of them much thickened upwards but still decidedly acute in profile and petals coloured to the base, characters of stems, leaves, petals and styles disagreeing with Haworth's account and (except sometimes the leaves) not found in any indigenous Australian plants. The "decagyno" of the diagnosis may be a slip.

There are many resemblances between Salm-Dyck's figures of *M. aequilaterale*, *M. aequilaterale* var. *chiloense* and *M. virescens*. In Dec. 1958 Miss C. Warner (now Mrs. Slater) sent plants from Tollgate Islands, off Bateman Bay, N.S.W., that resembled the plate of *M. aequilaterale* so closely (except for the 7–8 styles) that there seemed no doubt that the long-lost *M. aequilaterale* had been found; a plant of another collection by Mrs. Slater from the same island in March 1962

that flowered in my garden confirmed this. Between these times of collection plants from Tasmania collected by Dr. R. F. Thorne flowered in my garden that differed from other Tasmanian material and two Tasmanian collections (NSW), one in flower and one in fruit also appeared to be the same. The characters of the seeds of these confirmed that the plants were specifically distinct from other Australian material. The apparently sporadic distribution, the absence of a white base to the petals and the resemblance to the plate of *M. aequilaterale* var. *chiloense* suggested that the species was not indigenous to Australia and might be of American origin. Dr. R. Moran of San Diego sent living material from California in March 1961 but after persisting for two years in the Brisbane Botanic Gardens and my own garden the plants died without flowering. Later Dr. Moran sent an excellent series of pickled specimens of the forms found on the coast of southern California and Baja California, and Dr. R. Acevado de Vargas of Santiago sent dried material from Chile. Some of this material matches the plants from Australia very closely and another specimen from Chile (MEL) is conspecific so that the suspicion that *M. aequilaterale* is an American species seems to be confirmed. As mentioned above Haworth first saw the species at "Mr. Lee's"; James Lee was a well-known nurseryman with a large collection of succulents and an active importer of plants from Australia and Chile (E. J. Willson, James Lee and the Vineyard Nursery, Hammersmith, 25, 26 (1961)). The American material has been known as *M. chilense* Mol. (*C. chilensis* (Mol.) N. E. Br.). The interpretation of names published by Molina is often difficult because no specimens were preserved (Philippi, Bot. Zeit. 22, Beilage 1:1 (1864)) and the descriptions were very scanty; in this case there is little to distinguish it from other species of *Carpobrotus*.

Another plant in Australia, chiefly found in cultivation, that led to this revision on the assumption that it was a native species, was one of the last to be identified. It also has petals not white though paler at the base. Mrs. Bolus assured me that it did not agree with any recognized African species though it resembled *C. edulis* in some ways. In some states it strongly resembles Salm-Dyck's figures and account of *M. virescens* (*C. disparilis* N. E. Br.) if the large number of styles of the latter be ignored. This form was recognized among the material received from California and Chile. The lower pollen fertility of the American material at first suggested a hybrid origin, but the Australian plants have a much higher pollen fertility. Further study led to the conviction that these are only coarse plants of *C. aequilaterus* with some branches closely resembling part of the material from the Tollgate Islands. Therefore in the absence of other evidence, *M. chilense*, *M. aequilaterale* var. *chiloense* and *C. disparilis* must be treated as synonyms of *M. aequilaterale* (*Carpobrotus aequilaterus*) and *M. aequilaterale* var. *decagynum* should also be added to the synonymy.

#### DISCRIMINATION OF SPECIES

For distinguishing species, early workers relied largely on colour of flower and leaf, aequilateral or laterally compressed form of leaf, the presence or absence of denticulations on the margins of the leaf, the thickness of the stem, number of

styles and, to some extent, the shape of the calyx-tube. The number of styles varies from flower to flower on the same plant though within definite limits for any one species and the colour of the leaf is dependent to some extent on the environment. Brown's suggestion that the fruits might provide good distinguishing characters has been justified; the form of the fresh fruit is fairly distinctive for each species (Figs. 2-8) and the seeds were found to provide very good characters although some of these were not easy to describe (Fig. 1 (F-K)). The outline, length and breadth and the ratio between these, a tendency towards a trigonous cross section, and the prominence of the radicle are all useful. The African species (so far as seen) have seeds nearly symmetrical with both edges about equally curved and the point of the radicle scarcely affecting the outline. Seeds of the Australian species are less symmetrical with the radicle more or less obviously extended and appreciably affecting the general outline while one of the edges is commonly much less curved than the other, sometimes partly straight or even concave in side view. In *C. glaucescens* and *C. modestus* as well as in *C. aequilaterus* the edge against the endosperm is less curved than that against the embryo while in *C. virescens* and *C. rossii* the opposite is the case. The seeds of *C. glaucescens* and *C. aequilaterus* tend to be trigonous in cross section but in all species one side is less turgid than the other. If several seeds of any species rest on the less turgid side some will have the embryo to the left and others to the right; "right-handedness" and "left-handedness" seem to be independent of the upward and downward curving of the funicles. The "dotting" of the sepals and "streaking" of the petals and filaments are characters easily seen on herbarium specimens or withered flowers; on fresh flowers the dots are evident but not the streaks. In the native species the dots are restricted to a relatively narrow area around the herbaceous middle part, rarely and then usually only on one sepal extending about half way to the margin while the streaks on the petals are more or less confined to a narrow band along the mid-line (Fig. 1 A: k, s); the other species have the dots extending beyond halfway to the margin or up to the margin itself and the streaks occupying most of the width of the petal (Fig. 1 B: k, s). The beard of the filaments is composed mostly of slender moniliform hairs but in some species there are added, especially in the outer series, many shorter much broader non-septate hairs clavellate or narrowly oblong in outline. These clavellate hairs are not easily distinguished in dried material.

The number of petals and stamens varies within rather wide limits for each species and the numbers given are approximate though based on many counts. Counting is very tedious especially when it is undesirable to cut a flower.

The ratio of length to breadth of the leaf (leaf-index) is a useful character on undried material, but there is much differential shrinkage in drying and it is usually not possible to measure the width on dried specimens because of flattening from the side. In the examples measured, leaves shrank during drying to about  $\frac{2}{3}$ - $\frac{3}{4}$  of their length and the sides to about  $\frac{2}{3}$ - $\frac{1}{2}$  of their width. The ratio of length to width of side measurable on dried material is of little value.

In *C. glaucescens* and *C. virescens* the branchlets of the flowering branches do not grow out before or during flowering so that each flowering branch carries one, rarely two flowers (Figs. 4, 6). In *C. rossii* and *C. modestus* the branchlets grow out early and produce flowers so that the flowering branches of these species often resemble a small bush with several flowers (Fig. 7 (3)). In *C. aequilaterus* the flowering branches are but little differentiated from the long sterile branches, having often several nodes with elongated internodes (Fig. 3).

The following key is designed for use with fertile dried material and sterile or fertile living or pickled material.

Chromosome numbers are known for *C. glaucescens* (Barlow, unpublished, from Blake 21638) and a few African species including *C. edulis* (Darlington and Wylie, Chromosome Atlas of Flowering Plants 66 (1955)). In all  $n = 9$ .

#### KEY TO SPECIES OF *CARPOBROTUS*

Keel of leaf and larger sepals denticulate nearly throughout; petals yellow before fading; smaller sepals dotted throughout; stamens 400–600; seeds nearly symmetrical; fruit commonly wider than long  
1. *C. edulis*

Keel of leaf and larger sepals smooth for the greater part below the upturned part or that of the sepals  $\pm$  crenulate-denticulate in upper third; petals light purple, paler to white at the base; smaller sepals dotted only close to the herbaceous part or more rarely to beyond the middle; stamens 400 or less; seeds or some of them asymmetrical; fruit not wider than long:

Petals paler but not white towards base streaked  $\pm$  throughout their width when dry; some of the filaments with a streak; seeds symmetrical and asymmetrical in the same fruit with the radicle scarcely extended; stamens 280–400; leaves 6–12 times as long as wide or thick  
2. *C. aequilaterus*

Petals white at and near the base, the whiteness not always evident in freshly opened flowers, streaked when dry along the middle at least in the middle third; filaments without such streaks; seeds  $\pm$  asymmetrical with the radicle  $\pm$  distinctly extended. Stamens fewer or leaves thicker and wider than in *C. aequilaterus*:

Stamens about 250–400 in 4–6 series; anthers 1.2–2 mm long; fruit oblong to subglobose; seeds 1.25–1.6 times as long as wide; leaves  $\pm$  aequilateral about the middle, 3–8 times as long as wide; stems 5 mm thick or thicker; flowering branches usually not branching until flowering is over:

Calyx-tube suboblong to subcampanulate; fruit oblong, nearly cylindrical; seeds obliquely somewhat broadly obovate, compressedly trigonous, 1.25–1.45 times as long as wide, 1.05–1.3 mm long; sepals almost always 5; older parts of stem commonly brownish  
3. *C. glaucescens*

Calyx-tube  $\pm$  turbinate, sometimes subtetragonous; fruit broadly oblong-ellipsoid to subglobose; seeds obovate, 1.4–1.6 times as long as wide, 1.35–1.65 mm long; sepals often 4; older parts of stem commonly whitish  
4. *C. virescens*

Stamens 20–250 in 1–4 series; anthers 0.8–1.6 mm long; fruit  $\pm$  obovate or turbinate in side view; seeds 1.5–2 times as long as wide, lenticular; leaves mostly thicker than wide, 6–11 times as long as wide; stems often as slender as 3 mm thick; flowering branches commonly branching before and during flowering:

Petals 60 or more,  $\pm$  20–27 mm long,  $\pm$  acute to  $\pm$  obtuse in outline; stamens 3–4-seriate; calyx-tube turbinate; fruit turbinate to globose-ellipsoid, commonly pedicellate; both sides of leaves commonly  $\pm$  convex, mostly 8–11 mm wide 5. *C. rossii*

Petals 45–60, acute to acuminate in outline, 6–12 mm long; stamens 1–3-seriate; flowers usually sessile or nearly so with  $\pm$  oblong calyx-tube thickened transversely at the top; fruit  $\pm$  obovoid-oblong (side view) to ellipsoid (edge view); leaves commonly with one side  $\pm$  concave, narrower than the other, the sides 4–9 mm wide 6. *C. modestus*

1. **Carpobrotus edulis** [N. E. Br. in Phillips, Gen. S. Afr. Fl. Pl. 249 (1926), nomen nudum] (L.) L. Bolus, Fl. Pl. S. Afr. 7: sub t. 247 in textu (1927); Schwantes, Gartenflora 77: 68 (1928). Based on *Mesembryanthemum edule*. Combination published independently by Schwantes.

*Mesembryanthemum acinaciforme* L.  $\beta$  *flavum* L. Sp. Pl. 485 (1753). Based on "Mesembr. falcatum majus, flore amplo luteo. Dill. elth. 283, t. 212, f. 272" (1732) (lectotype) and "Ficoides s. Ficus aizoides africana major procumbens, triangulari folio, fructu maximo eduli. Herm. lugd. 244, t. 245" (1690).

*Mesembryanthemum edule* L. Syst. Nat. ed. 10, 2: 1060 (1759); Drummond, London J. Bot. 2: 174 (1843). Based on *M. acinaciforme*  $\beta$  *flavum*.

*Mesembryanthemum edule* L. var. *flavum* (L.) Moss, Cambr. Brit. Fl. 2: 151 (1914). Based on *M. acinaciforme* var. *flavum*.

*Abryanthemum edule* (L.) Rothm. Notizbl. Bot. Gart. Berlin 15: 413 (1941). Based on *Mesembryanthemum edule*.

Stems up to 2 m long, 8–13 mm thick, the angles  $\pm$  marginate; flowering branches 3–8-noded with elongated, ancipitous,  $\pm$  2-winged internodes 1–5 cm long, the penultimate one up to 13 mm thick, the lower ones as slender as 5 mm thick. Leaves dull green, slightly incurved, gradually acute from about the middle, in side view the keel about parallel with the edges and shortly upturned to the tip, about equilateral (about as thick as wide for the greater part, thicker than wide near the tip), all faces slightly concave, the keel permanently serrulate at least in the upper part, mostly 4–8 cm long, 8–17 mm wide, 8–15 mm thick, 4–7 times as long as wide. Flowers 7–8.5 cm diam., pedicellate, the pedicel slightly compressed, 10–20 mm long, ancipitous, with acute serrulate edges. Calyx-tube turbinate or oblong-turbinate or with convex edges, passing rather gradually into the pedicel, very little compressed, the edges very acute, serrulate-crenulate, (15–) 20–25 mm long, (15–) 20–25 mm wide, (13–) 17–22 mm thick. Sepals 5, the two longest 20–45 mm long with serrulate keels, the others short with leafy green points, densely dotted almost to the edge of the membranous margins. Petals about 120–130, 3–5-seriate, at first yellow, at length flesh pink becoming nearly white at the base, obtuse to  $\pm$  acute in outline, entire or variously toothed, 30–35 mm long, 1.5–2.5 mm wide (widest above the middle), densely streaked throughout when dry. Stamens about 400–600, about 6–7-seriate,

filaments 3.5–7 mm long, whitish to yellowish below, more definitely yellow above the beard or sometimes tinged pink, streaked when dry, the beards without clavellate hairs; anthers yellow, 1.8–3.5 mm long. Ovary convex on top with a central depression, becoming depressed in fruit; styles 8–10, 7–15 mm long. Fruit dull yellowish, pedicellate, nearly hemispherical to subglobose, or somewhat obovoid, only slightly compressed, depressed on top, about 2.5–3 cm long, 2.5–3.5 cm wide and 2.5–3.5 cm thick. Seeds obovate lenticular nearly symmetrical, the radicle not protruding beyond the curvature of the endosperm; the edge against the endosperm often abruptly contracted to the hilum, sometimes shortly straight or very slightly concave, 1.15–1.55 mm long, 0.7–1.05 mm wide, 1.4–1.65 times as long as wide. Figs. 1 (B, F), 2, 13.

WESTERN AUSTRALIA.—SOUTH-WEST PROVINCE: Stirling District—Reabold Hill, Oct. 1955, *Brittan* (v. fl.); Swan R., in 1890, *Ives* (MEL); Swanbourne, Oct. 1938, *Gorrie* (PERTH); South Perth, July 1923, *Carne* (PERTH); Sept. 1944, *Royce* (PERTH); Fremantle, *Oldfield* (MEL); Robb Jetty, S. of Fremantle, Nov. 1923, *Gardner* 2069 (PERTH); Pinjarrah, Oct. 1872, *Price* (MEL).

