

TAXONOMIC STUDIES ON THE GENUS CRASSULA L.

by

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## SUMMARY

The difficulties involved in the taxonomy of the genus Crassula, such as the extensive variation and often difficult species complexes, vicariousness and hybridization, are sketched against a historical background. These difficulties have prompted the author to review concepts of taxa from subspecific to generic level and have also led to the approach adopted in this work.

It is argued that in several genera and sections, as previously recognized, too much stress was placed on the several floral characters which form part of a pollination syndrome which is shown up by convergent developments of these flower types.

The different types of seedling morphology recognized are considered in relation to the morphology of adult plants and their affinities at specific and sectional level.

The distribution of the hydathodes has proved useful in the delimitation of supraspecific taxa. The morphology of the developing seedlings and the distribution of the hydathodes on the leaves become the main arguments for a new classification in the genus Crassula.

A cytological review stresses the different basic chromosome numbers (8,7) and their structural differences for the delimitation of the subgenera. Problems in determining the original basic number and the high percentage of polyploidy with various rainfall conditions are evaluated.

Subsequently the characteristics and affinities of Crassula and its subgeneric taxa are briefly discussed.

The key to the species, subspecies and varieties is divided into twelve groups which are similar to sections or groups of sections recognized.

Within the genus Crassula 2 subgenera, 21 sections, 11

subsections and 144 species with 124 subspecific taxa are distinguished, described, their variation recorded and their diagnostic features accentuated. Species insufficiently known and excluded are briefly discussed.

#### NEW TAXA AND NEW COMBINATIONS PROPOSED

The following new taxa are described: subgen. Levifolia, sect. Galpiniflora, sect. Caducifolia, subsect. Fasciculares, subsect. Glabrae, subsect. Scabrae, subsect. Amplexicaules, subsect. Imbricatae, subsect. Epedunculatae, subsect. Sphaericae, subsect. Deciduae, subsect. Caespitosae, C. tuberella, C. minuta, C. elsieae, C. brachystachya, C. latibracteata, C. ammophila, C. muscosa var. sinuata, var. rigida, C. corallina subsp. macrorrhiza, C. pellucida subsp. spongiosa, C. sarmentosa var. integrifolia, C. multicava subsp. floribunda, C. arborescens subsp. undulatifolia, C. sarco-caulis subsp. monticola, C. ericoides subsp. tortuosa, C. tetragona subsp. lignescens, C. setulosa var. longiciliata, C. southii subsp. sphaerocephala, C. brevifolia subsp. psammophila, C. ausensis subsp. ciliata and C. pageae is a new name.

New combinations are proposed for the following taxa: sect.

Acutifolia (Schonl.), sect. Kalosanthes (Haw.), sect. Argyrophylla (Schonl.), sect. Arta (Schonl.), subsect. Petiolata (DC.), subsect. Latifolia (DC.), subsect. Exilis (Schonl.), C. sebaeoides (Eckl. & Zeyh.), C. grammanthoides (Schonl.), C. natans var. filiformis (Eckl. & Zeyh.), C. thunbergiana subsp. minutiflora (Schonl. & Bak. f.), C. campestris subsp. pharnacioides (Steud.), C. pentandra subsp. transvaalensis (Kuntze), C. muscosa var. parvula (Eckl. & Zeyh.), C. expansa var. fragilis (Bak. f.), var. filicaulis (Haw.), var. pyrifolia (Compton), C. capensis var. promontorii (Schonl. & Bak. f.), var. albertinae (Schonl.), C. pellucida subsp. marginalis

(Dryand. in Ait.), subsp. brachypetala (Harv.), subsp. alsinoides (Hook.f.), C. tetragona subsp. acutifolia (Lam.), subsp. rudis (Schonl. & Bak.f.), subsp. robusta (Toelken), subsp. connivens (Schonl.), C. multiflora subsp. leucantha (Schonl. & Bak.f.), C. subulata var. fastigiata (Schonl.), var. hispida (Schonl. & Bak.f.), C. montana subsp. quadrangularis (Schonl.), C. barbata subsp. broomii (Schonl.), C. tomentosa var. interrupta (Harv.), C. cooperi subsp. sedifolia (N.E.Br.), C. setulosa var. deminuta (Diels), C. alba var. parvisepala (Schonl.), C. sediflora var. amatolica (Schonl.), C. obovata var. dregeana (Harv.), C. capitella subsp. thyrsiflora (Thunb.), subsp. meyeri (Harv.), subsp. enantiophylla (Bak.f.), subsp. nodulosa (Schonl.), C. rupestris subsp. commutata (Friedr.), subsp. marnierana (Huber & Jacobsen), C. perfoliata var. heterotricha (Schinz), var. falcata (Wendl.), C. lanuginosa var. pachystemon (Schonl. & Bak.f.), C. globularioides subsp. illichiana (Engl.), subsp. argyrophylla (Schonl.), C. sericea var. hottentotta (Marl. & Schonl.), var. velutina (Friedr.), C. namaquensis subsp. comptonii (Hutch. & Pillans), subsp. lutea (Schonl.), C. exilis subsp. garibina (Marl. & Schonl.), C. elegans subsp. namibensis (Friedr.), C. mesembryanthoides subsp. hispida (Haw.), C. pubescens subsp. radicans (Haw.), subsp. rattrayi (Schonl.), C. subaphylla var. virgata (Harv.).

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INTRODUCTION

Hermann (1687) published the first two illustrations of species of South African Crassula and these were soon followed by more illustrations and descriptions such as those of Breynius (1700), Commelin (1706), Boerhaave (1720), Bradley (1732), Dillenius (1732) and Burmann (1738). Linnaeus (1753) described ten species and during his lifetime accepted 28 species of Crassula not all of which are still included in the genus (cf. Tölken, 1972). The genera Septas and Tillaea were distinguished in Linnaeus's rigid system by their 7 and 4-merous flowers respectively.

The number of species then increased rapidly being mainly described by Thunberg (1778), Linné (1781), Solander and Dryander in Aiton (1789) and Lamarck (1786). Schultes (1820) enumerated 90 species. At the beginning of the nineteenth century Haworth (1812, 1821, etc.) described not only a number of new species, but also divided the genus into sections and separate genera. The subdivisions into sections (brought some grouping and) assisted enormously with identifications in the genus. Many of these sections, most of which were validly published later by De Candolle (1828), were based on a single character and often include a number of different elements. For instance, the species in the sect. Subulares with their subulate leaves are now incorporated in three different sections of two different subgenera. In the case of the genus Rochea, a varying number of different species was included in each new treatment. Ecklon & Zeyher (1837) added yet another six genera, but Harvey (1862) reduced their number from fourteen to six and recognized 112 species. An evaluation of those genera, which are now usually recognized at sectional level, was published by Schonland (1929).

Towards the end of the nineteenth century another upsurge in the interest in the genus Crassula resulted in many new species being described mainly by N.E. Brown, E.G. Baker and S. Schonland. So much so that Schonland (1929) distinguished 123 species without including the genera Rochea, Dinacria, Grammanthes and Pagella. This revision is the most recent work on the whole genus in Southern Africa and yet Schonland makes no claim of a complete monograph entitling his article "Materials for a critical revision of the Crassulaceae". Many species and names are not critically evaluated, so that many new names must be adopted. Also, it becomes clear from his annotations and manuscripts that Schonland was unable to investigate many types in great detail nor was he personally able to investigate Harvey's herbarium. This provisional situation prompted the present revision.

The situation at subgeneric level, especially Schonland's 'groups', reflects the tentativeness of his treatment. The groups usually comprise species with obvious affinities. The sections are based on those recognized by Harvey (1862), except that Schonland subdivided the sect. Eucrassula into the sections Tillaeoideae, Stellatae, Tuberosae, Campanulatae. In this way, he places even more stress on the shape of the flower, which must rather be viewed as a modification to form flower types with a definite pollination syndrome. The sect. Sphaeritis is the most striking example of a flower type which has developed in five different sections, as is discussed in a later chapter. In fact, Schonland (1929) suggests that the sect. Campanulatae is polyphyletic in origin, but continues to use an unnatural grouping due to excessive stress on a selected character.

On the other hand his sect. 'Globulea' is a natural group of species, but he did not realize that his C. anomala, which he recognized as an intermediate represents a transition from the Globulea-type of flower to the Sphaeritis-type. Consequently some more species were now included in the sect. Globulea.

In the genus Crassula there are few natural groups which are clearly recognizable at the same time. The two subgenera are not at all clearly distinguishable, because for each characteristic there are a few exceptions, but in each case one can deduce from other characteristics that the exceptions must be attributed to modifications, e.g. the petals of the Sphaeritis-type flower are smooth and do not have a dorsal appendage.

However, in a large genus such as this, it is desirable to divide it into sections (cf. Davies & Heywood, 1963) although some of them might be artificial groups such as the subsect. Fasciculares in the sect. Anacampseriodes which shows no clear discontinuity between it and the sect. Filipedes. Generally, the sections represent a basic unit of species and, like the previous example, shows continuity although one or several ultimate developments might be similar to other sections, e.g. the rosulate habit of C. crenulata is probably the reason why Schonland placed this species in the Vaginata group. The Sphaeritis-type of flower is another such development in several sections, while other flower types prove to be more significant or if they are polyphyletic in origin the vegetative part of the plant shows the true affinity of the species concerned. The seedling morphology and the distribution of the hydathodes are also a good indication of similarities of species such as C. namaquensis (sect. Argyrophylla) and C. atropurpurea var. anomala (sect. Globulea).

This means that the flower types are recognized at sectional

level when they are monophyletic in origin. For this reason the genera Rochea, Vauanthes and Dinacria were included in Crassula so as to achieve a more uniform approach. Berger (1930) among others, warns against the use of genera that become unmanageably large, but to compensate for this adverse effect the genus Crassula was extensively subdivided into subgenera, sections and subsections which then become recognizable groups.

Clear groups are desirable and will enhance stability but the level at which it is recognized cannot be dictated. The pessimistic statement by Uhl (1948) will remain a characteristic of the taxonomy of the Crassulaceae: "No two students agree as to how many species, or even how many genera, should be recognized, and the limits of certain genera and many species have long been in dispute." The nature of the taxonomy of succulent plants is usually not only complicated by the fact that herbarium specimens are somewhat different in appearance from live plants, but rather <sup>that</sup> the amount of variation and their horticultural interest impede simplicity of classification. It is further complicated in Crassula by the fact that most taxa consist of numerous populations many of which are sufficiently far apart to be geographically isolated. Individual populations often show some variation, so that the specific and subspecific levels must become subjective. For this reason the suggestion of Hedberg (1958) was followed in that a species is ~~distinguished by~~ <sup>may show</sup> showing discontinuous variation in at least two characters, and where possible these should also be visible in herbarium material, while subspecific rank is afforded to those populations separated only by a single such character. Sympatric forms of the latter type are given varietal level. Liberal use was made of subspecific taxa in order to be able to refer to some of the variation recorded.

*land*

Many species of Crassula prefer to grow in rock crevices or on shallow soil on rocks so that often only a few plants form an isolated population and consequently one cannot place as much stress on vicariousness in Crassula as in the Proteaceae (Rourke, 1972). Species complexes such as C. tetragona, where the individual taxa are geographically or ecologically isolated and might have evolved in the isolation, are considered as a number of subspecies. This approach stresses the similarities rather than dissimilarities.

Each taxon is seen in its phytogeographic distribution in order to evaluate its variation within a geographic unit. For instance, C. rupestris subsp. rupestris occasionally produces similar narrowly lanceolate leaves in a population on the Huis River Pass as plants of the subsp. commutata from the northern Richtersveld. However, the shape of the squamae and the dense inflorescence in the latter specimen, indicate that the two forms have developed independently, and do not represent intermediates. However, such convergent evolution is best illustrated at sectional level in the shape of the flowers, as discussed in chapter 2.

On the other hand, in some cases morphological separation and geographical isolation are not complete. Plants of C. umbella, south of the Vanrhyn's Pass, have two leaves which are only slightly fused at the base, while in the Kamiesberg they are almost completely fused to form a disc around the stem. On either side of this gap of about 160 Km a few intermediates which grade into each main population occur, indicating that the two populations cannot be recognized as separate taxa.

At the same time, if one views the taxa in their phytogeographic range putative hybrids become more obvious, as they occur in areas where closely related taxa show an overlap in their dis-

tribution or occur close to one another. The Doring River Valley presents the classic example of hybridization occurring where the valley forms a gap in the barrier of the north-south running mountains. C. tomentosa var. tomentosa and the var. interrupta both occur here next to each another and are apparently hybridizing extensively (see discussion under C. tomentosa).

In contrast with this, C. alpestris subsp. alpestris and the subsp. massonii occur on either side of the Doring River Valley, but there are strong indications that introgression can also be shown (see discussion under C. alpestris). However, this allopatric introgression is not as marked as the sympatric introgression observed in the case of C. scabra and C. pustulata on the Nieuwoudt Pass where the habitats of the two species come into close contact with one another.

Although hybridization occurs in a few cases, it is not common in the genus Crassula. These hybrids can usually be distinguished in the field by the wide variation the two putative parents develop in a limited space. Hybridization and introgression are recorded in the taxonomic part, but it is beyond the scope of this work to provide detailed field studies. Artificial pollination was not sufficiently successful to evaluate the results obtained, which must probably be attributed to the difficulty of establishing when the stigmatic surfaces are receptive. Pollen sterility of many putative hybrids was investigated with analin blue in lactophenol and recorded but was eventually abandoned because it was found that most of the plants grown in a glass house showed a significantly high percentage of sterile pollen.

The above examples stress the importance of field studies and only two of the species recognized here were not investigated in the field. Also, many variants were grown in glass houses to

ascertain whether the variation is genetically fixed or ecologically induced.

Also, the format of the description was chosen in order to be useful for both life plants and herbarium material. All the known variation was recorded but, at the same time, the diagnostic features of each taxon were accentuated and mentioned separately. These are not diagnoses in the sense of Harvey (1861), but are intended to distinguish a taxon from its closest affinities; the genus Crassula is too large to frame a diagnosis which will distinguish a taxon from all the other species.

In the citation of literature it was not attempted to record each <sup>reference</sup> account and especially not each illustration of the respective species, as so many of them are published in horticultural journals which are not <sup>all</sup> even represented in <sup>even</sup> all the larger libraries. However, references to <sup>? some</sup> popular books and their illustrations were included so as to assist with the identification of species.

This revision includes only species with known origin, while those known from cultivation are enumerated and briefly discussed in the chapter dealing with excluded and insufficiently known species.

In the case of the species attributed to Solander or Dryander, which were published in Aiton's Hortus Kewensis ed.1., a subjective decision had to be made because the manuscripts are incomplete. A list of species which was started by Solander, but corrected and added to by Dryander, was taken as the basis, as its final version agrees with the published enumeration of species. This index is kept with the manuscripts at the British Museum.

Finally, only specimens investigated in South African herbaria, except types, are included in the citations. The

abbreviations as accepted by Lanjouw & Stafleu (1964) Index Herbariorum ed. 5 were used, except in the case of NBG (National Botanic Gardens, Kirstenbosch) which may also represent a garden number when it consists of two figures<sup>?</sup>. At the same time, this explains why these specimens are often found in herbaria other than NBG. Similarly, SUG stands for Stellenbosch University Garden.

## 2. FLORAL MORPHOLOGY

Floral morphology has always played an important role in the taxonomy of the genus Crassula. In the most recent revision of the genus by Schonland (1929) only two out of the eight sections are not obviously based on floral morphology. It becomes even more important when one considers the similarity of the vegetative organs of some taxa belonging to different sections. For example, the development of the terete leaves is repeated in different sections of Crassula (fig. 7), and species such as C. nudicaulis var. subacaulis (sect. Globulea) and C. brevifolia subsp. psammophila (sect. Perfilatae) can only be distinguished by their different flowers.

However, the present investigation has shown that the floral morphology should be used with care, as a <sup>? particular species</sup> distinct flower often represents a flower type (cf. illustrations of Leguminosae in Faegri and van der Pijl, 1972). An example in Crassula is the pronounced petal appendage present in C. capitella (sect. Rosulares; fig. 3.4) and in most species of the sect. Globulea (fig. 3.2,3). Similarly the canaliculate petal apex of the Sphaeritis-type of flower has developed in five different sections (figs. 2,5,6,7,8)

of the genus. In most of these cases, taxa with the intermediate type of flower suggest convergent development in the different sections, while the affinities of the taxa may be <sup>better</sup> deduced from their vegetative organs.

In the case of the Globulea and Spaeritis-types, the petals as well as the whole flower are somewhat modified and the different flower types can be distinguished by several characters. However, it would be illogical to distinguish these groups of species by the sum of these characters, when they should rather be viewed as a single pollination syndrome.

A discussion of the main flower types is thus necessary for the understanding of the supraspecific grouping used in this work. The morphology is discussed, but little is known about the relation of the flower to the pollinating agent. The few field observations made revealed that the flowers are visited by many insects and the additional problem arises, whether specificity exists at all or whether only one of the visitors is the pollinating agent, while the others are merely searching for nectar (cf. Faegri & van der Pijl, 1972). Vogel (1953) groups the species of the genus according to their presumed pollination syndrome, but it is a preliminary account and he has failed to distinguish either the Globulea or Spaeritis-type.

In the following discussion the flower types found in Crassula are divided into two artificial groups, namely those with imbricate aestivation and those with contorted aestivation. The latter group of flower types, which have much in common, show that even the aestivation becomes part of the pollination syndrome and is therefore of no taxonomic use for the supraspecific delimitations.

A. The flowers with an imbricate aestivation are more common and represent the basic type in Crassula, as all the species

of the subgen. Levifolia belong to this group.

### 1. Stellata - type

Star-shaped flowers (cf. fig. 2.1) are found mainly in the sections Glomeratae, Anacampseroides, Tuberosae and Galpiniflora, but within them one finds quite a range of variation. Extreme developments of the Stellata-type are comparable with the example of Saxifraga aizoides in Faegri & van der Pijl (1972), except that in Crassula the anthers do not usually break off after the pollen has been shed. In these flowers the petals are scarcely fused at the base and spread at approximately right angles to the pedicel. The short petal tube, to which the base of the filament is also fused, is characteristic of the genus. If <sup>as?</sup> a <sup>?</sup> reduction of this character is found, as well as a reduction of the sepals (they are hardly recognizable in C. ovata and C. arbore-scens), it is unlikely that the Stellata-type of flower is primitive, as Schonland (1929) and Fröderström (1931) suggested. The Stellata-type represents in extreme cases at least a distinct flower type.

Among the species of the sect. Tuberosae one finds a considerable range of variation with a typical Stellata-type of flower in C. capensis to one with a short petal tube in C. nemorosa and a <sup>distinctly</sup> tubular one in C. saxifraga.

### 2. Campanulata-type

Flowers with a petal tube and the apex <sup>lobes</sup> <sup>? of the petals or corolla lobes</sup> recurved are found in both subgenera of Crassula, and several different types can be distinguished within this group.

a. The most common type shows little specialization and is found in most of the species of the sections Deltoides, Acutifolia, Squamulosae, Subulares, Curtogyne, Rosulares, Perfilatae, Argyrophylla and Crassula. The styles are more or less elongated and recurve progressively so that the receptive stigmas

are situated at the same level as the anthers after the latter have shed their pollen.

b. In most of the species of the subsect. Sphaericae a laterally placed sessile stigma is found at the same level as the anthers (cf. sect. Globulea). The flowers are distinctly protogynous and many species are self-sterile.

c. A similar effect is achieved in the sect. Arta, where the sessile terminal stigma is very much enlarged and found at the same level as the anthers when the stigma becomes receptive (fig. 2.4).

### 3. Rochea-type

In the sect. Kalosantes the flower tube is very much elongated, but the basic arrangement is as in 2a except that the floral parts are much larger (cf. fig. 3.1). However, C. fascicularis in itself <sup>represents</sup> forms a <sup>distinct</sup> flower type, because it exudes a heavy scent particularly towards the evening, while C. coccinea and C. obtusa are without scent.

### 4. Gentiana-type

In contrast to the previous type the flower of C. dichotoma forms a broader tube and the petals are brightly yellow or orange coloured with more or less distinct marking around the opening.

This flower seems to simulate the Gentiana-type, as Vogel (1954) has already suggested.

? but what about typical Gentiana-type spp. proper?

### 5. Dinacria-type

However, in the sect. Dinacria, to which the previous species also belongs, the stigmas are usually laterally placed and a projection of the style extends above it. In C. seabaiodes the style forms a shield-like structure, which covers up most of the opening of the petal tube, except for five narrow gaps above the stigmas. This mechanism offers not only five openings but,

at the same time, it ensures that the pollinating agent, which searches for the nectar below the stigma, must brush past the pollen in young flowers and later the stigmas. Both the anthers and the stigmas are at the same level and next to the opening in the critical stage.

C. filiformis, which also has a lateral stigma, seems to simulate the Sphaeritis-type with its short styles and contorted aestivation (cf. fig. 2.2). In other words, this species and C. sebaeoides represent different flower types and the similarity of the lateral stigmas was unnecessarily stressed by Schonland (1897), Berger (1930), to place the two species together in the genus Dinacria.

B. The flowers with contorted aestivation have a number of characters in common, among them the stiff erect petals with at the most a small poral opening. The flower must therefore be forcibly opened by the pollinating agent and closes immediately afterwards. In this connection it should be pointed out that both sides of the petals are unequal, and, in fact, slightly broadened below the petal apex in the Pyramidella-type and obviously so in the Sphaeritis and Globulea-type of flowers (see figs. 2.2,6,7,8 and 3.2,3,5,7), which together with the contorted aestivation would theoretically assist the petals to slip back into position with the least difficulty. The flowers are not only distinctly protandrous, but in most species xenogamy has been observed which seems to be essential if cross-pollination is preferred in spite of such a forceful pollination mechanism. Also, the mature flowers remain intact for up to one and a half months if they are not pollinated, a situation as would arise in a glass house.

## 6. Pyramidella-type

Superficially the flowers of this type are very similar to the Sphaeritis-type, except that the petals are oblong and the distance between the level of the anthers and that of the stigmatic surfaces, is about as much as the <sup>length of the!</sup> whole ovary (see fig. 3.5,6,7). Only in the fruiting stage do the stigmas reach the height of the anthers. The flowers produce a very strong scent mainly towards the evening and all the flowers are turned upwards, so that there is little doubt that they are "melittophil" (cf. Vogel, 1954).

A similar floral morphology is found in C. mesembryanthemopsis and C. namaquensis subsp. lutea in the sect. Argyrophylla. Within the species C. namaquensis one can observe a change from the Sphaeritis-type with panduriform petals in C. namaquensis subsp. namaquensis (fig. 2.7) and the subsp. comptonii where the petal apices are somewhat elongated approaching the Pyramidella-type with oblong elliptic petals in the subsp. lutea (fig. 3.5).

Plants with the Pyramidella-type of flower occur in arid or semi-arid regions with little or prostrate vegetation. The small plants are usually exposed and are often found on shallow sand on rock surface with no surrounding vegetation. )

## 7. Sphaeritis-type

This type has developed at least five times in the genus Crassula, and possibly for that reason it is not clearly outlined (cf. figs. 2.5,6,8). Characteristically the petal apex is drawn into a narrow canaliculate point together with the disappearance of the dorsal appendage. Also the petals are usually quite smooth and often more or less panduriform. The recurved or lateral stigma is at about the same level as the anthers when it is receptive, and the flowers are usually not scented.

In several species complexes such as C. sericea var.

sericea to the var. velutina or C. atropurpurea var. anomala to the var. watermeyeri a transition into the Sphaeritis-type of flower can be seen, as has been discussed under those species. In C. ciliata the petals are at first stiffly erect but recurve later, whereas in most of the other species of the section they are recurved from the beginning.

C. filiformis of the sect. Dinacria apparently simulates the Sphaeritis-type of flower with only a poral opening, very short styles and a contorted aestivation (fig. 2.2). The petal apices are somewhat broader than is usually found in this type.

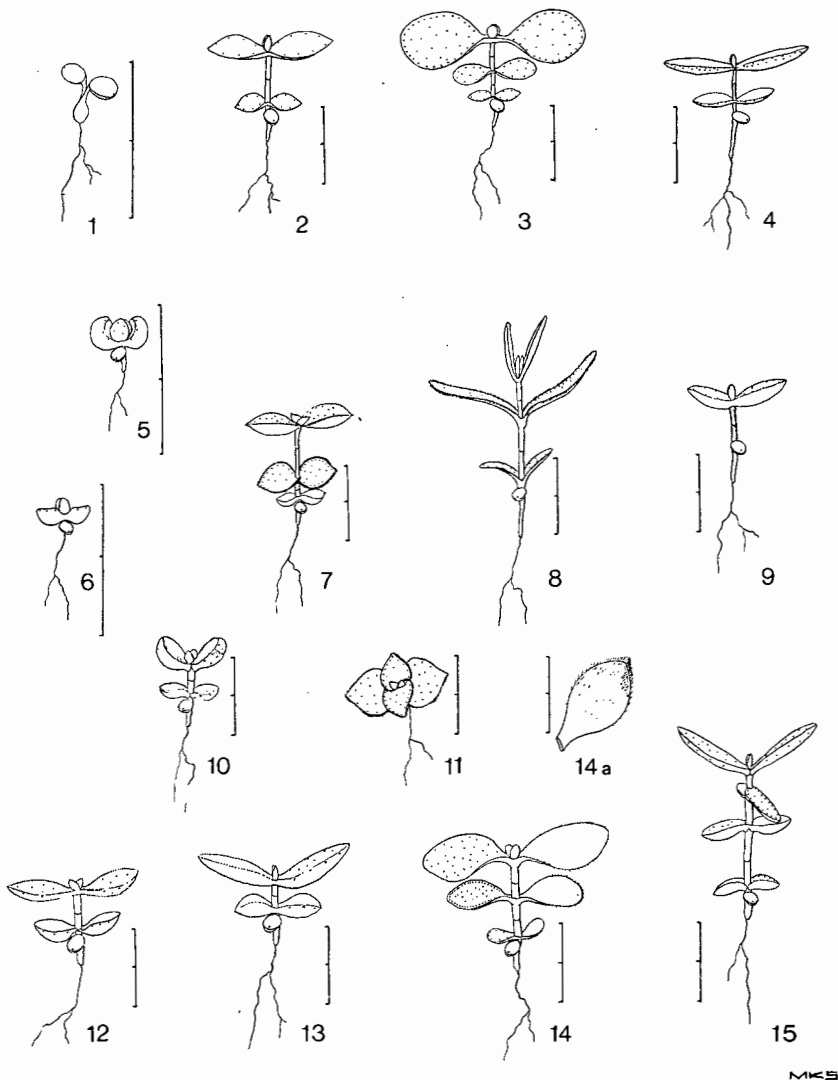
C. ericoides (fig. 2.3) apparently achieves a similar effect by its stiffly erect and slightly folded petal apices, although the carpels have distinct styles.

Eight out of the eleven species with a Sphaeritis-type of flower occur mainly in arid or semi-arid regions, but in contrast to plants with the Pyramidella-type, they are found predominantly in low scrub vegetation.

#### 8. Globulea-type

As Schonland (1896) pointed out, the flowers are effectively closed by the enlarged dorsal petal appendage which is situated in a terminal position. The latter character is also the distinguishing feature between this type and the Sphaeritis-type which are similar, but obviously not the same, as there would not have been the evolutionary potential for the development of the Sphaeritis-type of flower in the sect. Globulea. In some of the species of the latter section the laterally positioned petal apex has disappeared. Although this flower type is practically restricted to the sect. Globulea, a similar flower development is found in C. capitella.

Plants of the Globulea-type show no ecological preference and are widespread throughout most parts of the Cape Province, but



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Fig.1. - Seedlings; 1, C. saxifraga, the hypocotyl becomes tuberous (Tölken s.n.); 2, C. pellucida subsp. brachypetala, hydathodes marginal (Tölken 4383); 3, C. multicava subsp. multicava, hydathodes marginal and scattered over the leaf surface (Tölken 4394); 4, C. expansa var. expansa, hydathodes in one or two marginal rows (Tölken 4312); 5, C. columnaris subsp. semiorbicularis, erect fleshy leaves with scattered hydathodes (Tölken 1822); 6, C. deceptor, fleshy leaves recurved (Tölken 317); 7, C. rupestris subsp. rupestris, leaves with obvolute vernation and hydathodes on first leaves marginal and scattered but later only scattered (Wisura 2384); 8, C. multiflora, hydathodes marginal and scattered (Tölken 4315); 9, C. pallens, hydathodes marginal (Tölken 4201); 10, C. namaquensis subsp. namaquensis, hydathodes scattered (NBG 1919/70); 11, C. hemisphaerica, leaves with obvolute vernation and hydathodes marginal and scattered (Tölken 4224); 12, C. sericea, hydathodes scattered (Tölken 4178); 13, C. parfoliata, hydathodes scattered (Tölken); 14, C. cultrata, hydathodes as in 7; 14a, hairs on leaves becoming longer towards the margin (Tölken 4297); 15, C. subaphylla var. virgata, hydathodes as in 7 (NBG 932/69). (Scale 2 cm).

occur also on the lower slopes of the Drakensberg.

Convergent developments of the <sup>with</sup> <sup>floral</sup> flower morphology which are <sup>suggested as being such by other ideas of classification of the genus by variation</sup> indicated by seedling development, the distribution of hydathodes or tendencies towards such a development within a section (cf. chapter 3,4,6) have often marred a clearer understanding of the taxonomy of the genus. However, most of the flower types have had their main development in a section and hence the names. The only exceptions are the sections Sphaeritis ? and Stellata, which are antedated by earlier names.

### 3. SEEDLING MORPHOLOGY

The diversity of the morphology and the many convergent developments in the floral morphology prompted an investigation of seeds and their germination in order to be able assess on this basis similarities of different species and supraspecific categories. The morphology of the seedlings is compared without entering into the controversy of the significance of certain characters in the phylogeny of the taxon. Davis & Heywood (1963), who briefly reviewed the literature, stressed that "all stages of development of the plant should be examined for possible characters". The seedling development confirmed several supra-specific regroupings undertaken in this work.

Basically, all species investigated began to germinate within 8 - 12 days, but in many species germination was erratic.

In all the species of Crassula investigated the cotyledons had one hydathode towards the end of the adaxial surface of the cotyledon. One hydathode was found on the abaxial surface of species of Sedum investigated. It is also interesting that only

a single row of marginal hydathodes can be observed in the first pair of leaves of all species of Crassula.

The primary root develops more or less vigorously, but adventitious roots from the hypocotyl usually develop as well.

The hypocotyl is usually longer than the cotyledons in the subgen. Levifolia and elongates even more when shaded, except in the subsect. Latifolia and sect. Tuberosae. In the latter <sup>taxon</sup> section the hypocotyl, or part of it, swells out immediately to develop into a tuber, and in many species no leaves develop in the first year (fig. 1.1). In the subsect. Latifolia the hypocotyl is generally shorter and in C. ovata almost absent. The hypocotyl is absent in C. hemisphaerica, C. exilis and the species of the sect. Arta, all of which are plants of arid areas. The very fleshy cotyledons are predominantly found in perennial species from arid or semi-arid regions.

The two subgenera cannot be satisfactorily distinguished on the basis of their seedling morphology, but many of the sections have characteristic developments by which they can be identified. For instance, the oblong cotyledons are typical of the sect. Tillaeoideae and those in sections Anacampseroides and Tuberosae are orbicular or almost so.