SOUTH AUSTRALIA.—ADELAIDE PLAINS: Lefevre Peninsula, near Largs Bay, Nov. 1916, *Hb. J. M. Black* (AD); Grange, Oct. 1933, *E. C. Black* (AD); Grange Road, Oct. 1905, *J. M. Black* (AD); Adelaide, cult. from near coast, Oct. 1935, *J. M. Black* (AD); Port Adelaide, Apr. 1955, *Cleland* (AD), Nov. 1946, *Bridgland* (ADW), Jan. 1954, *Cleland* (v. fl. fr., Oct.–Dec. 1956, *Blake* 20177); Victor Harbour and Inman R. ? *Cleland* ? (AD); The Bluff, Encounter Bay, Jan. 1954, *Cleland* (v. fl.).

NEW SOUTH WALES.—CENTRAL COAST: Bellevue Hill, Sydney, in 1948, *Johnson in NSW.56480* (NSW); Lady Robinson's Beach, Botany Bay, Apr. 1913, *Hamilton in NSW.56481* (NSW). SOUTH COAST: Nowra, Sept. 1942, *Hb. F. A. Rodway* 12774 (NSW); Bermagui-Tilba Road, Sept. 1953, *Constable in NSW.26439* (NSW).

VICTORIA.—WIMMERA: Without further locality, in 1893, *Matthews* (MEL). SOUTHERN DISTRICT: "Australia Felix", Oct. 1852, *Mueller* (MEL); banks of the Plenty R., *Mueller* (MEL, seeds only); Cheltenham, May 1954, *M. Davis* 1479 (v.; Nov.–Dec. 1958, *Blake* 21489); Beaumaris, Jan. 1962, *Clifford* (v. fr.); Dromana, Nov. 1963, *Pedley* 1675, 1676 (v. fl.). GIPPSLAND: Lake Wellington, Feb. 1960, *Carolin* 1909 (SYD).

TASMANIA.—Near Hobart, Sept. 1955, *Curtis* (v. fl., Oct.–Dec. 1956, *Blake* 20174).

A native of South Africa in the coastal regions of Cape Province and Natal; introduced early into Australia and recorded as established near Fremantle in 1842 by Drummond, loc. cit. It has been widely planted as a sand binder and ornamental and is now naturalized in the southern part of Australia (Fig. 13), chiefly near the coast, Southern Europe and California.

Besides the specimens cited above I have seen dried (K) and pickled material from California (*Moran* 9780, BRI) and many dried specimens from South Africa (K, MEL). Mueller's specimen from "Australia Felix" must be from near Melbourne—Mueller had just moved to Melbourne from Adelaide and he seems to have used "Australia Felix" for "Victoria" in this and in other cases.

*C. edulis* is coarser than the native species, with larger flowers, and about equally triquetrous leaves with  $\pm$  concave sides and the keel prominently denticulate in the upper part; the keels of the larger sepals and the edges of the calyx-tube



are likewise denticulate. The petals are yellow when first expanded, turning pink on withering but remaining whitish at the base, the stamens are very numerous and the fruit is nearly hemispherical with ovate lenticular seeds.

This was the first known species of the genus and was cultivated in Europe as early as in the seventeenth century and has been known as Hottentot fig.

*Mesembryanthemum edule* L. was based on *M. acinaciforme* L.  $\beta$  *flavum* L. which in its turn was based on *Mesembryanthemum falcatum majus flore amplo luteo* Dill. and *Ficoides* s. *Ficus aizoides africana major procumbens, triangulari folio, fructu maximo eduli* Herm. Hermann's name was excluded from the synonymy by Haworth in 1803, so that the name and figure of Dillenius became the lectotype.

Moss, loc. cit., distinguished three varieties of *Mesembryanthemum edule* naturalized in Britain under the names *M. edule* L. var. *flavum* (L.) Moss, *M. edule* var. *virescens* (Haw.) Moss and *M. edule* var. *aequilaterum* (Haw.) Moss. The nomenclatural type of the first is the same as of *M. edule*; the second is based on *M. virescens* Haw. but the plant figured to which the name was intended to apply is apparently one of *C. edulis* with withering flowers. The third name is based on *M. aequilaterum* ("aequilaterum") Haw. but I do not know what plant Moss had in mind.

The following collections appear to represent a hybrid between *C. edulis* and *C. virescens*:

WESTERN AUSTRALIA.—SOUTH-WEST PROVINCE: Darling District—Cape Peron, Aug. 1959, *Blake* 20643 (v. fl.; Oct. 1963, *Blake* 22126); Bunbury, Sept. 1959, *Blake* 20982 (v. fl.; Oct. 1963, *Blake* 22127).

The plants have somewhat narrower leaves than *C. virescens*, scabrous-crenulate on the keels for a short distance below the upturned part, the sepals scabrous-crenulate on keels, keels of the calyx-tube mostly smooth, the smaller sepals dotted to the margins as in *C. edulis*, the petals (about 150–170) abruptly pale but distinctly yellowish at base, the remainder opening yellowish becoming mallow purple on about the third day and remaining this until withering, with the streaks mostly in a median band, and about 350–450 stamens with anthers 1.8–2 mm long; the pollen from the wild plants was 30% to 40% sterile but completely sterile and shrivelled on the cultivated plants.

**2. *Carpobrotus aequilaterus* (Haw.) N. E. Br. J. Bot. 66: 324 (1928). Based on *Mesembryanthemum aequilaterum*.**

*Mesembryanthemum aequilaterum* Haw. Obs. *Mesembryanthemum* 390 (1794) ("aequilaterum"), 477 (*aequilaterum*). Type: "I have been told, it is a native of the country about Botany Bay"; a plant cultivated in England of which no specimen was preserved but a drawing made later (K) to be accepted as neotype.

*Mesembryanthemum exile* Hort. ex Haw. loc. cit.

- Mesembryanthemum aequilaterale* Willd. Sp. Pl. 2/2: 1051 (1800); Haw. Misc. Nat. 77 (1803), Syn. Pl. Succ. 237 (1812), Rev. Pl. Succ. 120 (1821); Salm-Dyck, Monogr. *Aloes et Mesembryanthemi* fasc. 1, fig. 19 (1836); Johow, Rev. Chil. Hist. Nat. 49: 99 (1948) ("*Mesembrianthemum*"). Illegitimate name-change for *M. aequilaterum*.
- Mesembryanthemum chilense* Molina, Saggio sulla Storia Naturale de Chile, ed. 2, 133 (1810); Gay, Hist. Chile, Bot. 3: 7 (1847). Type: "Cresce nelle rive sabbiose del mar Chilense"; no specimen preserved. Neotype: San Sebastian, Chile, *Acevado de Vargas* (BRI.080352).
- Mesembryanthemum aequilaterale* "Haw." var. *decagynum* DC. Prodr. 3: 429 (1828). Type: Based on *M. aequilaterale*  $\beta$  Haw. Syn. Pl. Succ. 237 (1812)—"Communicavit Dom. Howard. Introd. circa 1801"; no specimen preserved.
- Mesembryanthemum aequilaterale* "Haw." var. *chiloense* Salm-Dyck, Monogr. *Aloes et Mesembryanthemi* fasc. 5, fig. 16 (1849). Type (lectotype): Salm-Dyck's plate.
- Mesembryanthemum chiloense* Hort. ex Salm-Dyck, loc. cit. in syn.
- Mesembryanthemum edule* L. var. *equilaterum* (Haw.) Moss, Cambr. Brit. Fl. 2: 151 (1914). Based on *M. "equilaterum"*.
- Carpobrotus chilensis* (Molina) N. E. Br. J. Bot. 66: 324 (1928); P. Wilson, North Am. Fl. 2 (4): 277 (1932). Based on *Mesembryanthemum chilense*.
- Carpobrotus disparilis* N. E. Br. J. Bot. 66: 323-4 (1928). Type: Plate and description in Salm-Dyck, Monogr. *Aloes et Mesembryanthemi* fasc. 1, fig. 20 (1836) (as *Mesembryanthemum virescens*).
- Carpobrotus aequilateralis* (Willd.) J. M. Black, Trans. & Proc. Roy. Soc. S. Aust. 56: 40 (1932). Based on *Mesembryanthemum aequilaterale*.

Stems up to 2 m long, 2-10 mm thick, young parts greenish,  $\pm$  compressed, older parts brown, polygonal with acute to almost wing-like angles, these finally weathering away; flowering branches not sharply distinct from sterile branches, ascending, 3-15-noded, branching from some or all nodes before flowering is over, the branchlets sometimes flower-bearing, internodes 0.5-5 cm long. Leaves dull green or somewhat glaucous, very slightly shining, nearly straight to decidedly incurved, gradually narrowed from about the middle or from near the base, about equilateral near the middle, thicker than wide upward, the keel nearly parallel to the edges for the greater part or somewhat divergent in the upper part, gradually to abruptly upturned to the tip, faces slightly convex to nearly flat or especially the top slightly concave, margins smooth or (especially the keel) slightly crenulate towards the tip, 3.5-9 cm long, 5-12 mm wide and thick, (5-) 6-12 times as long as wide or thick. Flower about 3.5-8 cm wide, pedicellate; pedicel 0.5-4 cm long,  $\pm$  compressed, ancipitous. Calyx-tube compressed turbinate, 2-edged

or  $\pm$  2-keeled with smooth or  $\pm$  crenulate edges, 12–25 mm long, 10–21 mm wide, 7–17 mm thick; longer sepals (0.6–) 1.5–5 cm long,  $\pm$  denticulate on keel, the margins very thin when dry, the membranous part of the smaller sepals densely dotted chiefly close to the herbaceous part and sparsely so to the veined area or nearly to the edge. Petals about 70–150 in about 3 series, obtuse to acute or acuminate in outline, entire or  $\pm$  denticulate, light purple throughout or pale to whitish near the base, 11–35 mm long, 0.5–2 mm wide, when dry much but not densely streaked over the greater part with brown raised lines and a few glistening white ones. Stamens about 150–400 in 4–6 series; filaments (1–) 2–8 mm long, yellow upwards or the outermost sometimes pink, outer and intermediate series sometimes even the innermost series with some broad or clavate non-septate hairs; anthers 1–2 mm long. Styles 7–11, about 3–8 mm long. Ovary descending convex to  $\pm$  convex on top. Fruit purple,  $\pm$  obovoid to  $\pm$  ellipsoid, abruptly sharply 2-edged, passing rather gradually into the pedicel, 15–30 mm long, 15–25 mm wide, 14–20 mm thick. Seeds broadly elliptic to subrotund or obovate and sometimes oblique with the endosperm edge less curved to nearly straight near the middle, scarcely emarginate, compressed with the embryo edge slightly the thicker and nearly flat sides, tip of radicle scarcely projecting, finely reticulate, 1–1.4 mm long, 0.75–0.95 mm wide, 1.25–1.7 times as long as wide.—Figs. 1 (G), 3, 12.

QUEENSLAND.—DARLING DOWNS DISTRICT: Stanthorpe, Dec. 1961 and Jan. 1962, *Taylor* (v. fl. fr.). MORETON DISTRICT: Brisbane, Dec. 1954, *Blake* 19788 (v. fl. fr.), Nov. 1961–Jan. 1962, *Blake* 21641 (v. fl. fr.), Dec. 1961, *Blake* 21658 (v. fl.).

NEW SOUTH WALES.—NORTH COAST: NW. of Singleton, July 1949, *L. Johnson* (NSW). SOUTH COAST: Tollgate Is., south island, Dec. 1958, *Warner* (v. fl. fr.); Mar. 1962, *Slater* (née *Warner*) C.S.248 (v. fl. fr.; Jan. 1963, *Blake* 22007). SOUTHERN TABLELANDS: Queanbeyan, Mar. 1956, *Pryor* (v. fr.); (Australian Capital Territory), Canberra, Nov. 1961, *Gray* (v. fl. young fr.).

VICTORIA.—GIPPSLAND: Gabo I., May 1922 (?), *hb. F. A. Rodway* 3810 (NSW), Feb. 1962, *John* (v. fl. fr.); Waratah Bay, Oct. 1954, *comm. J. H. Willis* (v.; Oct. 1955–Jan. 1956, *Blake* 19881). SOUTHERN DISTRICT: Point Lonsdale, Jan. 1962, *Clifford* (v.; Nov. 1963, *Blake* 22132).

TASMANIA.—North Breaksea I., Port Davey, Mar. 1954, *M. Davis* 1342 (MEL); Roaring Beach near Dover, Jan. 1961, *T. & J. Whaité* 2313, 2349 (NSW); Roaring Beach, Tasman Peninsula, Feb. 1960, *Thorne* (v. fl.; Oct. 1961, *Blake* 21640; Feb. 1963, *Blake* 22022); Eagle Hawk Neck, Feb. 1960, *Carolin* 1816 (SYD).

NEW ZEALAND.—SOUTH ISLAND: Oamaru, *comm. E. Edgar* 1963 (v.; Oct. 1966, *Blake* 22766).

CALIFORNIA.—Bodega, in 1841, *Hinds* (K); San Francisco, Mar. 1902, *Baker*, *Pl. Pacific Coast* 421 (K); Galida Beach S. of San Francisco, Apr. 1926, *Hall* 12235 (K); San Diego, Feb. 1927, *L. H. & E. Z. Bailey* 9184 (K), Sept. 1928, *Fleming in L. H. & E. Z. Bailey* 9199 (K), June 1927, *Fleming in hb. L. H. & E. Z. Bailey* 10379 (K); Del Mar, June 1962, *Moran* 9781, 9782, 9783, and July 1962, 9782A (all BRI).

MEXICO.—BAJA CALIFORNIA: El Consuelo, May 1962, *Wiggins* 17895 (BRI).

CHILE.—PROV. COQUIMBO: without further locality, in 1832, ? in *hb. Bentham* (K); La Serena,  $\pm$  10 m, Aug. 1924, *Werdermann Pl. Chilenses* 371 (K). PROV. CONCEPCION: San Sebastian, *Acevado de Vargas* (BRI). PROV. VALDIVIA: Valdivia in 1861, *Philippi* (K, MEL?); Chaguin, Dec. 1851, *Lechler* (K).

*C. aequilaterus* is native to the coastal sands of Chile from about 30° to 40° S. latitude according to Johow, loc. cit., and the specimens cited above (Fig. 12). According to Wilson, loc. cit., it has been introduced to California and Oregon but Campbell and Wiggins, Stanford Univ. Publ. Biol. Sci. 10: 17-18 (1947) included it in a long list of species native to both California and Chile but absent from intervening areas. It is naturalized in New Zealand, southern New South Wales, eastern Victoria and Tasmania, and it has been planted in New South Wales and recently in SE. Queensland to control erosion on embankments; the specimens cited from Queensland are from two gardens. It was evidently cultivated in England and Germany but according to Rowley (*in litt.*) it is not now known in England.

*C. aequilaterus* is distinguished by its narrow leaves more or less gradually acute in profile and the weakly differentiated often many-noded flowering branches carrying flowers with purple petals paler but not white at the base. The stems and leaves are often very slender, the smaller sepals are dotted at least half-way across the membranous margin and the dry petals tend to be streaked over the greater part.