However, species of the subgen. Crassula can often be distinguished from those of the subgen. Levifolia by the obvolute vernation, or the way in which at least the young leaves are bent to the one side of the stem. Young leaves of the sect. Rosulares are bent to opposite sides, while older ones are directly opposite to one another, but still show an obvolute vernation (fig. 1.11), which indicates that the one type of vernation is probably derived from the other. It must be stressed that leaves of the same rank will always overlap their opposite number in the same way or are

bent in the same direction. For this reason the equitant vernation of C. teres and C. columnaris are thought to be derived from one of the above types, as again the leaf of the same rank will always overlap its opposite number. Fleshy leaves do not have any of these arrangements (cf. figs. 19,10,15), so that many of the species of the sect. Squamulosae, Pyramidella, Argyrophylla, Arta and Crassula cannot be identified in this way. The converse, that species with either obvolute vernation or young leaves bent to the one side of the stem belong to the subgen. Crassula, is true. C. lactea of the sect. Anacampseroides often has an obvolute or equitant vernation, but in neither situation will the leaves of the same rank constantly overlap the opposite one.

In the subgen. Crassula two major groups can be distinguished by the presence of the marginal cilia on the first pair of leaves in the sections 10 - 15, except in the subsect. Gabrae of the sect. Squamulosae. Among these the hypocotyl of the sections Squamulosae, Subulares, Curtoqyne and Kalosanthes responds readily to shading by elongating even more. Seedlings of the sections Rosulares and Perfilatae have a shorter hypocotyl, which does not elongate appreciably with shading and at least the first pairs of leaves have an obvolute vernation. In fact, young seedlings of the two sections are indistinguishable and ~~it is only~~ <sup>although</sup> that species of the sect. Perfilatae become more woody later. They also usually lose their obvolute vernation and no longer have the typical two dense rows of marginal hydathodes that are typical of the sections 11 - 14 (cf. figs. 1.7 and 1.11).

The second group, including the sections 16 - 21 in the subgen. Crassula, does not produce distinct marginal cilia at least in the first leaves. The hairs become gradually longer towards the margins of the leaves and sepals (fig. 1.14a). Among these, seed

ling of the sect. Pyramidella can be distinguished by the very fleshy erect first leaves (fig. 1.5). Similar fleshy leaves are found at first in seedlings of both subsections Amplexicaules and Imbricatae, but in the later subsequent pairs become gradually less fleshy and eventually the very much dorsiventrally compressed adult leaves typical of this subsection are produced. In the sections Argyrophylla, Arta and Crassula the first leaves are similarly fleshy and keeled, but spreading at right angles to the stem (fig. 1.6,10,12,13). In contrast to this, the first leaves in the sect. Globulea are less fleshy and not keeled. There is a similar arrangement of the hydathodes in a dense marginal row in usually the second and third pair of leaves (fig. 1.14), as mentioned for several other sections previously. Both these features of the sect. Globulea are also observed in species with almost terete leaves (fig. 1.15), which is part of the reason why C. subaphylla was placed in this section. On the other hand, species such as C. namaquensis (fig. 1.12) with a similar floral morphology are placed in the sect. Argyrophylla.

The seedling morphology is therefore not so important in the species concepts, but rather in the delimitation of the supra-specific taxa, and in a few cases <sup>suggested</sup> convergent developments of the floral morphology could be verified in this way. To summarise, the species of the subgen. Levifolia can be recognized by their straight opposite leaves which show no overlap in the bud. The hypocotyl is long and ~~it is elongating~~ <sup>is</sup> when the seedlings are shaded, except in the sect. Tuberosae and subsect. Latifolia. The cotyledons and the first leaves are only slightly fleshy.

The leaves of the subgen. Crassula have an obvolute or equitant vernation or they are bent to the one side of the stem, except when they are fleshy. The cotyledons are more or less convex

on the abaxial surface. The hypocotyl is longer than the expanded cotyledons in the sections 10 - 13, and usually they elongate when the seedlings are shaded, while in the remaining sections it is shorter or absent mainly in the sect. Arta. The first leaves have marginal cilia in the sections 10 - 15, except in the subsect. Glabrae of the sect. Squamulosae. Although a distinct row of marginal cilia is occasionally found in adult plants of the species of the sections 16 - 21, a gradual transition from the short hairs on the leaf surface to the longer ones towards the margins of the first leaves can be observed (fig. 1.14a). The first leaves are distinctly convex and more or less keeled on their abaxial surface in the sections Pyramidella, Argyrophylla, Arta and Crassula in contrast to the only slightly convex ones found in species of the sect. Globulea.

#### 4. HYDATHODES

Species of Crassula are distinguished from other genera of the family in South Africa by the presence of hydathodes on their leaves. These hydathodes have an epithem layer, so that they are usually easy to distinguish without the aid of a microscope. However, in order to distinguish them more clearly, at least in some species, live material can be stained in a dilute solution of crystal violet; but the leaves must be slightly dehydrated before they will absorb the stain. The hydathodes are either situated at the end of veins or, when scattered over the leaf surface, they are often found above the point where two veins anastomose. Also, each cotyledon has one hydathode on the adaxial surface, but in contrast to other seedlings these hydathodes are inactive and no

exudate has been observed <sup>from</sup> ~~in~~ any of them.

In Crassulâ the hydathodes are arranged either in one or two rows along the margin or they are scattered over the leaf surface. Haberland (1914) records that in vascular plants the hydathodes are usually found along the leaf margin, and only in a few cases are they scattered over the leaf surface. It is thus interesting that most of the species belonging to the sect. Filipedes, as well as very similar species such as C. pellucida and C. elsieae, which are generally regarded as having several primitive characters, as discussed in Chapter 6, have a single row of hydathodes along the margin.

In C. expansa one finds some variation, namely that the hydathodes are situated in a single row along the margin in plants growing along the Natal coast, but in the eastern Cape near Port Elizabeth the leaves become progressively fleshier on the abaxial surface. The hydathodes vary from being arranged in more or less one to two rows along the margin, but the latter condition becomes more common along a cline towards the little Karoo (fig. 1.4). The var. filicaulis, which occurs along the southern Cape coast has also only two rows of hydathodes, while the leaves of the var. pyrifolia from Namaqualand are covered with scattered hydathodes on both surfaces. Similarly, they are also scattered over the upper surface of the leaves in the var. fragilis, which occurs in the summer rainfall <sup>area</sup> from Natal to tropical Africa, but judging by other characters as well, this seems to represent an independent development of the scattered hydathodes. Similar tendencies of the scattering of the hydathodes can be observed in the different sub-species of C. tetragona and in the sections Deltoides and Anacampseroides.

In the subgen. Levifolia the hydathodes are situated

predominantly along the leaf margin, while in the subgen. Crassula the hydathodes are more or less scattered over at least the upper leaf surface. In the sections 11 - 14, and sometimes in 15, the hydathodes are arranged in a dense row along the upper and lower margin and, in addition, some are scattered over the upper and/or the lower surface. This arrangement is also found in C. multicava (fig. 1.3), C. cordata, C. ovata and C. arborescence in the sect. Anacampseroides, but very often the marginal rows are not clearly discernible in adult plants. Lubbock's (1892) observation that the leaves of C. multicava are covered with many hydathodes is based on adult leaves and his illustration shows rather large plants. It seems highly likely that the cotyledons had worn off at that stage, as a similar condition of the cotyledons could not be confirmed in present material. It is interesting, however, that the above findings of a dense row of hydathodes in addition to the scattered ones is also found in juvenile leaves of species belonging to the sect. Globulea.

In the subgen. Crassula the species of the sect. Squamulosae usually have two subdistant rows of marginal hydathodes, but in its subsect. Glabrae they often become arranged into two dense marginal rows and some are scattered over the leaf surfaces as for example in C. pallens. Species of the sections Subulares, Curtoqyne, Kalosanthes and Rosulares are distinguished by the dense row of hydathodes on the upper and lower margins with some scattered mainly over the upper surface. Adult leaves of the sect. Perfilatae show no distinct pattern and many of them lack the two rows of marginal hydathodes. However, in a juvenile stage the hydathodes have a similar distribution as in species of the sect. Rosulares (figs. 1.7). Leaves of adult plants of the sections 16 - 21 do not have a dense row of marginal hydathodes and they are rather scattered

over the upper and lower surfaces, with a few exceptions in the subsect. Imbricatae. The latter phenomenon is interesting, as the leaves of both subsections <sup>have</sup> are similar in seedlings (cf. chapter 3).

Seedlings of the sect. Globulea have a dense row of hydathodes along the upper and lower margins of usually the second to fifth pair of leaves, after which these rows become less distinct (fig. 1.14). This phenomenon together with the fact that the first leaves of species of the sect. Globulea are only slightly convex and not keeled, is part of the reason why C. subaphylla (fig. 1.15) and C. ammophila have been placed into the sect. Globulea. C. namaquensis (fig. 1.12) and C. hirtipes, which have a similar Sphaeritis-type of flower were placed into the sect. Argyrophylla, because of their convex and keeled first leaves as well as their scattered hydathodes (see also discussion under the respective sections).

Generally the hydathodes are marginal in the subgen. Levifolia, except in some species of the sections Deltoideae, Anacampseroides and Acutifolia, but in each of these sections at least one species has hydathodes along the margins. The latter species have usually also flowers in the axils of the leaves, a character that may be regarded as primitive in Crassula (see chapter 6). This means the combination of the 'axillary' flowers and marginal hydathodes indicate that the sections in the subgen. Levifolia are radiating out from a central group of species.

In the subgen. Crassula the hydathodes are usually more or less scattered over the leaf surfaces, but two distinct tendencies can be observed, as outlined above. In the sect. Squamulosae both these tendencies are more or less clearly represented, so that this fact, together with the presence of an involute or equitant vernation, or <sup>that</sup> the leaves are bent to the one side of the stems, indicate that the sections of the subgen. Crassula are fanning out

from one point (cf. chapter 6).

Haberland (1914) refers to this type of hydathode, as found in the Crassula, as the inactive type, because the water is forced out by root pressure. In the softly herbaceous and annual species a white crust around the hydathodes indicates that guttation takes place frequently. However, leaves with scattered hydathodes do not usually show any indications of guttation. The function of these scattered hydathodes appears to be of a wider importance, and this can be demonstrated by placing leaves which show some signs of desiccation into a solution of crystal violet: within 15 - 30 minutes the hydathodes and the main veins of the leaves are stained. If branches are left in the stain for a longer time, the xylem in the stems becomes stained as well. In contrast to this, the movement of stain along the veins on cut surfaces of the leaves or of the stems is minimal. This absorption of fluid through the hydathodes could be shown in most species, even the annual species of Crassula. The only exceptions are C. rupestris, C. brevifolia and C. macowaniana which, in contrast to other species of Crassula, usually occur on exposed positions.

Furthermore, it seems significant that many species occurring in arid regions have densely hairy leaves, which are not water repellent. Even the spherical trichomes of C. deceptor, which are covered with a flaking substance resembling a wax layer, are not water repellent. In fact, if a drop of water splashes on the uneven surface it immediately sinks in. Furthermore, the rough epidermis and trichomes of C. tecta seem to reduce the surface tension, so that any moisture is immediately spread over a large area of the leaves. However, C. tecta is the only species where such a hygro-  
phil  
phobe reaction could be demonstrated. Marloth (1925) attributed the absorption of water to the epidermal cells, which, if one

considers Bornman's (1971) work could possibly contribute to absorption as well, but not at the speed shown for the hydathodes.

Most plants of Crassula without roots will grow well with only an occasional fine spray of water over the leaves. Also, the distribution of Crassula in the field indicates that such absorption of moisture is operative in nature. For instance, plants of this genus occur either in the shade or on the south-facing aspects of mountains in most parts of the Cape Province. However, in the Richtersveld great accumulations of Crassula species are found on the south-west-facing, but rarely on the south-east-facing slopes of hills or mountains probably because fog from the sea is important for the survival of these plants.

## 5. CYTOLOGY

Baldwin (1936) was the first to record sufficient chromosome counts to be able to establish the basic numbers 7 and 8 for Crassula. He assumed that 8 was the original basic number, because Schonland (1929) and Berger (1930) had proposed that the sect. Tillaeoideae was the most primitive group due to their rather 'simple' morphology. More chromosome counts were reported by Uhl (1948, 1961), Merxmüller et al. (1971) and Friedrich (1973) and the question of the original basic number was again revived. In their detailed work Merxmüller et al. (1971) argued that 8 must be the original basic number, because the number 7 had developed twice in different groups. Two pairs of chromosomes in the genome of the latter groups - the subgen. Crassula as defined here - show a double constriction. It is rather significant that the chromosomes of the two subgenera can be distinguished in spite of their small

size. Also, a decrease in chromosome number is usually regarded as more likely than an increase, although such increases have been reported (Stebbins, 1950). The original basic number 8 is also acceptable on morphological grounds, as Friedrich (1973) suggested and is reviewed in Chapter 6 particularly as it is found in most of the species of the subgen. Levifolia.

Concerning the structure of the chromosomes two problems are evident. Firstly, Friedrich (1973) points out that the chromosomes with the basic number 8 are usually smaller than those with the basic number 7 and the double constriction. Stebbins (1950, 1971) referred mainly to Babcock (1947) when he considered that a progressive decrease in the size of the chromosomes is usually found with evolution. This would contradict the assumption that the original basic number is 8 and certainly all the species investigated in the sect. Filipedes have short and not 'primitive' chromosomes as postulated by Merxmüller et al. (1971). However, it is pointed out in Chapter 6 that the subsect. Fasciculares is hardly different from the sect. Filipedes, and Friedrich (1973) illustrated much larger chromosomes for C. pellucida subsp. alsinoides of the subsect. Fasciculares. A reappraisal of all the species of the sect. Filipedes and closely related species would need to be undertaken to assess whether a link with chromosome size and basic number <sup>could</sup> can be found.

Secondly, the double constriction of the chromosomes in some species was tentatively explained by Merxmüller et al. (1971) as possibly due to translocation. This seems unlikely as only one of the constrictions appears to act as a centromere. Darlington (1965) indicates a relation between the double constriction found in chromosomes and the position of the nucleolus, a phenomenon that needs to be investigated in Crassula.

The genus Sedum, from which Schonland (1898, 1929) thought Crassula had been derived, shows a wide range of basic numbers from 5 - 12 (Darlington & Wylie, 1955), so that on the basis of the chromosomes little similarity can be claimed as the chromosomes are too small to show any identifiable structures. Other genera in the Crassulaceae have usually a higher basic number, so that <sup>in conclusion,</sup> the chromosomes ~~also~~ seem to indicate that Crassula shows no obvious similarity with any other group or genus in the family, except possibly Sedum.

In some of the Crassulaceae, and among them the genus Crassula, a remarkably high degree of polyploidy is found. Uhl (1961, 1970) also draws attention to the high levels of polyploidy, as he records the basic gametic numbers of between 240 - 275 for some species of the genus Graptopetalum from Mexico. The highest recorded basic number for Crassula is 140 (Friedrich, 1973).

The great number of counts published by Friedrich (1973) are analysed in Table 1 as they were all done using the same technique and are sufficiently numerous to allow a significant evaluation in most cases, <sup>while</sup> which in other parts they serve as a useful indication of possible tendencies. Each count is treated individually, as so often heteroploid species are found among the counts. Also, the great number of plants with known origin enables one to evaluate the percentage polyploidy in relation to different rainfall conditions. The following points are of interest:

1. The high percentage of polyploidy in the genus (44%) falls into the range of the classic examples of Salix 50% and Betula 42% (Stebbins, 1950, 1971), where this high percentage is generally attributed to glaciation.

It is also of interest that no significant difference between all the counts (column 1) <sup>exists?</sup> and only those with known origin

(column 2 & 3), which reduce the number of counts by about a quarter, <sup>maybe taken account of?</sup> can be noticed.

do not follow

2. The frequency of polyploidy varies considerably among families and genera and in their geographic range. Norlindh (1963), in his work on the Calendulae (Compositae), and Goldblatt (1971) in the Iridaceae, record a considerably lower percentage polyploids in the South African plants. In the subgen. Levifolia the level of polyploidy under various conditions, except in the summer rainfall area, is 20 - 30% higher than in the subgenus Crassula. This is partly due to the even higher percentage of polyploidy in the annuals, i.e. sect. 1 & 2, of the former subgenus.

3. The low percentage of polyploidy in the sections 11, 12, 14, 15, which is usually below 20%, except for the few species counted from the summer rainfall area is significant. However, nearly 80% of the specimens investigated were collected in the winter rainfall area.

4. Although only very few plants from the summer rainfall area have been investigated, the particularly high percentage of polyploidy leaves little doubt that this field requires further investigations. Goldblatt (1971) found a similar high degree of polyploids in the Iridaceae from the summer rainfall area.

5. Earlier researchers had attributed a high percentage of polyploidy to extreme conditions, an assumption based on the effects of glaciation in Europe. However, plants of Crassula collected in arid regions, i.e. <sup>with</sup> an average rainfall of less than 200 mm a year, show no significantly high degree of polypody. Similar findings by Stebbins (1971) are illustrated in Table 6.2.

6. The percentage of polyploids varies from one taxonomic group to the other, but one observes a particularly high number of polyploid forms in what <sup>are</sup> here regarded as species complexes.

	overall percentage polyploidy	plants from areas with average rainfall less than 200 mm	plants from areas with average rainfall more than 200 mm	plants from winter rainfall areas	plants from summer rainfall areas
genus <u>Crassula</u>	43,7 (190)	40,9 (88)	40 (45)	36,9 (103)	52 (25)
subgenus <u>Levifolia</u>	59,4 (64)	53,3 (15)	55,6 (27)	59,3 (27)	58,3 (12)
"annuals" sect. 1 + 2	58,6 (28)	54,5 (11)	61,5 (13)	63,2 (19)	40 (5)
"perennials" sect. 4 - 9	55,3 (36)	50 (4)	50 (14)	50 (8)	71,4 (7)
Subgenus <u>Crassula</u>	35,7 (126)	36,9 (73)	16,7 (18)	31,6 (76)	76,9 (13)
"ciliate leaves" sect. 11,12,14, 15	18 (50)	12 (25)	18,2 (13)	10,7 (13)	50 (4)
without "ciliate leaves" sect. 16 - 21	47 (76)	50 (48)	14,3 (7)	43,7 (48)	80 (5)

Table 1 Percentage polyploidy in the South African species of the genus Crassula and parts thereof, comparing plants collected in different rainfall regions.

The number of counts evaluated are indicated in brackets (based on Friedrich, 1973).

For instance, C. expansa has 2 polyploids in 6 counts, C. muscosa 8 in 9 counts, C. pentandra 5 in 6 counts and C. tetragona 4 in 6 counts. As most of these forms are geographically isolated, this seems to be a rewarding field for future cytological and phytogeographical studies.

## 6. CHARACTERISTICS AND AFFINITIES OF CRASSULA AND ITS SUBGENERIC TAXA

Linnaeus delimited the genus Crassula clearly, but this was mainly due to his rigid artificial approach which adhered to the five stamens in the strictly pentamerous flowers (cf. Tölken, 1972). The genera Tillaea and Septas were kept separate on the basis of their tetramerous and heptamerous flowers. Thunberg (1823) included Septas in Crassula but, at the same time, the latter genus become more and more subdivided and De Candolle (1828, 1828a) recognized nine genera, but kept them together in a group. Endlicher (1839) established the Tribus Crassulaea isostemones for all these related genera.

Crassula sensu lato was kept as a closely related entity by most systematists, but Schonland (1929) stated that he "assumed (in 1898) that Crassula is derived from the generally obdiplostemonous genus Sedum. This genus has a section Pro-crassula in the Mediterranean region (incl. the Canary Islands) and in central Europe with generally haplostemonous flowers". Berger (1930) doubted that there was a direct relation between Crassula and Sedum and placed them into separate subfamilies quite separated from each other, a stand accepted by Melchior (1964). Berger wrote: "Sicher ist, dass mit Crassula die haplostemonen südafrikanischen

*considered as a natural assembly of closely related species with obvious close affinity with other genera*

*one*

*with*

*ship*

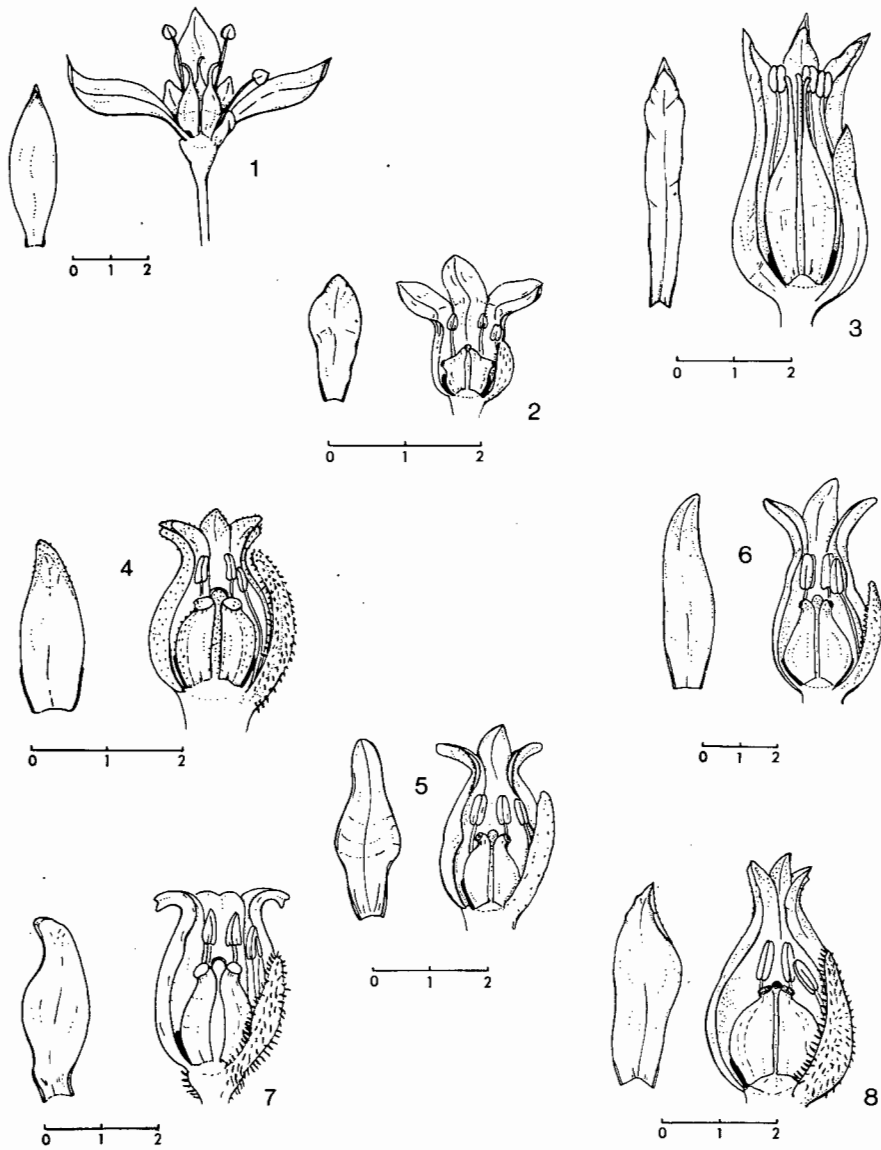


Fig.2. - Half flower and single petal of Stellata-type of flower: 1, C. cordata, petals scarcely fused at the base (Strey 9668); Variations of and flowers similar to the Sphaeritis-type of flower: 2, C. filiformis, stigma in lateral position (Tölken 1607); 3, C. ericoides, petals without dorsal appendages but with fleshy apices (Tölken 3843); 4, C. elegans subsp. elegans, stigmas enlarged and sessile (Tölken 4011); 5, C. subaphylla var. virgata, lateral membranous wings of petal apices recurved (Tölken 2917); 6, C. ciliata (Tölken 1648); 7, C. alstonii (NBG 969/69); 8, C. namaquensis subsp. namaquensis (Tölken 3808). (Scale 2 mm).

Gattungen Paqella, Dinacria, Rochea und Vauanthes eng zusammenhängen. Ob andere haplostemone Sektionen wie die frühere "Procrassula" und Gattungen wie Sinocrassula und Hypagophytum mit dieser Gruppe zusammenhängen ist jedoch zweifelhaft".

Fröderström (1930) in his revision of the genus Sedum could not endorse Schonlands view and according to him (1931) "Crassula (sensu strictiore) is an autonomous South African derivate of Tillaea ....." He argues as <sup>did</sup> Schonland (1929) that the stellate flowers are primitive and adds that the world-wide distribution of Tillaea proves its age. The age and area hypothesis <sup>accepted without reservation</sup> cannot be generalised and the remark by Uhl (1948) is appropriate, namely that "Tillaea" seems to provide the near-classic of morphological reduction in size and number of floral parts accompanying adaptations to the annual habitats".

Species of Sedum show some similarity with those of Crassula in characters such as, the fusion of the petals and stamens into a short tube, and some-species have hydathodes on their leaves <sup>of some spp.</sup> while the cotyledons of all the species investigated have one hydathode (but in contrast to Crassula, it is situated on the undersurface). The seeds of Sedum species are vertically striate, but usually have a pronounced hilum which is not found in Crassula seeds. Also, some species of Sedum have a mucro<sup>n</sup> on the petals, or rather a petal appendage as it is termed in Crassula, because it is usually not in the terminal position, but in contrast to Crassula this appendage occurs in some species and is absent in others quite unrelated to the position of the species and its subgeneric classification (Fröderström, 1930, 1931). The Sedum species recorded from ~~the~~ northern and central Africa and Madagascar do not show the latter characteristic. However, all the species of Sedum, even those with haplostemonous flowers mentioned

above, have alternate leaves, whereas they are always opposite in Crassula.

The basic chromosome number recorded for Sedum varies from 5 - 12 while those of Crassula are 7 <sup>or</sup> 8 and all the other <sup>of Crassulaceae have</sup> genera are 9 or more (Darlington & Wylie, 1955).

Quimby (1939) distinguishes four different types of the vascular systems <sup>in</sup> of the flowers <sup>of</sup> in the Crassulaceae, but these do not coincide with generic or subgeneric concepts. For instance, C. spathulata and C. multicava, which Schonland (1929) and the present author have placed into the same section, <sup>have</sup> belong to different types of vascular systems of the flowers according to Quimby's findings.

Mauritzon (1933, 1933a) <sup>found</sup> finds that he <sup>could</sup> can distinguish the few species of Crassula that he had investigated from other genera in the family by their development of the endosperm and especially by the nucellus-type, but admits <sup>that</sup> these differences could be derived from the <sup>those</sup> type found in Sedum. Also, the haustorium of the embryo is least developed in Crassula (Mauritzon, 1930).

The conclusion that Crassula shows closest resemblance to Sedum but that a direct relation <sup>ship</sup> can neither be proved nor rejected on existing evidence, seems permissible.

The genus Crassula includes such a diversity of shape and size of the various organs that a discussion on what characters may be primitive and which may be advanced becomes necessary if one strives to achieve a natural grouping. Schonland's (1929) suggestion that the annual species represent the most primitive group calls for comments when one finds that the first species <sup>? sing. or plural</sup> he lists produce <sup>?</sup> a single ovule per carpel. Uhl's (1948) comment that the morphology of the sect. Tillaeoideae is probably reduced is shown by the fact that the seeds of these species as well as

those of most of the annuals are smooth, whereas the vertical ridges or papillae arranged in vertical rows is one of the basic characteristics found in most genera of the Crassulaceae. In the sect. Glomerata the ovules have vertical ridges but these become less visible during the development of the seeds and thus indicate that in Crassula also the usual development from perennials to annuals seem to be applicable. That is, the third section of annuals, sect. Dinacria, usually has modified flowers, so that it is also advanced.

The basic chromosome numbers of 7 and 8 have been recorded for Crassula and 8 is considered to be the original basic number as has been discussed under in Chapter 5 on the cytology. The basic number 8 is found only in the subgen. Levifolia.

In the subgen. Levifolia there are a number of species that have either a single flower in the axil of the leaves and/or terminal clusters with flowers usually alternately arranged because of sympodial growth. All the species with a single flower in the axil of the leaves have sympodial growth, as can be demonstrated by cutting off the growing point immediately above the node with the flower which will result in the development of the second axillary bud (see also discussion under the sect. Tillaeoideae).

A distinct axillary inflorescence with one to several flowers is found among the species of the sect. Glomeratae. The perennial species of this section particularly, often have a single axillary flower, but through branching it is obvious that this represents monopodial growth with an extreme reduction of the axillary inflorescence.

In each section of the subgen. Levifolia there is at least one species which has no distinct peduncle, while in the subgen. Crassula the inflorescence always has a peduncle, except

in the sect. Rosulares and sect. Pyramidella. However, the inflorescence in the former is a definite dichasium or thyrses so that it cannot be confused with most of the types of inflorescences found in the subgen. Levifolia. In the sect. Pyramidella a tendency for the inflorescence to become more compact may be observed in species such as C. columnaris. The inflorescence of C. congesta must be classified as a <sup>capitulum</sup> capitulum, which is generally regarded as more advanced than the dichasium (Melchior et al., 1954).

The subgen. Crassula is regarded as more advanced as its chromosomes show the basic number 7 and it is also reflected in the shape of the leaves. They are more or less clearly divided into a petiole and an expanded lamina in the subgen. Levifolia. While the petiole is often very much shortened or even absent, the laminae of the opposite leaves do not usually touch one another where the sheath begins, and the latter forms a membranous or carnosose connection between the leaf bases. The leaves are usually phyllode-like in the subgen. Crassula and are usually so broad at the base that the lower part of the lamina of the opposite leaves touch or even overlap one another where the sheath begins. The sheath gives the impression that it was formed by the partial fusion of the lamina, which at times also occurs in both subgenera.

The petals in the subgen. Crassula have a pronounced dorsal petal appendage unless the petals are modified as in the case of the Shaeritis and Pyramidella types of flower (see chapter 2 for the floral morphology). In both these cases the petals become smooth, but in contrast to those in the subgen. Levifolia, they are drawn into a canaliculate rostrum.

In the subgen. Levifolia one finds that all the species of the sect. Filipedes, C. pellucida of the sect. Anacampseroides and C. corallina of the sect. Deltoideae sometimes or always have

a single flower in the axils of the leaves. It seems significant that the species of the sect. Filipedes, at least in some of their forms, and C. pellucida, have only one row of hydathodes along the margin. As has been discussed in Chapter 4, that if the hydathodes are scattered over the leaf surface, this is usually found in plants growing in arid regions or in plants that are known to have other advanced characteristics.

Merxmüller et al. (1971) derived, in their phylogenetic diagram, all the existing "groups" of species from the sect. Filipedes, but there seems to be little evidence for such a specific approach especially as the chromosomes of the investigated species are probably not primitive (see discussion in chapter 5). However, all the sections of the subgen. Levifolia group themselves <sup>are basically</sup> around <sup>composed of species</sup> the plants with a single axillary flower <sup>although</sup> and all the sections have at least one species with a terminal cluster of flowers or a terminal inflorescence without a peduncle. Similarly, the species with marginal hydathodes on the leaves occur in each section of the subgen. Levifolia. In other words, each section of the subgen. Levifolia <sup>has some species with</sup> shows some similarity to plants with primitive characters. The proposal by Merxmüller et al. (1971) to recognize three subgenera within this group seem to place excessive stress on divergent developments, especially as they themselves admit that each group can be traced back morphologically via existing species to the sect. Filipedes.