As mentioned early in this paper, the name *Mesembryanthemum aequilaterale* was applied to all Australian plants and Bentham also treated the American plants as conspecific. Bentham's opinion was generally accepted until N. E. Brown drew attention to the distinctness of what he called *Carpobrotus aequilaterus*. Brown treated *C. chilensis* and *C. disparilis* as distinct, but from the evidence now available it appears that all three names refer to one species, variable, in stoutness, but not extraordinarily so. Brown based the name *C. disparilis* on Salm-Dyck's figure and description of a plant misidentified as *M. virescens*; publication of the name is validated in the key.

On the other hand, slender plants of *C. rossii* are much like some plants of *C. aequilaterus*, but the former has better differentiated flowering stems, leaves tending to be thicker than wide about the middle with the keel usually more abruptly upturned to the tip and smooth almost or quite throughout, sepals dotted only close to the herbaceous part, petals streaked only along the mid-line, prominently white towards the base, and much narrower seed with the embryo edge the less curved.

In the absence of original specimens and early figures the best studied specimen from Chile has been selected as the neotype of *M. chilense*. It is, however, possible that the epithet *chiloense* in *M. chiloense* and *M. aequilaterale* var. *chiloense* is a mistake for *chilense*; the island of Chiloe is a little to the south of the range of distribution given above. The name *M. edule* var. *aequilaterum* was discussed under *M. edule*.

3. ***Carpobrotus glaucescens*** (Haw.) Schwantes, Gartenflora 77: 69 (Feb. 1928); N. E. Br. J. Bot. 66: 324 (Nov. 1928). Based on *Mesembryanthemum glaucescens*. Combination published independently by Brown.

*Mesembryanthemum glaucescens* Haw. Syn. Pl. Succ. 236 (1812), Rev. Pl. Succ. 120 (1821). Type: "Habitat in Nova Hollandia . . . Introd. circa 1804. Communicavit Reverend Dom. Kirby". No specimen preserved. Neotype: *Blake* 19677 (BRI.080357-9).

Stems up to 2 m long, (4-) 5-10 mm thick, the older parts reddish brown; flowering branches ascending to erect, (2-) 3-5 (-7)-noded with internodes up to 3 cm or more long but often very short, usually not branching until the flower has withered. Leaves slightly glaucous, straight or  $\pm$  incurved, gradually acute from about or below the middle as seen from above and sometimes curved; in side view the keel nearly straight and parallel with the margins for the greater part to near the tip where it is more or less abruptly upcurved and as thick or almost as thick as wide, rarely slightly thicker and usually in the upper part only, sometimes narrowed to the base; upper surface flat above the callus, sides flat in the upper part often  $\pm$  convex towards the base, the edges thin, smooth or the upcurved part of the keel somewhat crenulate, mostly 3.5-10 cm long, with the sides 0.9-1.5 cm wide, mostly 4-8 times as long as wide. Flowers subsessile to distinctly pedicellate with the pedicel up to 2 (rarely 3) cm long, 4-6 cm diam. Calyx-tube suboblong with nearly parallel edges at least about the middle to subcampanulate, rounded at base, slightly expanded at top, slightly wider than thick, the edges acute but not winged, 15-25 mm long, 14-20 mm wide, 12-16 mm thick. Sepals 5, the longer ones 16-40 mm long with the keel entire or obscurely crenulate in upper part, the others dotted to about half-way across the membranous margins or less. Petals about 100-150 in 3-4 series, light purple, shading to white at and near the base, obtuse to acute in outline, usually irregularly 2-3-denticulate or erose, 1.6-3 cm long, 1-2 mm wide, streaked only close to the mid-line when dry. Stamens about 300-400 in 5-6 series; filaments about 3-5 mm long, yellow to orange in the upper part, paler to white or purplish towards the base, clavellate hairs sometimes present in the beards of the outer series; anthers 1.2-2.1 mm long. Ovary descending convex on top; styles 7-10, 7-12 mm long. Fruit sessile or pedicellate, red to purple, oblong and nearly cylindrical or somewhat ellipsoid, slightly compressed and 2-ribbed, rather abruptly narrowed to the pedicel if present, 2-3 cm long, 1.6-2.4 cm wide, 1.4-2 cm thick. Seeds light brown, obliquely obovate or somewhat broadly so or broadly somewhat elliptic, with the edge against the endosperm commonly nearly straight about the middle or for the greater part and gradually thinning to this edge, irregularly lenticular or subtrigonous often with at least one side depressed about the middle, minutely reticulate-punctulate, 1.05-1.3 mm long, 0.75-0.95 mm wide, about 1.3-1.5 times as long as wide; embryo occupying the greater part of the seed; radicle slightly protruding.—Figs. 1 (A, H), 4, 5, 14.

QUEENSLAND.—PORT CURTIS DISTRICT: Percy Is., in 1859, *Denham* (K); Keppel Sands, E. of Rockhampton, Mar. 1957, *Bellert* (v. fl.); near Rockhampton, *Jones* 445; Rat I. near Gladstone, Dec. 1959, *McKenzie* (v. fl.); coast [about NE. of] Rosedale, May 1937, *Dovey* (BRI). WIDE BAY DISTRICT: Sandy C., Fraser I., Apr. 1966, *Blake* 22678 (v. fl.); Fraser I., Nov. 1930, *Hubbard* 4794 (K); about 17 miles SSW. of Double Island Point, Oct. 1964, *Everist* 7719 (BRI); Teewah, NNW. of Noosa Head, Apr. 1954, *Blake* 19278 (v. fl.; Nov.

1954, *fr.*); Noosa Head, May 1951, *L. A. S. Johnson* (NSW); near (S. of) Noosa Head, Aug. 1956, *Blake* 20033 (*v. fl.*); about 4 miles SW. of Noosa Head, Oct. 1968, *Baxter & Lebler* 1114 (BRI). MORETON DISTRICT: Coolum Beach, Jan. 1954, *Blake* 19250 (*v. fl. fr.*); Nov. 1955, *Blake* 19884; Nov. 1961, *Blake* 21638); near Coolum Beach, Oct. 1954, *A. McDonald* (BRI); Point Arkwright, Jan. 1955, *Everist* (*v. fl.*); near Point Cartwright, bank of Maroochy R., Nov. 1960, *Blake* 21437 (*v. fl.*); Caloundra, Dec. 1961, *Blake* 21656 (*v. fl. fr.*); Deception Bay, Nov. 1932, *White* 8685 (BRI); Scarborough, near Brisbane, Jan. 1934, *Blake* 5047 (BRI); Moreton I., *Shirley* (BRI), May 1934, *Blake* (photo only BRI); between Amity Point and Point Lookout, Stradbroke I., Apr. 1930, *Hubbard* 2317 (K); Swan Bay, Stradbroke I., Jan. 1962, *Baxter* (*v. fl. fr.*); Jumpinpin, on small island, Oct. 1954, *Pedley* (*v. fl. fr.*); Southport, Feb. 1953, *Cribb* (*v. fl. fr.*); Mar. 1954, *Blake* 19251A, Sept.–Nov. 1954, *Blake* 19678; seedling from this, Nov. 1960, *Blake* 21439); Mermaid Beach, Dec. 1961, *Blake* 21653 (*v. fl. fr.*); Currumbin, *O'Brien* 4866 (BRI).

NEW SOUTH WALES.—NORTH COAST: Bogonor Headland, 28° 21' S., Feb. 1961, *Caulfield & Trapnell* (*v. fl.*); Byron Bay, Apr. 1961, *Trapnell* A.169 (*v. fl.*; Nov. 1961, *Blake* 21639); Richmond R., *Fawcett* C.3 (MEL); Iluka, Dec. 1961, *Pedley* 945 (*v. fl. fr.*); new entrance to Macleay R., Oct. 1959, *L. Johnson in NSW.56484 and NSW.56485* (NSW); Tiona, Oct. 1951, *Garden in NSW.19201* (NSW); Newcastle, Sept. 1912, *Cleland* (AD). CENTRAL COAST: Cowan Creek near Hornsby, June 1916, *Blakely* (NSW); North Bondi, May 1951, *L. A. S. Johnson* (NSW); Lady Robinson's Beach, Brighton-le-Sands, July 1912 and Jan. 1913, *A. A. Hamilton* (NSW); Sandringham (Botany Bay), Aug. 1952, *Blake* (*v.*; Nov. 1953, *Blake* 19239; Sept.–Nov. 1954, *Blake* 19677); La Perouse, Dec. 1959, *Carolin* 1092 (SYD); C. Solander, Oct. 1945, *L. A. S. Johnson* 276 (NSW); Cronulla, Aug. 1933, *Tillyard* (SYD); Five Islands, July 1961, *Davies & Rowley* (*v. fl.*); Five Islands, northern island, July 1938, *F. A. Rodway* 3814 (NSW); Five Islands, island No. 2, July 1938, *F. A. Rodway* 3813 (NSW); Windang I., Lake Illawarra, Sept. 1937, *C. Davis in Hb. F. A. Rodway* 3808 (NSW); Stack I., mouth of Minnamurra R., Mar. 1939, *F. A. Rodway* (NSW). SOUTH COAST: Bowen I., Jervis Bay, Nov. 1919, *F. A. Rodway* 3806 (NSW); Conjola, Sept. 1898, *Heron* (NSW); Tabourie I., Jan. 1940, *F. A. Rodway* 3807 (NSW); Brush I., Aug. 1936, *F. A. Rodway* 3811 (NSW), 3812 (NSW); Tathra, Oct. 1952, *M. Mueller* 906 (MEL); Disaster B., Oct. 1954, *Constable in NSW.32166* (NSW, K).

NORFOLK I.—In 1884, *I. Robinson* 98 (MEL); Aug. 1957, *Quintal* (*v. fl. fr.*).

*Carpobrotus glaucescens* is a coastal species (Fig. 14) growing over rocks as well as sand. McDonald's specimen from near Coolum Beach was collected some little distance inland on disturbed sandy soil. In the same area I saw it inland on top of a low rocky peak (Mt. Peregian) (Qd Nat. 10: 111 (1938) as *Mesembrianthemum aequilaterale*).

It is on the whole a stout  $\pm$  glaucous plant, with commonly short internodes, thick aequilateral leaves sometimes noticeably thicker in the upper part, frequently sessile flowers with the edges of the calyx-tube partly parallel or nearly so, many stamens, subcylindrical fruit, and prominently oblique seeds with relatively small endosperm; the flowering branches do not branch much until the flower has withered but occasionally two fruits are found close together. Fig. 5 (2) shows an unusual situation in which a mature fruit is flanked by an immature fruit and a bud. In habit, it resembles *C. virescens* but flowers, fruit and seed differ as given in the key. *Blake* 21439 has unusually slender stems in parts only 2.5 mm thick but this was from a very young plant.

Living plants of *C. glaucescens* and *C. aequilaterus* are readily distinguished, the latter being on the whole more slender with relatively narrower usually less glaucous leaves, much more acute in profile, sometimes more scabrous on the keel, much less sharply differentiated often several-noded flowering branches, more turbinate often smaller calyx-tube, petals paler but not white at the base, and more obovoid fruit, but herbarium specimens, especially if scanty, may be much more difficult to discriminate. The streaking of the petals is more effuse in *C. aequilaterus* which also has a tendency to have seeds more variable in form within the same fruit, less frequently D-shaped and often more symmetrical than *C. glaucescens*. Some of the meagre specimens from the southern coast of New South Wales cited above may not belong.

On historical grounds this would be the most likely one to be described by Haworth as *M. aequilaterum* if his locality was correct, but the stoutness of the plant and the white bases of the petals do not accord while his account of *M. glaucescens* agrees very well. It is almost certain that material from Sydney or its neighbourhood would have been sent to England and for this reason I have selected as neotype a specimen from a plant grown from material from Botany Bay.

Unlike other species *C. glaucescens* (at least in south-eastern Queensland) may be found in flower at different times throughout the year.

**4. *Carpobrotus virescens* (Haw.) Schwantes, Gartenflora 77: 69 (Feb. 1928).**

Based on *Mesembryanthemum virescens* Haw.

*Carpobrotus abbreviatus* (Haw.) Schwantes, Gartenflora 77: 68 (1928).

Based on *Mesembryanthemum abbreviatum*.

*Mesembryanthemum virescens* Haw. Syn. Pl. Succ. 236 (1812), Rev. Pl. Succ. 120 (1821). Type: "Habitat in Nova Hollandia . . . Introd. circa 1804 [Communicavit Reverend Dom. Kirby]." No specimen preserved. Neotype: Blake 20910 (BRI.080355-6).

*Mesembryanthemum abbreviatum* Haw. Phil. Mag. 68: 329 (1926); Salm-Dyck, Monogr. *Aloes et Mesembryanthemi* fasc. 5, fig. 7 (1849). Type: "Habitat in Australasia . . . Vigebat in regio horto Kewense A. D. 1825;" no specimen; drawing (K) apparently lost. Neotype: Salm-Dyck's figure.

*Mesembryanthemum edule* L. var. *virescens* (Haw.) Moss, Cambr. Brit. Fl. 2: 151 (1914), quoad basionym *M. virescens* Haw.

Stems up to 1.5 m long, 6-11 mm thick, the old ones whitish; flowering branches 4-7 (-8)-noded, branched, the internodes 0.5-3 cm long, conspicuous or not. Leaves green rather than glaucous,  $\pm$  incurved to straight, gradually acute from about the middle or lower down, in side view the greater part of the keel parallel with the edge and  $\pm$  shortly abruptly upturned to the tip, about equally triquetrous or if not then very slightly thicker than wide, the top slightly concave below to slightly convex towards the tip, the sides slightly convex, the

upturned part of the keel irregularly crenulate, the margins otherwise smooth, mostly 3.5–5 cm long, top and sides 9–17 mm wide, 3–6 (–8) times as long as wide. Flowers subsessile to conspicuously pedicellate, about 4–6 cm wide; pedicel about 5–15 mm long, 2-edged but not much compressed. Calyx-tube  $\pm$  turbinate,  $\pm$  gradually narrowed to the pedicel in side view, less so in edge view with the sides often shortly parallel, 2-edged with the edges obtuse, not very prominent, smooth and sometimes shortly parallel, very little compressed and  $\pm$  subtetragonous, about 15–20 mm long, 14–18 mm wide and 13–18 mm thick. Sepals 4 or 5, the longer ones about 12–22 mm long, the smaller ones dotted only close to the herbaceous part. Petals about 80–120 in 3–4 series, purple or light purple shading to white near the base, more or less rounded to obliquely subacute in outline, entire or irregularly denticulate at the tip, about 2–2.7 cm long, 1–2.3 mm wide, when dry streaked close to the mid-line. Stamens about 250–300 in 4–5 series; filaments 2–7 mm long, pinkish to white (or yellow, Geraldton, *Butler*), a few of the hairs sometimes clavellate, not streaked when dry; anthers 1.4–2 mm long. Ovary flat or slightly downwardly convex on top; styles 7–10, about 5 mm long. Fruit purplish red at maturity, subsessile or pedicellate, broadly oblong-ellipsoid to subglobose, 2–3 cm long, 2–2.8 cm wide, as thick or almost as thick as wide; seeds  $\pm$  obliquely obovate to elliptic obovate often nearly symmetrical, the sides  $\pm$  turgid, the edge against the embryo commonly less curved, subplanoconvex, the radicle shortly extended, 1.35–1.65 mm long, 0.85–1.1 mm wide, 1.4–1.6 times as long as wide.—Figs. 1 (I), 6, 14.

WESTERN AUSTRALIA.—SOUTH-WEST PROVINCE:—without definite locality, *Drummond* (MEL). IRWIN DISTRICT: mouth of Murchison R., *Oldfield* (MEL, K), Aug. 1960, *Butler* (v. fl.); Murchison R., 25 miles upstream from coast, Aug. 1960, *Butler* (v. fl.); North I., Houtman's Abrolhos, Sept. 1959, *Storr* 2246 (PERTH); near Horrocks Beach, W. of Northampton, Apr. 1960, *Marchant* (BRI); Geraldton, Aug. 1960, *Butler* (v. fl.). DARLING DISTRICT: Yanchep Beach, 32 miles N. of Perth, Aug. 1960, *Butler* (v. fl.), Jan. 1963, *R. W. Johnson* (v. fr.); City Beach, 4 miles N. of Perth, Oct. 1955, *Brittan* (v. fl.); Swan R., *Drummond* (K); near Swan R., *Oldfield* (MEL); near Fremantle, Dec. 1838, *Preiss* 1908 (MEL); Cape Peron (S. of Fremantle), Aug. 1959, *Blake* 20642 (v. fl.), Aug. 1961, *Carolin* 3192 (SYD); Garden Island, Aug. 1959, *Blake* 20644 (v. fl.). AVON DISTRICT: Mt. Caroline, in 1886, *Sewell* (MEL). WARREN DISTRICT: Cape Leeuwin, Jan. 1963, *R. W. Johnson* (v. fr.); Windy Harbour, near D'Entrecasteaux Pt., Mar. 1961, *George* 2329 (v.). STIRLING DISTRICT: Albany, Sept. 1959, *Blake* 20910 (v. fl., fr. in Dec.), Nanarup, Dec. 1958, *Brittan* (v. fl. fr.). EYRE DISTRICT: Bremer B., Nov. 1943, *Gardner* (PERTH); near Hopetoun, Feb. 1960, *George* 529 (v. fr.); Esperance, Mar. 1956, *Daw* (v.; Dec. 1957, *Blake* 20189; Nov. 1958, *Blake* 20485), Sept. 1961, *Carolin* 3192 (SYD); below SW. side of Mt. Ragged, Dec. 1960, *George* 2029 (v. fl.; Sept. 1961, *Blake* 21623).

Most of the specimens seen are from coastal localities either on rocks or on or between sand-dunes (Fig. 14). Three collections were collected at places more or less remote from the coast, namely one of *Butler's* from the Murchison R. on sandstone cliffs, *Sewell's* collection from Mt. Caroline, and *George* 2029. White flowers are reported from *Storr* 2246 and some of *Butler's* material from the mouth of the Murchison R. ("white, pink and crimson flowers").



The outstanding characters of *C. virescens* are the general stoutness of the plants, the whitish colour of the older parts of the stem, about equally triquetrous relatively broad leaves, more or less turbinate, more or less tetragonous calyx-tube, commonly four rather than five sepals, petals white at base and commonly obtuse at the tip, stamens in 4–5 series with comparatively large anthers and beards of nearly exclusively slender moniliform hairs, broadly oblong-ellipsoid to subglobose fruit and obovate to somewhat elliptic seeds larger than those of other species and commonly less asymmetrical than those of other native species, though the edge against the embryo is commonly less curved than the other. This species has not grown well in Brisbane and the flowers are not so well known to me as those of the other native species. The original plant of *M. virescens* was very likely raised from material collected by R. Brown at King George Sound in January 1802; as neotype I have selected material collected from this locality that agrees with Haworth's description and with Brown's manuscript account of the plants there. Some of my material is a very close match for Salm-Dyck's plate of *M. abbreviatum* which I have selected as neotype of this name because Haworth's original drawing seems to have been lost. The plant described and figured by Salm-Dyck as *M. virescens* does not agree with Haworth's account and must be of another species as pointed out by Brown. Brown proposed the name *Carpobrotus disparilis* for it, but I believe it belongs to *C. aequilaterus*. The name *Mesembryanthemum edule* var. *virescens* was based on *M. virescens*, though it is probable Moss had in mind Salm-Dyck's figure. His own figure suggests that he had before him a piece of *C. edulis* with withering flowers.

5. *Carpobrotus rossii* (Haw.) Schwantes, *Gartenflora* 77: 68 (Feb. 1928); *N. E. Br. J. Bot.* 66: 325 (Nov. 1928). Based on *Mesembryanthemum rossii*. Combination published independently by Brown.

*Mesembryanthemum rossii* Haw. *Rev. Pl. Succ.* 120 (1821); Salm-Dyck, *Monogr. Aloes et Mesembryanthemi* fasc. 3, fig. 13 (1840). Type: "A seminibus e Van Diemen's Land ortum, A.D. 1820, a Dom. Gulielm. Ross, apud Stoke Newington, qui mihi communicavit." No specimen. Neotype: Salm-Dyck's figure.

Stems up to 1 m or more long, 3–11 mm thick; flowering branches ascending to erect, 3–5-noded with internodes 0.5–3 cm long conspicuous or not, tending to branch from all axils. Leaves glaucous,  $\pm$  incurved rarely nearly straight, sometimes curving to one side, gradually acute nearly from the base or from about the middle, in side view the greater part of the keel parallel with the edge, somewhat shortly upturned to the tip, as thick as, or more usually slightly thicker than wide with top and sides slightly convex, the upturned part of the keel minutely crenulate, the angles otherwise smooth, mostly 3.5–10 cm long, (6–) 7–10 (–11) mm wide on top, (6–) 8–11 mm wide on the sides, about 5.5–10 times as long as wide, and 4.5–8 times as long as thick. Flowers pedicellate, 3.5–5.5 cm diam., the pedicel compressed and ancipitous about (5–) 10–28 mm long, rarely short. Calyx-tube turbinate or oblong-turbinate, tapering to the pedicel, much compressed downwards, prominently 2-edged with acute smooth edges,

(10-) 12-18 mm long, 12-16 mm wide, 10-15 mm thick at the top. Sepals 5 rarely 4, the longer ones 12-25 mm long, the smaller ones dotted only close to the herbaceous part. Petals about 60-160 (-200), 3-4-seriate, light purple shading to white in the lowermost  $\frac{1}{2}$ , more or less acute to more or less obtuse and often obliquely so, entire or irregularly denticulate, about 2-2.7 cm long 1.7-2 (-2.5) mm wide, streaked only close to the mid-line when dry. Stamens about 100-250 in 3-4 series; filaments 2-4.5 mm long, white (or the outer pale pink) below, cream or light yellow upwards, the second or third series sometimes with many clavellate hairs, not streaked when dry; anthers 0.9-1.6 mm long; ovary flat to somewhat convex and green on top; styles (6-) 7-10, about 3-4.5 mm long. Fruit purplish red or nearly carmine, long (rarely shortly) pedicellate, turbinate in front view with the two edges prominent, globose-ellipsoid in side view, 1.6-2.2 cm long, 1.5-1.8 cm wide, 1.3-1.6 cm thick, sometimes as thick as wide. Seeds  $\pm$  narrowly obovate, thinly  $\pm$  biconvex, smooth, 1.1-1.4 mm long 0.6-0.8 mm wide, (1.5-) 1.6-1.9 times as long as wide, the edge against the embryo sometimes less curved than that against the endosperm, or even shortly straight to somewhat concave, not thicker, and if anything, more acute than the latter.—Figs. 1 (J), 7, 14.

WESTERN AUSTRALIA.—EREMAEAN PROVINCE:—AUSTIN DISTRICT: Carnarvon, Sept. 1963, *Hutchinson* (v. fl.). SOUTH-WEST PROVINCE:—IRWIN DISTRICT: Bernier I., July 1959, *Royce* 5970 ( $\frac{1}{2}$  v.); Peron Peninsula, Aug. 1961, *Carolin* 3301 (NSW). STIRLING DISTRICT: Nancy Peak, Porongorup Range, 600 m, Oct. 1959, *G. G. Smith* (v. fl.), Sept. 1963, *Willis* (v. fl.).

SOUTH AUSTRALIA.—WEST COAST: S. of Wigunda Gate, Jan. 1963, *R. W. Johnson* (v. fr.); Bight Well, Nov. 1955, *Cleland* (v. fl. fr.); Fowler's Bay, Nov. 1955, *Cleland* (v. fl.), Feb. 1954, *Womersley* (v. old fl.); June 1954, *Blake* 19284, Sept.-Nov. 1954, *Blake* 19676); S. of Penong, Jan. 1963, *R. W. Johnson* (v. fr.); Pt. Sinclair, Sept. 1959, *Symon* (ADW), Sept. 1960, *Wilson* 1584 (AD); Denial B., Sept. 1960, *Wilson* 1531 (AD, K); Pearson I., Jan. 1923, *Osborn* (NSW); Middle Pearson I., Nov. 1960, *Specht* 2196 (AD). EYRE PENINSULA: Spalding Cove, W. of Cape Donington, Sept. 1958, *Wilson* 315 (AD); Fishery B., SW. of Port Lincoln, Nov. 1960, *Symon* 953 (ADW); Sleaford Bay, Nov. 1960, *Specht* (v. fl.). YORKE PENINSULA: Port Hughes, Dec. 1935, *J. M. & A. D. Black* (AD); about 3 km S. of Pondalowie Bay, Jan. 1961, *E. N. S. Jackson* 330 (AD). KANGAROO I.: C. Borda, Nov. 1958, *Wilson* 695 (v. fl.); West B., Flinders Chase, Nov. 1958, *Eichler* 15525 (v. fl., AD); Kingscote, Sept. 1955, *Cleland* (v. fl.); near Kingscote, Oct. 1960, *G. Jackson* 63 (v. fl., Sept.-Nov. 1961, *Blake* 21611). ADELAIDE PLAINS: Holdfast Bay, Dec. 1850, *Mueller* (MEL); Outer Harbour Nov. 1960, *Eichler* 17064 (v. fl., AD; Oct. 1961, *Blake* 21622), Jan. 1911, *Black* (AD); near Osborne, Port Adelaide, Dec. 1930, *Ising* (AD); Semaphore, Sept. 1932, *Black* (AD); Findon, Sept. 1882, *Tate* (AD); Hexley Beach, Aug. 1918, *Ising* (AD); Glenelg, Dec. 1903, *Hb. Black* (AD); S. of Glenelg, Dec. 1912, *Hb. Black* (AD); Brighton, Nov. 1924, *Black* (AD); Somerton, Feb. 1954, *Jackman* (v. fr.; Nov. 1954, *Blake* 19709, Oct.-Nov. 1955, *Blake* 19883); Clarendon, Oct. 1913, *Hb. J. M. Black* (AD); seashore near mouth of Inman R., Jan. 1934, *Hb. J. M. Black* (AD); Victor Harbour, cult. Adelaide, Nov. 1934, *Black* (AD). MT. LOFTY RANGE: Emu Downs, Sept. 1934, *Hopf* (AD, K). MURRAY MALLEE: Mannum, Aug. 1954, *Cleland* (v.); Sept. 1955, *Blake* 19875); Murray Bridge, Sept. 1954, *Specht* (v. fl. fr.; Sept. 1955, *Blake* 19873); near Murray Bridge, Aug. 1958, *Blake* 20451 (v. fl.; Nov. 1960, *Blake* 21406). SOUTH COAST: 8 miles S. of Meningie, facing Coorong, Oct. 1954, *Specht & Chippendale* (v. fl.); Beachport, Dec. 1917, *Hb. J. M. Black* (AD), Jan. 1925, *Ising* (AD). SOUTH-EAST: Cape Northumberland, Nov. 1959, *Wilson* 1350 (v. fl., AD).

VICTORIA.—WIMMERA: Without further locality, in 1893, *Matthews* (MEL). WESTERN DISTRICT: Wando Vale (N. of Portland), Sept. 1843, *J. G. Robertson* 441 (NSW); Lawrence Rock, Portland, Jan. 1954, *Beaulehole* 3144 (MEL); Cape Otway, Nov. 1955, *Willis* (v.); Cumberland R., Nov. 1955, *Willis* (v. fl.). SOUTHERN DISTRICT: Portsea, Nov. 1963, *Pedley* 1673 (v. fl.).

TASMANIA: Without further locality, *Gunn* 818 (K), *Hb. Archer* (NSW); King I., in 1877, *Spong* (NSW), in 1882, *Spong* (MEL), in 1931, coll.? (ADW), Sept. and Nov. 1961, *McGarvie* (v. fl.); Cape Wickham, King I., in 1885, *Dobson*; Flinders I., Nov. 1912, *Cleland* (AD); Harford, *Groome* (MEL); W. of Strahan, ocean beach, Jan. 1949, *L. A. S. Johnson* (NSW), Jan. 1960, *Thorne* (BRI); Blackman's Bay, near Hobart, Sept. 1955, *Curtis* (v. fl.); Grass Tree Hill, East Risdon (inland), Jan. 1960, *Thorne* (v. fr.); Bellerive, Jan. 1916, *F. A. Rodway* 3805 (NSW), Sept. 1955, *Curtis* (v. fl.).

*C. rossii* is predominantly coastal (Fig. 14), sometimes on rocky cliffs (*Specht* 2196, King I. in ADW, *Willis*) probably more usually on sands, ascending the Murray R. for a considerable distance to enter Mallee scrub (e.g. *Blake* 20451). *Thorne's* specimen from Grass Tree Hill, Tasmania, was noted as growing inland, and *Hopf's* specimen from Emu Downs, S.A., and *Robertson* 441 from forest land, Wando Vale, Victoria, are from decidedly inland localities.

The occurrence of this species in two widely separated areas in Western Australia so far from the main distribution cannot be easily explained. On Nancy Peak the species is abundant on granite slopes at 600 m; elsewhere in the Porongroups *C. modestus* has been collected and this is the species that would have been expected.

*C. rossii* is distinguished by usually slender stems, relatively narrow leaves usually evidently thicker than wide, turbinate calyx-tube much compressed towards the usually conspicuous pedicel, petals often predominantly acute in outline and conspicuously white in the lower fifth, the relatively few stamens often with many clavellate hairs, relatively small anthers, fruit little larger than the calyx-tube in flower, relatively narrow seeds with the edge against the embryo often less curved than that against the endosperm, and in habit; usually the flowering branches branch early with the branchlets flowering about the same time as the terminal flower, whereas in other species except *C. modestus* it is rare to find even two flowers or fruits on a flowering branch. Stout plants before flowering approach *C. virescens* in appearance but the leaves are decidedly narrower and much more commonly thicker than wide; *C. rossii* also has fewer stamens with, on the whole, smaller anthers and often fewer petals, the calyx-tube is much more compressed and the fruits and seeds much smaller; it is the only species in which the ripe fruit is not conspicuously larger than the calyx-tube in flower and it has the narrowest seeds.