In contrast to this, the subgen. Crassula shows no such connection to the sect. Filipedes or any group in the subgen. Levifolia. Even the species of the sect. Squamulosae, with only two marginal rows of hydathodes, have a definite peduncle and denticulate petals with a pointed dorsal petal appendage, a characteristic of the subgen. Crassula. The sections within the latter subgenus

can be placed into two groups, namely those with marginal cilia in the seedling stage, which includes sections 10 - 15, while those without cilia comprise sections 16 - 21. Although the sect. Pyramidella is included in the latter group it does not show great affinity to the rest of the sections in that group. The equitant vernation or the absence of any overlap of the leaves in the buds is unusual. In the monocarpic nature of many species these resemble the sections Squamulosae and Subulares, as in many species of the latter two sections the upper parts of the branches die after flowering. The leaves are bent to the one side of the stem or show obovate vernation at least in some species of each section of the subgen. Crassula, except in the fleshy leaves of the sections Squamulosae and Pyramidella (see discussion under seedling morphology), while the leaves in the subgen. Levifolia are directly opposite to one another. This also indicates that the subgen. Crassula is monophyletic in origin contrary to what Merxmüller et al. (1971) indicated. It is interesting that their phylogenetic diagram seems to postulate a polyphyletic origin of the basic number 7, with the double constriction on two chromosomes, because they envisage three groups with the basic number of 8 to be included as basis in this proposed subgenus. A monophyletic origin fanning out, but showing a greater or lesser degree of similarity to one another rather than a complicated pattern of interrelationships, seems more likely.

The scatter of the "groups" now included in the sect. Rosulares, by these authors, and that some of them should have formed the basis for their sect. Sphaeritis and sect. Globulea, cannot be supported by findings of the seedling morphology, distribution of hydathodes, presence or absence of marginal cilia and the vernation.

Also, their diagram also indicates quite correctly that their sect. Sphaeritis is polyphyletic in origin, and, as mentioned

before, it seems to represent a flower type not a taxonomic group. However, it seems more than unlikely that the sect. Globulea is derived from the sect. Sphaeritis, polyphyletically, involving a loss and a reinsertion of the petal apex. For this reason it is suggested that in the sect. Globulea <sup>the</sup> development <sup>of the</sup> ~~via a flower,~~ such as, for example, is found ~~such as found~~ in C. atropurpurea var. anomala <sup>progressed</sup> from the Globulea-type to the Sphaeritis-type ~~took place~~ and not vice versa. This example as well as the development of a flower that seems to simulate the Pyramidella-type in C. namaquensis subsp. lutea, indicates that these flower types represent extreme developments within their section, but neither of them are ultimate developments within the genus as Schonland (1929) and Merxmüller et al. (1971) <sup>suggested</sup> had ~~intended~~ when they placed them in a terminal position. The fact that the sect. Globulea is also placed at the end, and the sect. Tillaeoideae at the beginning in this work does not reflect their relative position in Crassula, but is rather a consequence of <sup>the</sup> ~~a~~ linear system, <sup>adopted for convenience of presentation</sup> and <sup>in the</sup> the desire to retain the known order as far as possible. <sup>taxonomic treatment</sup>

In the following synopsis the similarities and tendencies found in various sections are briefly enumerated to show their position relative to one another. In the genus Crassula, where such ~~a~~ wide variation occurs, developmental lines in groups of species within a section must be given as much importance as single characters in evaluating similarities, convergent developments and characteristics of the sections and their subordinate groups of species.

#### A. Subgen. Levifolia

##### I. Sect. Tillaeoideae:

Schonland (1929) included the sect. Glomeratae, but the species of the sect. Tillaeoideae have sympodial growth (see above), while it is monopodial in the former. Characteristically the sepals

are usually less than half as long as the petals in the latter section, and also the seeds are released through a whole ventral slit of the carpels. Both these characters are not found in species, of the sect. Filipedes. The cotyledons are oblong in contrast to the ovate or orbicular ones in other sections of the genus.

While branches and leaves of C. natans and C. inanis usually float when inundated, they remain stiffly erect in C. tuberculata, and C. vailantii and the latter <sup>pair of spp. also</sup> prefer to grow in marshy areas. However, the very much swollen internodes in C. vailantii <sup>which conditions</sup> under these conditions are interesting, as these are hardly distinguishable from those of C. aphylla, which is part of the reason why this species <sup>is not</sup> cannot be recognized <sup>here</sup> as belonging to a separate genus.

## II. Sect. Glomeratae:

Monopodial growth often with axillary inflorescences is found in this section. Characteristically the sepals are slightly broadened towards the apex and are longer or about as long as the petals, both of these characters are usually also ~~being~~ found in the sect. Filipedes. Three main groups have developed in this section, but they cannot be clearly separated, so that no taxonomic rank can be assigned to them.

(a). The carpels are glabrous and usually with 4 - 16 ovules, while the fruit dehisces with apical pores, except in C. pageae, which shows <sup>a</sup> close resemblance to C. roggeveldii and C. dodii in spite of its superficial resemblance to C. umbellata.

(b). The papillose carpels usually show a reduction to 1 or 2 ovules. The fruits release the seeds through apical pores, but also develop an abscission layer at the base as for instance in C. thunbergiana. In other species, such as C. hirsuta, an apical pore is no longer found.

(c). The carpels are usually glabrous, but a similar reduction in ovules to usually two is found and the fruits dehisce by an apical pore. Typical of these plants are the short, triangular leaves and sinuous branches, which give them a similar appearance to species of Lycopodium. Some of these species are perennials.

### III. Sect. Dinacria:

The plants are erect annuals like many of the species in the previous two sections, but their flowers are tubular and the anthers longer than 3 mm. The styles are as long as the ovary or variously modified and with a lateral stigma. The closely related species C. depressa and C. grammanthoides represent an intermediate between <sup>the genus</sup> Crassula <sup>(in origin, mostly unisexual)</sup> with a terminal stigma and Dinacria with a lateral stigma. The style is more or less modified into a horn in C. filiformis and a shield in C. sebaoides, both of which represent divergent trends in the development of flower types (see discussion on flower morphology in chapter 2). In other words, it <sup>would be</sup> <sup>include</sup> is artificial to ~~place~~ these two ultimate developments into one genus by ~~itself~~ <sup>consequent</sup> with the obvious necessity to ~~create~~ <sup>accept</sup> another genus, Vauanthes, for C. dichotoma, <sup>whose flowers</sup> which simulates the Gentiana-type of flower. Both genera, Dinacria and Vauanthes, are included in this section.

### IV. Sect. Filipedes:

These soft perennials are often <sup>are they the annual w.</sup> <sup>do they merely flower in</sup> <sup>the first year + continue</sup> <sup>as perennials</sup> found as annuals. The flowers are single and born in the axils of the leaves or in terminal clusters, but then branch alternately, which indicates sympodial growth. The seeds are covered with separate teeth in vertical rows, a character even more pronounced in the sect. Anacampseroides, which is hardly separable from the sect. Filipedes if one considers the similarity of C. tenuicaulis to C. pellucida. C. expansa shows a

whole range from flat leaves with a marginal row of hydathodes to terete leaves covered with scattered hydathodes (see discussion on hydathodes in chapter 4).

V. Sect. Deltoideae:

<sup>These spp.</sup>  
The ~~plants~~ are soft perennials with fleshy deltoid leaves, which are usually irregularly papillose with hydathodes scattered over the upper surface except in C. elsileae. Characteristically, the flowers are urn-shaped and usually clustered at the apex or in a terminal dichasium in C. vestita and C. deltoidea. Although the tubular flowers resemble those of the subgen. Crassula, the petals are smooth and the dorsal appendage is no more than a swelling towards the apex of the petals.

VI. Sect. Anacampseroides:

Characteristic of this section are the wide open star-like flowers and the slender styles, which are <sup>from</sup> half to longer than the ovary. The seeds have prominent teeth and the cotyledons of seedlings are broadly ovate to orbicular.

The subsect. Fasciculares produces either single flowers in the axils of the leaves or terminal clusters, which makes it difficult to distinguish between C. pellucida and species of the sect. Filipedes (see also discussion under the latter section).

The subsect. Petiolares is a very diverse group, but is characterised by the more or less clearly petiolate leaves, which are not deciduous. Serrate leaves with hydathodes between the teeth are found in C. spathulata, C. sarmentosa and C. crenulata. While the hydathodes are scattered over the leaves in C. cordata and C. multicava, the very similar species C. streyi has two marginal rows of hydathodes. C. lactea is very similar to species of the subsect. Latifolia with its thick carnosose leaves, but they are not deciduous and the hydathodes are not scattered over the

leaf surfaces. The vernation of C. lactea may at times appear to be obvolute, but on closer examination, the overlap is not consistent on the same plant and leaves of the same rank do not always overlap their opposites.

#### VII. Sect. Tuberosae:

The flat, broad leaves with hydathodes along the margin, the pronounced star-like flowers with carpels with usually long styles and the broad orbicular cotyledons are similar to those found in the species of the sect. Anacampseroides. Only C. saxifraga produces tubular flowers. However, the stem tubers and the very much reduced annual stems which ~~will~~ produce a maximum of four pairs of leaves is unique in the genus. The first tubers are formed by part of the whole hypocotyl, but usually an underground rhizome produces more ~~such~~ tubers at a later stage.

#### VIII. Sect. Galpiniflora:

The axillary inflorescence represents a modified branch from the previous years growth. Unusual in this subgenus are the rosulate leaves, but they have a marginal row of hydathodes, the stellate flowers and the denticulate ovules which are reminiscent of those in the sect. Filipedes. The fleshy leaves might be confused with those of C. dependens of the sect. Acutifolia, but the flowers are quite different.

#### IX. Sect. Acutifolia:

The tubular flowers without a denticulate petal appendage and the sessile fleshy and usually subulate leaves are characteristic of this section. The leaves and the finely denticulate ovules of at least some species are similar to those of the sect. Galpiniflora and sect. Filipedes.

A tendency of some species to produce short petals, <sup>a</sup>well

developed peduncle and smooth stems can especially be noticed in C. tetragona, while the petals are longer, no distinct peduncle, and finely papillose stems occur in C. dependens, C. ericoides and C. sarcocaulis, <sup>although</sup> but a clear separation of the two groups can not be effected. Also, in C. tetragona, the hydathodes are more or less scattered over the upper and/or the lower surfaces of the leaves.

#### B. Subgen. Crassula

##### X. Sect. Squamulosae:

This section is characterized by ~~the~~ opposite leaves which are not bent to the one side of the stem, the hydathodes are in two rows along the margin and rarely scattered over the leaf surfaces. The stilt roots, found in most species of this section and in C. expansa, are unique in the genus. C. muricata has a Sphaeritis-type of flower.

The subgen. Crassula can be divided into two groups on the basis of the presence or absence of the marginal cilia on the first leaves or the presence of cilia on the sepals in a single or indistinct marginal row. In the sect. Squamulosae similar tendencies are found.

a. The absence of the robust trichomes and marginal cilia ~~in seedlings~~ <sup>of seedlings</sup> on the leaves and short styles in the subsect. Glabrae are remarkably similar to what one finds in the sections 16 - 21.

b. In the subsect. Scabrae the seedlings produce distinct marginal cilia on their first leaves similar to <sup>those on</sup> adult leaves and the long styles are similar to what one finds in sections 11 - 15.

A long hypocotyl, that ~~will~~ elongate<sup>s</sup> with shading, is found in all the species of the sect. Squamulosae as well as in the sections 11 - 14, but rarely in section 15, while the hypocotyl is distinctly shorter and does not elongate in the sections 16 - 21.

XI. Sect. Subulares:

The leaves are usually bent to the one side of the stem. The short petals (2 - 4 mm long) and oblong squamae distinguish the sect. Subulares from the sections Curtoogyne and Kalosanthes.

C. ciliata, C. multiflora and C. subulata have a Sphaeritis-type of flower.

XII. Sect. Curtoogyne:

This section holds an almost intermediate position between the sections Squamulosae and sect. Kalosanthes, the latter being mainly distinguished from the sect. Curtoogyne by the larger flowers. The latter section is distinguished from the sect. Subulares by its longer petals (5 - 9 mm long) and the transversely oblong squamae.

XIII. Sect. Kalosanthes:

In vegetative characters the species of this section are almost indistinguishable from the <sup>sp. of</sup> section Curtoogyne, but the distinguishing characteristic of the sect. Kalosanthes are the long tubular flowers with petals 20 - 60 mm long. However, measurements show that the whole flower with all its parts is enlarged, so that it is rather seen as a flower type than a separate genus (cf floral morphology in chapter 2).

XIV. Sect. Rosulares:

Characteristic of this section are the leaves which have marginal cilia, an obvolute vernation and are arranged in a basal rosette. Usually the leaves become gradually shorter below the inflorescence, but in a group of species similar to C. orbicularis they are abruptly constricted so that a distinct peduncle is visible below the inflorescence. However, even this group of species cannot be given <sup>separate</sup> taxonomic rank, because a range of intermediate conditions is found in species such as C. montana.

The sect. Rosulares is the largest in the genus and obvious tendencies in it are the flat-topped thyrse and spike-like inflorescences. Among the species with a spike-like inflorescence C. capitella subsp. capitella and subsp. nodulosa have a similar inflorescence and also simulate the flower type characteristic of the sect. Globulea.

not clear

XV. Sect. Perfilatae:

The plants usually have woody stems with the leaves evenly spaced. However, in the seedling stage, plants are not distinguishable from those in the sect. Rosulares, as they have leaves with marginal cilia, hydathodes arranged in a row along the upper and lower leaf margin and more or less scattered over the surfaces. This condition is still more or less clearly seen in adult plants of C. fusca, where the leaves are also fascicled at the base. In the adult plants of other species, the above characters are usually no longer visible.

The small flowers, together with a not very pronounced dorsal petal appendage in this section, might be the reason why previous workers placed this "group" next to the sect. Acutifolia.

XVI. Sect. Pyramidella:

The flowers represent a distinct type, but the leaves are also unusual for this subgenus, because they are not bent to the one side of the stem as is the case in the sect. Rosulares. The equitant vernation found in C. teres and C. columnaris, in which the leaf of the same rank always overlaps its opposite number, might indicate similarity or a derivation of the typical leaf arrangement in the subgen. Crassula.

However, the sect. Pyramidella seems to show greater similarity to the second group of sections within the subgenus,

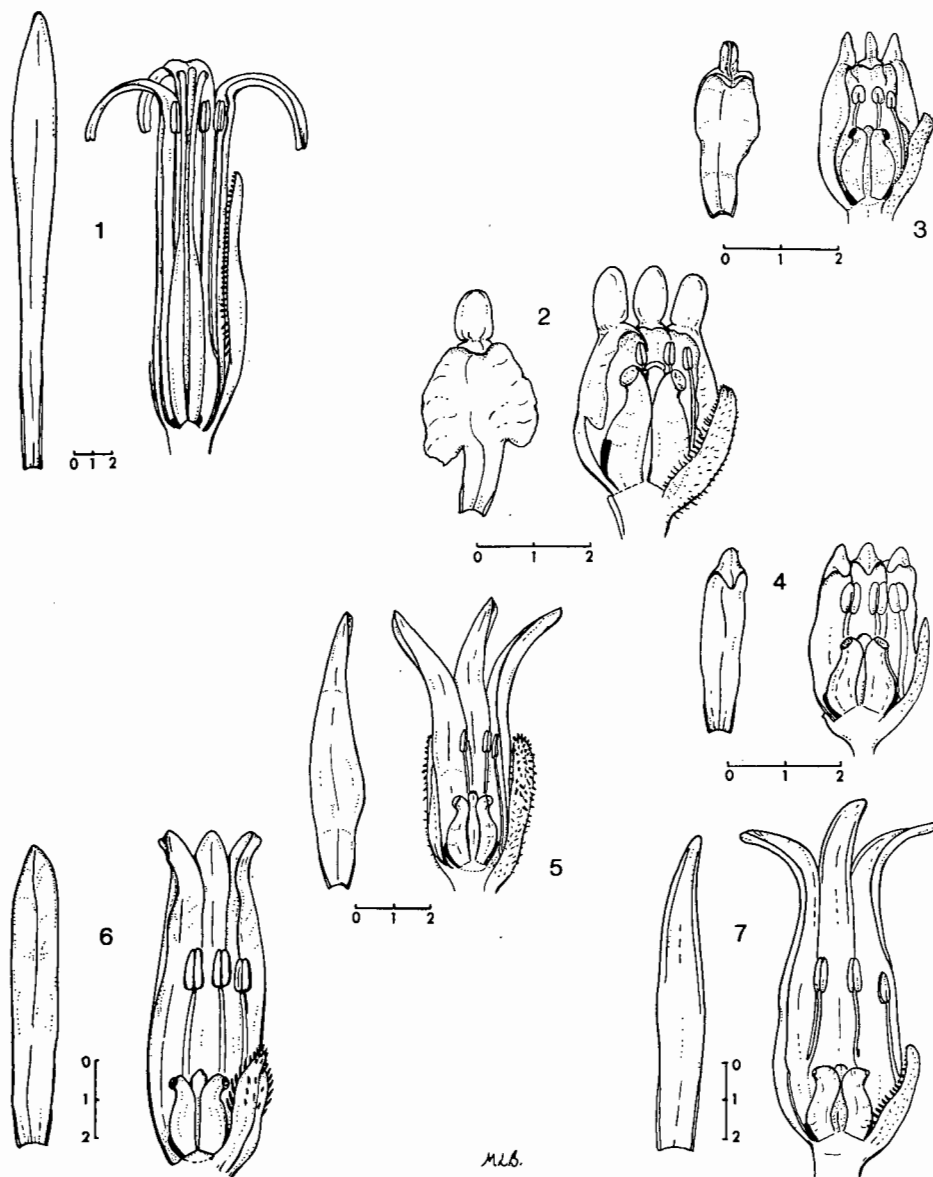


Fig.3. - Half flower and single petal of Rochea-type of flower: 1, C. fascicularis, petals with small dorsal appendages (Tölken 4384); Globulea-type of flower: 2, C. cotyledonis, petals with unequal sides, enlarged dorsal appendages and membranous apices (Tölken 1894); 3, C. mollis, petals with unequal sides, enlarged dorsal appendages and fleshy petal apices (NBG 63/69); 4, C. capitella subsp. capitella, oblong petals with enlarged dorsal appendages scarcely discernible from the petal apices (Tölken 3059); Pyramidella-type of flower: 5, C. namaquensis subsp. lutea, lacelate petals with unequal sides and without dorsal appendages (Tölken 3623); 6, C. columnaris subsp. semiorbicularis, oblong petals with unequal sides and without dorsal appendages (Tölken 1822); 7, C. mesembrianthemopsis, lanceolate petals with unequal sides and without dorsal appendage (NBG 1310/70). (Scale 2 mm).

because the first leaves do not produce marginal cilia and the hydathodes are at first in a marginal row, but later are irregularly scattered or in some species only along the margin. The latter type of distribution is mainly found in species with dorsiventrally compressed leaves, but in seedlings their first leaves are fleshy and clasping <sup>like</sup> as those of C. columnaris. Generally, the first leaves have a very convex abaxial surface but, in contrast to those of the sect. Argyrophylla and sect. Arta, they are erect and pressed against each other and are without an abaxial keel. The leaves remain convex and clasping in species of the subsect. Amplexicaules, while they become progressively more dorsiventrally flattened in species of the subsect. Imbricatae.

XVII. Sect. Argyrophylla:

The tubular flowers, which are usually arranged in dense part-inflorescences, and the dense cover of hairs on the leaves and sepals, are typical of this section. If marginal cilia on the leaves are present they are usually not arranged in one row or at least <sup>only?</sup> so in seedlings, but the transition becomes less distinct with age. On the sepals, the transition from the shorter hairs on the surface to the longer marginal ones is usually shown more clearly in this section but in sections 18 - 21 even these marginal cilia are in one row.

In the seedling stage, the sections Argyrophylla, Arta and Crassula are distinguished by their very fleshy and usually keeled first leaves, in contrast to those of the sect. Globulea, and this adds to the reasons why C. namaquensis, and C. hirtipes have been placed <sup>and</sup> into the sect. Argyrophylla, although they have a Sphaeritis-type of flower similar to C. atropurpurea.

C. lanuginosa is placed into a separate subsection Epedunculata, because the leaves gradually become shorter towards

the inflorescence, and although the internodes are more or less elongated, the plants seem to lack a peduncle. Also, in contrast to the subsect. Sphaericæ the inflorescences are irregularly branched and the flowers are not borne in dense <sup>axillary clusters?</sup> part-inflorescences. In the latter subsection, the carpels have indistinct styles and laterally placed stigmas. This subsect. Sphaericæ is the most diverse in the section and the Sphaeritis-type of flowers occurs in for instance C. alstonii and C. namaquensis and the Pyramidella-type of flower in C. mesembrianthemopsis.

XVIII. Sect. Arta:

Although this section is very similar to the sect. Argyrophylla, the very much shortened petals and the ampulla-like carpels with a broad terminal stigma seem to represent a different type of flower. Also, the species of the sect. Arta flower irrespective of rainfall in January to March, the driest period <sup>in</sup> of the Namaqualand.

Seedlings of this section do not produce a hypocotyl below the fleshy cotyledons, a condition almost as well developed in C. exilis.

XIX. Sect. Crassula: *The only species in this section*

C. perfoliata is distinguished from the sect. Argyrophylla by its robust woody stems, which are not swollen at the base, and the terminal flat-topped thyrses. The leaves are densely covered with rounded papillae similar to those found in many species of the latter section.

XX. Sect. Caducifolia:

C. decidua, the only species in this section, takes an intermediate position between the previous three sections <sup>because of</sup> by its tubular flowers with membranous petals without pronounced appendage,

as well as the spherical trichomes on the leaves, and sect.

Globulea with its deciduous leaves and spike-like inflorescence.

Also, the leaves are strongly bent to the one side of the stem as ~~it~~ is usually found in the latter section.

No seeds were available for investigation.

XXI. Sect. Globulea:

Haworth (1821) drew attention to the peculiar flower type <sup>of this section - its</sup> with the pronounced petal appendage, but it is now shown that a further development has taken place in some species. C. atropurpurea var. anomala has an intermediate flower type between the Globulea and Sphaeritis-type and might represent a transitional element as might have occurred in the development from the former to the latter type. Also, in C. mollis, C. mesembryanthoides and C. latibracteata, the petal apex <sup>has</sup> disappeared and the dorsal appendage is in a terminal position.

In contrast to sections 17 - 19, the first leaves are almost flat, even in species which ultimately have terete leaves, e.g. C. subaphylla var. virgata (fig. 1.15).

The subsect. Deciduae is distinguished by its deciduous leaves, which are evenly distributed along the stem, while the subsect. Caespitosae has non-deciduous leaves borne in basal rosettes.

7. SUMMARY OF THE PROPOSED CLASSIFICATION OF SPECIES AND  
INFRA-SPECIFIC TAXA IN SUPRA-SPECIFIC TAXA WITHIN THE  
GENUS CRASSULA

A. Crassula subgen. Levifolia

I. Sect. Tillaeoideae

1a. C. natans var. natans, 1b. var. filiformis; 2.  
C. inanis; 3. C. tuberella; 4. C. vaillantii; 5. C. apylla.

II. Sect. Glomeratae

6. C. strigosa; 7. C. numaisensis; 8. C. lambertiana;  
9. C. dodii; 10. C. roggeveldii; 11. C. pageae; 12.  
C. umbellata; 13. C. tenuipedicellata; 14. C. glomerata;  
15a. C. thunbergiana subsp. thunbergiana, 15b. subsp.  
minutiflora; 16a. C. decumbens var. decumbens, 16b.  
var. brachyphylla; 17. C. minuta; 18. C. hirsuta; 19.  
C. bergoides; 20a. C. campestris subsp. campestris, 20b.  
subsp. pharnacioides; 21a. C. pentandra var. pentandra,  
21b. var. transvaalensis; 22a. C. muscosa var. muscosa,  
22b. var. sinuata, 22c. var. rigida, 22d. var. parvula.

III. Sect. Dinacria

23. C. dichotoma; 24. C. depressa; 25. C. grammanthoides;  
26. C. filiformis; 27. C. sebaeoides.

IV. Sect. Filipedes

28. C. papillosa; 29a. C. expansa var. expansa, 29b.  
var. filicaulis, 29c. var. pyrifolia, 29d. var. fragilis,  
29e. var. peculiaris; 30. C. tenuicaulis.

V. Sect. Deltoideae

31. C. elsieae; 32a. C. corallina subsp. corallina, 32b.  
subsp. macrorrhiza; 33. C. vestita; 34. C. deltoidea.

VI. Sect. Anacampseroides

VIa. Subsect. Fasciculares: 35a. C. pellucida subsp. pellucida, 35b. subsp. spongiosa, 35c. subsp. marginalis, 35d. subsp. brachypetala, 35e. subsp. alsinoides.

VIb. Subsect. Petiolares: 36. C. inandensis; 37. C. spathulata; 38a. C. sarmentosa var. sarmentosa, 38b. var. integrifolia; 39. C. crenulata; 40. C. streyi; 41. C. cordata; 42a. C. multicava subsp. multicava, 42b. subsp. floribunda; 43. C. lactea.

VIc. Subsect. Latifolia: 44. C. ovata; 45a. C. arborescens Subsp. arborescens, 45b. subsp. undulatifolia.

VII. Sect. Tuberosae

46. C. umbella; 47. C. simulans; 48. C. nemorosa; 49. C. dentata; 50a. C. capensis var. capensis, 50b. var. albertinae, 50c. var. promontorii; 51. C. saxifraga; 52. C. alsicornis; 53. C. umbraticola.

VIII. Sect. Galpiniflora

54. C. peploides.

IX. Sect. Acutifolia

55a. C. ericoides subsp. ericoides, 55b. subsp. tortuosa; 56. C. dependens; 57a. C. sarcocaulis subsp. sarcocaulis, 57b. subsp. rupicola; 58. C. biplanata; 59a. C. tetragona subsp. tetragona, 59b. subsp. acutifolia, 59c. subsp. rudis, 59d. subsp. robusta, 59e. subsp. lignescens, 59f. subsp. connivens; 60. C. planifolia.

B. Crassula subgen. Crassula

X. Sect. Squamulosae

Xa. Subsect. Glabrae: 61. C. pallens; 62. C. rudolfii;

63. C. whiteheadii; 64. C. muricata.

Xb. Subsect. Scabrae: 65. C. scabra; 66. C. pustulata;

67. C. pruinosa.

XI. Sect. Subulares

68a. C. multiflora subsp. multiflora, 68b. subsp.

leucantha; 69. C. cymosa; 70. C. lasiantha; 71.

C. ciliata; 72a. C. subulata var. subulata, 72b.

var. fastigiata, 72c. var. hispida.

XII. Sect. Curtoqyne

73. C. flava; 74. C. rubricaulis; 75. C. dejecta;

76. C. undulata.

XIII. Sect. Kalosanthes

77. C. fascicularis; 78. C. obtusa; 79. C. coccinea.

XIV. Sect. Rosulares

80. C. flanaganii; 81. C. orbicularis; 82. C. pseudo-

hemisphaerica; 83a. C. montana subsp. montana, 83b.

subsp. quadrangularis; 84a. C. barbata subsp. barbata,

84b. subsp. broomii; 85a. C. tomentosa var. tomentosa,

85b. var. interrupta; 86. C. intermedia; 87. C. socialis;

88a. C. cooperi subsp. cooperi, 88b. subsp. sedifolia;

89. C. tabularis; 90a. C. setulosa var. setulosa,

90b. var. jenkensis, 90c. var. deminuta, 90d. var.

curta, 90e. var. longiciliata; 91. C. natalensis; 92.

C. vaginata; 93. C. acinaciformis; 94a. C. alba var.

alba, 94b. var. parvisepala; 95a. C. southii subsp.

southii, 95b. subsp. sphaerocephala; 96a. C. sediflora

var. sediflora, 96b. amatolica; 97a. C. obovata var.

obovata, 97b. var. dregeana; 98. C. brachystachya;

99. C. compacta; 100. C. hemisphaerica; 101a.

C. capitella subsp. capitella, 101b. subsp. nodulosa,

101c. subsp. enantiophylla, 101d. subsp. meyeri,  
101e. subsp. thyrsiflora.

XV. Sect. Perfilatae

102. C. fusca; 103. C. sladenii; 104. C. perforata;  
105a. C. rupestris subsp. rupestris, 105b. subsp.  
marnierana; 105c. subsp. commutata; 106a. C. brevifolia  
subsp. brevifolia, 106b. subsp. psammophila; 107.  
C. macowaniana.

XVI. Sect. Pyramidella

XVIa. Subsect. Amplexicaules: 108a. C. congesta subsp.  
congesta, 108b. laticephala; 109a. C. columnaris subsp.  
columnaris, 109b. subsp. semiorbicularis; 110. C. barklyi.  
XVIb. Subsect. Imbricatae: 111a. C. alpestris subsp.  
alpestris, 111b. subsp. massonii; 112. C. pyramidalis;  
113. C. multiceps.

XVII. Sect. Argyrophylla

XVIIa. Subsect. Epedunculatae: 114a. C. lanuginosa  
var. lanuginosa, 114b. var. pachystemon.  
XVIIb. Subsect. Sphaericae: 115a. C. globularioides  
subsp. globularioides, 115b. subsp. illichiana,  
115c. subsp. argyrophylla; 116a. C. sericea var. sericea,  
116b. var. velutina, 116c. var. hottentotta; 117.  
C. alstonii; 118a. C. namaquensis subsp. namaquensis,  
118b. subsp. comptonii, 118c. subsp. lutea; 119.  
C. hirtipes; 120. C. tecta.  
XVIIc. Subsect. Exilis: 121a. C. ausensis subsp. ausensis,  
121b. subsp. ciliata; 122a. C. exilis subsp. exilis,  
122b. subsp. garibina; 123. C. susannae; 124.  
C. mesembrianthemopsis.

XVIII. Sect. Arta

125. C. grisea; 126a. C. elegans subsp. elegans, 126b. subsp. namibensis; 127. C. columella; 128. C. plegmatoides; 129. C. deceptor.

XIX. Sect. Crassula

130a. C. perfoliata var. perfoliata, 130b. var. miniata, 130c. var. falcata, 130d. var. heterotricha.

XX. Sect. Caducifolia

131. C. decidua.

XXI. Sect. Globulea

XXIa. Subsect. Decidua: 132a. C. mesembryanthoides subsp. mesembryanthoides, 132b. subsp. hispida; 133. C. mollis; 134. C. latibracteata; 135a. C. pubescens subsp. pubescens, 135b. subsp. radicans, 135c. subsp. rattrayi; 136. C. cultrata; 137. C. rogersii; 138a. C. atropurpurea var. atropurpurea, 138b. var. cultriformis, 138c. var. watermeyerii, 138e. var. rubella, 138f. var. purcellii; 139a. C. subaphylla var. subaphylla, 139b. var. virgata; 140. C. ammophila.

XXIb. Subsect. Caespitosa: 141. C. cotyledonis; 142. C. clavata; 143. C. erosula; 144a. C. nudicaulis var. nudicaulis, 144b. var. subacaulis, 144c. var. platyphylla.