The name was based on a plant raised from seed from Tasmania in 1820 that had not flowered when the original description was published. *Salm-Dyck's* account (and plate) do not disagree with this description and Tasmanian specimens agree with both although the very acute tips of the petals of the plate look as much like those of *C. modestus*. I have selected the plate as neotype.

**6. *Carpobrotus modestus*** S. T. Blake; species nova affinis *C. rossii* (Haw.)

Schwantes, sed fere omnibus partibus minoribus, tubo calycis fere oblongo, petalis pro genere paucis  $\pm$  acuminatis, staminibus 1–3-seriatis sine pilis clavellatis, seminis margine juxta endosperma saepe partim rectiusculo praecipue differt.—Typus: *Blake* 19876 ad Brisbane in horto auctoris culta ex Yumali, Australiae Australis a Specht missa (holotypus: BRI.080353–4).

Caules prostrati  $\pm$  repentes usque ad 35 cm longi, 3–6 mm crassi; rami florigeri 2–5-nodi saepius ex axillis omnibus mox ramigeri. Folia saepissime paullo crassiora quam lata per longitudinem fere aequae crassa vel sursum paullo crassiora, carina apicem versus gradatim vel abrupte incurva hic interdum crenulato-scabra vel marginibus omnibus laevia vel fere laevia, pro more 3.5–7 cm longa supra 4.5–7 mm lata, lateribus 4–9 mm crassa interdum asymmetrica, pro more 6–10-ies longiora quam lata vel 5.5–9-ies longiora quam crassa. Flores sessiles vel subsessiles raro distincte pedicellati, circa 2 cm lati. Calyci tubus suboblongus, leviter compressus, anceps marginibus acutis laevibus, apice leviter incrassatus, pro more 10–13 mm longus 8–11 mm latus 6–9 mm crassus. Sepala 5 raro 4, longiora 8–18 mm longa, breviora prope centrum herbaceum brunneo-punctata. Petala circa 45–60, 3-seriata, sursum purpurea basin versus alba, acuta, acuminata vel acute 2–3-dentata, 6–12 mm longa, 0.8–1.35 mm lata, in sicco secundum lineam medianam brunneo-virgata. Stamina circa 20–80, 1–3 seriata, 2–2.5 mm longa, exteriora interdum antheris carentia; filamenta sine pilis clavellatis, alba vel exteriora sursum incarnata; antherae 0.8–1.1 mm longa. Ovarium apice planum; styli 6–10, 2–3 mm longi, basi brevissime connati. Fructus  $\pm$  pedicellatus pedicello usque 7 mm longo, tandem purpureus, oblongo-ellipsoideus vel obovoideo-oblongus fronte visus,  $\pm$  ellipsoideus latere visus, anceps sed marginibus angustis vix prominentibus, 15–20 mm longus, 13–15 mm latus, saepissime fere isodiametricus. Semina dilute brunnea, obovato-oblonga interdum obliqua, valde compressa, marginibus aequaliter rotundata eo juxta endosperma saepe rectiusculo, lateribus fere plana vel  $\pm$  plano-convexa, 1–1.3 mm longa, 0.6–0.8 mm lata, 1.5–1.8-ies longiora quam lata.

Stems up to 35 cm long, 3–6 mm thick; flowering branches ascending to erect, 2–5-noded with the internodes 0.5–2.5 cm long, potentially branching from all axils. Leaves more or less glaucous or tinged reddish or brownish, incurved to nearly straight, sometimes, especially when young, also slightly laterally curved or twisted, mostly slightly thicker than wide with the top face flat, one side slightly convex and the other slightly convex to slightly concave and in the latter case asymmetric, acute in top view from about the middle or narrowing from near the base, about equally thick nearly throughout or slightly thickened in the upper part, the keel gradually to abruptly upcurved to the tip, the keel crenulate-scabrous towards the top or all edges nearly to quite smooth, mostly 3.5–7 cm long, 4.5–7 mm wide on top, 4–9 mm wide on the sides, mostly 6–10 times as long as wide, and 5½–9 times as long as thick. Flowers closely sessile or subsessile, rarely with pedicel up to 7 mm long, about 2 cm wide. Calyx-tube suboblong, shortly narrowed to pedicel if present, slightly compressed, 2-edged with acute smooth

edges, slightly thickened all round at the top, mostly 10–13 (up to 15) mm long, 8–11 (–13) mm wide, 6–9 mm thick. Sepals 5 sometimes 4, the longer ones 8–18 mm long, the smaller ones dotted close to the herbaceous part. Petals about 45–60 in 3 series, light purple, shading to white in the lower  $\frac{1}{4}$ – $\frac{1}{4}$ ,  $\pm$  erect at base,  $\pm$  spreading upwards, acute or acuminate or acutely 2–3-toothed, 6–12 mm long, 0.8–1.35 mm wide, streaked close to the mid-line when dry. Stamens about 20–80 in 1, 2 or 3 series, the outermost ones or some of them sometimes without anthers; filaments 2–2.5 mm long, not streaked when dry, white or the outer ones tipped pink and these also glabrous to the base, inner ones bearded at or near the base, the hairs neither clavellate nor moniliform; anthers cream or pale yellow, 0.8–1.1 mm long; ovary flat-topped, green; styles 6–10, 2–3 mm long, united into a short column 0.25 mm high. Fruit more or less distinctly pedicellate (pedicel 3–7 mm), finally purple, oblong-ellipsoid or obovoid-oblong in front view, more ellipsoid in side view, 2-edged but the edges narrow and not very prominent, 15–20 mm long, (11–) 13–15 (–17) mm wide, usually about as thick as wide. Seeds pale brown, obovate-oblong, sometimes obliquely so (with the edge against the endosperm somewhat straight about the middle), strongly compressed with equally thick edges, the sides nearly flat or one  $\pm$  distinctly convex especially towards the hilum, radicle shortly extended, (1–) 1.05–1.3 mm long, (0.6–) 0.65–0.8 mm wide, 1.5–1.8 times as long as wide.—Fig. 1 (K), 8, 13.

WESTERN AUSTRALIA.—SOUTH-WESTERN PROVINCE:—DARLING DISTRICT: Claremont, Sept. 1902, *Andrews* 383 (K). STIRLING DISTRICT: Wagin, Aug. 1959, *Blake* 20796 (v. fl.); 15 miles S. of Lake Grace, Sept. 1961, *Royce* (v. fl. fr.); Chester's Pass, Stirling Range, Nov. 1944, *Muir* (PERTH), "Braeside", Needalup, May 1962, *Seddon* (v. fr.). EYRE DISTRICT: N. side of West Mt. Barren, Nov. 1960, *George* 1804 (v. fr.; Oct.–Nov. 1961, *Blake* 21632); near Hopetoun, Nov. 1960, *George* 273 (v. fr.); 46 miles N. of Esperance, Jan. 1963, *R. W. Johnson* (v. fl. fr.).

SOUTH AUSTRALIA.—EYRE PENINSULA: Near Verran, Dec. 1959, *Cleland* (v. fl. fr.). ADELAIDE PLAINS: Warpo, E. of Gawler, Oct. 1927, *Ising* (AD). MURRAY MALLEE: Chauncey's Line Reserve near road to Monarto South, Sept. 1958, *Eichler* 14972 (AD, a young plant in fl.); Chauncey's Line near Monarto South, Sept. 1955, *Cleland* (v. fl. immature fr.); near Murray Bridge, Sept. 1954, *Specht* (v. fl. fr.; Sept.–Oct. 1955, *Blake* 19873); 4 miles W. of Murray Bridge, Aug. 1943, *Crocker* (ADW); Kinchina, near Murray Bridge, Oct. 1955, *Cleland* (v. old fl.); Karoonda, Jan. 1937, *Ising* (AD); near Wellington, Sept. 1954, *Cleland* (v. fl. fr.); about 8 miles N. of Lameroo, July 1957, *Cleland* (v.); Sept. 1958, *Blake* 20480; Sept. 1959, *Blake* 21012); Lameroo, *Lothian* (v.; Sept.–Oct. 1961, *Blake* 21633); Meningie Road, S. of L. Albert, Oct. 1955, *Cleland* (v. old fl.); Wood's Well, Coorong, Oct. 1955, *Cleland* (v. fl. fr.); Yumali, Jan. 1954, *Specht* (v. fr.; Dec. 1954, *Blake* 19786, Sept.–Nov. 1955, *Blake* 19876); Stirling Range, 5 miles ENE. of Keith, Jan. 1954, *Specht* (v.; Aug.–Nov. 1954, *Blake* 19675), Sept. 1954, *Specht* (v. fl. fr.); Coonalpyn Downs, Inglewood (near Bordertown), Oct. 1954, *Chippendale & Specht* (v. fl. fr.); Naracoorte, Sept. 1960, *Cleland* (v. fl.), South Australia, without definite locality or date, *Mueller* (MEL).

VICTORIA.—WESTERN DISTRICT: Grampians, between View Point Rock and Chatangua Peak, Nov. 1959, *Symon* 214 (ADW). SOUTHERN DISTRICT: Brisbane Ranges, S. of Bacchus Marsh, Sept. 1954, *Willis* (v. fl.; fr. in Nov.); Anakie, Aug. 1955, *Blake* 19848 (v. fl.); near Melton, Aug. 1955, *Blake* 19847 (v. fl.).

This is chiefly an inland species (Fig. 13) found in a variety of habitats—Eucalyptus forest on stony soil (*Blake* 19848, *Willis*), mallee (*Blake* 19847), mallee-heath (*Specht*, etc.), "sandplain" (heath, *Blake* 20796), sandy soil around salt lake (*Royce*).

Mueller's specimen from Holdfast Bay appears to have been collected on coastal sand dunes ("in syrtibus arenosis sinus Holdfast Bay"). It has fruit and the mostly immature seeds are those of *C. modestus* rather than the narrow ones of *C. rossii*; associated is a detached damaged, prominently pedicellate flower that could well belong to the coastal *C. rossii*.

*C. modestus* is well distinguished from all other species by the unusually small flowers with a transverse ridge at the top of the calyx-tube, few petals and stamens, and the beard on the filaments with neither clavate nor moniliform hairs. Especially flowers with only one or two series of stamens look at first sight quite unlike those of *Carpobrotus*, but those with three series show a transition to the condition found in *C. rossii*. Plants flower when quite small and these also look out of place in the genus, but well grown plants have quite the habit of some other species. The styles are very shortly united at the base but otherwise there is nothing in the pistil, fruit or seed to suggest that the species is wrongly placed in this genus. Other distinguishing characters are the slender stems and small narrow leaves usually a little thicker than wide and often asymmetric with one side convex and the other concave, and the usually sessile calyx-tube.

In its slenderness and sometimes few styles it approaches the description and figure of *C. aequilaterus* but the predominantly acute petals are white for a considerable distance above the base, the shape of the calyx-tube is different and the leaves are less acute in profile. From the presently known range of the species it is highly unlikely that it could have been introduced to England before 1800.

### Sarcozona

**Sarcozona** J. M. Black, Trans. & Proc. Roy. Soc. S. Aust. 58: 176 (1934).

Calyx 4–5-lobed with a  $\pm$  campanulate tube entirely adnate to the ovary but not produced above it, 2 of the lobes green and fleshy, leaf-like, shortly auriculate at the base, the others with broad scarious margins. Petals free, linear, 1–3-seriate. Stamens loose, 1–3-seriate, at least the inner (most) densely long-bearded towards the base with finely filiform many-celled hairs. Ovary completely inferior, 4–5-celled, each cell with a parietal placenta extending throughout its length and about half-way up the axis, with very numerous ovules on filiform funicles; styles 4–5, subulate trigonous, free or very shortly united at the base, stigmatic and papillose all over the inner side, the papillae coarser downwards. Disc annular. Fruit succulent, with as many cells as stigmas, indehiscent, crowned by the persistent sepals; seeds very numerous, exarillate, obliquely obovate or broadly so, with the edge against the endosperm concave to nearly straight about the middle, thickly lenticular to subtrigonous, rounded on the edges, loosely reticulate and verrucose, the reticulations elongated lengthwise;

embryo curved.—Succulent, glabrous, small shrubs reiterately branched from most or all the nodes with usually well exposed internodes, the branches erecto-patent or erect, but the lower ones at length prostrate rarely rooting at the lowermost nodes, the younger parts 2-edged, the older parts woody and  $\pm$  polygonal. Leaves opposite, sessile, exstipulate, those of each pair very much alike, narrow,  $\pm$  incurved, connate at the base sometimes for more than their thickness, acutely triquetrous and as thick or slightly thicker than wide, commonly asymmetrical with one side  $\pm$  convex and the other  $\pm$  concave, the upper surface with a slight transverse thickening against the stem otherwise flat to slightly convex, gradually narrowed from the base to near the more abruptly acute tip or  $\pm$  parallel-sided below the middle, the keel approximately parallel to the edges for the greater part, gradually or  $\pm$  abruptly upturned to the tip, pellucid-dotted with many of the dots tending to extend above the general surface, edges and keel not thickened but  $\pm$  verrucose or denticulate upwards, at length withering away leaving the connate bases as a persistent collar on the branches, the uppermost (or only) pair on the flowering branches frequently much more connate forming a cup-shaped 2-lobed involucre partly or nearly enclosing the flower and fruit, the free parts sometimes simulating sepals. Flowering branches 1 (–3)-noded. Flowers variable in size, light purple or very rarely white, opening during the day for about six days, solitary, sessile or subsessile within the involucre or sometimes solitary and pedicellate at the ends of branches from the topmost node of which axillary branches arise so that the flower soon comes to be in the fork. Sepals often subequal in length, the leafy ones deltoid in outline, triquetrous,  $\pm$  longer than the others which are broadly rounded. Petals white towards the base. Filaments white, at length  $\pm$  erect, those of the outer series (if more series than one) slightly dilated at the base, often glabrous; anthers narrowly oblong, yellow. Ovary green on top; loculi much higher than wide; funicles long, nearly horizontal, alternately up-curved and down-curved. Styles small, at first erect then lengthening and spreading, green. Disc not prominent. Fruit purplish or pallid, the fruiting involucre likewise coloured or withering. Seeds brown, small; embryo occupying about half the perimeter, the radicle extended. Epidermal cells of stems, leaves, calyx and seeds convex on outer surface, those of the stem and seeds longitudinally oblong.—Figs. 1 (C–E), 9–11.

Species two, in the drier parts of southern Western Australia, South Australia and western New South Wales (Fig. 15). Type: *Sarcozona pulleinei* (J. M. Black) J. M. Black (*Carpobrotus pulleinei* J. M. Black) = *S. praecox* (F. Muell.) S. T. Blake ex Hj. Eichler.

The parietal placentas extending up the central axis and indehiscent, succulent fruit suggest a close relationship with *Carpobrotus* which *Sarcozona* also resembles in leaf-form, sepals, shape, arrangement and colour of petals, stamens and nectary. It differs in the few papillose rather than plumose stigmas, verrucose seeds, more or less strongly convex outer wall of the epidermal cells, habit, and from nearly all species of *Carpobrotus* in the often small flowers and few stamens (Fig. 1). The plants of *Sarcozona* (Fig. 9) are mostly much smaller than is usual in *Carpobrotus*, more compact with little tendency to creep, showing no or but very

little tendency to produce distinct flowering branches, with leaves united to a greater extent at the base and these united bases persisting as collars on old stems, the uppermost pair often very much connate and enclosing part or most of the calyx-tube. Sometimes these leaves are so strongly connate with such short laminae that the latter look like two extra sepals as shown in Fig. 10 (2, 4). This involucre, when well developed, is very characteristic but is sometimes not very conspicuous, especially early in the season; in such cases a 1-noded shoot with a  $\pm$  strongly involucre flower commonly grows out from the axil of the subtending leaves. The pellucid dots of the leaves are larger and tend to give a papillose effect, at least on the sepals, that has not been seen in *Carpobrotus*.

In cultivation in Brisbane both species have flowered sporadically nearly throughout the year. Plants must be self-fertile or apomictic.

#### KEY TO SPECIES OF *SARCOZONA*

- Calyx-tube and fruit  $\pm$  terete, not prominently 2-keeled, commonly half or more than half hidden by the well developed involucre; petals commonly obtuse in outline; ovary  $\pm$  concave on top; styles mostly 4; fruit mostly longer than wide; seeds verrucose chiefly over the embryo; leaves with abundant raised dots..... 1. *S. praecox*
- Calyx-tube and fruit prominently and acutely 2-keeled, much or nearly quite exerted from the often ill defined involucre; petals acute or acuminate in outline; ovary  $\pm$  convex on top; styles usually 5; fruit  $\pm$  globose to depressed ovoid; seeds equally verrucose over most of the surface; leaves nearly smooth on the faces..... 2. *S. bicarinata*

1. ***Sarcozona praecox*** (F. Muell.) S. T. Blake ex Hj. Eichler, Suppl. Fl. S. Aust. 134 (1965). Based on *Mesembryanthemum praecox*.

*Mesembryanthemum praecox* F. Muell. Linnaea 25: 384 (1852) ("*Mesembrianthemum*"), non L. Bolus. Type: "In planitiebus subsalinis occidentalibus secus montes Flinders range", Oct. 1851, F. Mueller (MEL, holotype; photo, BRI).

*Carpobrotus pulleinei* J. M. Black, Trans. & Proc. Roy. Soc. S. Aust. 56: 40 (1932). Lectotype: Pine Creek near Broken Hill, N.S.W., A. Morris (AD, photo BRI; iso, K).

*Sarcozona pulleinei* (J. M. Black) J. M. Black, Trans. & Roy. Soc. S. Aust. 58: 176 (1934). Based on *Carpobrotus pulleinei*.

Plant  $\pm$  glaucous. Stems and branches 3.5–8 mm thick, almost terete and pale green when young with the internodes broadened upwards, finally striate-angular and light grey. Flowering branches mostly 1-noded. Leaves subcultrate-lanceolate in top view gradually narrowed from about the base and more abruptly so below the acute tip, apiculate or muticous, the keel about parallel to the edges and  $\pm$  abruptly upturned to the tip, 5–10 (?–12) times as long as wide, the faces somewhat convex or the top almost flat, all with prominent raised dots and closely rugulose-bullate, margins and keel irregularly denticulate to verrucose-denticulate, about 3–10 cm long, 4.5–7 mm wide and 5–8 mm thick. Involucre commonly enclosing the calyx-tube for more or much more than half the length of the latter,



somewhat turbinate and 2-ribbed, slightly compressed, rarely reduced, the lobes (leaves) about 5–30 mm long. Flower 2.5–6 cm diam. Calyx-tube subturbinate, terete or somewhat tetragonous, about (5–) 10–15 mm long and (6–) 8–10 (–12) mm wide; sepals 3.5–10 mm long. Petals 20–80, 4–28 mm long, 0.5–1.8 mm wide, acute, rounded or variously 2–3-denticulate at the tip, white towards the base (occasionally white throughout). Stamens 20–150 in 1–3 series; filaments 1–3 mm long, white; anthers 0.8–1.5 mm long. Ovary concave on top. Styles usually 4, 2.5–4.5 mm long, free or united up to 0.5 mm. Fruit enclosed for about half its length or more by the enlarged fleshy or marcescent involucre, 10–20 mm long and 8–16 mm wide. Seeds obovate, 0.85–1.15 mm long, 0.55–0.75 mm wide, (1.3–) 1.4–1.6 times as long as wide, verrucose chiefly over the embryo, less prominently so elsewhere.—Figs. 1 (C, D), 9, 10, 15.

WESTERN AUSTRALIA.—FREMAYAN PROVINCE:—AUSTIN DISTRICT: 3½ miles S. of Morawa, Aug. 1945, *Gardner* (PERTH); Lake Monger, Aug. 1960, *Gardner* (v. fl. fr.). COOLGARDIE DISTRICT: Southern Cross, Jan. 1906, *Morrison* 16013 (K); Norseman in 1897, *Batt* (MEL); 31° S., about 124° 30' E. which is between Kitchener and Naretha\*, Aug. 1901, *Anketel* (PERTH). Western Australia, without definite locality, in 1890, *Forrest* (MEL) and (probably South-West Province), *Drummond* (MEL, K).

SOUTH AUSTRALIA.—NORTH-WEST PLAINS: Lake Yarle, S. side, about 15 km N. of Watson, sandhills, Sept. 1960, *Wilson* 1761 (AD; v. fl.; Apr.–June 1961, *Blake* 21513); about 5 km N. of Ooldea, sandhills, Sept. 1960, *Wilson* 1784 (AD; v. fl.; Mar.–July 1961, *Blake* 21463); Ooldea, Nov. 1934, *Tindale* (AD), Aug. 1939, *E. C. Black* (AD), sandhills, Oct. 1954, *Cleland* (v. fl. fr.). FAR NORTH: Near Angle Swamp, SW. of Lake Eyre, Dec. 1960, *Symon* 1030 (sterile, ADW; cult. ADW, v. fl.; June–July 1961, *Blake* 21541); E. side of Lake Eyre, low undulating sandy country, in 1939, *Crocker* (AD); Leigh Creek, Sept. 1959, *Lothian* 352/59 (v. fl. fr.; Feb.–Oct. 1961, *Blake* 21452). EYRE PENINSULA: Gawler Range, Nonning, *Pulleine* (cult. 1932–1934 (? 1939, 1948 ?) *J. M. Black*) (AD, MEL, K); Gawler Range, Yandinga Falls N. of Minnipa, in rock crevice, Sept. 1958, *Wilson* 503 (AD); Port Augusta, North Beach, Aug. 1960, *Higginson* (AD; v. fl.; July–Oct. 1961, *Blake* 21539); Port Augusta, Oct. 1961, *Cleland* (v. fl.); Wudinna Hill, SE. of Minnipa, Sept. 1935, *Ising* (AD); between Whyalla and Kimba, Oct. 1954, *Cleland* (BRI); Whyalla, *Lothian* 289/56 (v.), 206/58 (v. fl.); Whyalla Knob, Sept. 1944, *Cleland* (AD). NORTHERN MOUNT LOFTY RANGE: Emu Downs S. of Burra, Sept. 1934, *Hopf* (AD); between Flinders Range and Spencer Gulf, subsaline plains, Oct. 1851, *Mueller* (MEL); Murray, *F. Mueller* (MEL). SOUTH AUSTRALIA OR QUEENSLAND: Near the Mulligan R. in 1885, *Cornish* (MEL).

NEW SOUTH WALES.—FAR WESTERN PLAINS: Pine Creek near Broken Hill, *A. Morris* (AD, K); Broken Hill, Sept. 1933, *A. Morris* (AD, K), Oct. 1933, *A. Morris* (AD).

VICTORIA.—MALLEE: Near Sunnyclyffs, ± 2.5 miles NW. of Red Cliffs, July 1968, *Willis* (v. fl.).

This species appears to be usually a sand-dweller, but *Wilson* 503 is from rock crevices. It varies chiefly in the number and length of petals and the number of stamens. Petals and stamens vary independently from one another and both organs vary much in flowers from the same plant. For example, in *Blake* 21452 (Fig. 10), the number of petals varied from 50 to 60, the longer ones varied in

\* The label reads "Muir's Surv. Tr. R.8, 18 Aug. 1901". According to Muir's "Report on country between Kalgoorlie and Eucla" in Minutes and Votes and Proceedings of Parliament (Western Australia) 1901–2, 3, No. 42: 6 (1901) he would have been at the locality given above on 18th August.

length from 9 to 15 mm and number of stamens from 40 to 65; the original plant (*Lothian* 352/59) had about 50 petals 7–9 mm long and about 65 stamens. *Wilson* 1784 had 65–80 petals 8–11 mm long and 70–90 stamens; in cultivation (*Blake* 21463) it had 53–57 petals the longer of them 16–24 mm long and about 100–150 stamens. On Batt's specimen the 40 petals were only 4–5 mm long and there were about 20 stamens; several small petals were found on the specimen from Whyalla 206/58 and few stamens (20–30) on *Blake* 21541 and *Wilson* 503. Cleland's plant from the same area (Ooldea) had only 20 petals and about 60 stamens. Higginson's plant from Port Augusta had about 30–40 petals (the longer 12–13 mm) and about 72 stamens; under cultivation (*Blake* 21539) it had 48–68 petals the longer ones 12–15 mm long and 82–120 stamens (Fig. 9 (5)). This plant is the only one recorded as having entirely white petals and Higginson (*in litt.*) stated that it was the only one he had seen in an area where the species is apparently very common; flowers with 5 sepals and styles are common as well as the usual 4 (Fig. 9 (7–9)) and one flower was found that had 4 sepals, 5 ovary-cells and 6 styles. The bases of the topmost pair of leaves are commonly much connate (often with very short free parts) enclosing at least half and sometimes nearly all the calyx-tube, but occasionally the calyx-tube is well exerted and in *Blake* 21539 early flowers were pedicellate above ordinary leaves with later ones much enclosed.

The name *Mesembryanthemum praecox* was founded on small plants collected in October 1851. Mueller stated in the protologue that he did not see flowers but that there was mature fruit in October when other species were in flower. There are three specimens at Melbourne evidently part of the same collection; one of these has a label reading: "Mesembryanthemum praecox, ferd. Mill. In planitiebus subsalsis ad latus occidentale montium Flinders-range. Jam Octobre fructiferum dum alia nondum sunt matura. Diffusum sat amplum ramis erectis Oct. 51 ferd Mueller fol. glauco-viridia triquetra." These specimens must form the type collection, the words on the label quoted above agreeing well with the protologue. But the specimens have flowers as well as fruit and it is hard to understand Mueller's definite statement in the protologue "Flores non vidi" (I have not seen flowers).

In the protologue of *Carpobrotus pulleinei* J. M. Black cited: Nonning (Gawler Ranges) coll. R. H. Palleine; Pine Creek, near Broken Hill, New South Wales, coll. A. Morris. He described the flower as having about 30 petals 7 mm long and about 20 stamens. When he described *Sarcozona* he had more material from Broken Hill and he stated that the petals of the plant from Nonning were 7 mm long and those of the plant from the Barrier Range (Broken Hill) were 11 mm long. No specimen in flower from Nonning has been found that could have been examined by Black before July 1932 when the paper was read, so the collection from Pine Creek becomes the lectotype. From notes to specimens in his herbarium (AD) he was growing a plant from Nonning in his garden that was not in flower in May 1932; he missed the first flowering but saw it in fruit in Nov. 1932. This plant must have flowered again that year for he sent flowering specimens to Melbourne in Dec. 1932. The figures of seed and section of flower with involucre

in Black's paper must have been taken from sketches in his herbarium (AD) made from the specimen from Pine Creek, but there is no specimen that could have supplied the figure of the habit nor of the figure in the second paper; these might have been taken from the living plant.

From letters from N. E. Brown to Black (AD), it is clear that Black sent Brown two "flowers" (immature fruit) and later fresh material collected by Morris in Sept. 1933. Brown suggested that the species represented a new genus.

The length of petals given by Black in his second paper do not well agree with his herbarium notes, but the length is not mentioned for Morris's first collection; little significance should be attached to this in view of the known variability from flower to flower. It would seem that most of the protologue is based on Morris's first collection which should be accepted as lectotype.

- 2. *Sarcozona bicarinata*** S. T. Blake, species nova a *S. praecoci* (F. Muell.) S. T. Blake ex Hj. Eichler foliis haud rugulosis, foliis superioribus haud alte connatis, calycis tubo 2-carinato, seminibus latioribus fere ubique verrucosis distinguenda. Typus: *Blake* 21514 e plantis prope oppidulo Lock in Australia Australi statu juveni a R. L. Specht lectis et in horto auctoris cultis (holotypus, BRI.080351; isotypi distribuendi).

Fruticulus succulentus parvus vel depressus viridis. Caules rami ramuli erecto-patentes erective vel caules tandem prostrati, pro more haud radicantes, primo  $\pm$  ancipites tandem irregulariter polygoni, brunnei denique pallidi. Folia subbacinaciformia asymmetrica (triquetra) pro more crassiora quam lata, supra visa sublanceolato-cultrata acuta, carina nonnunquam marginibusque prope apicem  $\pm$  denticulata vel laevia, faciebus haud rugulosis sed punctis majusculis prominulis vel immersis conspersa, 2.5–5 cm longa, supra 5–9 mm lata lateribus 4–9 mm lata, 5–10-ies longiora quam lata; par supremum altius connatum. Flos sessilis vel brevissime pedicellatus liber vel foliorum basibus connatis partim obtectus. Calycis tubus anguste acuteque 2-carinatus carina usque ad 2.5 mm alta, vel late campanulatus vel cyathiformis vel ellipsoideus ejus longitudo latitudinem haud vel vix adaequans, haud compressus, 4.5–9 mm longus, 5–10 mm latus, 5–9 mm crassus. Sepala 5–4, 2 longiora 3.5–8 mm longa marginibus tribus denticulata. Petala 20–55, (1–) 2–3-seriata, vel acuta vel irregulariter acuminata vel 2–3-denticulata, 5–14 mm longa, 0.4–1.2 mm lata. Stamina 20–50, 1–2-seriata; filamenta 1.5–3 mm longa; antherae 0.7–1.5 mm longa. Styli 5, raro 4, liberi vel basi brevissime coaliti. Ovarium supra convexula vel fere plana. Fructus breviter pedicellatus pedicello usque 2 mm longo, exsertus, vel subglobosus vel globoso-ovoideus vel depresso ovoideus, anguste 2-carinatus ceterum transversim isodiametricus, 7–15 mm longus, 7–15 mm latus, 6.5–13 mm crassus. Semina oblique lateque obovata vel oblique obovata, pro majore parte grosse reticulato-verrucosa, 0.95–1.1 mm longa 0.7–0.8 mm lata.