8. TAXONOMIC TREATMENT OF SOUTHERN AFRICAN TAXA

(Republic of South Africa, Lesotho, Swaziland and South West Africa)

- Crassula L., Sp. Pl. ed. 1 : 282 (1753) et Gen. Pl. ed 5 : 136 (1854);  
 Haw., Syn. Pl. Succ. 51 (1812); DC., Prodr. 3 : 383 (1828) et  
 Mem. Fam. Crass. 16 (1828a); Eckl. & Zeyh., Enum. 294 (1837);  
 Harv., Fl. Cap. 2 : 332 (1862); Benth. & Hook. f., Gen. Pl. 1  
 : 657 (1865); Britt. in Fl. Trop. Afr. 2 : 388 (1871); Schonl.  
 in Pflanzenfam. ed 1, 3, 2a : 35 (1890); et in Trans. Roy. Soc.  
 S. Afr. 17 : 160 (1929); Berger in Pflanzenfam. ed. 2, 18a :  
 386 (1930); Friedr. in Prodr. Fl. S. W. Afr. 52 : 11 (1968).
- Tillaea L., Sp. Pl. ed. 1 : 128 (1753) et Gen. Pl. ed 5 : 62  
 (1754); DC., Prodr. 3 : 381 (1828); Benth. & Hook. f., Gen. Pl.  
 1 : 657 (1865); Britt. in Fl. Trop. Afr. 2 : 386 (1871).
- Septas L., Pl. Afr. Rar. 10 (1760); Amoen. Acad. 7 : 87 (1764);  
 Haw., Syn. Pl. Succ. 61 (1812); DC., Prodr. 3 : 383 (1828);  
 Eckl. & Zeyh., Enum. 292 (1837).
- Gomara Adans., Fam. Pl. 2 : 248 (1763).
- Bullardia DC. in Bull. Sc. Soc. Philom. 3 : 1 (1801) et Prodr. 3  
 : 382 (1828); Eckl. & Zeyh., Enum. 289 (1837); Harv., Fl. Cap.  
 2 : 329 (1862).
- Rochea DC., Pl. Hist. Succ. t. 103 (1802) et Prodr. 3 : 393  
 (1828) et Mem. Fam. Crass. 21 (1828a); Eckl. & Zeyh., Enum. 304  
 (1837); Harv., Fl. Cap. 2 : 369 (1862); Benth. & Hook. f., Gen.  
 Pl. 1 : 658 (1865); Schonl. in Pflanzenfam. ed. 1, 3 2a : 38  
 (1890); Berger in Pflanzenfam. ed. 2, 18a : 401 (1930); Adamson,  
 Fl. Cape Penins. 437 (1950), nom. cons.
- Larochea Pers., Syn. Pl. 1 : 357 (1805); Haw., Syn. Pl. Succ. 50  
 (1812).
- Globulea Haw., Syn. Pl. Succ. 60 (1812); DC., Prodr. 3 : 390  
 (1828); Eckl. & Zeyh., Enum. 301 (1837).
- Dietrichia Tratt., Arch. Gewächsk. 449 (1812); Eckl. & Zeyh.,  
 Enum. 304 (1837), nom. illeg. - non Giseke.
- Curtogyne Haw., Rev. Pl. Succ. 8 (1821); DC., Prodr. 3 : 392  
 (1828); Eckl. & Zeyh., Enum. 303 (1837).

Kalosanthes Haw., Rev. Pl. Succ. 6 (1821) et in Phil. Mag. 64 : 185 (1824).

Purgosea Haw., Rev. Pl. Succ. 14 (1821), Turgosea, et in Phil. Mag. 3 : 184 (1828); Eckl. & Zeyh., Enum. 298 (1837), Pyrgosea.

Vauanthes Haw., Rev. Pl. Succ. 18 (1821); Berger in Pflanzenfam. ed. 2, 18a : 402 (1930); Adamson in Fl. Cape Penins. 437 (1950).

Dasytemon DC., Prodr. 3 : 382 (1828); et Mem. Fam. Crass. 14 (1828a).

Grammanthes DC., Prodr. 3 : 392 (1828); Eckl. & Zeyh., Enum. 302 (1837); Harv., Fl. Cap. 2 : 331 (1862); Benth. & Hook., Gen. Pl. 1 : 658 (1865); Schonl. in Pflanzenfam. ed. 1, 3, 2a : 37 (1890).

Helophytum Eckl. & Zeyh., Enum. 288 (1836); Harv., Fl. Cap. 2 : 328 (1862).

Petrogeton Eckl. & Zeyh., Enum. 291 (1837).

Sarcolipes Eckl. & Zeyh., Enum. 290 (1837).

Tetraphyle Eckl. & Zeyh., Enum. 292 (1837), Dietr., Syn. Pl. 2 : 1033 (1840).

Sphaeritis Eckl. & Zeyh., Enum. 299 (1837), Dietr., Syn. Pl. 2 : 1034 (1840).

Thisantha Eckl. & Zeyh., Enum. 302 (1837), Dietr., Syn. Pl. 2 : 1035 (1840).

Combesia A. Rich., Tent. Fl. Abyss. 1 : 307 (1847).

Disporocarpa A. Rich., Tent. Fl. Abyss. 1 : 307 (1847), nom nud.

Dinacria Harv., Fl. Cap. 2 : 330 (1862); Benth. & Hook. f., Gen. Pl. 1 : 657 (1865); Berger in Pflanzenfam. ed. 2, 18a, 401 (1930); Adamson in Fl. Cape Penins. 436 (1950).

Pagella Schonl. in Ann. Bolus Herb. 3 : 67 (1921); Berger in Pflanzenfam. ed. 2, 18a, 400 (1930).

Rhopalota N.E.Br. in Cactus Succ. J., Los. Ang. 3 : 7 (1931) et in Hook. Icon. Pl. 32, t. 3171 (1932).

Plants perennial, biennial or annual and varying from prostrate herbs to erect shrubs but rarely with woody branches. Leaves opposite, sessile or petiolate, usually entire but also serrate or crenate (lobed only in C. alcicornis), membranous to convex on one or both surfaces or terete, with more or less <sup>few to many</sup> hydathodes on or along the margin and/or some scattered over the upper and/or the lower surface, with a leaf sheath or the leaf bases fused to one another in various degrees. Inflorescence varying from single flowers in the axils of the leaves to terminal clusters or usually terminal cymes, with (4-) 5 (-8) merous flowers which are star-shaped or tubular. Sepals more or less fleshy, green rarely tinged red or yellow. Petals lanceolate to oblanceolate or panduriform, fused into a tube not more than one-eighth of their length, with or without dorsal appendage sometimes in terminal position. Stamens 5, with anthers yellow, purple or brown, and with base of the filament somewhat fused to the petal tube. Squamae dorsiventrally flattened to more or less fleshy and not fused to the carpels. Ovaries free to somewhat fused at the base, with or without styles and with terminal or lateral stigmas, with one to numerous ovules. Seeds glabrous or usually with vertical rows of papillae and without a distinct hilum.

The genus Crassula is represented by 144 species in Southern Africa, approximately 10 species on the rest of the African continent and 10 - 20 species occur scattered throughout the world. The perennial species occur on the African continent except for the two species that extended their distribution into Arabia and northern India, while the annual species occur widespread throughout the world and have often a very wide distribution range.

#### Diagnostic Features:

Species of the genus Crassula are distinguished from other genera in the family by the combination of opposite leaves and haplostemonous

flowers. Vegetative material of the genus in Southern Africa is recognized by the opposite leaves, with a short leaf sheath and hydathodes. Even seedlings have one hydathode on the adaxial surface of the cotyledon.

#### Key to the Species, Subspecies and Varieties

The key below is so long that it seemed desirable to divide it into 12 groups. The latter are based largely on the taxonomic sections or groups of sections and only group 12 is completely artificial. In order to simplify the key to the groups, some sections are distinguished only by their main characters, and a few species will consequently key out in a group not corresponding to the section to which they belong. Groups and sections are thus not strictly synonymous. However, some users of the key may be familiar with the sections, as many are similar to those recognized by Schonland (1929), so that a compromise was sought. Species 'not characteristic' of their section are thus included in both the group to which they are keyed out as well as the group representing the section. This facilitates the use of the key on the basis of groups and at the same time enables the user familiar with the taxonomy of the genus to start directly with the section, i.e. the group, to which the species in question belongs.

The diagnosis for each group then combines the characteristics of the groups and the sections, but special emphasis is placed on the sections. The identification of incomplete live material can be attempted with the diagnoses of the leaf characters provided separately, but in many cases it is impossible to identify such material with certainty.

## KEY TO THE GROUPS

- A Anthers 0,01 - 0,02 (-0,03) cm long; usually annuals or rarely perennials with sessile axillary inflorescences; flowers star-shaped ..... Group 1
- AA Anthers (0,04-) 0,05 - 0,2 (-0,5) cm long; perennials or if annuals with tubular flowers with only the apices of the petals recurved:
- B Annuals with single erect main stem c. 0,1 cm in diameter; flowers tubular..... Group 1
- BB Perennials with main branches at least 0,2 cm in diameter or if narrower than decumbent or prostrate and/or with star-shaped flowers:
- C Flowers star-shaped with petals spreading from the base or with a tube up to 0,1 cm long or less than half the length of the spreading lobes (see fig. 2.1):
- D Leaves subulate and almost terete, in a basal rosette; inflorescences axillary and originating from below the rosette..... Group 2
- DD Leaves lanceolate, elliptic, obovate or spatulate, distinctly dorsiventrally flattened; inflorescence terminal or single axillary flowers:
- E Leaves 0,2 - 0,4 cm long, 0,1 - 0,3 cm broad.... Group 2
- EE Leaves at least 0,6 cm long, 0,5 - 10 cm broad:
- F Plants with (1) 2 or 3 (4) pairs of leaves; stem tubers usually almost spherical and covered with adventitious roots..... Group 5
- FF Plants with at least 8 pairs of leaves; tubers if present irregularly shaped and of root origin  
..... Group 4
- CC Flowers tubular with petals erect or recurved only at the apex:

- G Plants with (1) 2 or 3 (4) pairs of leaves which are very much dorsiventrally compressed to almost membranous..... Group 5
- GG Plants with at least 8 pairs of leaves, or if not then the leaves more or less fleshy:
- H Petals with a smooth ovoid to almost spherical appendage in terminal position (see fig. 3.2, 3, 4)..... Group 11
- HH Petals with or without dorsal appendage but if present then denticulate and usually pointed:
- I Squamae T-shaped to spatulate; petals narrowly oblong and without dorsal appendage but longer than 0,45 cm; inflorescence sessile or almost so..... Group 6
- II Squamae transversely oblong to oblong-cuneate; petals lanceolate, oblanceolate or panduriform and with dorsal appendage, but if without then either up to 0,4 cm long or with a distinct peduncle:
- J Petals panduriform and ending in a canaliculate rostrum stiffly erect (see fig. 2.5, 6, 7)..... Group 12
- JJ Petals lanceolate to oblanceolate, acute or obtuse, recurved or reflexed:
- K Leaves borne in a basal rosette and usually becoming gradually shorter towards the apex, dorsiventrally compressed and often cymbiform (leaves with obvolvate vernation in fresh material (see fig. 1.11).... Group 8
- KK Leaves more or less evenly scattered over the branches, but if fascicled at the base of the branches then either very fleshy and almost terete or falcate and somewhat bent to the one side and with a distinct peduncle (leaves opposite in buds):
- L Leaves covered with hairs or papillae, with or without marginal cilia:

- M Leaves subulate or linear ..... Group 7
- MM Leaves lanceolate, elliptic to obovate:
- N Flowers axillary or in terminal clusters; pedicels elongating  
after flowering..... Group 2
- NN Flowers in terminal inflorescences; pedicels not elongating  
after flowering ..... Group 10
- LL Leaves glabrous but often with marginal cilia:
- O Leaves dorsiventrally compressed:
- P Leaves with a distinct horny margin and usually with marginal  
cilia ..... Group 7
- PP Leaves without a horny margin and marginal cilia ..... Group 3
- OO Leaves triangular to round in section:
- Q Petals with a denticulate dorsal appendage:
- R Petals up to 2 mm long; stems carnose and up to 15 cm  
long..... Group 10
- RR Petals (0,3-) 0,4 - 0,5 (-0,6) cm long; stems woody 20 -  
50 (-150) cm long ..... Group 9
- QQ Petals usually without dorsal appendage or if present  
inconspicuous and smooth:
- S Flowers axillary or in terminal clusters ..... Group 2
- SS Flowers in a terminal inflorescence:
- T Leaves subulate to lanceolate, smooth or if dentate  
then subulate ..... Group 3
- TT Leaves angular obovate to rarely elliptic, rough or  
irregularly papillose ..... Group 2

## GROUP 1

Annuals usually delicate, rarely slightly woody perennials with sessile axillary inflorescences and anthers up to 0,3 cm long. Flowers usually star-shaped rarely tubular and with anthers up to 0,6 cm long. Petals without dorsal appendage.

Sections Tillasoideae, Glomeratae, Grammanthes.

Leaves opposite, dorsiventrally flattened or rarely almost terete, with hydathodes on the margin, without marginal cilia and usually glabrous; sheath membranous or almost absent.

- 1 Inflorescence axillary; petals 0,4 - 0,8 cm long  
 ..... 111b. C. alpestris subsp. massonii
- 1a Inflorescence terminal or if axillary then petals up to 0,2 cm long:
- 2 Sepals obtuse and about half as long as the petals:
- 3 Internodes club-shaped and apparently leafless  
 ..... 5. C. aphylla
- 3a Internodes linear and if swollen then along the whole length:
- 4 Petals (0,3-) 0,4 - 0,8 (1,5) cm long, flowers tubular:
- 5 Stigma at the end of slender style:
- 6 Petals yellow to orange, (0,5-) 0,7 - 1,5 cm long  
 ..... 23. C. dichotoma
- 6a Petals white or pink, 0,3 - 0,4 cm long  
 ..... 24. C. depressa
- 5a Stigma lateral and with a horn-like projection or two wings in terminal position:
- 7 Style and projection above the stigma filiform and half as long as the ovary....25. C. grammanthoides
- 7a Style hardly distinguishable from the gradually constricted ovary and with short stout ventral horn about as long as the style  
 ..... 26. C. filiformis

7b Style hardly distinguishable from gradually constricted ovary and with wing-like projections above the stigma

..... 27. C. sebaeoides

4a Petals 0,1 - 0,2 cm long; flowers star-shaped:

8 Carpels each with one ovule:

9 Leaves lanceolate to ovate; inflorescence with 5 - 10 (-20)

flowers in the axil of the leaves ..... 2. C. inanis

9a Leaves oblanceolate to linear-elliptic; inflorescence with

1 - 3 flowers in the axils of the leaves:

10 Petals c. 0,2 cm long and recurved to about right angles

from the pedicel.....1a. C. natans var. natans

10a Petals up to 0,1 cm long and erect so as to form a short

tubular flower.....1b. C. natans var. filiformis

8a Carpels each with (2-) 4 - 8 ovules:

11 Leaves linear to linear-elliptic:

12 Stems stiffly erect and rarely branched and with underground rhizome ending in numerous small tubers

..... 3. C. tuberella

12a Stems spreading to decumbent and much branched and without underground rhizome; leaves 0,2 - 0,4 cm long

..... 4. C. vaillantii

11a Leaves oblanceolate, obovate or spatulate:

13 Leaves with denticulate upper surface; stems filiform; pedicels elongating after flowering

..... 12. C. umbellata

13a Leaves smooth and partly fused to the stem and

inflorescence so as to form a crust-like plant flat on

the soil..... 11. C. pageae

2a Sepals acute and as long as or longer than petals but if only two-thirds of the length of the petals then sepals sharply acute or awned:

14 Inflorescence axillary cymes:

15 Leaves more or less convex to terete and without terminal colourless setae:

16 Petals c. 0,1 cm long and folded lengthwise when old; carpels release upper seed through the apical pore while the second one remains in the carpel which breaks off at the base:

17 Axillary inflorescences sessile or almost so

.....15a. C. thunbergiana subsp. thunbergiana

17a Axillary inflorescence pedunculate (0,2 - 0,4 cm long)

.....15b. C. thunbergiana subsp. minutiflora

16a Petals 0,2 - 0,3 (-0,4) cm long and not folded; carpels releasing seeds through apical pore:

18 Petals triangular, c. 0,15 cm broad at the base; leaves terete, subulate

.....16a. C. decumbens var. decumbens

18a Petals ovate and up to 0,3 cm broad; leaves obconical to club-shaped

.....16b. C. decumbens var. brachypetala

15a Leaves dorsiventrally compressed and flat and usually with colourless terminal setae or perennials with stems thicker than 0,2 cm:

19 Carpels denticulate:

20 Leaves and stems with spreading hairs

.....18. C. hirsuta

20a Leaves and stems glabrous.....19. C. bergoides

## 19a Carpels smooth:

21 Sepals two-thirds of the length of the petals; stems usually woody and hardly visible between the leaves:

22 Stems at base without old leaves and with peeling bark; leaves yellowish-green and up to 0,1 cm long

..... 22c. C. muscosa var. rigida

22a Stems with old leaves at the base; leaves grey-green 0,2 - 0,4 (-0,6) cm long:

23 Squamae emarginate; stems wiry-woody with leaves adpressed 0,2 - 0,3 cm in diameter and up to 40 cm long.....22b. C. muscosa var. sinuata

23a Squamae truncate; stems woody or if wiry then with spreading leaves and produced by erect tufts up to 15 cm high:

24 Stems with leaves 0,2 - 0,4 (-0,6) cm in diameter; plants more or less branched and up to 60 cm long..... 22a. C. muscosa var. muscosa

24a Stems with leaves c. 0,25 cm in diameter; plants erect tufts up to 15 cm high

..... 22d. C. muscosa var. parvula

21a Sepals as long as or longer than petals; stems thin and wiry in erect annuals or fleshy to carnose in perennials:

25 Perennials; stems carnose or if filamentous then decumbent and rooting at the nodes:

26 Main roots tuberous and sprouting annually; leaves towards the base often twice as long as those becoming gradually shorter towards the apex (excluding young leaves at apex)

..... 21b. C. pentandra var. transvaalensis

- 26a Roots fibrous or rarely slightly swollen and the stem above it similarly thickened; leaves more or less equally long on the whole plant (excluding young leaves at apex)  
 ..... 21a. C. pentandra var. pentandra
- 25a Annuals; stems filamentous to wiry and erect:
- 27 Seeds just longer than broad; Cape Province  
 ..... 20a. C. campestris subsp. campestris
- 27a Seeds twice as long as broad; central and northern South West Africa and Tropical Africa  
 ..... 20b. C. campestris subsp. pharnacioides
- 14a Inflorescence terminal, densely or loosely cymose:
- 28 Leaves lanceolate or linear-lanceolate and terete or almost so:
- 29 Squamae oblong cuneate; flowers sessile or almost so; carpels denticulate ..... 14. C. glomerata
- 29a Squamae transversely oblong with strongly cuneate base; flowers pedicelate; carpels smooth or slightly rough:
- 30 Flowers single in the axils of the leaves but terminal only; leaves 0,1 - 0,3 cm long  
 ..... 17. C. minuta
- 30a Flowers in terminal or axillary cymes; leaves 0,3 - 0,6 cm long (often shrivelled up before seeds mature):
- 31 Petals triangular and c. 0,15 cm broad at the base; leaves terete, subulate  
 ..... 16a. C. decumbens var. decumbens
- 31a Petals ovate and up to 0,3 cm broad; leaves obconical to club-shaped  
 ..... 16b. C. decumbens var. brachypetala
- 28a Leaves elliptic, oblanceolate obovate to spatulate and dorsiventrally flattened:

- 32 Plants crust-like and with leaves flat on the soil:
- 33 Flowers and leaves partly fused to the stem; fruit indehiscent.....11. C. pageae
- 33a Flowers and leaves free; fruits dehiscing by apical pore ..... 12. C. umbellata
- 32a Plants erect or decumbent, stems visible:
- 34 Ovary dentate:
- 35 Flowers sessile or almost so.....14. C. glomerata
- 35a Flowers with pedicels at least 3 times longer than the flower.....13. C. tenuipedicellata
- 34a Ovary smooth:
- 36 Leaves and sepals hairy or at least with terminal seta .....6. C. strigosa
- 37 Leaves clustered at the base and often four at a node ..... 9. C. dodii
- 37a Leaves in pairs and about equally spaced along the stem:
- 38 Leaves sessile elliptic, elliptic-obovate:
- 39 Leaves 0,4 - 1 cm broad; squamae narrowly oblong-cuneate ..... 7. C. numaisensis
- 39a Leaves 0,1 - 0,3 cm broad; squamae broadly T-shaped..... 8. C. lambertiana
- 38a Leaves petiolate or spatulate:
- 40 Stems decumbent or prostrate and often rooting at the nodes; leaves smooth .....10. C. roggeveldii
- 40a Stems erect, without adventitious roots; leaves denticulate .....12. C. umbellata

## GROUP 2

Herbaceous perennials often slightly woody at the base, shrublets. Flowers star-shaped or tubular, single axillary or clustered at the apex or rarely in a inflorescence with a peduncle. Petals smooth and without dorsal appendage.

Sections Filipedes, Deltoides, Galpiniflora.

Leaves opposite, dorsiventrally flattened, convex to terete, with hydathodes along the margin or scattered over the upper surface but then the leaves usually rough or hairy, without marginal cilia and usually glabrous; sheath membranous or rarely formed by the fusion of the leaf bases.

## 1 Flowers star-shaped:

2 Leaves linear-lanceolate, subulate and sessile; inflorescence axillary and from below the basal rosette..... 54. C. peploides

2a Leaves elliptic, cuneate or petiolate; single axillary flowers ..... 28. C. papillosa

## 1a Flowers tubular:

3 Leaves more or less fused in a ring which is at least half as long as the lamina..... 33. C. vestita

3a Leaves with a basal leaf sheath not longer than an eighth of the lamina:

4 Leaves angular obovate, oblanceolate or rhombic, rough or covered with irregular papillae:

5 Leaves 1 - 1,5 (-2,5) cm long; inflorescence with peduncle ..... 34. C. deltoidea

5a Leaves 0,2 - 0,6 cm long; inflorescence without peduncle or flowers clustered towards the end of the branches:

6 Petals not saccate at the base; squamae oblong ..... 31. C. elsiae

- 6a Petals saccate at the base, squamæ transversely oblong:
- 7 Roots fibrous or if slightly thickened then stems above similarly thickened; stems with adventitious roots  
 ..... 32a. C. corallina subsp. corallina
- 7a Roots tuberous; stems filamentous and with adventitious roots  
 ..... 32b. C. corallina subsp. macrorrhiza
- 4a Leaves elliptic, lanceolate to subulate, smooth or hairy:
- 8 Sepals and leaves with spreading hairs:
- 9 Hydathodes on the margin of the leaves; moist places in shade on Swartberg range  
 ..... 29e. C. expansa subsp. peculiaris
- 9a Hydathodes scattered over the upper leaf surface; in shade Northern Natal, Transvaal..... 29d. C. expansa subsp. fragilis
- 8a Sepals and leaves glabrous:
- 10 Leaves dorsiventrally compressed, elliptic and cuneate or petiolate:
- 11 Stems erect or decumbent and becoming slightly woody at the base without adventitious roots  
 ..... 29a. C. expansa var. expansa
- 11a Stems prostrate and not becoming woody at the base:
- 12 Pedicels 1 - 2 cm long; flowers tubular  
 ..... 30. C. tenuicaulis
- 12a Pedicels 0,3 - 0,6 (-0,8) cm long; flowers star-shaped ..... 28. C. papillosa
- 10a Leaves terete or almost so, linear-lanceolate to subulate:
- 13 Leaves with one or two rows of hydathodes; stems without adventitious roots; widespread from northern Natal to southern and northern Cape  
 ..... 29a. C. expansa var. expansa

- 13a Leaves with one or two rows of hydathodes; stems with woody adventitious roots; along the coast from Port Elizabeth to Cape Peninsula..... 29b. C. expansa var. filicaulis
- 13b Leaves with hydathodes scattered at least over the upper surface: Namaqualand and into south-western South West Africa, west of the mountains..... 29c. C. expansa var. pyrifolia

### GROUP 3

Herbaceous perennials often somewhat woody at the base and usually shrubs. Flowers tubular in a terminal rounded to flat-topped thyrse usually with a peduncle. Petals without a distinct dorsal appendage.

#### Section Acutifolia.

Leaves opposite, subulate to lanceolate, dorsiventrally compressed to terete with hydathodes in two rows along the margin but spreading more and more and often scattered over much of the upper and lower leaf surface, without marginal cilia and smooth except denticulate in C. sarcocaulis; sheath usually formed by the partial fusion of the leaf bases.

(The peduncle is often ill-defined in these plants. Therefore, in the following a pair of bracts are the leaf-like structures, sometimes only very short, on the stalk below the inflorescence where the internodes between the pair of bracts and the first pair of leaves is distinctly longer than between any two pairs of leaves on the plant below.)

- 1 Petals 0,4 - 0,5 (-0,6) cm long; young internodes papillose or papillose-hairy at least below the inflorescence:

- 2 Stems erect or spreading; old leaves dropping with leaf sheath or petals not recurving at the apex:
- 3 Leaves linear-lanceolate or ovate, broadest at the base:
- 4 Leaves ovate and 0,3 - 0,7 cm long; petals erect or spreading but not recurving:
- 5 Ovary with 8 - 12 ovules; growing on lower mountain slopes up to 700 m altitude  
 ..... 55a. C. ericoides subsp. ericoides
- 5a Ovary with 4 ovules; growing at high altitude  
 (usually above 1000m)  
 ..... 55b. C. ericoides subsp. tortuosa
- 4a Leaves linear-lanceolate, 0,8 - 2 cm long; petals recurving at the apex:
- 6 Squamae obpyramidal with upper surface sloping down centrifugally; stems carnose 0,5 - 3 cm in diameter  
 ..... 57b. C. sarcocaulis subsp. rupicola
- 6a Squamae flat, rectangular to wedge-shaped; stems woody or carnose up to 0,4 cm in diameter..... 58. C. biplanata
- 3a Leaves elliptic, broadest at about the middle  
 ..... 57a. C. sarcocaulis subsp. sarcocaulis
- 2a Stems decumbent or prostrate; often rooting; old leaves drying, then often breaking off and leaving the leaf sheath, but eventually stems also without remains of leaves:
- 7 Petals erect or spreading, but not recurving:
- 8 Ovary with 8 - 12 ovules; growing on lower mountain slopes up to 700 m altitude..... 55a. C. ericoides subsp. ericoides
- 8a Ovary with 4 ovules; growing at high altitude (usually above 1000 m)..... 55b. C. ericoides subsp. tortuosa
- 7a Petals recurving at the apex..... 56. C. dependens

- 1a Petals 0,1 - 0,15 (-0,3) cm long; young internodes and peduncle smooth, except in C. tetragona subsp. connivens:
- 9 Bracts on peduncle 2 or 3 pairs, if less than inflorescence irregularly branched or a flat-topped dichasium:
- 10 Leaves flat and at least 4 - 0,6 (-0,8) cm broad  
 ..... 60. C. planifolia
- 10a Leaves terete or almost so, 0,1 - 0,3 cm broad:
- 11 Leaf sheath 0,05 (-0,1) cm long; stem decumbent, rooting..... 59b. C. tetragona subsp. acutifolia
- 11a Leaf sheath (0,15-) 0,2 cm long; stems erect not rooting:
- 12 Inflorescence with flowers densely clustered; plant with stems repeatedly branching  
 ..... 59a. C. tetragona subsp. tetragona
- 12a Inflorescence loosely branched; plant with one main branch and rarely with few axillary branches  
 ..... 59c. C. tetragona subsp. rudis
- 9a Bracts on peduncle 0 - 1 pair; inflorescence a round-topped thyse:
- 13 Stems carnose with flaking bark, 0,3 - 1 (-1,5) cm in diameter..... 59d. C. tetragona subsp. robusta
- 13a Stems woody with flaking bark, 0,2 - 0,4 (-0,6) cm in diameter..... 59e. C. tetragona subsp. lignosa
- 13b Stems carnose with peeling bark, 0,2 - 1,5 (-2) cm in diameter..... 59f. C. tetragona subsp. connivens

## GROUP 4

Herbaceous perennials often with thick carnose stems, scramblers to shrubs up to 150 cm high. Flowers star-shaped and in a terminal cluster or thyrse. Petals usually sharply acute and with dorsal appendage terminal and pointed but smooth.

Section Anacampseroides.

Leaves opposite, dorsiventrally compressed to almost membranous or rarely slightly convex on either side, with hydathodes in one of two rows along the margin or sometimes scattered over the upper or often also the lower surfaces, without marginal cilia and glabrous; sheath membranous or a tough ridge between the leaf bases.

1 Flowers axillary or clustered at the end of branches and without a peduncle and often half hidden by the upper leaves:

2 Leaf sheath glabrous:

3 Leaves ovate and abruptly constricted at the base and more or less fused to one another

..... 35c. C. pellucida subsp. marginalis

3a Leaves elliptic to elliptic-lanceolate with a cuneate to subpetiolate base:

4 Receptacle and carpels remaining soft and membranous when fruiting; perennials with branches often longer than 20 cm long; south-western Cape to the Winterhoek-berge..... 35a. C. pellucida subsp. pellucida

4a Receptacle and lower parts of carpels becoming tough and spongy when fruiting; annuals with branches rarely longer than 15 cm; mountains near Nieuwoudtville

..... 35b. C. pellucida subsp. spongiosa

## 2a Leaf sheath hairy:

- 5 Internodes and pedicels glabrous: leaves abruptly constricted at the base and more or less fused to one another

..... 35c. C. pellucida subsp. marginalis

## 5a Internodes and pedicels hairy; leaves cuneate:

- 6 Flowers single at the apex and in the axile of the leaves; leaf margin regularly denticulate

..... 35e. C. pellucida subsp. alsinoides

- 6a Flowers in terminal clusters and rarely single; leaf margin irregularly denticulate

..... 35d. C. pellucida subsp. brachypetala

## 1a Flowers in a terminal inflorescence with a peduncle at least 2 cm long:

- 7 Sepal lobes rarely longer than 0,1 cm and at least 5 times shorter than petals; leaves deciduous:

- 8 Flowering period: June - August; leaves shiny green (covered with silvery flakes in dried material) rarely with white powder in Natal

..... 44. C. ovata

## 8a Flowering period: November, December; leaves grey to almost white (covered with white powder in dried material); southern Cape:

- 9 Leaves broadly obovate to almost orbicular with entire margin..... 45a. C. arborescens subsp. arborescens

## 9a Leaves elliptic to oblanceolate and with undulate margins

..... 45b. C. arborescens subsp. undulatifolia

- 7a Sepal lobes (0,15-) 0,2 - 0,4 cm long and 2 - 3 times shorter than petals; old leaves remaining attached to the stems:

- 10 Leaves regularly crenate to serrate:
- 11 Internodes below the inflorescence distinctly shorter or not visible; leaves with hydathodes towards the end of and below the rounded teeth..... 36. C. inandensis
- 11a Internode below the inflorescence usually slightly elongated; leaves with hydathodes between the pointed teeth:
- 12 Petals 0,2 - 0,4 cm long; leaves with petiole 0,3 - 1,8 cm long..... 37. C. spathulata
- 12a Petals 0,5 - 1 cm long; leaves sessile but with cuneate base:
- 13 Inflorescence a flat-topped thyse with all flowers directed upwards; leaves at least 4 times longer than broad  
..... 39. C. crenulata
- 13a Inflorescence a rounded thyse with flowers spreading at about right angles to one another; leaves usually twice as long as broad  
..... 38a. C. sarmentosa subsp. sarmentosa
- 10a Leaves entire rarely irregularly undulate:
- 14 Leaves with rounded apex rarely obtuse:
- 15 Leaves 1 - 2,5 cm long; lamina cordate or if not then stem thinner than 0,2 cm in diameter..... 41. C. cordata
- 15a Leaves 3 - 6,5 cm long; lamina cuneate:
- 16 Leaves sessile and with hydathodes in two rows along the margin of the undersurface; ovules elongate  
..... 40. C. streyi
- 16a Leaves petiolate and with hydathodes scattered over the upper and lower surfaces; ovules spherical or almost so:

- 17 Petals 0,3 - 0,4 cm long; flowers predominantly 4-merous  
and with adventitious buds developing on old inflorescences  
..... 42a. C. multicava subsp. multicava
- 17a Petals 0,5 - 0,6 cm long; flowers predominantly 5-merous and  
without adventitious buds on old inflorescences  
..... 42b. C. multicava subsp. floribunda
- 14a Leaves acute or acuminate:
- 18 Stems with leaves 0,1 - 0,2 cm in diameter; leaves petiolate;  
or if not then more or less fused to one another to form a ring  
around the stem:
- 19 Internodes below inflorescence distinctly shorter or not  
visible; inflorescence elongate..... 36. C. inandensis
- 19a Internode below inflorescence longer than below;  
inflorescence flat to rounded:
- 20 Leaves petiolate; Natal  
..... 38b. C. sarmentosa subsp. integrifolia
- 20a Leaves sessile, abruptly constricted and more or less  
fused to one another; south-eastern Cape  
..... 35c. C. pellucida subsp. marginalis
- 18a Stems with leaves 0,4 - 0,6 (-0,8) cm in diameter; leaves  
sessile:
- 21 Leaves almost membranous and with recurved margin; petals  
0,3 - 0,4 (-0,45) cm long ..... 40. C. streyi
- 21a Leaves tough and somewhat convex on both surfaces; petals  
0,5 - 0,8 cm long..... 43. C. lactea

## GROUP 5

Herbaceous perennials sprouting annually, with (1) 2 or 3 (4) pairs of leaves produced by the usually almost spherical stem tubers which are covered with adventitious roots. Flowers star-shaped to cup-shaped or rarely tubular in C. saxifraga, arranged in a terminal thyrse and rarely only with a few flowers. Petals without distinct dorsal appendage.