Plant up to about 10 cm high; stems or main branches 3–6 (–7) mm thick, becoming bright brown, finally pallid. Leaves dull green,  $\pm$  strongly flushed with red or purple, the edges and keel red at least when young, mostly thicker than wide especially upwards, united at base for about 5 mm, top flat or nearly so, very gradually acute from below the middle or near the base, keel mostly gently upcurved to the tip, keel and sometimes margins somewhat denticulate near the tip chiefly when young, or the margins smooth or nearly so, faces with pellucid dots numerous beneath the surface and a few scattered ones higher than the general level but not evidently rugulose, 2.5–5 cm long, 5–9 mm wide on top, 4–9 mm wide on the faces (convex face up to 1 mm wider than the concave face), 5–10 times as long as wide; uppermost pair connate to a greater degree, sometimes partly embracing the calyx-tube. Flowers solitary terminal or finally ternate, sessile or very shortly pedicellate, free (especially the early ones) or shortly included in the connate bases of the final leaves. Calyx-tube narrowly and acutely 2-ribbed, with the rib 0.5–2.5 mm high and smooth, broadly campanulate or cup-shaped or  $\pm$  ellipsoid, about as wide or somewhat wider than long and about as thick as wide excluding the ribs, 4.5–9 mm long, 5–10 mm wide, 5–9 mm thick. Sepals 5 or 4, the longer ones 3.5–8 mm long, denticulate on the margin and keel. Petals 20–55 (–90?), (1–) 2–3-seriate, acute, or irregularly acuminate or 2–3-denticulate, 5–14 mm long, 0.4–1.2 mm wide. Stamens 20–50, 1–2-seriate; filaments 1.5–3 mm long; anthers 0.7–1.5 mm long. Styles 5, rarely 4, 1.5–3 mm long, free or very shortly united at base. Ovary slightly convex to nearly flat on top. Fruit becoming purplish, shortly pedicellate (pedicel up to about 2 mm long), exserted from the withering leaves, subglobose, globose-ovoid or depressed ovoid, narrowly 2-ribbed with the ribs up to 1.5 mm high in the upper part otherwise about as thick as wide, 7–15 mm long, 7–15 mm wide, 6.5–13 mm thick. Seeds obliquely broadly obovate to obliquely obovate, coarsely reticulate-verrucose over the greater part, 0.95–1.1 mm long, 0.7–0.8 mm wide, 1.25–1.5 times as long as wide.—Figs. 1 (E), 11, 15.

SOUTH AUSTRALIA.—EYRE PENINSULA: Hundred of Murlong, SW. of Kimba, Dec. 1959, *Cleland* (v.); 15 miles NE. of Lock, sand-dune country, Nov. 1960, *Specht* (v. fl. fr.); 25 miles SE. Lock, sand-dune country, Nov. 1960, *Specht* (v.; BRI; June–Oct. 1961, *Blake* 21514); Whyalla–Cromwell Road, about 74 km S. of Whyalla, sandhill country, Oct. 1958, *Wilson* 101 (AD); Reserve S. of Tooligie Hill, Dec. 1959, *Cleland* (v. bud); near Verran, Dec. 1959, *Cleland* (v. bud; July 1961, *Blake* 21540); near Mt. Verran, Nov. 1960, *Cleland* (Sept. 1961, *Blake* 21613). YORKE PENINSULA: In 1879, *Tepper* 260 (MEL). MURRAY MALLEE: About 14 miles NNE. of Keith, by swamp in sandy soil, Aug. 1961, *Wilson* 1957 (v. fl.).

At first sight this species looks very different from *S. praecox* and more like *Carpobrotus modestus* in general appearance, leaf form, small flowers with acute petals, and scarcely modified topmost pair of leaves, but the branching habit, persistent collar-like leaf bases, epidermal cells, 5 or 4 styles and ovary cells, and verrucose seeds are like those of *S. praecox* while the broad strongly 2-keeled, almost 2-winged calyx-tube and fruit are different from either. The leaves lack the characteristic rugulose appearance of *S. praecox* because most of the very similar large pellucid dots (ideoblasts) do not project above the general surface of the leaf; the seeds, however, are more verrucose than in *S. praecox*. The type

material is from plants in my garden received as young plants from R. L. Specht who collected them in sand-dune country 25 miles SE. of Lock, 4th Nov. 1960. Specht collected two plants on 8th Nov. 1960, from 15 miles NE. of Lock; one was mature with some ripe fruits from most of which the contents had been removed by some animal through holes in the lower part of the pericarp. The second plant was immature but it disappeared from my garden shortly after planting.

The distribution is shown in Fig. 15.

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#### ADDENDA

In the National Library at Canberra there is a recognizable water-colour drawing of *Carpobrotus glaucescens* made by Governor Arthur Phillip about 1789.

The citations of the following collections of *Sarcozona praecox* were accidentally omitted from those on p. 35 and the localities are not mapped in fig. 15.

WESTERN AUSTRALIA.—COOLGARDIE DISTRICT: 50 miles W. of Coolgardie, Sept. 1960, *Briggs in NSW*. 56488 (NSW).

NEW SOUTH WALES.—WESTERN PLAINS: Yerranbah Station, New Angledool, in 1915, *Wiggan in NSW*. 56505 (NSW).

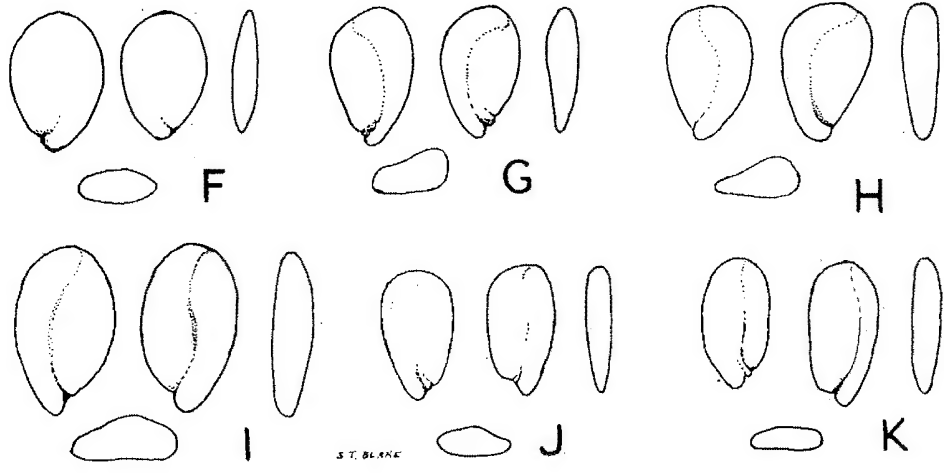
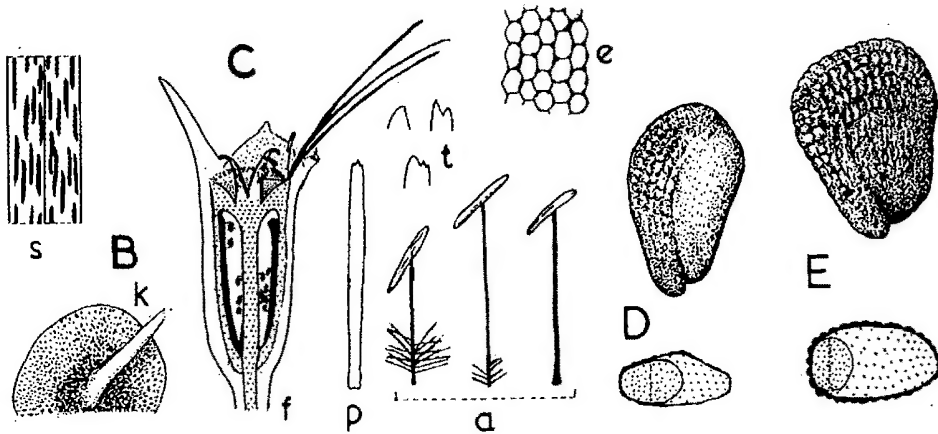
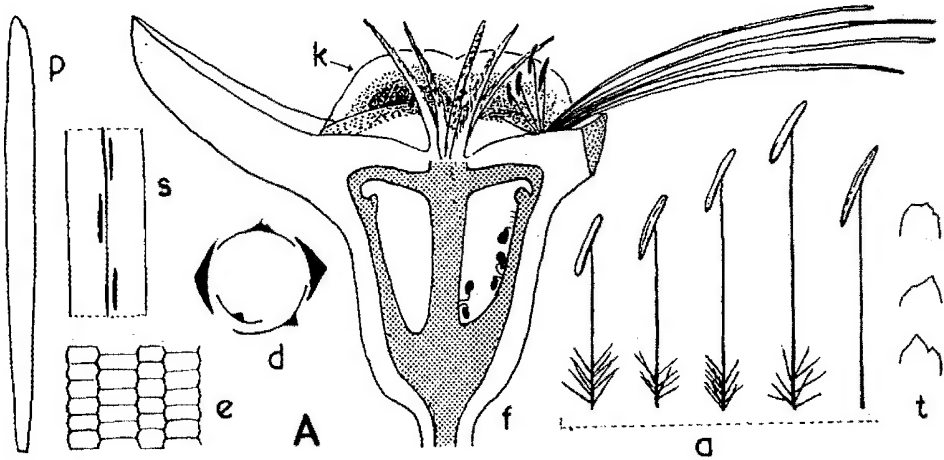
Wiggan's collection is from a locality far to the E. of any other.

FIG. 1.

A-C, floral details of *Carpobrotus glaucescens* (A), *C. edulis* (B), and *Sarcozona praecox* (C): a, stamens, one from each series, innermost at left; d, diagram of sepals; e, epidermis from stem; f, flower, vertical section through lateral sepals, most petals and stamens removed, partly diagrammatic; k, smaller sepal; p, petal; s, middle part of dry petal showing streaks; t, tips of other petals; f, k, p,  $\times 3$ ; a, s,  $\times 8$ ; e,  $\times 80$ .

D-K, seeds: (D), *Sarcozona praecox* and (E), *S. bicarinata*  $\times 25$ , with transverse sections; (F), *Carpobrotus edulis*; (G), *C. aequilaterus*; (H), *C. glaucescens*; (I), *C. virescens*; (J), *C. rossii*; (K), *C. modestus*; right- and left-handed seeds, vertical and transverse sections,  $\times 15$ , outlines only.

All from collections figured in Figs. 2-11.



S.T. BLANK

FIG. 2. *Carpobrotus edulis*.

1. Part of plant with small portion of prostrate stem at bottom left.
2. Transverse sections of leaf near middle (right) and from upper part (left).
3. Flower from above.
4. Transverse section of calyx-tube and ovary.
5. Fruit  $\times \frac{1}{2}$ , side view (left) and edge view.

From *Blake* 20177.





FIG. 3. *Carpobrotus aequilaterus*.

1. Pieces of plant with fruit and withering flowers.
2. Transverse sections of leaves.
3. Flower.
4. Vertical section of flower.
5. Transverse section of calyx-tube.

From *Slater* C.S.248 (1, 2, 4, 5) and *Blake* 22007.

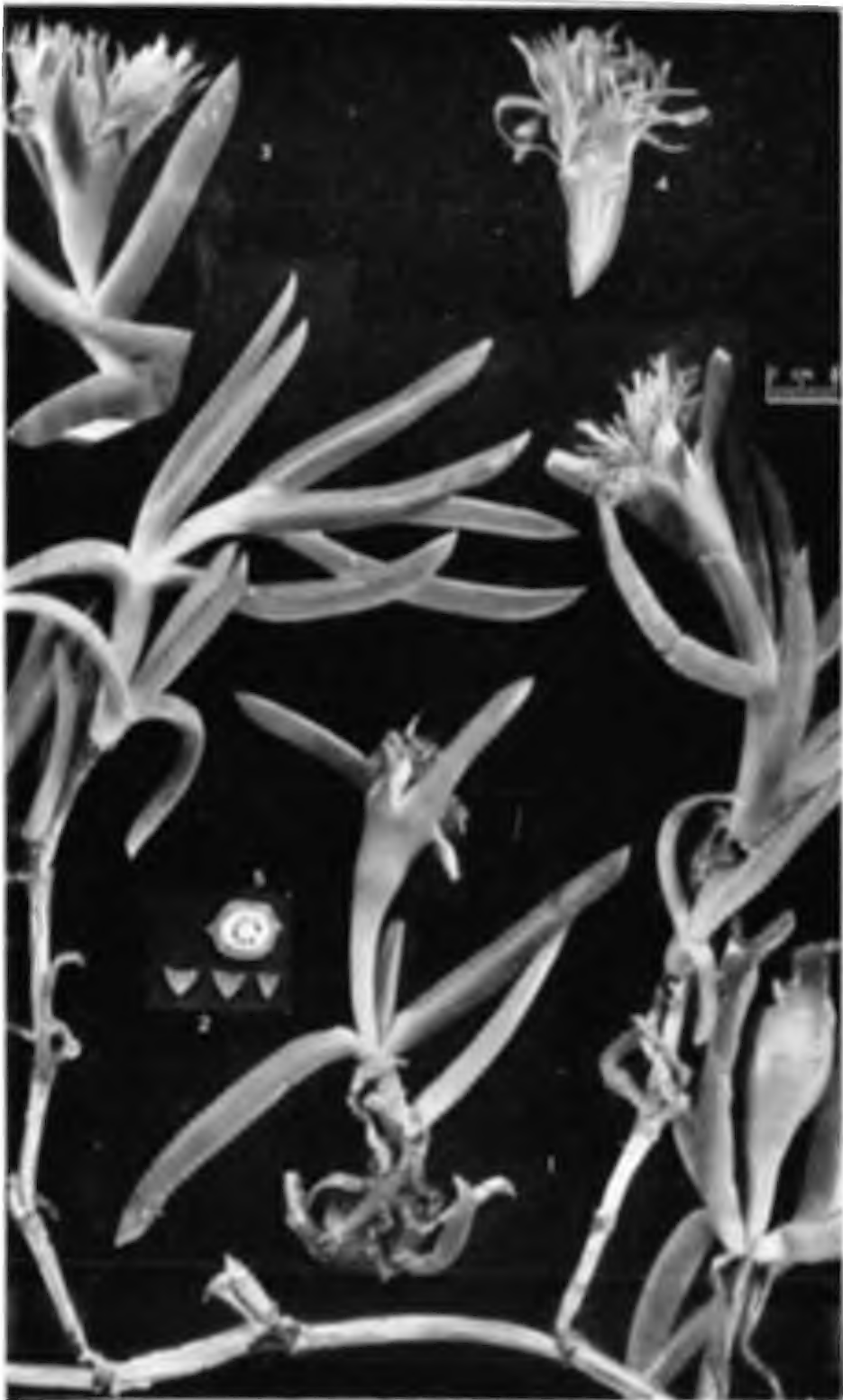


FIG. 4. *Carpobrotus glaucescens*.