Section Tuberosae.

Leaves opposite, usually crenate but also lobed to entire, dorsiventrally compressed to almost membranous, with hydathodes on the margin, marginal cilia absent and glabrous except for some plants of C. dentata; sheath membranous.

- 1 Inflorescence with distinct peduncle present:
  - 2 Leaves deeply divided ..... 52. C. alcicornis
  - 2a Leaves entire, serrate or dentate:
    - 3 Petals forming a tube twice the length of the sepals, recurved at the apex; pedicel rarely as long as 1 cm:
      - 4 Bracts at branching point of pseudo-umbel absent or rarely only a single one; leaves 1 (2) pairs  
..... 51. C. saxifraga
      - 4a Bracts at branching point of pseudo-umbel at least one pair but usually a whorl; leaves 2 - 3 (4) pairs  
..... 50a. C. capensis var. capensis
    - 3a Petals spreading from the base, forming an open star-shaped flower; pedicel usually longer than 1 cm:
      - 5 Squamulae up to 0,05 cm long, usually broader than long:
        - 6 Internodes between leaves c. 1 cm long; leaf blade elliptic; Drakensberg in Cape and Natal  
..... 53. C. umbraticola

6a Internodes between leaves usually less than 0,5 cm long  
or leaf blade broadly ovate to orbiculate; south-  
western Cape ..... 50a. C. capensis var. capensis

5a Squamae 0,07 cm or longer, longer than broad:

7 Leaves 3(4) pairs; leaf blade linear to elliptic, longer than  
broad on the lowest pair of leaves

..... 47. C. simulans

7a Leaves 1 (2) pairs; leaf blade broadly ovate, broader than  
long in the lowest pair of leaves

..... 46. C. umbella

1a Inflorescence without peduncle with flowers terminal or axillary,  
single or in clusters:

8 Leaves 4 at least at the lowest node..... 49. C. dentata

8a Leaves in pairs:

9 Flowers yellowish-green to brown, shortly campanulate, usually  
single with or without several bracts at the base (apparent  
racemose inflorescence)..... 48. C. nemorosa

9a Flowers white, star-shaped, in axillary or terminal  
inflorescences:

10 Leaves without petiole..... 46. C. umbella

10a Leaves with distinct petiole:

11 Petiole of lowest leaves longer than lamina broad;  
mountains of the northern Cape Peninsula

..... 50b. C. capensis var. promontorii

11a Petiole of lowest leaves shorter than lamina broad;  
Drakensberg in the Cape and Natal

..... 53. C. umbraticola

## GROUP 6

Herbaceous biennials or perennials with leaves forming a dense column around the stem, usually little branched and rarely taller than 15 cm. Flowers tubular in a dense terminal thyrse or capitulum. Petals (0,4-) 0,5 - 1,2 cm long, narrowly oblong and canaliculate at the apex and without dorsal appendage. Squamae spatulate to T-shaped 0,6 - 1,5 mm long.

Section Pyramidella.

Leaves opposite and often with equitative vernation, dorsiventrally flattened patelliform, convex below, with hydathodes arranged along the margin and/or scattered over the upper and lower surfaces, usually with marginal cilia at least at the base but lamina glabrous; sheath formed by the partial fusion at the leaf bases.

- 1 Leaves flat and up to 2 mm thick:
  - 2 Leaves whorled..... 113. C. multiceps
  - 2a Leaves opposite:
    - 3 Leaves of equal length; squamae 0,1 - 0,15 cm long  
..... 112. C. pyramidalis
    - 3a Leaves longer below becoming shorter towards the apex; squamae 0,03 - 0,06 cm long:
      - 4 Inflorescence terminal flat-topped dichasia  
..... 111a. C. alpestris subsp. alpestris
      - 4a Inflorescence globular axillary and terminal dichasia  
..... 111b. C. alpestris subsp. massonii
  - 1a Leaves convex at least on the lower surface, 0,4 - 1,2 cm thick:
    - 5 Leaves lanceolate, longer than broad:
      - 6 Leaves terete with a blunt apex pointing upwards  
..... 108a. C. congesta subsp. congesta

6a Leaves flat on upper surface and with pointed apex recurved  
 ..... 108b. C. congesta subsp. laticephala

5a Leaves transversely-compressed-ovate or orbicular, usually shorter  
 than broad:

7 Plants freely branching with column of adpressed leaves around  
 the stem 0,8 - 1,3 cm broad, not constricted below the  
 inflorescence ..... 110. C. teres

7a Plants if branched then axillary branches not longer than 1 cm,  
 with column of adpressed leaves around the stem 1,5 - 4 cm broad  
 at the base often constricted below the inflorescence:

8 Carpels with 8 - 10 (-12) ovules and distinct styles  
 ..... 109a. C. columnaris subsp. columnaris

8a Carpels with (14-) 16 - 24 ovules and styles much broadened  
 so that they are not distinguishable from the ovary  
 ..... 109b. C. columnaris subsp. semiorbicularis

#### GROUP 7

Perennials usually with somewhat woody stems and often shrubs. Flowers  
 sessile or pedicellate in a terminal thyrse rounded to flat-topped.  
 Petals 0,3 - 0,6 (-6) cm long, tubular and with pointed denticulate dorsal  
 appendage.

Sections Squamulosae, Curtogyne, Subulares, Kalosanthes

Leaves opposite and usually bent to the one side of the stem, dorsiventrally  
 compressed to almost terete, with hydathodes arranged in a dense row along  
 the upper and lower margin and more or less scattered over predominantly the  
 upper surface, with marginal cilia and usually glabrous lamina; sheath  
 formed by the partial fusion of the leaf bases.

- 1 Petals 1,5 - 6 cm long:
- 2 Leaves 1 - 3 times longer than broad; petals usually red, rarely pink or white; anthers 0,4 - 0,5 cm long..... 79. C. coccinea
- 2a Leaves 4 - 10 times longer than broad; petals white or pale yellow-green; anthers 0,1 - 0,3 cm long:
- 3 Flowers (3) 5 - 15, sessile and their base hidden by bracts; recurved petal lobes slightly broader than the petal base  
..... 77. C. fascicularis
- 3a Flowers 1, 2 (4), pedicellate; recurved petal lobes 2 - 3 times broader than the petal base..... 78. C. obtusa
- 1a Petals 0,3 - 1 cm long:
- 4 Leaves subulate, triangular in section to almost terete:
- 5 Leaves covered with blister-like papillae:
- 6 Leaves 2 - 3,5 cm long..... 65. C. scabra
- 6a Leaves 0,5 - 1,5 cm long:
- 7 Sepals triangular and densely covered with papillae; petals 0,5 - 0,6 mm long..... 67. C. pruinosa
- 7a Sepals awn-shaped, glabrous or with a few scattered papillae; petals 0,7 - 0,8 cm long...66. C. pustulata
- 5a Leaves glabrous or with marginal cilia:
- 8 Petals panduriform and usually without dorsal appendage:
- 9 Internodes glabrous:
- 10 Leaves narrowly oblong, 3 - 6 cm long  
.....68a. C. multiflora subsp. multiflora
- 10a Leaves oblanceolate, 1,5 - 2,5 cm long  
.....68b. C. multiflora subsp. leucantha
- 9a Internodes at least in parts hairy:
- 11 Internodes with strips of hairs continuing from the hairy leaf sheath downwards along the internodes..... 72a. C. subulata var. subulata

- 11a Internodes hairy:
- 12 Roots tuberous, shallow soil on rocks....64. C. muricata
- 12a Roots fibrous; rocky slopes or on sand dunes:
- 13 Leaves hairy..... 72c. C. subulata var. hispida
- 13a Leaves glabrous....72b. C. subulata var. fastigiata
- 8a Petals lanceolate to oblanceolate and with denticulate dorsal  
appendage:
- 14 Petals 0,5 - 0,9 cm long..... 73. C. flava
- 14a Petals 0,2 - 0,4 cm long:
- 15 Leaves glabrous; stems greyish-white.... 61. C. pallens
- 15a Leaves with marginal cilia; stems brown:
- 16 Sepals and leaves with colourless setose apex:
- 17 Stems erect, fastigiata; squamae narrowly  
oblong..... 95a. C. southii subsp. southii
- 17a Stems decumbent; squamae transversely oblong  
to square  
..... 95b. C. southii subsp. sphaerocephala
- 16a Sepals and leaves without colourless setose apex:
- 18 Flowers sessile or almost so; Namaqualand:
- 19 Roots tuberous; shrublets rarely  
higher than 20 cm.....63. C. whiteheadii
- 19a Roots fibrous; shrubs or scramblers 30-  
50 cm high  
..... 62. C. rudolfii
- 18a Flowers with pedicels 0,2 - 0,4 cm long;  
eastern Cape and Natal:
- 20 Leaves 1 - 3,5 cm long; internodes (0,4-)  
0,8 - 1,5 cm long and elongated below the  
inflorescence  
..... 96a. C. sediflora var. sediflora

20a Leaves 0,4 - 0,8 cm long; internodes 0,2 - 0,4 cm long and not elongating below the inflorescence

..... 96b. C. sediflora var. amatolica

4a Leaves lanceolate, oblong, obovate:

21 Inflorescence spike-like with sessile axillary part-inflorescences:

22 Styles slender half to three-quarter the length of the ovary

..... 97a. C. obovata var. obovata

22a Styles broad and up to one quarter of the length of the ovary:

23 Squamae oblong; lower slopes or mountains in north-eastern Transvaal

..... 101c. C. capitella subsp. enantiophylla

23a Squamae transversely oblong to square; coastal mountains central Natal

..... 101d. C. capitella subsp. meyeri

21a Inflorescence a flat or round-topped thyrses:

24 Leaves with marginal cilia swollen and becoming almost cylindrical and obtuse:

25 Leaves lanceolate (3) 4 - 8 times longer than broad, acute ..... 73. C. flava

25a Leaves obovate, oblong to obovate and up to twice longer than broad, obtuse..... 75. C. dejecta

24a Leaves with marginal cilia hair-like and acute or rudimentary teeth:

26 Leaves with marginal cilia in a dense row, erect or slightly recurved and c. 0,1 cm long:

27 Petals (0,5-) 0,6 - 0,8 cm long; squamae transversely oblong:

28 Internodes glabrous; south western Cape

..... 76. C. undulata

- 28a Internodes with recurved hairs; eastern Cape Province,  
southern and central Natal..... 97a. C. obovata var. obovata
- 27a Petals 0,3 - 0,4 cm long; squamae oblong:
- 29 Stems prostrate; leaves up to 0,8 cm long  
..... 70. C. lasiantha
- 29a Stems erect; leaves 1,2 - 6 cm long:
- 30 Leaves in a basal rosette, 0,5 - 1 cm broad  
..... 71. C. ciliata
- 30a Leaves mainly on decumbent stems, 0,2 - 0,3 cm broad  
..... 69. C. cymosa
- 26a Leaves with subdistant marginal cilia recurved and adpressed or  
denticulate and usually wearing off towards the apex:
- 31 Petals 0,2 - 0,3 cm long, pale yellow:
- 32 Flowers sessile; leaves leathery, ovate and if lanceolate  
with short marginal cilia..... 104. C. perforata
- 32a Flowers pedicellate (0,2 - 0,4 cm long); leaves  
herbaceous and brittle, lanceolate to subpetiolate  
..... 80. C. flanaganii
- 31a Petals 0,4 - 0,5 (-0,6) cm long, white or tinged pink:
- 33 Leaves obovate, oblong and slightly curved to the one side  
of the stem:
- 34 Hydathodes arranged in a dense row along the upper,  
and lower margin and scattered mainly over the upper  
surface; south-eastern Cape..... 74. C. rubricaulis
- 34a Hydathodes scattered over the upper and lower  
surfaces; northern Natal, Swaziland, eastern Transvaal  
..... 225c. C. globularioides subsp. argyrophylla
- 33a Leaves ovate to lanceolate and not curved to the one side of  
the stem:

- 35 Leaves ovate and up to twice as long as broad and slightly convex  
on both surfaces..... 103. C. sladenii
- 35a Leaves linear-lanceolate or narrowly triangular, cymbiform  
..... 102. C. fusca

## GROUP 8

Perennials with herbaceous stems rarely slightly woody towards the base and with leaves in a basal rosette and then becoming gradually shorter below the inflorescence. Flowers usually pedicellate in a flat-topped, elongate to spike-like thyrses. Petals 0,2 - 0,5 (-0,8) cm long, tubular and usually with pointed denticulate dorsal appendage.

Section Rosularis.

Leaves opposite and with obvolute vernation (visible even at the base of adult leaves) dorsiventrally compressed and more or less cymbiform, herbaceous (almost terete in C. obovata) with hydathodes arranged in a dense row along the margin and more or less scattered over at least the upper surface, with marginal cilia and glabrous or hairy lamina; sheath formed by the partial fusion of the leaf bases.

- 1 Inflorescence a flat or round-topped thyrses or rarely with a few terminal flowers;
- 2 Leaves 0,5 - 2,5 (-3) cm long;
- 3 Leaves (0,5-) 0,7 - 6 cm broad;
- 4 Leaves in rosette 4-ranked;
- 5 Style strongly reflexed so as to appear fused to the ovary; squamae narrowly oblong;
- 6 Leaves obovate or orbicular and with obtuse apex  
..... 86. C. intermedia

6a Leaves ovate to lanceolate and with acute apex

..... 87. C. socialis

5a Style erect or slightly recurved; squamae transversely oblong to square:

7 Leaves gradually becoming shorter below inflorescence:

8 Erect stem c. 0,1 cm in diameter; leaves acute

..... 90a. C. setulosa var. setulosa

8a Erect stem (0,2-) 0,3 - 0,4 cm in diameter; leaves obtuse rarely bluntly acute

..... 101d. C. capitella subsp. meyeri

7a Leaves abruptly shortened below the inflorescence and with much shorter bracts on the peduncle:

9 Squamae abruptly constricted towards the base (if only

3 - 5 flowers then leaves lanceolate and three times

longer than broad)..... 83a. C. montana subsp. montana

9a Squamae gradually constricted towards the base (if only

3 - 5 flowers then leaves ovate and almost as broad as

long)..... 83b. C. montana subsp. quadrangularis

4a Leaves in rosette or at the base spirally arranged:

10 Petals 0,5 - 0,8 cm long..... 97. C. obovata var. obovata

10a Petals 0,2 - 0,3 (-0,4) cm long:

11 Petals obtuse or rounded and with indistinct smooth dorsal

appendage..... 91. C. natalensis

11a Petals acute and with distinct dorsal appendage:

12 Leaves not rosulate; stems decumbent in flowering

specimens; marginal cilia wearing off with age

..... 80. C. flanagani

12a Leaves rosulate; marginal cilia persistent and spreading:

- 13 Leaf surface hairy; marginal cilia in a dense row and touching one another, or if leaves glabrous and/or with subdistant cilia then from the Transvaal ..... 90a. C. setulosa var. setulosa
- 13a Leaf surface glabrous; marginal cilia subdistant; eastern Cape ..... 88a. C. cooperi subsp. cooperi
- 3a Leaves at the base 0,2 - 0,4 cm broad:
- 14 Plants with leaves not in an obvious basal rosette:
- 15 Petals without distinct dorsal appendage:
- 16 Squamae narrowly oblong; marginal cilia on leaves more than 0,1 cm long ..... 90e. C. setulosa var. longiciliata
- 16a Squamae transversely oblong; marginal cilia and/or papillae very short and often not present towards the apex of the leaves:
- 17 Leaves 1 - 3,5 cm long; internodes (0,4-) 0,8 - 1,5 cm long and becoming longer below the inflorescence.....96a. C. sediflora var. sediflora
- 17a Leaves 0,4 - 0,8 cm long; internodes 0,2 - 0,4 cm long and not elongating below the inflorescence. .... 96b. C. sediflora var. amatolica
- 15a Petals with pointed dorsal appendage:
- 18 Sepals acute but without colourless seta ..... 90b. C. setulosa var. jenkensii
- 18a Sepals acute and with colourless seta:
- 19 Styles short and hardly distinguishable from the gradually constricted ovary; stigma lateral .....101d. C. capitella subsp. meyeri
- 19a Styles slender and erect; stigma terminal:

- 20 Leaves without terminal colourless seta; petals 0,5 - 0,8 cm long..... 97a. C. obovata var. obovata
- 20a Leaves with terminal colourless seta; petals 0,2 - 0,35 cm long:
- 21 Stems erect, fastigiata; squamae narrowly oblong  
..... 95a. C. southii subsp. southii
- 21a Stems decumbent; squamae transversely oblong to square  
..... 95b. C. southii subsp. sphaerocephala
- 14a Plants with leaves in a basal rosette:
- 22 Petals obtuse or rounded and with insignificant dorsal appendage:
- 23 Leaf sheath on erect stem (0,5-) 0,8 - 1,5 cm long; leaves usually with papillae along the margin  
..... 92. C. vaginata
- 23a Leaf sheath on erect stem 0,1 - 0,2 (-0,3) cm long; leaves with marginal cilia hair-like:
- 24 Squamae narrowly oblong and about 3 times longer than broad; leaves with marginal cilia about 0,15 cm long  
..... 90e. C. setulosa var. longiciliata
- 24a Squamae transversely oblong, square or rarely slightly longer than broad; leaves with marginal cilia c. 0,05 cm long and often wearing off with age  
..... 90d. C. setulosa var. curta
- 22a Petals acute and with pointed denticulate dorsal appendage:
- 25 Petals (0,45-) 0,5 - 0,8 cm long:
- 26 Leaves with spreading marginal cilia and if hairy then with recurved adpressed hairs  
..... 97a. C. obovata var. obovata
- 26a Leaves with recurved hairs and cilia indistinguishable from another..... 97b. C. obovata var. dregeana

25a Petals 0,2 - 0,35 (0,4) cm long:

27 Leaf surface covered with hairs:

28 Leaves in a basal rosette even when flowering; plants up to 15 cm high when flowering

..... 90a. C. setulosa var. setulosa

28a Leaves not in an obvious basal rosette when flowering;

plants 20 - 30 cm long..... 97a. C. obovata var. obovata

27a Leaf surface glabrous:

29 Plants (25-) 18 - 35 cm high and usually only with one terminal inflorescence:

30 Leaves on erect stem with sheath (0,5-) 0,8 - 1,5 cm long; carpels each with 4 (-6) ovules

..... 92. C. vaginata

30a Leaves on erect stem with sheath 0,2 - 0,4 cm long; carpels each with 8 (-10) ovules

..... 94a. C. alba var. parvisepala

29a Plants 3 - 10 (-12) cm high and usually with several terminal inflorescences:

31 Erect stems with 6 - 12 pairs of leaves and with vegetative axillary buds below the inflorescence

..... 90b. C. setulosa var. jenksensii

31a Erect stems with (1) 2 - 4 (5) pairs of leaves and without vegetative axillary buds:

32 Erect stem glabrous:

33 Stems somewhat woody and thickened at the base (up to 1 cm in diameter); mountains on both sides of lower Orange River

..... 88b. C. cooperi subsp. sedifolia

33a Stems wiry and slightly thickened 0,1 - 0,2 (-0,3) cm in diameter); central and eastern Transvaal

..... 90a. C. setulosa var. setulosa

32a Erect stems hairy:

34 Leaves dorsiventrally compressed and with subdistant marginal cilia..... 88a. C. cooperi subsp. cooperi

34a Leaves dorsiventrally flattened and more or less cymbiform; marginal cilia in a dense row and touching one another

..... 90a. C. setulosa var. setulosa

2a Leaves at the base (4,5-) 5 - 25 cm long:

35 Styles reflexed onto the top of the ovary; leaves obovate, obtuse..... 86. C. intermedia

35a Styles erect or slightly recurved; leaves lanceolate, elliptic, acute:

36 Petals obtuse or rounded and with indistinct smooth dorsal appendage:

37 Leaf sheath on erect branches (0,5-) 0,8 - 1,5 cm long; tap root tuberous..... 92. C. vaginata

37a Leaf sheath on erect branches 0,1 - 0,3 cm long; tap root fibrous..... 91. C. natalensis

36a Petals acute and with denticulate dorsal appendage:

38 Stems decumbent and without a distinct basal leaf rosette in flowering stage..... 80. C. flanaganii

38a Stems erect and with basal leaves remaining clustered in a rosette:

39 Styles short and hardly distinguishable from the gradually constricted ovary; stigma lateral  
..... 101d. C. capitella subsp. meyeri

39a Styles slender erect and with terminal stigmas:

- 40 Plants up to 10 cm high when flowering  
 ..... 88a. C. cooperi subsp. cooperi
- 40a Plants 15 - 30 (-100) cm high when flowering:
- 41 Leaves with marginal cilia very much broadened at the base  
 (about as broad as long) and not recurved  
 ..... 93. C. acinaciformis
- 41a Leaves with marginal cilia slightly broadened towards the  
 base (at least 4 times longer than broad) and recurved:
- 42 Petals (0,45-) 0,5 - 0,6 cm long; carpels each with  
 14 - 30 ovules..... 94a. C. alba var. alba
- 42a Petals 0,2 - 0,35 cm long; carpels each with 8 (-10)  
 ovules..... 94b. C. alba var. parvisepala
- 1a Inflorescence a spike-like or an elongate thyrses:
- 43 Leaves in the basal rosette 4-ranked or apparently 2-ranked:
- 44 Styles reflexed onto the top of the ovary  
 ..... 86. C. intermedia
- 44a Styles erect or slightly recurved at the apex:
- 45 Sepals hairy and with marginal cilia:
- 46 Leaves becoming gradually shorter below the  
 inflorescence.....85a. C. tomentosa var. tomentosa
- 46a Leaves abruptly shortened below the inflorescence  
 ..... 85b. C. tomentosa var. interrupta
- 45a Sepals glabrous but usually with marginal cilia:
- 47 Ovary smooth; sepals acute  
 ..... 83a. C. montana subsp. montana
- 47a Ovary denticulate; sepals obtuse or rounded  
 ..... 82. C. pseudoemisphaerica
- 43a Leaves in rosette spirally arranged:
- 48 Leaves abruptly shortened below the inflorescence:
- 49 Lateral part-inflorescences distinctly stalked:

- 50 Stems decumbent and much branched; leaves not fascicled at the base of the stem..... 80. C. flanaganii
- 50a Stems erect and rarely branched; leaves fascicled into basal rosette:
- 51 Sepals glabrous or with a few marginal teeth; leaves obovate obtuse or mucronate.....100. C. hemisphaerica
- 51a Sepals with marginal cilia; leaves lanceolate, elliptic or oblong..... 81. C. orbicularis
- 49a Lateral part-inflorescences sessile or almost so:
- 52 Erect stems hairy:
- 53 Sepals glabrous; petals 0,2 - 0,25 cm long and recurved from the middle..... 100. C. hemisphaerica
- 53a Sepals with marginal cilia; petals 0,35 - 0,45 cm long and slightly recurved at the apex.....99. C. compacta
- 52a Erect stems glabrous:
- 54 Stems with (1) 2 (3) nodes with sessile part inflorescences..... 90c. C. setulosa var. deminuta
- 54a Stems with 4 - 6 nodes with sessile part-inflorescences:
- 55 Sepals glabrous; leaves obovate, obtuse or mucronate.....100. C. hemisphaerica
- 55a Sepals with marginal cilia; leaves lanceolate, elliptic or oblong..... 81. C. orbicularis
- 48a Leaves becoming gradually shorter below the inflorescence:
- 56 Styles slender erect and with insignificant terminal stigma:
- 57 Stems 5 - 15 (-18) cm long:
- 58 Leaves abruptly constricted below the inflorescence:
- 59 Carpels each with 8 - 16 ovules; moist grassveld in south-eastern Transvaal and northern Orange Free State..... 99. C. compacta

- 59a Carpels each with 26 - 34 ovules; moist shaded  
rock crevices on the northern Swartberg and  
Witteberg..... 98. C. brachystachya
- 58a Leaves gradually constricted below the inflorescence:
- 60 Sepals glabrous; petals 0,2 - 0,25 (-0,3) cm long  
..... 101e. C. capitella subsp. thyrsiflora
- 60a Sepals with marginal cilia; petals (0,3-) 0,4 - 0,8  
cm long:
- 61 Squamae oblong; erect stem with fine erect or  
slightly recurved hairs  
..... 101c. C. capitella subsp. enantiophylla
- 61a Squamae transversely oblong; erect stem glabrous  
or with recurved and adpressed stiff hairs:
- 62 Erect stems glabrous; northern Swartberg  
and Witteberg..... 98. C. brachystachya
- 62a Erect stems with recurved and adpressed hairs;  
north-eastern Cape to central South West  
Africa..... 89. C. tabularis
- 57a Stems 20 - 35 (-40) cm long:
- 63 Sepals glabrous; petals 0,2 - 0,25 (-0,3) cm long  
..... 101e. C. capitella subsp. thyrsiflora
- 63a Sepals with marginal cilia; petals (0,3-) 0,4 - 0,8 cm  
long:
- 64 Squamae transversely oblong; eastern Cape  
..... 97a. C. obovata var. obovata
- 64a Squamae oblong; Transvaal  
..... 101c. C. capitella subsp. enantiophylla
- 56a Styles short and broad or absent; stigmas lateral:

- 65 Sepals tomentose..... 85a. C. tomentosa var. tomentosa
- 65a Sepals glabrous or only with marginal cilia;
- 66 Petals with smooth ovoid appendage in terminal position; leaves in rosette recurved and more or less adpressed to the ground:
- 67 Bracts subtending part-inflorescences glabrous except usually with marginal cilia; squamae emarginate.  
..... 101a. C. capitella subsp. capitella
- 67a Bracts subtending part-inflorescences covered with hairs; and with marginal cilia; squamae truncate  
..... 101b. C. capitella subsp. nodulosa
- 66a Petals with denticulate acute appendage in dorsal position; leaves erect and spreading:
- 68 Erect stems 0,3 - 0,4 cm in diameter and with recurved hairs; leaves rarely in a basal rosette  
..... 101d. C. capitella subsp. meyeri
- 68a Erect stems 0,1-0,2 cm in diameter and glabrous; leaves in a basal rosette:
- 69 Leaves oblong or oblanceolate or rarely obovate and with cilia 0,3 - 0,5 cm long  
..... 84b. C. barbata subsp. broomii

## GROUP 9

Perennials usually with woody stems, with leaves evenly distributed over the stem (except C. fusca with rosulate leaves) and shrubby. Flowers usually pedicellate and in a rounded thyrses. Petals 0,2 - 0,5 cm long, tubular and with pointed denticulate dorsal appendage.

Section Perfilata.

Leaves opposite and often with obvolvate vernation (visible in buds or young plants), dorsiventrally compressed, somewhat convex to terete, with hydathodes arranged in a dense row along the margin (usually not present in species with rounded leaf margin) and more or less scattered over the upper and lower surfaces, with marginal cilia usually wearing off and with glabrous lamina; sheath formed by the partial fusion of the leaf bases.

- 1 Stigma sessile; leaves cymbiform and with sharp margin  
 ..... 102. C. fusca
- 1a Stigma on distinct style; leaves terete to dorsiventrally compressed, or if patelliform then without sharp margin:
- 2 Leaves linear-lanceolate to subulate and triangular to round in section:
- 3 Stems with leaves carnose (0,3-) 0,4 - 0,6 cm in diameter:
- 4 Sepals obtuse or rounded.....107. C. macowariana
- 4a Sepals acute:
- 5 Leaves acute and bent upwards; inflorescence a rounded to elongate thyse, loosely arranged  
 ..... 122a. C. exilis subsp. exilis
- 5a Leaves obtuse, spreading about at right angles to the stem; inflorescence a flat-topped thyse with flowers in dense clusters  
 .....106b. C. brevifolia subsp. psammophila
- 3a Stems with leaves brittle woody and 0,2 (-0,3) cm in diameter:
- 6 Internodes not visible between the leaves; leaves obtuse; quartzite gravel or sand dunes along the coast  
 ..... 106b. C. brevifolia subsp. psammophila

- 6a Internodes visible between the leaves; leaves acute; rock outcrops or sheltered kloofs:
- 7 Leaves 0,5 - 1 cm long, spreading at about right angles to the stem.....105c. C. rupestris subsp. commutata
- 7a Leaves (1,2-) 1,5 - 5 cm long and curved upwards .....106a. C. brevifolia subsp. brevifolia
- 2a Leaves ovate and more or less fused to form a ring around the stem, more or less dorsiventrally compressed:
- 8 Leaves fused in pairs half to almost the whole length of the lamina:
- 9 Petals 0,4 - 0,5 cm long, white; pairs of bracts below the inflorescence (0,3-) 0,4 - 0,5 cm long, spreading ..... 105b. C. rupestris subsp. marnierana
- 9a Petals 0,2 - 0,3 cm long, cream to pale yellow; pair of bracts below the inflorescence, if present, up to 0,15 cm long and adpressed:
- 10 Squamae oblong; inflorescence with peduncle .....104. C. perforata
- 10a Squamae transversely oblong; inflorescence sessile ..... 33. C. vestita
- 8a Leaves fused in pairs but less than a quarter of the length of the lamina:
- 11 Petals 0,2 - 0,3 cm long, pale yellow; pairs of bracts on peduncle up to 0,15 cm long and adpressed ..... 104. C. perforata
- 11a Petals 0,4 - 0,5 (-0,6) cm long, white; pairs of bracts on peduncle (0,3-) 0,4 - 0,5 cm long and spreading:
- 12 Leaves (2) 2,5 - 4 (-6) cm long and dorsiventrally compressed or slightly but evenly convex on both surfaces .....103. C. sladenii

12a Leaves 0,5 - 1,5 cm long, concave above and distinctly convex

below ..... 105a. C. rupestris subsp. rupestris

#### GROUP 10

Perennials rarely with a woody base as in C. perfoliata and with leaves often close to one another but not rosulate and abruptly constricted below the inflorescence. Flowers often sessile and usually in clusters within the thyrses. Petals 0,2 - 0,5 (0,7) cm long, tubular and usually with pointed denticulate dorsal appendage.

Sections Crassula, Argyrophylla, Caducifolia, Arta.

Leaves opposite and often slightly bent to the one side of the stem, usually convex at least on the under surface to terete, with hydathodes scattered over the upper and lower leaf surface, usually without distinct marginal cilia but often with hairy lamina; sheath formed by the partial fusion of the leaf bases.

- 1 Trichomes on leaves swollen and with rounded apex to form blister-like, irregular or spherical (with or without basal stalk) papillae:
  - 2 Inflorescence spike-like; leaves caducous..... 131. C. decidua
  - 2a Inflorescence an elongate to flat-topped thyrses:
    - 3 Petals 0,5 - 0,8 cm long or if shorter then plants with woody stems 30 - 100 cm high; inflorescence a dense flat-topped thyrses:
      - 4 Leaves terete or almost so and covered with recurved adpressed hairs..... 97b. C. obovata var. dregeana
      - 4a Leaves dorsiventrally or laterally compressed and densely covered with rounded erect papillae:

- 5 Flowering period: May - August; stems branched and usually decumbent; Natal, Transvaal or rarely in the Cape bordering Natal..... 130d. C. perfoliata subsp. heterotricha
- 5a Flowering period: November - February; stem erect and rarely branched; eastern Cape:
- 6 Leaves laterally compressed and falcate; bracts on peduncle obtuse.....130c. C. perfoliata var. falcata
- 6a Leaves dorsiventrally compressed and cymbiform; bracts on peduncle acute:
- 7 Petals white or yellowish green, obtuse, 0,3 - 0,4 cm long .....130a. C. perfoliata subsp. perfoliata
- 7a Petals red, acute, 0,5 - 0,7 cm long  
.....130b. C. perfoliata subsp. miniata
- 3a Petals 0,2 - 0,4 cm long or if longer then with carnose stems which are usually swollen towards the base and up to 15 cm long; inflorescence a rounded thyse but usually divided into a number of part-inflorescences:
- 8 Petals 0,4 - 0,5 cm long, white; stigma lateral and insignificant:
- 9 Trichomes spherical or almost so, c. 0,05 cm across:
- 10 Stems up to 5 cm long, prostrate; Little Karoo and adjoining mountains.....120. C. tecta
- 10a Stems 7 - 15 cm long, erect or rarely decumbent when longer than 10 cm; coastal hills of northern Namaqualand and southern South West Africa  
..... 116c. C. sericea var. hottentotta
- 9a Trichomes spherical at least at the apex and with a distinct stalk, less than 0,02 cm across:

- 11 Leaves acute and spaced along the stem  
 .....122b. C. exilis subsp. garibina
- 11a Leaves truncate or obtuse, rosulate:
- 12 Leaves canaliculate; inflorescence with flowers well  
 above the leaves.....123. C. susannae
- 12a Leaves triangular in section; inflorescence almost  
 sessile and with flowers half hidden between the leaves  
 .....134. C. mesembryanthemopsis
- 8a Petals 0,2 - 0,3 cm long, cream to pale yellow; stigma terminal,  
 capitate:
- 13 Leaves spreading at about right angles from the stem:
- 14 Leaf sheath with a few spreading hairs; plants usually  
 much branched.....116c. C. sericea var. hottentotta
- 14a Leaf sheath with papillae or if with hairs then recurved  
 and adpressed.....125. C. grisea
- 13a Leaves more or less clasping the stem to form a column:
- 15 Peduncle at the top with recurved hairs; leaf apices  
 adpressed forming a rarely branched column 5 - 15 cm  
 long.....128. C. plematoides
- 15a Peduncle at the top with recurved blunt papillae;  
 leaf apices more or less clasping to form a column 3 -  
 5 cm long and usually much branched from the base  
 .....129. C. deceptor
- 1a Trichomes on leaves hair-like and with sharp apices or leaves glabrous:
- 16 Leaves (hairy or glabrous) with marginal cilia:
- 17 Flowers in terminal dichasia without peduncles and leaves  
 gradually constricted below the inflorescence:
- 18 Leaves sharply acute, 0,2 - 0,7 (1,2) cm long  
 .....114a. C. lanuginosa var. lanuginosa

- 18a Leaves obtuse rarely bluntly acute (1-) 1,5 - 3,5 cm  
long .....114b. C. lanuginosa var. pachystemon
- 17 Flowers usually in several dense dichasia in a terminal thyrse  
with peduncles; leaves abruptly constricted below the  
inflorescence:
- 19 Leaf surface glabrous:
- 20 Leaves dorsiventrally compressed  
.....115c. C. globularioides subsp. argyrophylla
- 20a Leaves triangular in section to almost terete  
.....122a. C. exilis subsp. exilis
- 19a Leaf surface densely hairy:
- 21 Stem c. 1 cm long; south-western South West Africa  
.....121b. C. ausensis subsp. ciliaris
- 21a Stems 4 - 15 cm long; north-eastern Natal to  
northern Transvaal  
.....115c. C. globularioides subsp. argyrophylla
- 16a Leaves (hairy or glabrous) without marginal cilia:
- 22 Petals panduriform to oblong-panduriform and with canaliculate  
rostrum and without distinct dorsal appendage:
- 23 Leaves with spreading hairs, obovate to orbicular  
.....116b. C. sericea var. velutina
- 23a Leaves with recurved and adpressed hairs, lanceolate,  
oblong to oblanceolate:
- 24 Peduncle with spreading hairs; leaves acute; petals  
0,3 - 0,4 cm long.....119. C. hirtipes
- 24a Peduncle with recurved and usually adpressed hairs;  
leaves obtuse or if acute then the petals are 0,7 -  
0,8 cm long:

- 25 Leaves apparently 2-ranked, clustered and adpressed to one another in almost spherical body.....117. C. alstonii
- 25a Leaves spirally arranged and more or less clustered at the base but not adpressed to one another:
- 26 Petals with rostrate apex up to 0,1 cm long, white, cream .....118a. C. namaquensis
- 26a Petals with rostrate apex 0,2 - 0,3 cm long, yellow:
- 27 Leaves terete, club-shaped, obtuse, 0,6 - 1,2 cm long; petals 0,3 - 0,5 cm long .....118b. C. namaquensis subsp. comptonii
- 27a Leaves conical, acute, 1,5 - 3 cm long; petals 0,7 - 0,9 cm long.....118c. C. namaquensis subsp. lutea
- 22a Petals oblanceolate, acute and with denticulate dorsal appendage:
- 28 Leaves glabrous or with a few scattered hairs .....122a. C. exilis subsp. exilis
- 28a Leaves densely covered with spreading or recurved hairs:
- 29 Flowers pedicellate and in a subumbellate inflorescence; petals 0,5 - 0,7 cm long .....121a. C. ausensis subsp. ausensis
- 30 Hairs on leaves recurved and somewhat swollen at the base.....97a. C. obovata var. dregeana
- 30a Hairs on leaves fine and erect .....121a. C. ausensis subsp. ausensis
- 29a Flowers sessile or almost so and grouped into several part-inflorescences; petals 0,3 - 0,4 cm long:
- 31 Petals acute and with distinct denticulate dorsal appendage; lower slopes up to 600 m altitude .....116a. C. sericea var. sericea
- 31a Petals acuminate and with indistinct dorsal appendage; towards the apex of mountains at an altitude of 1 000 m ..... 116b. C. sericea var. velutina

## GROUP 11

Perennials with slightly woody to woody stems, with leaves sometimes rosulate but abruptly constricted below the inflorescence or shrublets. Flowers sessile or almost so and in dense part-inflorescences (often spherical) within the thyrses. Petals panduriform 0,3 - 0,6 cm long, tubular, erect and with ovoid to spherical smooth dorsal appendage in terminal position rarely with a fleshy canaliculate rostrum and then the lateral membranous margin above broadened part of petal recurved.

Section Globulea.

Leaves opposite and slightly bent to the one side of the stem, dorsiventrally compressed convex to terete, with hydathodes scattered over the upper and lower leaf surface, with or without marginal cilia but often with hairy lamina; sheath formed by the partial fusion of the leaf bases.

- 1 Leaves ovate to lanceolate with marginal cilia in a dense row and recurved, gradually becoming shorter towards the inflorescence; bracts on lower inflorescence leaf-like:
  - 2 Bracts subtending part inflorescences hairy and with marginal cilia; squamae truncate.....111b. C. capitella subsp. nodulosa
  - 2a Bracts subtending part-inflorescences glabrous but with marginal cilia; squamae emarginate.....111a. C. capitella subsp. capitella
- 1a Leaves oblanceolate, obovate or oblong, with marginal cilia erect if present, abruptly constricted below the inflorescence; bract on inflorescence scale-like:
  - 3 Petals with dorsal appendage in terminal position:
    - 4 Leaves spaced along the stem and usually internodes visible between them; stems with leaves 0,1 - 0,2 cm in diameter:

- 5 Leaves subulate or linear-lanceolate:
- 6 Petals with terminal appendage and without membranous petal apex:
- 7 Leaves densely covered with fine erect hairs hardly visible with the naked eye.....133. C. mollis
- 7a Leaves with coarse reflexed hairs c. 0,1 - 0,2 cm long:
- 8 Leaves 1 - 1,5 (-2) cm long and becoming gradually shorter below the inflorescence  
.....132a. C. mesembryanthoides subsp. mesembryanthoides
- 8a Leaves (2-) 3 - 5 cm long and clustered at the base of the stems and then abruptly shortened below the inflorescence  
.....132b. C. mesembryanthoides subsp. hispida
- 6a Petals with dorsal appendage in terminal position and with membranous petal apex bent downwards:
- 9 Leaves pubescent; petal appendage elongate and about twice as long as broad.....135a. C. pubescens subsp. pubescens
- 9a Leaves glabrous; petal appendage almost spherical  
.....135b. C. pubescens subsp. radicans
- 5a Leaves oblanceolate, obovate to oblong and usually somewhat bent to the one side of the stem:
- 10 Leaves oblong and usually canaliculate above, becoming deep red under adverse conditions.....144. C. erosula
- 10a Leaves oblanceolate to obovate, becoming yellowish-green to dull reddish-brown:
- 11 Petals with terminal appendage and without membranous petal apex; flat-topped thyse surrounded by broad bracts  
.....134. C. latibracteata
- 11a Petals dorsal appendage in terminal position and with membranous petal apex curved downwards; bracts acute:

- 12 Inflorescence a flat or rounded thyse (i.e. part-inflorescences are produced by 1 or 2 nodes):
- 13 Leaves hairy; petal appendage elongate and about twice as long as broad .....135a. C. pubescens subsp. pubescens
- 13a Leaves glabrous; petal appendage spherical or almost so .....135b. C. pubescens subsp. radicans
- 12a Inflorescence an elongate thyse (i.e. part-inflorescences are produced from (3) 4 - 10 nodes):
- 14 Flowers shortly pedicellate and loosely arranged in part-inflorescences; leaves dorsiventrally compressed and with sharp usually horny margin; plants 20 - 100 cm high ..... 136. C. cultrata
- 14a Flowers sessile and in dense almost spherical part-inflorescences; leaves almost terete to somewhat dorsiventrally flattened but if with sharp margin then stems not longer than 10 cm.
- 15 Petal appendage about twice as long as broad .....135a. C. pubescens subsp. pubescens
- 15a Petal appendage spherical or almost so:
- 16 Leaves obovate to orbicular; on rock faces in S.W. Cape.....138c. C. atropurpurea var. anomala
- 16a Leaves oblanceolate to elliptic; rocky slopes in the eastern Cape Province:
- 17 Leaves dorsiventrally compressed with short hairs hardly visible to the naked eye .....135c. C. pubescens subsp. rattrayi
- 17a Leaves with at least the lower surface very much convex, tomentose.....137. C. rogersii

- 4a Leaves rosulate and with internodes not visible between them:
- 18 Leaves hairy:
- 19 Marginal cilia in more than one row.....141. C. cotyledonis
- 19a Marginal cilia on leaves absent or in a single row:
- 20 Leaves oblanceolate to obovate, hairy but without marginal cilia:
- 21 Petal appendage elongate and up to twice as long as broad; leaves with erect hairs; Little Karoo and adjoining mountains northwards to near Nieuwoudtville  
..... 135a. C. pubescens subsp. pubescens
- 21a Petal appendage spherical or almost so; leaves with short hairs hardly visible with the naked eye; between Cradock and Graaff Reinet  
.....135c. C. pubescens subsp. rattrayi
- 21b Petal appendage spherical or almost so; leaves with erect hairs; northern Namaqualand  
..... 143. C. clavata
- 20a Leaves oblong, linear-lanceolate or subulate, hairy and usually with marginal cilia:
- 22 Pairs of bracts on the peduncle forming an obtuse angle where fused to one another; northern Namaqualand..... 144. C. erosula
- 22a Pairs of bracts on peduncle forming an acute angle where fused to one another; south-western to eastern Cape  
.....142a. C. nudicaulis var. nudicaulis
- 18a Leaves glabrous or with marginal cilia:

## 23 Leaves glabrous:

24 Leaves terete or almost so and curved upwards; grey-green to brown..... 142b. C. nudicaulis var. subacaulis

24a Leaves dorsiventrally compressed or if somewhat fleshy then recurved, green to deep red:

## 25 Leaves oblong:

26 Squamæ oblong; leaves brittle and often canaliculate on the upper surface  
.....144. C. erosula

26a Squamæ transversely oblong to square; leaves tough and flat or slightly convex on the upper surface.....142a. C. nudicaulis var. nudicaulis

## 25a Leaves oblanceolate to obovate:

27 Pairs of bracts on the peduncle form an acute angle where fused to one another; northern Cape, Orange Free State, north-western Natal  
.....142a. C. nudicaulis var. nudicaulis

27a Pairs of bracts on the peduncle forming an obtuse angle where fused to one another; Little Karoo and adjoining mountains and northwards to Nieuwoudtville.....143. C. clavata

## 23a Leaves glabrous but with marginal cilia:

28 Leaves obovate to orbicular, blue-green to grey-green  
.....142c. C. nudicaulis var. platyphylla

28a Leaves lanceolate to oblong, green to yellowish-green  
..... 142a. C. nudicaulis var. nudicaulis

## 3a Petals with canaliculate rostrum:

## 29 Leaves glabrous:

30 Leaves oblanceolate to obovate and somewhat bent to the one side of the stem:

- 31 Lateral branches with internodes more or less equal in length; peduncle with (2) 3 - 5 bracts without part-inflorescences.....138a. C. atropurpurea var. atropurpurea
- 31a Lateral branches with first internodes much longer than subsequent ones; peduncle with (0) 1 (2) pairs of bracts without flowers....138b. C. atropurpurea var. cultriformis
- 30a Leaves subulate or linear-lanceolate:
- 32 Stems glabrous, erect.....139b. C. subaphylla var. virgata
- 32a Stems with minute fine hairs, decumbent  
.....139a. C. subaphylla var. subaphylla
- 29a Leaves hairy (sometimes only with marginal cilia):
- 33 Leaves triangular to almost round in section:
- 34 Leaves with minute erect hairs  
..... 139a. C. subaphylla var. subaphylla
- 34a Leaves with recurved and adpressed hairs:
- 35 Stems decumbent or scrambling, brittle; sandy areas along the western Cape coast .....140. C. ammophila
- 35a Stems erect, tough and woody; eastern Cedarberg to Witteberg.....138f. C. atropurpurea var. purcellii
- 33a Leaves dorsiventrally compressed:
- 36 Leaves with recurved marginal cilia  
.....138e. C. atropurpurea var. rubella
- 36a Leaves without marginal cilia or if present then spreading:
- 37 Petals with membranous apex curved downwards and with terminal appendage more or less canaliculate  
.....138c. C. atropurpurea var. anomala
- 37a Petals without membranous apex and with canaliculate fleshy rostrum  
.....138d. C. atropurpurea var. watermeyeri

## GROUP 12

An artificial group of perennials with panduriform petals continued into a terminal canaliculate rostrum, smooth and without dorsal appendage.

- 1 Inflorescence spike-like with part-inflorescences sessile:
  - 2 Leaves gradually constricted into the inflorescence
    - ..... 85a. C. tomentosa var. tomentosa
  - 2a Leaves abruptly constricted below inflorescence
    - ..... 85b. C. tomentosa var. interupta
- 1a Inflorescence thyrsoid and with stalked part-inflorescences or terminal rounded one:
  - 3 Leaves glabrous or with marginal cilia:
    - 4 Leaves oblanceolate to obovate and somewhat bent to the one side of the stem:
      - 5 Lateral branches with internodes more or less equal in length; peduncle with (2) 3 - 5 bracts without part-inflorescences.....138b. C. atropurpurea var. cultriformis
    - 4a Leaves subulate or linear-lanceolate and erect:
      - 6 Leaves glabrous:
        - 7 Stems with leaves 0,3 - 0,4 cm in diameter, carnose and up to 8 cm long.....119. C. hirtipes
        - 7a Stems with leaves 0,1 - 0,2 cm in diameter, woody and 10 - 50 cm long:
          - 8 Stems glabrous, erect
            - .....139b. C. subaphylla var. virgata
          - 8a Stems with minute erect hairs, decumbent
            - .....139a. C. subaphylla var. subaphylla
          - 8b Stems with recurved adpressed hairs, erect, fastigate..... 64. C. muricata

6a Leaves with marginal cilia at least when young:

9 Internodes glabrous:

10 Leaves narrowly oblong to lanceolate-oblong, 3 - 6 cm  
long..... 68a. C. multiflora subsp. multiflora

10a Leaves oblanceolate, 1,5 - 2,5 cm long  
..... 68b. C. multiflora subsp. leucantha

9a Internodes hairy at least in young plants below the leaf  
attachment:

11 Internodes with recurved adpressed hairs when young;  
roots tuberous..... 64. C. muricata

11a Internodes with spreading or recurved hairs; roots  
fibrous:

12 Internodes with hairs in two strips continuing  
downwards from where the leaf bases have fused  
..... 72a. C. subulata var. subulata

12a Internodes more or less evenly hairy  
..... 72b. C. subulata var. fastigiata

3a Leaves hairy:

13 Leaves subulate or linear-lanceolate and acute:

14 Stems up to 8 cm long and with leaves fascicled at the base:

15 Peduncle with spreading hairs; stem carnose  
..... 119. C. hirtipes

15a Peduncle with recurved adpressed hairs; stems woody:

16 Petals with rostrate apex up to 0,1 cm long, white  
or cream... 118a. C. namaquensis subsp. namaquensis

16a Petals narrowly panduriform and with rostrate  
apex 0,2 - 0,3 cm long, yellow  
..... 118c. C. namaquensis subsp. lutea

- 14a Stems (10-) 15 - 50 cm long and with internodes visible between the leaves:
- 17 Leaves dorsiventrally compressed and covered with spreading hairs..... 72c. C. subulata var. hispida
- 17a Leaves triangular in section to almost terete:
- 18 Leaves densely covered with fine erect hairs hardly visible with the naked eye  
.....139a. C. subaphylla var. subaphylla
- 18a Leaves covered with recurved adpressed hairs:
- 19 Stems decumbent or scrambling, brittle; sandy areas along the western Cape coast  
.....140. C. ammophila
- 19a Stems erect, tough and woody; eastern Cedarberg to Witteberg  
..... 138f. C. atropurpurea var. purcellii
- 13a Leaves oblong, oblanceolate, obovate:
- 20 Leaves with recurved marginal cilia  
.....138e. C. atropurpurea var. rubella
- 20a Leaves without marginal cilia or if present then they are spreading:
- 21 Leaves with erect hairs:
- 22 Petals with membranous apex curved downwards and with terminal appendage more or less canaliculate  
..... 138c. C. atropurpurea var. anomala
- 22a Petals without membranous apex and with canaliculate rostrum.....138d. C. atropurpurea var. watermeyeri
- 21a Leaves with recurved adpressed hairs:

23 Stems (0,3-) 0,4 - 0,6 cm in diameter; petals with terminal rostrum up to 0,1 cm long

..... 118a. C. namaquensis subsp. namaquensis

23a Stems 0,2 (-0,3) cm in diameter; petals with terminal rostrum 0,2 - 0,3 cm long..... 118b. C. namaquensis subsp. comptonii

A. Crassula subgen. Levifolia Toelken, subgen. nov.

Plantae annuae vel perennes ramis herbaceis vel carnosis rare lignescen-  
tibus ad basim. Folia petiolata vel sessilia sed plerumque cuneatis  
ad bases, glabra et levia rare pilis paucis vel papillis marginalibus,  
hydathodis plerumque secus marginem vel rare plus minusve dispersis  
supra vel/et subtus; vaginae membranaceae ad carnosae. Inflorescentia  
saepe flos singularis axillaris, fasciculus terminalis vel rare dica-  
sium terminale vel laterale pedunculo. Petala levia et sine appendici-  
bus dorsalibus propriis sed interdum porcata tumida ad apices. Antherae  
flavae ad purpureae vel interdum atrobruneeae. Carpella plerumque  
stylis propriis et stigmatibus terminalibus.

Type species: C. natans Thunb.

Annuals or perennials with herbaceous or carnosae stems rarely becoming  
woody at the base. Leaves petiolate or sessile but usually with cuneate  
base, glabrous and smooth or rarely with a few hairs or with a few  
marginal teeth or papillae, with hydathodes usually along the margin  
or rarely more or less scattered over one or both surfaces; sheath  
membranous to carnosae. Inflorescence often a single flower in the  
axil of the leaves, terminal clusters or rarely a terminal or lateral  
dichasium with a peduncle. Petals smooth and without distinct dorsal  
appendages but sometimes ridged or with a swelling towards the apex.  
Anthers yellow to purple or sometimes dark brown. Carpels usually  
with distinct styles and terminal stigmas.

Taxonomy:

The two subgenera cannot be distinguished by a single character, because many developments within the sections have obscured these specific characteristics. This can be demonstrated in the distribution of the hydathodes, which tend to occur along the margins in the subgen.

Levifolia, but are scattered over the leaf surface in some species of the sections Deltoideae, Anacampseroides and Acutifolia. In the subgen. Levifolia there are in each section at least one species with marginal hydathodes and axillary flowers or flowers clustered at the apex of the stems without a distinct peduncle as well as the basic chromosome number 8, which indicate that the sections within the subgenus are radiating out from a group of 'primitive' species, as is discussed in chapter 6. In contrast to this, the subgen. Crassula is an entity of its own which does not show any close similarities to any section within the subgen. Levifolia or the latter group of species around which the sections are clustered.

The epithet Levifolia was derived from the most conspicuous characteristic of that subgenus and as the leaves of the subgen. Crassula tend to be hairy, but in each case there are a few exceptions as is discussed under the latter subgenus.

- I. Crassula sect. Tillaeoideae DC., Prodr. 3 : 389 (1928), partly;  
 Schonl. in Ann. Bolus Herb. 2 : 41 (1916), partly, et in  
 Trans. Roy. Soc. S. Afr. 17 : 160 (1929), partly; Berger  
 in Pflanzenfam. ed. 2, 18a : 388 (1930), partly; Friedr. in  
 Garcia de Orta, Ser. Bot. 1 : 50 (1973), partly.  
 Type species: C. inanis Thunb.  
 --- group Helophytum (Eckl. & Zeyh.) Schonl. in Ann. Bolus  
 Herb. 2 : 44 (1916) et in Trans. Roy. Soc. S. Afr. 17 : 161  
 (1929); Berger in Pflanzenfam. ed. 2, 18a : 388 (1930);

Friedr. in Garcia de Orta, ser. Bot. 1 : 50 (1973).

--- group Vaillantii Schonl. in Ann. Bolus Herb. 2 : 44 (1916), partly et in Trans. Roy. Soc. S. Afr. 17 : 161 (1929), partly; Berger in Pflanzenfam. ed. 2, 18a : 388 (1930), partly, incl. C. vaillantii.

--- group Aphylla Schonl. in Ann. Bolus Herb. 2 : 44 (1916) et in Trans. Roy. Soc. S. Afr. 17 : 161 (1929); Berger in Pflanzenfam. ed. 2, 18a : 388 (1930).

Bullardia DC. in Bull. Sc. Soc. Philom. 3 : 1 (1801) et Prodr. 3 : 382 (1828); Eckl. & Zeyh., Enum. 289 (1837); Harv., Fl. Cap. 2 : 329 (1862).

Type species: B. aquatica (L.) DC.

Tillaea L. sect. Bullardia (DC.) Walp., Rep. 2 : 251 (1843); Benth. et Hook.f., Gen. Pl. 1 : 657 (1865).

Crassula sect. Tillaea (L.) Schonl. in Pflanzenfam. ed. 1, 3, 2a : 37 (1890).

--- group Bullardia Schonl. in Pflanzenfam. ed. 1, 3, 2a : 37 (1890).

--- group Helophytum (Eckl. & Zeyh.) Schonl. in Pflanzenfam. ed. 1, 3, 2a : 37 (1890).

Helophytum Eckl. & Zeyh., Enum. 288 (1836); Harv., Fl. Cap. 2 : 328 (1862).

Tillaea sect. Helophytum (Eckl. & Zeyh.) Walp., Rep. 2 : 252 (1843); Benth. & Hook.f., Gen. Pl. 1 : 657 (1865).

Rhopalota N.E. Brown in Cactus Succ. J., Los. Ang. 3 : 7 (1931) et in Hook. Icon. plate 32, t. 3171 (1932).

Annuals or rarely perennials, with erect or decumbent habit, with herbaceous stems often forming an underground rhizome, glabrous. Leaves sessile or scarcely constricted towards the base, dorsiventrally compressed, glabrous, with few hydathodes on the margin and pronounced

membranous sheath between the leaf bases. Inflorescence cymes with 1 - many 4-merous flowers in the axils of the leaves due to sympodial growth and without a peduncle. Sepals 0,15 - 1 mm long and about half as long as the petals, obtuse, glabrous, almost membranous. Petals 1 - 2,5 mm long, forming a short tube and the free apices recurved at about right angles, without a dorsal appendage. Stamens with yellow to purple anthers 0,1 - 0,2 mm long. Squamae oblong-cuneate, truncate or slightly rounded at the apex, scarcely fleshy, usually white or yellow. Carpels with reniform ovaries abruptly constricted into thin styles up to a quarter of the length of the ovary and with terminal stigmas; ovary with 1 - 2 (-6) ovules. Fruits recurved and splitting along the whole suture and releasing the seeds through a not well defined pore.

Widespread in Southern Africa and different species occur also on the African continent as well as in many parts of the world.

#### Diagnostic Features:

Species of this section are similar annual plants as found in the sect. Glomeratae, but the sect. Tillaeoideae is distinguished by its sympodial growth, the obtuse sepals which are about half as long as the petals and the fruits usually recurve at maturity to release the seeds along the whole of the split of the anterior suture.

#### Taxonomy:

Similar to the sect. Glomeratae the sect. Tillaeoideae has representative species occurring in many parts of the world. Therefore the full range of variation cannot be evaluated from the species in Southern Africa, but the two sections are mainly distinguished on the basis of the sympodial growth in the sect. Tillaeoideae and monopodial growth in the sect. Glomeratae. The sympodial growth can easily be established by cutting the stem just above a node with a flower in the axil of the leaf, and the second axillary bud will soon start sprouting.

Superficially plants of the sect. Tillaeoideae can usually be recognized by the fact that flowers are found only in the axil of the two opposite leaves (see fig. 4). These leaves with flowers in their axils may alternate from one side to the other on successive nodes, but in many species they remain on the same side of the stem. In C. inanis for instance, the upper branches with the flower-bearing nodes appear to be a helicoid cyme.

The fruits are unusual in the genus Crassula, as the carpels recurve more or less to release the seeds through a ventral slit along the whole suture.

It is also noteworthy that most of the species of the sect. Tillaeoideae are water or marsh plants, while the species of the sect. Glomeratae usually grow in moist shaded localities and rarely in marshy areas.

The first species that De Candolle (1828) cited under the sect. Tillaeoideae is C. natans, but a question mark next to the name indicates his uncertainty about this species. C. inanis is the second species enumerated and the only remaining species to which the characters 'herbaceae subaquaticae glabrae' of the original diagnosis applies. For that reason C. inanis was selected as the type species of this section.

1. C. natans Thunb., Prodr. 54 (1794) et Fl. Cap. ed. Schultes 281 (1823); DC., Prodr. 3 : 389 (1828); Schonl. in Ann. Bolus Herb. 2 : 47, fig. 1 & plate 2, fig. 1 (1916) et in Trans. Roy. Soc. S. Afr. 17 : 181 (1929).

Type: Cape, near Cape Town, Thunberg in Herb. Thunberg 7772 (UPS, holo!; G!; S!).

Annuals with branches 2 - 25 cm long, erect, decumbent or floating in water, usually much branched and soft and fleshy, glabrous, sometimes

with branches underground and with leaves at about equal distances from one another. Leaves sessile, oblanceolate rarely elliptic to oblong, 0,3 - 1,2 cm long, 0,1 - 0,3 cm broad, obtuse to acute, dorsiventrally flattened and slightly fleshy but rarely convex, glabrous, green; sheath up to 0,1 cm long and membranous. Hydathodes a few along the margins, inconspicuous. Inflorescence with terminal flowers in the axils of the leaves due to sympodial growth with 1 - 2 (3) pedicellate flowers which are 4-merous. Sepals broadly triangular, 0,3 - 0,5 mm long, obtuse glabrous, slightly fleshy, green. Petals obovate to spatulate, 1,5 - 2 mm long, obtuse and without dorsal appendage, hardly fused at the base, with apices recurved from about the middle, white or often tinged pink. Stamens 0,5 - 1 mm long, with yellow to purple anthers 0,1 - 0,2 (-0,3) mm long and broad, with filaments hardly broadened downwards not constricted at the base. Squamae oblong-cuneate, 0,4 - 0,6 x 0,1 - 0,2 mm, truncate and gradually constricted towards the base, slightly fleshy, yellow or red. Carpels broadly reniform to obconical, abruptly constricted into thin styles usually less than a quarter as long as the ovary and with terminal stigmas; ovary smooth and with one elongate ovules with faint ridges.

#### Diagnostic Features:

The oblanceolate to obovate leaves will distinguish this species from C. inanis when both of them are growing in standing water. Plants of C. natans growing on moist or marshy areas usually produce oblong-elliptic leaves, but such plants are much branched in contrast to those of C. inanis which will mainly branch from the base or the underground rhizome under such conditions. This marsh form of C. natans is also very similar to those of C. vaillantii, a species which is always distinguished by having more than one ovule per carpel.