- 1, 2. Parts of plant in flower.
3. Transverse sections of leaves.
4. Transverse section of calyx-tube and ovary.
5. Fruit, edge view.
6. Transverse section of fruit.

From *Blake* 19677.

[See also FIG. 5.]



F.G. 5. *Carpobrotus glaucescens*.

1. Portion of plant showing creeping stem and erect flowering branches.

2. Tip of flowering branch with mature fruit in edge view (centre), immature fruit in side view (right) and bud (left).

3. Flower, showing one large sepal (left) and two others.

4. Vertical section of flower.

5. Vertical section of mature fruit.

From *Blake* 19677 (2, 3), 21653 (5), 21656 (1, 4).

[See also FIG. 4.]



FIG. 6. *Carpobrotus virescens*.

- 1, 2. Pieces of plants in flower.
3. Fruits.
- 4, 5. Transverse sections of leaves.

From *Blake* 20910 (2, 5), 20910A (1, 4) and *Brittan's* specimen from Nanarup.





FIG. 7. *Carpobrotus rossii*.

1. Upper part of prostrate creeping stem with young flowering branches.
2. Flowering branch with bud and flower.
3. Flowering branch with flowers and immature fruit.
- 4, 5. Portions of plant with fruits.
6. Transverse sections of leaf about the middle (left) and towards tip.
7. Transverse section of calyx-tube and ovary.
8. Transverse section of fruit.

From *Blake* 19709.



FIG. 8. *Carpobrotus modestus*.

1. Portions of plant in flower.
2. Portions of plant in fruit.
3. Transverse sections of leaves.
4. Vertical section of flower.
5. Transverse section of calyx-tube and ovary.

From *Blake* 19876.



FIG. 9. *Sarcozona praecox*.

1. Plant with fruit in various stages of maturity.
2. Transverse section of immature fruit with involucre and pair of leaves below, seen from above.
3. Upper part of same, seen from the side.
4. Vertical section of flower and involucre with pair of ordinary leaves below.
5. Vertical section of flower in involucre from another plant.
6. Fruiting involucre completely enclosing fruit.
- 7, 8. Transverse sections of the usual 4-celled fruits.
9. Transverse section of a 5-celled fruit.

From *Lothian* 352/59 (1-3), *Blake* 21539 (5, 7-9), 21513 (4), 21541 (6).

[See also FIG. 10.]

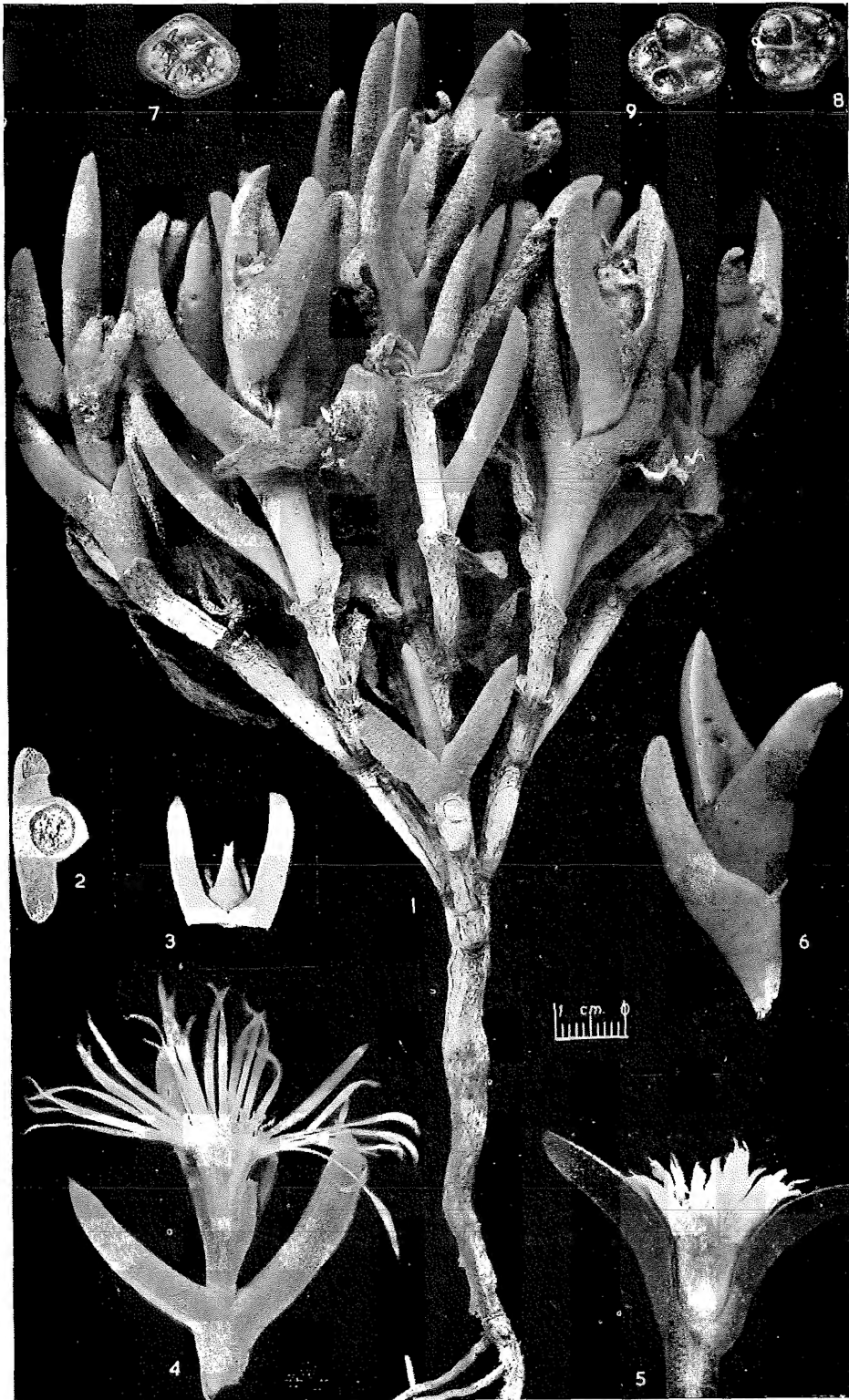


FIG. 10. *Sarcozona praecox*.

1. Two pieces of plant in flower.
2. Flowering branch, involucre almost enclosing calyx-tube.
3. Same flower from above.
4. The same, flower and involucre in vertical section.
5. The same, other half of flower.
6. The same, other half of involucre.
7. Fruit in partly withered involucre.
8. The same in transverse section, upper part seen from below.
9. The same, lower part seen from above.
10. Fruit with shorter completely withered involucre.

From *Blake* 21452.

[See also FIG. 9.]





FIG. 11. *Sarcozona bicarinata*.

1. Plant in fruit.
2. Part of plant with fruit in edge view.
- 3, 4. Parts of plant in flower.
5. Vertical section of flower in involucre.
6. Transverse section of calyx-tube.
7. Transverse section of leaf.

From *Blake* 21514.





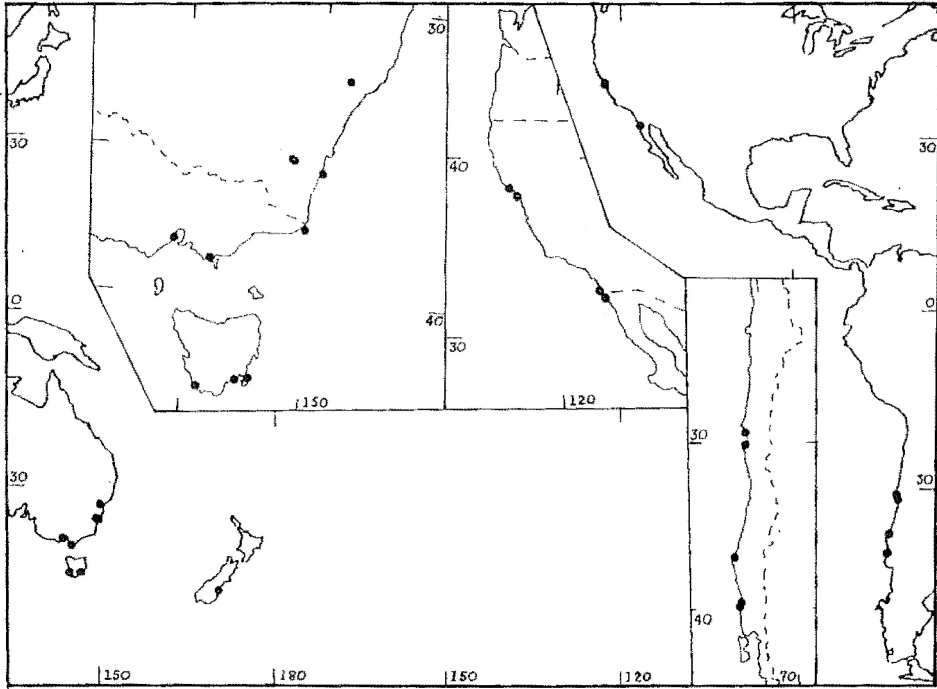


FIG. 12. Distribution of *Carpobrotus aequilaterus*; insets show detailed distribution in Australia (left), North America (upper right) and South America (lower right).

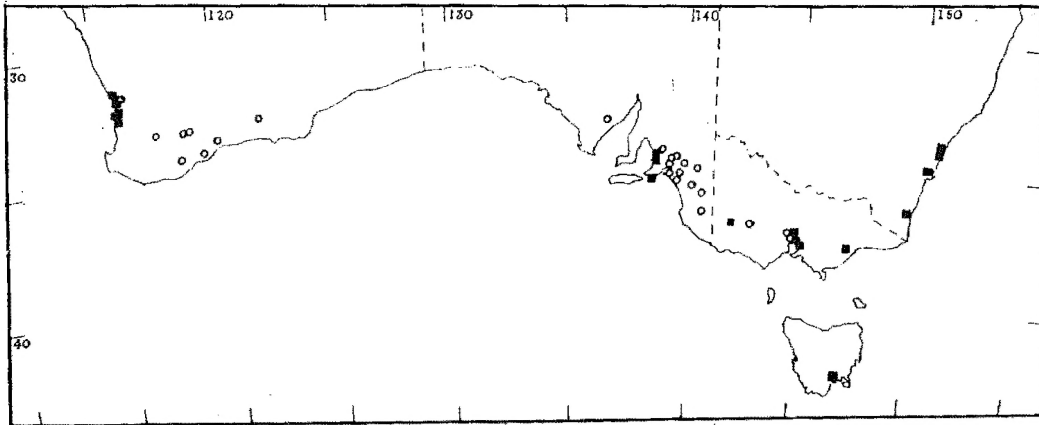


FIG. 13. Distribution of *Carpobrotus edulis* ■ and *C. modestus* ○.

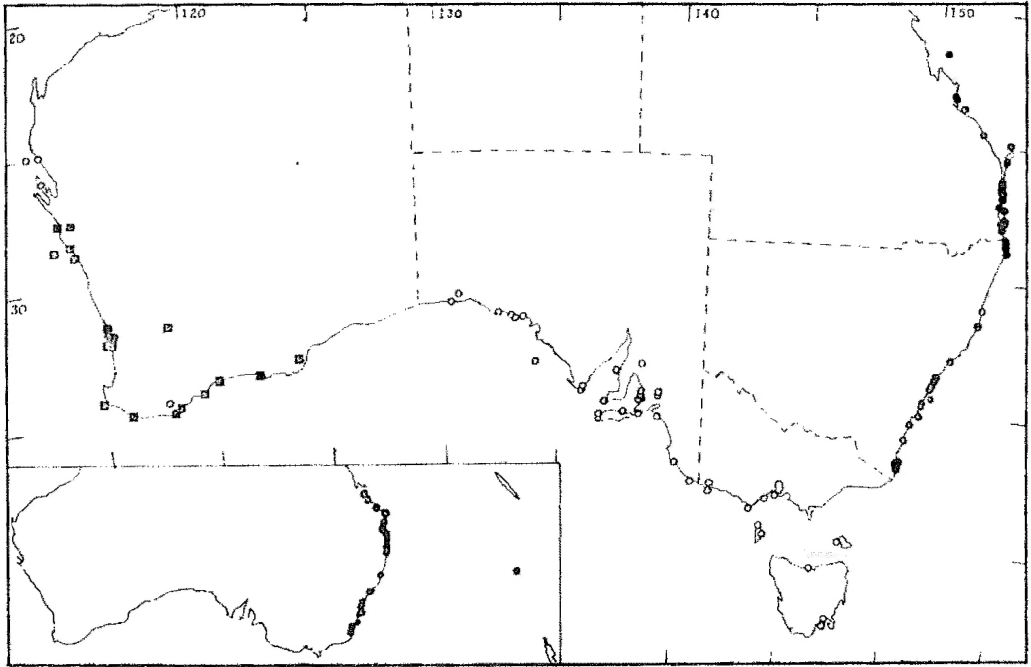


FIG. 14. Distribution of *Carpobrotus virescens* ■ *C. rossii* ○ and *C. glaucescens* ●.

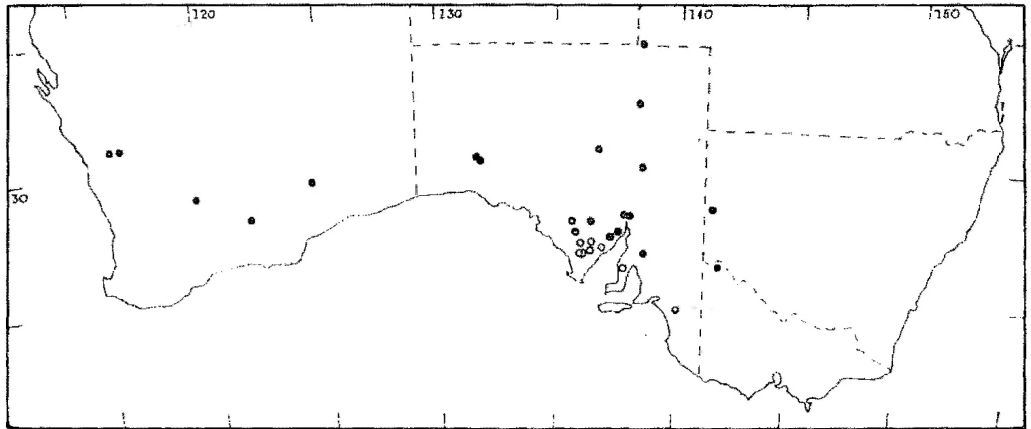


FIG. 15. Distribution of *Sarcosoma praecox* ● and *S. bicarinata* ○.

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