The var. filiformis which is much finer than the var. natans is mainly distinguished by its flowers which are rarely up to 1 mm long

and the petals do not recurve, the leaf sheath of the var. natans is 1 - 2 mm long while in the var. filiformis it is only half as long, but this is not a useful character in herbarium material.

Variation and taxonomic Notes:

As already the extensive synonymy indicates much variation is found in this species between the two extreme forms namely those plants growing on marshes as compared with those which are partly submerged.

Among them Bullardia elatinoidea represents seedlings under marshy conditions which have at first a single erect stem and narrowly oblong leaves and only by their long leaf sheath they can be identified as var. natans. However, plants might not look like a seedling because C. natans is able to produce flowers already at the second node.

The form named C. levynsiae is very similar to the preceding one particularly because of its little branched stems which are rarely longer than 3 cm, that is unless the environment is changed. At the type locality of C. levynsiae the plants grow in marshy or usually on shallow moist sand on surface calcrete. However, other plants from near Fish Hoek (Levyns s.n.) and near Port Elizabeth (Zeyher 2510) indicate that under slightly saline conditions similar forms develop. Extreme plants of it taken from the type locality and grown on humus rich soil with much water available soon made these plants indistinguishable from the typical var. natans (Tölken 4215).

Among the forms found in plants which are more or less submerged are firstly those with slender oblong to oblong-elliptic leaves which have been recently covered with water and which have not developed the typical obovate floating leaves at the apex of plants such as Helophyllum fluitans var. obovatum. However, if the water level suddenly recedes or branches get entangled in other plants above the water level, the immediate reaction of such plants of C. natans is to reflex their

leaves. The plants will continue growing and flowering except that the new leaves are not as broad but also not oblong (see fig. 4.5). A typical example of such plants is the type specimen of Helophytum reflexum.

Some plants that are submerged in water develop very much swollen stems but usually their internodes are very much elongated at the same time. Indications are that most of these plants are growing in deep permanent water. However, a form from near Cathedral Peak described by Killick (1969) is of particular interest as its internodes are not elongated and are in fact bulging (see fig. 4.7). These plants have short narrowly lanceolate leaves at the base which become gradually broader towards the obovate leaves at the apex. The latter characteristic is usually used to distinguish C. granvikii from tropical Africa. However, as Killick (1969) pointed out that Drège 6877b from Paarl Mountain shows a complete range of intermediates into typical var. natans.

The var. filiformis usually grows on moist or marshy areas away from the water's edge. However, at times it also becomes submerged and under those conditions it will develop elongated oblong-elliptic leaves but never floating leaves (cf. fig. 4.1 and 4.2). These plants will not flower much under these conditions but can still be recognized by their short pedicels and leaf sheaths. Very few specimens are found in herbaria (e.g. Wolley Dod 272) probably because the var. filiformis often grows at the same locality as the var. natans and the latter becomes much more showy under those conditions.

1a. var. natans

C. natans Thunb., Prodr. 54 (1794) et in Fl. Cap. ed. Schultes 281 (1923); DC., Prodr. 3 : 389 (1828); Schönl. in Ann. Bolus Herb. 2 : 47, fig. 1 & plate 2, fig. 1 (1916) et in Ark. Bot. 21A, 16 : 9 (1927) et in Trans. Roy. Soc. S. Afr.

S. Afr. 17 : 181 (1929); Adamson in Fl. Cape Penins. 430 (1950); Kidd, Wild Flow. Cape Penins. plate 42, 12 (1950); Killick in Bothalia 10 : 70, fig. 4 (1969); Jacot Guill., Fl. Lesotho 182 (1971); Mason, W. Cape Sandveld Flow. plate 48, 3 (1972).

--- forma fluitans (Eckl. & Zeyh.) Schonl. in Ann. Bolus Herb. 2 : 49 (1916).

Type: Cape, Swartkops River, Ecklon & Zeyher 1845 (S!; SAM!).

--- forma parvifolia Schonl. in Ann. Bolus Herb. 2 : 49 (1916).

Type: Cape, Drège s.n. (GRA, holo!).

--- forma obovata (Eckl. & Zeyh.) Schonl. in Ann. Bolus Herb. 2 : 49 (1916).

Type: Cape, Swartkops River, Ecklon & Zeyher 1845 c (S!; SAM!).

--- forma amphibia (Harv.) Schonl. in Ann. Bolus Herb. 2 : 49 (1916).

Syntypes: Cape, Swartkops River, Ecklon & Zeyher 1846 (S!; SAM!); Zeyher 2510 (S!; SAM); Onrust River Mouth, Zeyher 2513 (S!; SAM!); Drège 9540 (S!).

Helophytum natans (Thunb.) Eckl. & Zeyh., Enum. 288 (1837); Harv., Fl. Cap. 2 : 328 (1862).

--- var. fluitans (Eckl. & Zeyh.) Harv., Fl. Cap. 2 : 328 (1862).

--- var. obovatum (Eckl. & Zeyh.) Harv., Fl. Cap. 2 : 328 (1862).

--- var. amphibia Harv., Fl. Cap. 2 : 328 (1862).

Tillaea capensis L.f., Suppl. 129 (1781); Willd., Syst. Veg. 1, 2 : 170 (1798); Walp., Rep. 2 : 252 (1843).

Type: Caput Bonae Spei, Sparrmann in LINN 178.6 (holo!).

Bullardia capensis (L.f.) E. Mey. ex Drège, Zwei Pfl. Doc. 112 (1843), partly.

Crassula capensis (L.f.) Schonl. in Trans. Roy. Soc. S. Afr. 17 : 181 (1929), nom. illeg. - non. (L.) Baill.

Helophytum filiforme Eckl. & Zeyh., Enum. 289 (1837).

Type: Cape, Swartkops River, Ecklon & Zeyher 1844 (SAM!).

--- var. parvulum Eckl. & Zeyh., Enum. 289 (1837).

Type: Cape, Swartkops River, Ecklon & Zeyher 1844 b (S!; SAM!).

Tillaea filiformis Endl. ex Walp. Rep. 2 : 252 (1843).

--- var. parvula (Eckl. & Zeyh.) Endl. ex Walp., Rep. 2 :  
252 (1843).

Helophytum fluitans Eckl. & Zeyh., Enum. 289 (1837).

--- var. intermedium Eckl. & Zeyh., Enum. 289 (1837).

Type: Cape, near Swellendam, Ecklon & Zeyher 1845 b (S!; SAM!).

--- var. obovatum Eckl. & Zeyh., Enum. 289 (1837).

Tillaea fluitans (Eckl. & Zeyh.) Endl. ex Walp., Rep. 2 :  
252 (1843).

--- var. intermedia (Eckl. & Zeyh.) Endl. ex Walp., Rep. 2 :  
252 (1843).

--- var. obovata (Eckl. & Zeyh.) Endl. ex Walp., Rep. 2 :  
252 (1843).

Helophytum reflexum Eckl. & Zeyh., Enum. 289 (1837).

Type: Cape, Swartkops River, Ecklon & Zeyher 1846 (S!; SAM!).

Tillaea reflexa (Eckl. & Zeyh.) Endl. ex Walp., Rep. 2 :  
252 (1843).

Bullardia elatinoïdes Eckl. & Zeyh., Enum. 290 (1837).

Type: Cape, Table Mountain, Ecklon & Zeyher 1849 (G!; P!;  
S!; SAM!).

Tillaea elatinoïdes (Eckl. & Zeyh.) Walp., Rep. 2 : 251 (1843).

Crassula levynsiae Adamson in J. S. Afr. Bot. 9 : 153 (1943)  
et Fl. Cape Penins. 430 (1950).

Type: Cape, Klipfontein Road, Levyns sub Adamson 3497 (BOL,  
holo!; CT!; SAM!).

Plants with decumbent or floating stems 0,1 - 0,3 (-0,5) cm in diameter. Leaves oblanceolate, obovate to rarely elliptic-oblong (0,1-) 0,2 - 0,3 (-0,4) cm broad and usually becoming broader towards the apex; sheath 0,1 - 0,2 cm long. Flowers with pedicels (0,4-) 0,6 - 1,5 cm long, spreading when flowering and fruiting. Petals obovate 1 - 2 mm long, recurved at about right angles from about the middle. Fig. 4.4, 5, 7.

In moist areas or in standing water from the central Transvaal, eastern Orange Free State, sporadically in Lesotho and most parts of the Cape except the central Great Karoo.

Flowering Period: Mainly May - November in the winter rainfall areas and mainly October - January in the summer rainfall areas, but practically throughout the whole year some flowers can be found particularly on plants in shaded positions will flower even during midsummer.

Diagnostic Features:

See under the species.

Specimens examined:

TRANSVAAL. - 2528 (Pretoria): Irene (-CC), Obermeyer 120 (PRE); Apies River, Rehmann 4235 (BOL). 2530 (Lydenburg): Belfast (-CA), Jenkins in TRV 6780 (GRA). 2626 (Klerksdorp): Hakboslaagte (-AC), Kinges 1787 (PRE); near Ventersdorp, Kinges 1900 (PRE). 2627 (Potchefstroom): Van Wyk's Rust (-BD), Dimovic in J 28 008 (PRE). 2628 (Johannesburg): Benoni (-AB), Bradfield 137 (PRE). 2629 (Bethal): 6 Km south-east Hendrina (-BA), Tölken 1123 (PRE); Standerton (-CD), Schlechter 3467 (BOL, GRA, NH).

NATAL. - 2929 (Underberg): On Little Berg between Loteni & Giant's Castle (-BC), Killick 3869 (PRE); Giants Castle Game Reserve (-BC), Killick & Vahrmeijer 4047 (PRE).

ORANGE FREE STATE. - 2925 (Jagersfontein): Fauresmith (-CD), C.A. Smith 4371 (PRE). 2926 (Bloemfontein): Tempe Farm (-AA), Potts 3570 (PRE); Thaba Nchu (-BB), Roberts 2912 (PRE). 2927 (Maseru): Ladybrand (-AB),

Tölken 1235 (PRE).

LESOTHO. - 2827 (Senekal): Matsoeberane (-DD), Dieterlen 942a (PRE, SAM). 2828 (Bethlehem): Pela Tsoen (-DD), Jacot Guillarmod 2064 (RUH). 2927 (Maseru): Likhoele (-BD), Dieterlen 1146 (NBG, PRE); Roma (-CB), Schmitz 215 (PRE); Tsekelos (-CC), Jacot Guillarmod 2538 (RUH). 2929 (Underberg): Pone Valley (-AB), Coetzee 817 (PRE).

CAPE. - 2723 (Kuruman): Batharos (-AC), Silke in BOL 16 578. 2824 (Kimberley): near Warrenton (-BB), Acocks 1275 (BOL, PRE); 5581 (BOL). 2917 (Springbok): Nababeep (-DB), Bolus 9545 (BOL). 2924 (Hope Town): Doringbult (-CA), Hafström 1302 (PRE); Esterhuysen s.n. (BOL). 3017 (Hondeklipbaai): Kamieskroon (-BB), Compton 5546 (NBG); between Kamieskroon and Garies, Thorne in SAM 49 964. 3018 (Kamiesberg): near Eselsfontein (-AC), van der Schijff & Schweickerdt 5777 (PRE).

3028 (Aliwal North): Burgersdorp (-CD), Pocock 34 (GRA). 3119 (Calvinia): Oorlogskloof (-AC), Compton 20 881 (BOL); Meulsteenvlei (-AC), Taylor 3946 (NBG); Lokenberg (-CA), Acocks 17 721 (PRE). 3123 (Victoria West): Murraysburg (-DD), Tyson 70 (GRA). 3126 (Queenstown): 18 Km south of Jamestown (-BB), Tölken 1237 (PRE). 3217 (Vredenburg): Vredenburg (-DD), Horrocks 179 (NBG); between Vredeburg and Saldanha (-DD), Leipoldt 595 (BOL). 3218 (Clanwilliam): 8 Km west of Lambert's Bay (-AB), Davis in SAM 65 076; between Sandberg and Paleisheuvel (-BC), Mauve 4663 (PRE, STE); Papkuil (-CB), Pearson 3998 (BOL); Langvlei (-DA), Maguire 424 (NBG); Eendekuil (-DB), Hafström & Acocks 547 (PRE); Pools (-DD), Compton 6622 (NBG). 3219 (Wuppertal): Helpmekaar (-CC), Hanekom 1285 (PRE, STE); Skitterykloof (-DC), Tölken 3633 (BOL). 3220 (Sutherland): Junction of Sutherland, Ceres and Matjesfontein road (-CB), Tölken 3549 (BOL). 3225 (Graaff Reinet): Graaff Reinet (-AB), Bolus 455 (BOL). 3226 (Fort Beaufort): Swart Kei River, Barber s.n. (GRA). 3227 (Stutterheim): near Komga (-DB), Flanagan 2384 (GRA, PRE). 3318 (Cape Town): near Hopsfield (-AB),

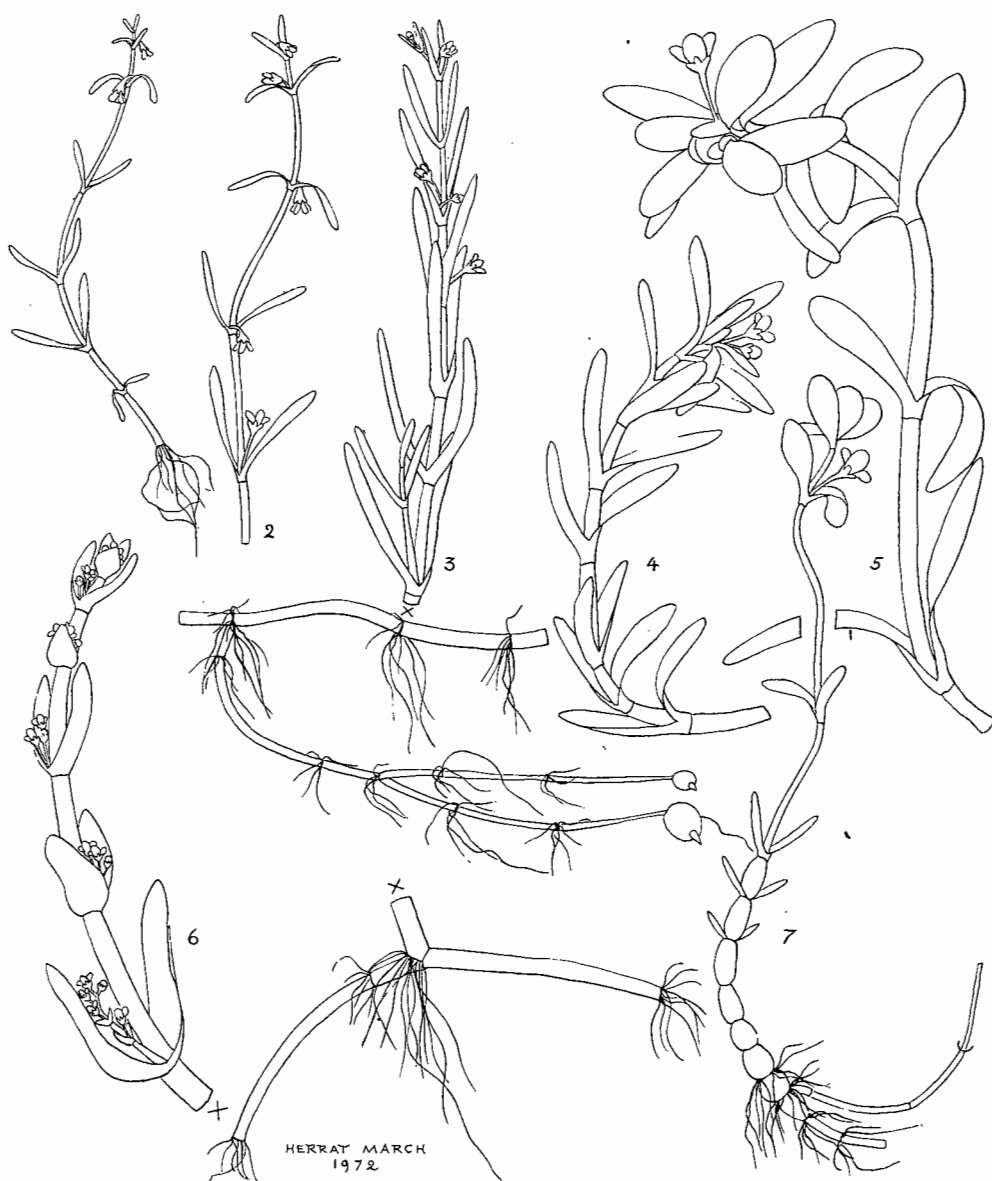


Fig.4. - 1, C. natans var. filiformis, branch of plant growing on marshy soil,  $\times 1\frac{1}{2}$ ; 2, floating branch,  $\times 1\frac{1}{2}$  (Tölken 1601); 3, C. tuberculata,  $\times 1\frac{1}{2}$  (Tölken 3117); 4, C. natans var. natans, branch of plant growing on marshy soil,  $\times 1\frac{1}{2}$ ; 5, floating branch,  $\times 1\frac{1}{2}$  (Tölken 4215); 6, C. inanis,  $\times 1\frac{1}{2}$  (Tölken 4051); 7, plant of Drakensberg form,  $\times 1\frac{1}{2}$  (Killick & Vahrmeijer 4047).

Letty 139 (PRE); Porterville (-BB), Schlechter 4909 (BOL); near Hermon (-BD), Marsh 727 (PRE, STE); Mamre (-CB), Barker 1598 (NBG); Cape Town (-CD), Thunberg in Herb. Thunberg 7772 (G, S, UPS); Ecklon & Zeyher 1849 (SAM); Green Point (-CD), Thode 7781 (STE); Klipfontein Road (-DC), Levyns 3497 (BOL); Tölken 4215 (BOL); near Duinefontein (-DC), Wolley-Dod 1781 (PRE); Vlakkenberg (-DD), Salter 6286 (BOL); Stellenbosch (-DD), Strey 536 (PRE); Bos 269 (STE). 3319 (Worcester): Die Eike (-AA), Esterhuysen 23 477 (BOL); Inkruip (-AA), Esterhuysen 23 399 (BOL); near Ceres (-AD), Kolbe in BOL 14 377; Brandvlei (-CB), Marsh 799 (PRE, STE). 3320 (Montagu): Pampoenkloof (-CA), Walgate in BOL 24 051; Baden (-CA), Walgate s.n. (BOL). 3325 (Port Elizabeth): Enon (-BC), Thode A 2647 (NH, PRE); Komachs River (-CD), Gibson s.n. (GRA); Swartkops River (-DC), Ecklon & Zeyher 1844 (SAM); 1844b (S, SAM); 1845 (S, SAM); 1845c (S, SAM); 1846 (S); Zeyher 2510 (S, SAM); Bethelsdorp (-DC), West 350 (BOL). 3418 (Simonstown): Hangberg (-AB), Esterhuysen 12 939 (BOL); Retreat Vlei (-AB), Wolley Dod 1218 (BOL, GRA, PRE); Wynberg Flats (-AB), Wolley Dod 1262 (BOL, GRA); Buffels Bay (-AD), Axelson 522 (NBG); Phillippi (-BA), Compton 22 725 (BOL, NBG); Lansdown (-BA), Adamson 3552 (BOL). 3419 (Caledon): Hermanus (-AC), Gillett 512 (BOL); Onrus River Mouth (-AC), Zeyher 2513 (S, SAM); Nuwejaarsrivier (-DB), Gaigher 1 (STE). 3420 (Bredasdorp): near Stormsvlei (-AA), Gillett 1140 (BOL); near Swellendam (-AB), Ecklon & Zeyher 1845b (S, SAM); Bredasdorp (-CA), Wasserfall 394 (NBG). 3421 (Riversdale): Oude Tuin (-AA), Muir 2459 (PRE); Weltevrede (-AB), Muir 4491 (PRE).

1b. var. filiformis (Eckl. & Zeyh.) Toelken, comb. nov. et stat. nov.

Bullardia filiformis Eckl. & Zeyh., Enum. 290 (1837).

Type: Cape, Platteklip, Ecklon & Zeyher 1850 (GRA!; K!; P!; S!; SAM!).

Helophytum natans (Thunb.) Eckl. & Zeyh. var. filiformis  
(Eckl. & Zeyh.) Harv., Fl. Cap. 2 : 329 (1862), partly.

--- var. minus Eckl. & Zeyh., Enum. 288 (1837).

Type: Cape, Green Point, Ecklon & Zeyher 1843b (S!; SAM!).

Crassula natans Thunb. forma filiformis (Eckl. & Zeyh.)

Schonl. in Ann. Bolus Herb. 2 : 49 (1916).

Tillaea ecklonis Walp., Rep. 2 : 251 (1843).

Type: same as Bullardia filiformis.

Tillaea capensis L.f. var. minor Walp., Rep. 2 : 252 (1843).

Type: same as for Helophytum natans var. minus.

Plants with decumbent or floating stems about 0,05 mm in diameter.

Leaves linear to linear-elliptic, 0,03 - 0,1 cm broad and not broadening towards the apex of the stem; sheath 0,01 - 0,05 cm long. Flowers with pedicels 0,1 - 0,3 cm long, erect when flowering then recurved erect again when the seeds are released. Petals oblanceolate 0,5 - 0,8 (-1) mm long, erect. Fig. 4.1,2.

In moist depressions or marshy areas and rarely with branches floating in water; occurring mainly in the south western Cape Flats and at Bredasdorp.

Flowering Period: June - October.

Diagnostic Features:

See under the species.

Specimens examined:

CAPE. - 3318 (Cape Town): Darling Reserve (-AD), Barker 8648 (NBG); Robben Island (-CD), Walgate 455 (NBG); Green Point (-CD), Ecklon & Zeyher 1843 (S, SAM); Zeyher 116 (SAM); Platteklip (-CD), Ecklon & Zeyher 1850 (GRA, K, P, S, SAM); MacOwan 1857 (BOL, GRA, SAM); Rondebosch (-CD), Wolley Dod 271 (BOL, GRA); 272 (BOL, GRA); Rietvlei (-DC), Garside 6483 (BOL); Klipfontein Road (-DC), Tölken 4216 (BOL). 3420 (Bredasdorp): near Swellendam (-AB), Zeyher 634 (PRE, SAM).

2. C. inanis Thunb., Prodr. 54 (1794) et Fl. Cap. ed. Schultes 282

(1823); DC., Prodr. 3 : 389 (1828); Schonl. in Ann. Bolus  
Herb. 2 : 50 (1916) et in Ark. Bot. 21A, 16 : 8 (1927) et  
in Trans. Roy. Soc. S. Afr. 17 : 182 (1929), Gladhill, E.  
Cape Veld Flow. plate 28,4 (1971); Jacot-Guill., Fl.  
Lesotho 182 (1972).

Type: Caput Bonae Spei, Thunberg in Herb. Thunberg 7762 (UPS,  
holo!).

Helophytum inane (Thunb.) Eckl. & Zeyh., Enum. 289 (1837);  
Harv., Fl. Cap. 2 : 329 (1862).

--- var. latifolium Eckl. & Zeyh., Enum. 289 (1837).

Type: Cape, Langkloof near George, Ecklon & Zeyher 1847 (S!; SAM!).

Tillaea perfoliata L.f., Suppl. 129 (1781); Willd., Sp. Pl.

1,2 : 721 (1798); Walp., Rep. 2 : 252 (1843), nom. illeg.-non L.

Perennials rarely annuals with branches often up to 30 cm long, little branched, soft and fleshy and upper branches often floating in water but also forming an underground rhizome, glabrous, with leaves at about equal distances from one another. Leaves sessile, lanceolate to triangular, (0,8-) 1 - 2 cm long, 0,2 - 0,3 (-0,5) cm broad, obtuse or bluntly acute, dorsiventrally flattened but slightly fleshy, glabrous, green; sheath 0,05 - 0,15 cm long and formed by the partial fusion of the leaf bases. Hydathodes a few along the margin, inconspicuous. Inflorescence with sessile axillary dichasia with 3 - 5 (-14) pedicellate flowers which are 4-merous. Sepals broadly triangular, 0,3 - 0,5 mm long, obtuse and without dorsal appendage, hardly fused at the base, with apices recurved from about the middle, white. Stamens 0,6 - 1 mm long, with yellow to purple anthers 0,1 - 0,2 mm long and broad, with filaments not broadened downwards nor constricted at the base. Squamae oblong-cuneate, 0,4 - 0,6 x 0,2 - 0,3 mm, truncate or with rounded apex, usually abruptly constricted towards the base, membranous or

almost so, white or pale yellow. Carpels with broadly reniform to almost obconical ovaries which are usually truncate at the apex and with thin styles about a quarter of the length of the ovaries and with terminal stigmas; ovary smooth and with one elongate ovule covered with minutely papillose ridges. Fig. 4.6.

In marshy areas but usually associated with permanent, standing water or along the banks of slow-flowing rivulets; occurring mainly in high rainfall areas in the southern Transvaal and the adjoining northern Natal and Orange Free State, sporadically in Lesotho and in the eastern Cape mainly along the coast from King William's Town to near George.

Flowering Period: November - March.

Diagnostic Features:

C. inanis is distinguished from the very similar species C. natans by its lanceolate or triangular leaves and it usually produces more than 3 flowers per axillary cyme. C. natans produces rarely more than one or two flowers per axillary cyme at the time. Depauperate plants of C. inanis are superficially similar to C. tuberella, a species which is distinguished by its stiffly erect branches and more than one ovule per carpel.

Variation and taxonomic Notes:

The size of the leaves of C. inanis vary considerably with environmental conditions but only rarely do they become almost elliptic and this is when it becomes difficult to distinguish this species from C. natans particularly in herbarium material. However, depauperate plants of C. inanis rarely branch above the soil level.

During winter the branches above the soil level usually lose their leaves and often die off in parts.

Tillaea perfoliata L.f. is the oldest name for this species but because of Crassula perfoliata L. this combination cannot be used legitimately in the genus Crassula.

Specimens examined:

TRANSVAAL. - 2729 (Volksrust): Volksrust (-BD), Jenkins in TRV 10 235 (PRE). 2730 (Vryheid): Wakkerstroom (-AC), Tölken 1121 (PRE); 3118 (BOL).

NATAL. - 2729 (Volksrust): near Charlestown (-BD), Wood 4799 (NH). 2730 (Vryheid): Naauihoek (-AC), Devenish 779 (NH, PRE); Groenvlei (-AC), Strey 9147 (NH, PRE). 2829 (Harrismith): Van Reenen's Pass (-AD), Thode 2799 (STE). 2929 (Underberg): Tabamhlope (-BA), Downing s.n. (PRE). 2930 (Pietermaritzburg): near Mooi River (-AA), Mogg 3348 (PRE).

ORANGE FREE STATE. - 2727 (Kroonstad): Vredefort, (-AB), Obermeyer in TRV 31 681 (PRE). 2828 (Bethlehem): Witzieshoek (-DB), Thode 3562 (STE). 2829 (Harrismith): near Harrismith (-AC), Sim 15 001 (GRA, PRE).

LESOTHO. - 2828 (Bethlehem): Leribe (-BB), Dieterlen 809 (NH, SAM); Butha Buthe (-CC), Coetzee 403 (NBG). 2928 (Maseru): Semongkong (-BB), Jacot Guillarmod 1784 (PRE). 2929 (Underberg): Sehlabathebe (-DD), Jacot Guillarmod et al. 109 (BOL, RUH); 327 (BOL).

CAPE. - 3029 (Kokstad): Mount Currie (-AC), Sister Stephanie 622 (BOL); near Kokstad (-CB), Haygarth in NH 19 104 (NH). 3127 (Lady Frere): Barkly Pass (-BB), Hilliard & Burt 6745 (NBG). 3225 (Somerset East): near Cradock (-BA), Bennie sub Schonland 409 (GRA). 3227 (Stutterheim): near Dohne (-AD), Acocks 20 257 (PRE); Pirie (-CA), Godfrey 99 (GRA); near Komga (-DB), Flanagan 1105 (BOL, GRA, PRE, SAM); King William's Town (-CD), Sim 1199 (GRA, PRE). 3228 (Butterworth): Kentani (-CC), Pegler 792 (BOL). 3322 (Oudtshoorn): George (-CD), Compton 15 775 (NBG); Fair View (-DC), de Villiers in STE 17 035, Homtini River (-DD), Schlechter 5899 (GRA, PRE); Langkloof, Ecklon & Zeyher 1847b (S, SAM). 3323 (Willowmore): Deepwalls (-CC), J. Phillips 185 (GRA). 3325 (Port Elizabeth): Uitenhage (-CD), Thode A 643 (NH); Newton Park (-DC), Long 1357 (PRE); Swartkops River (-DC),

Ecklon & Zeyher 1847 (SAM); Zeyher 729 (BOL, GRA, SAM); Zeyher 2509 (SAM); Holland 613 (GRA). 3326 (Grahamstown): Salem (-AD), Wells 3886 (GRA); King's Road (-BA), Britten 581 (PRE); near Grahamstown (-BC), MacDwan 1186 (BOL, NH); Daly & Sole 184 (GRA, PRE); Schonland 605 (NH, PRE); near Charlgrove (-DA), Acocks 18 354 (GRA, PRE); Bushmans River Mouth (-DA), Archibald 3919 (PRE). 3421 (Riversdale): Oakdale (-AA), Muir 2779 (BOL, PRE). 3423 (Knysna): Belvidere (-AA), Duthie 809 (STE); Knysna Flats (-AA), Galpin 4013 (GRA, PRE); Keet 1026 (GRA, PRE); Keurbooms River (-AB), Fourcade 1480 (BOL, GRA, PRE); 5314 (STE). Caput Bonae Spei, Thunberg in Herb. Thunberg 7762 (UPS).

3. C. tuberella Toelken sp. nov. ab C. natanti et C. inani rhizomate tuberellis et carpello ovulis sex differt.

Herba ramis fastigiatis usque ad 15 cm altis et ramis paucis efferentibus rhizomate ramulis tuberellis terminalibus sphaericis usque ad 0,3 cm diametro. Folia linearia 0,5 - 1,5 cm longa, 0,1 - 0,15 cm lata, obtusa, plus minusve plana supra, convexa subtus, erecta vel curva acropete, viridia; vagina usque ad 0,1 cm longa, succulenta et adpressa. Hydathodi tres vel quattuor seriales in marginem et una terminales. Inflorescentia 1 (-3) floribus axillaribus, pedicello erecto 3 - 6 mm longo et floribus tetrameris. Sepala anguste triangularia 0,8 - 1 mm longa, obtusa, succulenta, viridia. Petala ovata vel fere rhombica, 1,5 - 2 mm longa, obtusa et sine crista dorsali, apicibus recurvis, alba. Stamina c. 1 mm longa, antheris atropurpureis et 0,1 - 0,2 mm longis, filamentis vix latescentibus ad basim et non connatis tubo petalorum. Squamae oblongo-cuneatae, 0,3 - 0,4 x 0,2 - 0,3 mm, truncatae, aliquantum constrictae ad basim, vix succulentae, albae vel roseae. Cappella ovarii paene obconicis, stylis brevissimis et stigmatibus terminalibus ovarium glabrum ovulis sex fere sphericis et leviter papillois.

Type: Natal, Naauiwhoek near Wakkerstroom, Tölken 3117 (BOL, holo!).

Herbs with fastigiate erect branches up to 15 cm high, little branched and produced from an underground rhizome which has many small branches terminating in almost spherical tubers up to 0,3 cm in diameter.

Leaves linear, 0,5 - 1,5 cm long, 0,1 - 0,15 cm broad, obtuse rarely bluntly acute, more or less flat on the upper surface, convex below, erect or often curved upwards from the middle, green; sheath up to 1 mm long, fleshy and adpressed. Hydathodes 3 - 4 in one row along the leaf margin and a terminal one below the apex. Inflorescence with 1 (-3) flowers in the axils of the leaves, with erect pedicels 3 - 6 mm long, with 4-merous flowers. Sepals narrowly triangular, 0,8 - 1 mm long, bluntly pointed, fleshy, green. Petals ovate to almost rhombic, 1,5 - 2 mm long, bluntly pointed and without a dorsal ridge, recurved, white. Stamens about 1 mm long, with purple anthers 0,1 - 0,2 mm long, with filaments hardly broadened towards the base and not fused to the petal tube. Squamae oblong-cuneate, 0,3 - 0,4 x 0,2 - 0,3 mm, truncate, mainly constricted below the apex, slightly fleshy, white or pink. Carpels with broad almost obconical ovaries and with very short styles from the inside margin of the ovaries and with terminal insignificant stigmas; ovary glabrous and with 6 ovules each almost spherical and densely covered with rows of faint papillae. Fig. 4.3.

In marshy areas or shallow vleis at high altitude in the mountains between Wakkerstroom and Ermelo.

Flowering Period: January - March.

Diagnostic Features:

The character that distinguishes this species most clearly from similar species is the underground rhizome with small tubers attached to it. However, these are usually missed by collectors as the rhizome is very brittle and occurs about 2 cm below the soil level. Nevertheless, C. tuberella can be distinguished by its narrow linear leaves

which are always bent upwards and thus add to the fastigate habit of the plant. Even in standing water the branches remain erect.

Variation and taxonomic Notes:

This species is known only from a few localities and these specimens show little variation. Although many of the vleis in which it occurs do not dry up during winter, the sprouts above the soil die down in autumn and the plant perennates by its tubers and/or the rhizome.

Specimens examined:

TRANSVAAL. - 2630 (Carolina): Lake Chrissie (-AC), Moss 16 287 (J).

NATAL. - 2730 (Vryheid): Naauwhoek (-AC), Devenish 1005 (PRE);

Tilken 3117 (BOL).

LESOTHO. - 2828 (Bethlehem): Leribe (-CC), Dieterlen 732 (NH).

4. C. vaillantii (Willd.)Roth., Enum. Pl. Phan. Germ. 1 : 992 (1827);

Schonl. in Ann. Bolus Herb. 2 : 51, fig. 3 & plate 2, fig.

4 (1916) et in Trans. Roy. Soc. S. Afr. 17 : 182 (1929).

Type: France, sine leg. in herb. Willdenow 3217 (B, holo!).

Tillaea vaillantii [Vaill., Bot. Paris. 181, T.10, fig. 2

(1727)] Willd., Sp. Pl. 1, 2 : 720 (1798).

Bullardia vaillantii (Willd.) DC., Pl. Hist. Succ. t.74

(1801) et Prodr. 3 : 382 (1828); Eckl. & Zeyh., Enum. 289

(1837); Harv., Fl. Cap. 329 (1862).

--- var. subulata Harv., Fl. Cap. 2 : 330 (1862).

Type: Cape, Rietkuil near Swellendam, Zeyher 634a (S, holo!).

Tillaea aquatica sensu Lam., Encycl. 1 : 361, t. 90 (1785).

Annuals with branches erect or decumbent and up to 15 cm long, more or less branched and often producing adventitious roots where the branches touch the ground. Leaves linear 0,2 - 0,4 (-0,6) cm long, 0,05 - 0,2 cm broad, obtuse or acute, more or less flat above and convex below, shorter below becoming longer towards the upper parts of the stem,

glabrous, fleshy, green to brown or deep red; sheath up to 0,1 cm long, fleshy and adpressed. Hydathodes few on the margin, inconspicuous. Inflorescence 1 (-3) pedicellate, 4-merous flowers in the axils of the leaves along the upper parts of the stems. Sepals broadly triangular, 0,2 - 0,4 mm long, obtuse, glabrous, fleshy and green to red. Petals ovate to elliptic, 1,2 - 2 mm long, obtuse and rarely acute and without dorsal appendage, hardly fused at the base, with apices recurved from about the middle, white. Stamens 1 - 1,5 mm long, with purple anthers 0,1 - 0,2 mm long and broad, with filaments slightly broadened downwards and not constricted towards the base. Squamae oblong-cuneate, 0,4 - 0,7 x 0,1 - 0,2 mm, slightly rounded at the apex and gradually constricted towards the base, slightly fleshy, yellow to red. Carpels broadly reniform to obconical, abruptly constricted into thin styles usually less than a quarter as long as the ovary and with terminal stigmas; ovary smooth and with one elongate ovule with faint ridges.

In moist places and often in mud around standing water; occurring from the south-western Cape to the Kamiesberg and in the mountains along the Karoo to the Drakensberg and at odd intervals in central and northern Africa and southern Europe.

Flowering Period: September - January, but flowers can be found throughout the year if conditions for vigorous growth are prevailing.

Diagnostic Features:

The short fleshy leaves distinguish this species from most other species in the sect. Tillaeoides, except that plants of C. natans which grow on marshy areas resemble C. vaillantii closely. However, C. vaillantii has (2-) 4 - 8 ovules per carpel and usually the seeds are twice as long as broad.

Variation and taxonomic Notes:

C. vaillantii is very variable in size and shape and similar to C. natans it can vary from a small moss-like plant which forms cushions

up to 2 cm high in moist places in the mountains to more robust plants with branches up to 15 cm long and 0,2 - 0,5 cm in diameter around vleis in karroid areas. The latter robust plants produce much thinner branches if the plants are grown on humus rich soil or on pure sand as derived from Table Mountain sandstone. Much of the variation recorded can thus be attributed to environmental factors rather than local variation. This can also be deduced from distribution patterns of the extreme forms, as for instance the robust plants are mainly found on Karoo formations. The very delicate form has been recorded from either side of the Karoo, namely in the Drakensberg and the mountains of the south-western Cape Province, as well as on the Cape Flats. These delicate plants have often only 2 ovules per carpel.

The more delicate plants that are found in the north-eastern Cedarberg are of special interest because they are very similar to C. aphylla as the latter species produces two ovules in this area. The first leaves are usually very short in C. vaillantii, so that it becomes difficult to distinguish it from plants of C. aphylla which has leaves more or less fused to the stems. The two species can only be distinguished by the club-shaped internodes of C. aphylla while those of C. vaillantii are more or less evenly fleshy along the whole internode.

C. minuta, which also occurs in this area, is superficially very similar to the delicate form of C. vaillantii, but is distinguished by its larger sepals and transversely oblong-cuneate squamae as mentioned above.

The type specimen is a very delicate plant with rather elongated pedicels, which is unusual for plants of this species in South Africa, but it seems to fall within the range of variation found in Europe. The illustrations of Le Vaillant (1727) and De Candolle (1801) depicts plants as they are usually found in South Africa.

Specimens examined:

- TRANSVAAL. - 2627 (Potchefstroom): 9 Km west of Oberholzer (-AD), Vahrmeijer 1563 (PRE).
- NATAL. - 2829 (Harrismith): Oliver's Hoek Pass (-CA), Thode in STE 3564. 2830 (Dundee): Umlumba Mountains (-CD), Acocks 10 523 (NH). 2929 (Underberg): Injasuti area (-AD), Esterhuysen 20 235 (BOL); Sulpher Springs (-BB), Acocks 10 570 (NH, PRE); Meteor Ridge (-BB), Mogg 7030 (PRE).
- ORANGE FREE STATE. - 2926 (Bloemfontein): Bloemfontein (-AA), Potts 2374 (GRA); Thaba Nchu (-BB), Mostert 1188 (PRE).
- LESOTHO. - 2827 (Senekal): Matsoeberane (-DD), Dieterlen 942 (SAM). 2828 (Bethlehem): Leribe (-BB), Dieterlen 804 (NH, SAM); Motiti River (-DB), Jacot Guillarmod 2094 (RUH). 2927 (Maseru): Likhoale (-BD), Dieterlen 1056a (GRA); Thaba Chitja (-CC), Jacot Guillarmod 1294 (GRA); Mamanthes (-DB), Lawson 804 (NH). 2929 (Underberg): Putha (-AB), Compton 21 644 (NBG); Mokhotlong (-AC), Jacot Guillarmod 1191 (PRE, RUH).
- CAPE. - 2917 (Springbok): Klipfontein (-BA), Herre in STE 12 061; Steinkopf (-BB), Taylor 1191 (BOL). 3017 (Hondekliipbaai): Kamieskroon (-BB), Thorne in SAM 48 869; between Kamieskroon and Garies (-BD), Thorne in SAM 49 969. 3018 (Kamiesberg): De Kruis (-AC), Wisura 1936 (NBG); south of Leliesfontein (-AC), Tölken 3667 (BOL). 3027 (Lady Grey): Sterkspruit (-CB), Hepburn 44 (GRA). 3028 (Matatiele): Quachas Nek (-BA), Galpin s.n. (BOL). 3118 (Vanrhynsdorp): Vanrhynsdorp (-DB), van der Schijff 7021 (PRE); Gifberg (-DC), Phillips 7493 (SAM). 3119 (Calvinia): 27 Km south of Loeriesfontein (-AB), Acocks 14 413 (PRE); Oorlogskloof (-AC), Schlechter 10 936 (BOL, GRA). 3126 (Queenstown): Andriesberg (-DA), Galpin 1922 (GRA). 3127 (Lady Frere): Berkly Pass (-BB), Galpin 7295 (GRA). 3219 (Wuppertal): above Bidouw Valley (-AA), Tölken 4141 (BOL); Boontjieskloof (-AA), Esterhuysen 32 219 (BOL); near Sneekop (-AC), Esterhuysen 7546 (PRE).

3220 (Sutherland): Sutherland (-BC), Marloth 1430 (PRE); Top of Verlatenkloof Pass (-DA), Tölken 3554 (BOL). 3225 (Somerset East): Craddock Zebra Park (-AB), Acocks 16 208 (PRE); foot of Bosberg (-DA), MacOwan 250 (SAM). 3226 (Fort Beaufort): Mount Hopley (-BB), Galpin 2644 (GRA). 3318 (Cape Town): Darling (-AD), Schlechter 5351 (BOL, GRA, PRE); Maitland (-CD), Wolley Dod 3065 (BOL, GRA). 3319 (Worcester): Hottentotskloof (-BC), Compton 11 794 (NBG); Lakensvlei (-BC), Compton 12 073 (NBG); Worcester (-BC), Thorne in SAM 44 599; between Worcester and Robertson, Zinn in SAM 68 020. 3320 (Montagu): Whitehill (-BA), Compton 13 990 (NBG); Montagu (-CC), Tölken 1588 (BOL). 3323 (Willowmore): Baviaanskloof (-AD), Bayliss 4970 (NBG). 3325 (Port Elizabeth): near Uitenhage (-CD), Thode A 483 (NH); Swartkops River (-DC), Ecklon & Zeyher 1848 (SAM); Redhouse (-DC), Paterson 2324 (GRA). 3420 (Bredasdorp): Rietkuil (-BA), Zeyher 634a (S!).

5. C. aphylla Schonl. & Bak. f. in J. Bot., Lond. 36 : 371 (1898);

Schonl. in Ann. Bolus Herb. 2 : 54, fig. 5 & plate 3, fig. 7

(1916) et in Trans. Roy. Soc. S. Afr. 17 : 184 (1929).

Type: Cape, Boontjes River, Schlechter 8665 (GRA, holo!; BM!; BOL!; E!; G!; K!; P!; PRE!; S!; SAM!; Z!).

Rhopalota aphylla (Schonl. & Bak.f.) N.E. Br. in Cactus Succ.

J., Los Ang. 3 : 7 (1931) et in Hook. Icon. Pl. 32, t. 3171 (1932).

Annuals 0,6 - 3 cm tall with prominent erect club-shaped branch there more or less repeatedly branched and often with more than two branches per node, glabrous. Leaves apparently absent but in fact fused into a fleshy ring around the upper part of an internode and giving each internode the characteristic club-shape or rarely with two distinct lobes, glabrous, convex and fleshy, green to brown; sheath 0,1 - 0,2 cm long and formed by the partial fusion of the leaf bases. Hydathodes usually only one terminal, inconspicuous. Inflorescence terminal or lateral

cymules of two to three 4-merous flowers with a pedicel 0,05 - 0,15 (-3) mm long. Sepals a fleshy ring c. 0,5 mm long often with indistinct obtuse lobes and not separable from the fleshy receptacle, glabrous, green. Petals ovate-oblong, 1 - 2 mm long, bluntly acute to obtuse and without dorsal appendage, recurved at about right angles when flowering, white or often tinged red. Stamens c. 1 mm long with yellow to brown anthers 0,1 - 0,2 mm long, with filaments hardly broadened downwards and not constricted at the base. Squamae narrowly oblong, 0,3 - 0,5 x 0,05 - 0,1 mm, slightly rounded or truncate at the apex, gradually constricted towards the base, fleshy, yellow. Carpels with broadly reniform to obconical ovaries usually abruptly constricted at the apex and with thin styles rarely longer than a quarter of the length of the ovaries and with terminal stigmas; ovary smooth and with 1 or 2 ovules with an almost smooth surface.

In rock pools in sandstone usually on top of hills; occurring from Vanrhyns Pass through the Cedarberg to the Hex River Mountains.

Flowering Period: August - October.

Diagnostic Features:

At times C. aphylla is very similar to C. vaillantii, except that in the former all the branches are club-shaped, while those of C. vaillantii, when they are much broadened even the internodes are broadened. Also, C. aphylla has 1 (2) ovules per carpel.

Variation and taxonomic Notes:

C. aphylla is restricted to rock pools on top of sandstone formations. The leaves are sometimes still visible in the form of two lobes at the top of the club-shaped segments in plants from the northern Cedarberg. Generally, plants from the northern parts of the distribution area are more similar to C. vaillantii especially in that they are more branched and also produce two ovules per carpel. Schonland (1916) reported even "2 - 4 ovules" per carpel, but this claim

could not be confirmed while N.E. Brown's findings of only one ovule per carpel applies to plants from the southern Cedarberg and localities to the south of it. In view of this variation and close resemblance to C. vaillantii, C. aphylla was transferred back from the genus Rhopalota to Crassula.

Specimens examined:

CAPE. - 3119 (Calvinia): Van Rhyns Pass (-AC), Hutchinson 768 (BOL); near Nieuwoudtville (-AC), Marloth 7633 (PRE); Lokenburg (-CA), Acocks 18 482 (PRE). 3219 (Wuppertal): Boontjesrivier (-AA), Schlechter 8665 (BM, BOL, E, G, GRA, K, P, PRE, S, SAM, Z); Pakhuis Pass (-AA), Compton 4277 (BOL); Krakadouwberg (-AA), Esterhuysen 7516 (BOL); Jor- daan s.n. (STE); Tafelberg (-AC), Marloth 11 682 (PRE); Rennie in BOL 19 407; Apollo Peak (-CA), Esterhuysen 18 084 (BOL, PRE); Sandfontein Peak (-CB), Esterhuysen 13 863 (BOL); 21 322 (PRE); Suurvlakte (-CD), Esterhuysen s.n. (BOL); Winkelhaaksrivier (-CD), Levyns in CT 1928 (BOL). 3319 (Worcester): twenty-four Rivers-mountains (-AA), Esterhuysen 21 908 (BOL); Milner Peak (-AC), Esterhuysen 8497 (BOL).

II. Crassula sect. Glomeratae Haw., Rev. Pl. Succ. 12 (1821); DC.,  
Prodr. 3 : 389 (1828).

Type species: C. glomerata Berg.

Crassula sect. Eucrassula Harv., Fl. Cap. 2 : 332 (1862).

--- group Glomeratae (Haw.) Harv., Fl. Cap. 2 : 335 (1862).

--- group Lycopodioides Harv., Fl. Cap. 2 : 334 (1862).

--- group Filipedes Harv., Fl. Cap. 2 : 335 (1862), partly  
incl. C. sarcolipes & C. diaphana.

Crassula sect. Tillaeoideae DC., Prodr. 3 : 389 (1828), partly;  
Schonl. in Ann. Bolus Herb. 2 : 41 (1916).

--- group Glomeratae (Harv.) Schonl. in Ann. Bolus Herb.  
2 : 45 (1916) et in Trans. Roy. Soc. S. Afr. 17 : 162 (1929);  
Berger in Pflanzenfam. ed. 2, 18a : 388 (1930); Friedr. in  
Garcia de Orta, ser. Bot. 1 : 52 (1973).

--- group Muscosa Schonl. in Ann. Bolus Herb. 2 : 45 (1918)  
et in Trans. Roy. Soc. S. Afr. 17 : 162 (1929); Berger in  
Pflanzenfam. ed. 2, 18a : 389 (1930).

--- group Lycopodioides (Harv.) Schonl. in Ann. Bolus Herb. 2 : 46  
(1918) et in Trans. Roy. Soc. S. Afr. 17 : 163 (1929); Berger  
in Pflanzenfam. ed. 2, 18a : 390 (1930); Friedr. in Garcia  
de Orta, ser. Bot. 1 : 52 (1973).

--- group Umbellata Schonl. in Ann. Bolus Herb. 2 : 46 (1916)  
et in Trans. Roy. Soc. S. Afr. 17 : 163 (1929); Berger in  
Pflanzenfam. ed. 2, 18a : 390 (1930).

Tillaea L., Sp. Pl. ed. 1 : 128 (1753) et Gen. Pl. ed. 5 : 62  
(1754); DC., Prodr. 3 : 381 (1828); Benth. & Hook.f., Gen.  
Pl. 1 657 (1865); Britt., Fl. Trop. Afr. 2 : 386 (1871).

Crassula sect. Tillaea (L.) Schonl. in Pflanzenfam. ed. 1, 3,  
2a : 37 (1890).

--- group Eutillaea Schonl. in Pflanzenfam. ed. 1, 3, 2a : 37 (1890).

--- group Combesia (A. Rich.) Schönl. in Pflanzenfam. ed. 1, 3, 2a : 37 (1890).

Tillaea sect. Combesia (A. Rich.) Benth. & Hook.f., Gen. Pl. 1 : 657 (1865).

Thisantha Eckl. & Zeyh., Enum. 302 (1837); Dietr., Syn. Pl. 2 : 1034 (1840); Walp., Rep. 2 : 256 (1843).

Sarcolipes Eckl. & Zeyh., Enum. 290 (1837).

Crassula sect. Sarcolipes (Eckl. & Zeyh.) Walp., Rep. 2 : 252 (1843).

Tetraphyle Eckl. & Zeyh., Enum. 292 (1837); Dietr., Syn. Pl. 2 : 1033 (1840).

Crassula sect. Tetraphyle (Eckl. & Zeyh.) Walp., Rep. 2 : 253 (1843).

Disporocarpa Fisher & C.A. Mey., Ind. Sem. Hort. Petr. 8 : 56 (1841); A. Rich., Tent. Fl. Abyss. 1 : 307 (1847), nom. nud.

Combesia A. Rich., Tent. Fl. Abyss. 1 : 307 (1847).

Tillaea sect. Combesia (A. Rich.) Benth. & Hook.f., Gen. Pl. 1 : 657 (1865).

Crassula sect. Sedoides Schönl. in Pflanzenfam. ed 1, 3, 2a : 37 (1890).

Pagella Schönl. in Ann. Bolus Herb. 3 : 67 (1921); Berger in Pflanzenfam. ed. 2, 18a, 400 (1930).

Annuals rarely perennials with erect or decumbent habit, with stems delicate and translucent to wiry or carnose, glabrous or rarely hairy.

Leaves sessile and sometimes with a pronounced cuneate base, dorsiventrally compressed to rarely almost terete, glabrous to hairy or with a few marginal teeth towards the base, with few hydathodes on the margin and with a membranous sheath between the leaf bases. Inflorescence with terminal cymes with pedicellate flowers which are 4- 5-merous and/or with axillary cymes with often only a few flowers and without a defi-

nite peduncle. Sepals 1 - 2 (-4) mm long usually about as long as the petals, acute or awned, glabrous rarely hairy, fleshy. Petals 1 - 3 mm long, spreading from the base or with a short tube and recurved at the apex. Stamens with yellow anthers 0,1 - 0,2 (-0,3) mm long.

Squamae oblong-cuneate to T-shaped, truncate or slightly emarginate, usually almost membranous, pale yellow or white. Carpels with reniform ovaries gradually constricted into thin styles usually about half as long as the ovaries; ovary (1-) 2 - 16 ovules. Fruit usually splitting along the whole suture but releasing the seeds through an apical pore or breaking off at the base by forming an abscission layer.

Widespread in Southern Africa but also represented in the rest of the African continent and extending its distribution into northern India, but some species also occur in Australasia.

#### Diagnostic Features:

Species of the sect. Glomeratae are either delicate annuals or perennials with sessile axillary inflorescences along the upper parts of the stems. Their anthers are shorter than 0,3 mm, as is also found in the sect. Tillaeoideae, but species of the sect. Glomeratae are distinguished by their acute sepals which are usually as long or longer than the petals and often slightly constricted towards the base. In contrast to the annual species of the sect. Dinacria, species of the sect. Glomeratae have star-shaped flowers with square to transversely oblong squamae and anthers shorter than 0,3 mm long. The species of the sect. Glomeratae are distinguished from those of the sect. Filipedes by their shorter anthers (0,1 - 0,2 mm long) and smooth seeds.

#### Taxonomy:

The sect. Glomeratae is very variable and within it at least three divergent tendencies can be distinguished. Some species of the section show a great similarity to the sect. Filipedes and Merxmüller et al. (1971) and Friedrich (1973) included a number of species in their

group Filicaulis, but they are here placed into the first "group" of species of the sect. Glomeratae. C. pellucida of the sect. Anacampseroides shows a great similarity to some species of the sect. Filipedes, but because it represents the starting point of a development which leads up to the other species of the sect. Anacampseroides, it seems desirable to maintain this natural grouping. In sect. Glomeratae the shorter anthers and glabrous seeds already found in the "transitional species" indicate a similar new development. In fact, Merxmüller et al. (1971) remarked when referring to this group of species: "Die hierher gehörigen sehr kurzlebigen annuellen Sippen haben bereits innerhalb der Gruppe als abgeleitet zu gelten". Although it might seem convenient to subdivide the sect. Glomeratae into subsections, this can only be done on the basis of one-character-differences, which must result in artificial groupings in a section which has an interwoven pattern of similarities.

A similarity also exists between constituent species of the sections Glomeratae and Dinacria, for example it is practically impossible to separate C. depressa of the sect. Dinacria from some of the above-mentioned "transitional species" of the sect. Glomeratae. However, an obvious similarity of sepals, squamæ and anthers in the species C. depressa, C. dichotoma and C. grammanthoides (see discussion under sect. Dinacria and in chapter 6) indicates that these species together with C. filiformis and C. sebacoides form a natural grouping.

The three main developments of groups of species within the sect. Glomeratae are:

a. The carpels are glabrous and with 4 - 16 ovules, and the fruit dehisce with apical pores, except in C. pageae, which shows a close resemblance to C. roggeveldii and C. dodii in spite of its superficial similarity to C. umbellata. Some of these species show a close resemblance to the sect. Filipedes.

b. The papillose carpels usually show a reduction to one or two ovules. The fruits release the seeds through apical pores, but also develop an abscission layer at their base, as for instance in C. thunbergiana. In some species, such as C. hirsuta, an apical pore is absent. This "group" seems to agree well with the concept of the group Glomerata of Merxmüller et al. (1971) and Friedrich (1973), but C. thunbergiana has an almost smooth ovary and its similarity to C. decumbens ("group a" according to latter authors) in its almost terete leaves, its axillary inflorescences and cuneate squamæ is obvious. At the same time, C. thunbergiana has two ovules per carpel and keeled old petals which are characteristic of the third "group". This in itself indicates that the "groups" cannot be given taxonomic rank.

c. The carpels are usually glabrous, but a similar reduction of the ovules to usually two and the fruit dehisce mainly by an apical pore. However, in many species the carpels break off at the base as well. This Lycopodioides-group is, according to Merxmüller et al. (1971), derived from an ancestral plant similar to C. bergioides, which has white flowers often arranged rather loosely in axillary inflorescences. In addition C. bergioides has papillose ovaries and almost T-shaped squamæ, which are similar to those of C. thunbergiana of the "group b".

Merxmüller et al. (1971) also derive their group Glomerata from the ancestral species similar to C. bergioides, but it seems unlikely that the flat-topped thyrses, as in C. glomerata, should develop from an axillary cyme, which is found only in the sect. Glomeratae and C. alpestris subsp. massonii of the sect. Pyramidella.

In view of the closely interwoven similarities found in this section, the three main tendencies are regarded as developmental lines rather than taxonomic groups.

Haworth (1821) included only C. glabra under his sect. Glomeratae, but indicated that it was synonymous with C. glomerata b of Ait.,

Hort. Kew. In other words, he was aware of C. glomerata and had possibly envisaged a similar concept of the section as outlined by De Candoille (1828) and published C. glabra as the only addition to it. Thus, according to article 22 of the Int. Code Bot. Nomcl. (1972), C. glomerata becomes "the type of the name of the subdivision of the genus", because "the epithet of the subdivision of the genus is derived from the epithet of one of its constituent species", and Haworth did not designate a type.

6. C. strigosa L., Pl. Rar. Afr. 10 (1760); DC., Prodr. 3 : 389

(1828); Tölken in J. S. Afr. Bot. 38 : 75 (1972).

Type: Caput Bonae Spei, in Burman Herbarium (G, holo!).

C. centauroides L., Pl. Rar. Afr. 9 (1760); Sp. Pl. ed. 2 :

454 (1762); Amoen. Acad. 6 : 85 (1763); Tölken in J. S.

Afr. Bot. 38 : 75 (1972).

Type: Caput Bonae Spei, in Burmann Herbarium (G, holo!).

C. pellucida sensu Thunb., Prodr. 54 (1794); Fl. Cap. ed.

Schultes 282 (1823), non L.

C. sylvatica Licht. ex Schultes, Syst. 6 : 726 (1820); DC.,

Prodr. 3 : 390 (1828); Harv., Fl. Cap. 2 : 368 (1862); Schonl.

in Ann. Bolus Herb. 2 : 72, plate 6, fig. 24 (1916), *sylvatica*,

et in Trans. Roy. Soc. S. Afr. 17 : 190 (1929), *sylvatica*;

Adamsen, Fl. Cape Penins. 433 (1950), *sylvatica*.

Type: Cape, near Swellendam, Lichtenstein s.n. (B, holo†).

Sarcolipes pubescens Eckl. & Zeyh., Enum. 290 (1837).

Type: Cape, Brackfontein near Clanwilliam, Ecklon & Zeyher

1853 (G!; K!; P!; S!; SAM!).

Crassula pubescens (Eckl. & Zeyh.) Walp., Repert. 2 : 252

(1843), nom. illeg. - non Thunb.

C. sarcolipes Harv., Fl. Cap. 2 : 355 (1862).

Syntypes: Cape, Brackfontein near Clanwilliam, Ecklon & Zeyher 1853 (G!; K!; P!; S!; SAM!); Simons Bay, Wright 560 (TCD); Piquetberg, Drège s.n. (E-GL!; P!; K!; S!).

C. diaphana Drège ex Harv., Fl. Cap. 2 : 355 (1862); Drège, Zwei Pfl. Doc. 75, 118 (1843), nom. nud.; Schonl. in Ann. Bolus Herb. 2 : 73 (1916).

Type: Cape, between Nieuwekloof and Slangenheuvel, Drège s.n. (S, holo!; G!; K!).

Annuals with erect or decumbent stems 3 - 12 (-17) cm long, soft and often translucent, usually covered with spreading but slightly recurved hairs which are visible to the naked eye, with leaves at about equal distances from one another. Leaves, at least the lower ones, with a petiole 0,1 - 0,7 (-1) cm long; lamina elliptic 0,4 - 1,5 (-2) cm long, 0,2 - 0,7 cm broad, obtuse to bluntly acute and usually with a stout terminal hair, covered with fine scattered hairs rarely glabrous, soft and membranous to slightly fleshy, green to yellowish-green and sometimes with red linear markings; sheath up to 1 mm long, membranous. Inflorescence a loose terminal cyme with few to many pedicellate 5-merous flowers. Sepals lanceolate to elliptic, 1 - 2 mm long bluntly acute to obtuse but usually with a terminal hair, as long as the petals or sometimes longer than the petals, somewhat fleshy, green. Petals lanceolate 1,5 - 2 mm long, acute, without dorsal appendage, fused into a tube c. 0,1 mm long, erect or somewhat spreading, white rarely tinged pink. Stamens c. 1,5 mm long, with yellow anthers 0,15 - 0,25 mm long and broad, with filaments somewhat broadened towards the base but not constricted where fused to the petal tube. Squamae linear, 0,4 - 0,6 x 0,03 - 0,08 mm, rounded at the apex, slightly fleshy, white. Carpels with reniform ovaries abruptly constricted into thin styles up to half as long as the ovaries and with insignificant terminal stigmas;

ovary glabrous and with 4 - 8 elongate ovules usually with papillae often in indistinct rows. Fruit splitting along the whole suture but releasing the seeds through an apical pore.

In moist shady places under rocks or sometimes among other plants, but often a pioneer plant or as a garden weed; common in the south-western Cape Province but occurring from Springbok to Bredasdorp.

Flowering Period: August - October.

Diagnostic Features:

Characteristic of this species are the spreading hairs on most parts of the plant, but occasionally these hairs wear off or are not formed except for the terminal hairs on the calyx lobes, which will distinguish this species from C. lambertiana. Also, the linear squamae are typical of this species.

Variation and taxonomic Notes:

As in most of the annual Crassulas, the variation induced by environmental conditions is great and is particularly pronounced in C. strigosa which occurs in such a wide range of habitats. Basically, any variation between the two following extremes can be expected. Plants that grow under exposed conditions are usually single plants with firm but often translucent stems up to 7 cm high and with somewhat fleshy leaves and often produce red striations along the main veins. The spreading hairs are usually very pronounced in this form.

On the other hand those plants that grow in deep shade, and depending on the amount of water available, will produce an entirely different appearance. These plants often grow in dense stands and thus usually support one another, but the soft translucent stems may at times be decumbent. The leaves grow to extreme sizes and are often more than 2 cm long, and the whole plant becomes more or less glabrous. Apart from that, plants in the vicinity of Clanwilliam often are less hairy than the typical form, but usually produce hairs at the ends of the calyx

lobes. Shade forms can usually also be recognized by their large leaves, because those of C. lambertiana rarely exceed 3 mm in width.

Specimens examined:

CAPE. - near Komaggas (-CD), Tölken 3479 (BOL); on road to Hondeklipbaai (-CD); Thompson 1065 (PRE, STE); Mesklip (-DD), Esterhuysen 5830 (BOL). 3118 (Vanrhynsdorp): Meerhofkasteel (-AB), Barker 7331 (NBG). 3119 (Calvinia): Van Rhy'n's Pass (-AC), Hutchinson 770 (PRE); Diels 609 (GRA). 3218 (Clanwilliam): Brackfontein (-BB), Ecklon & Zeyher 1853 (G, K, P, S, SAM); near Clanwilliam (-BB), Diels 289 (GRA); Schlechter 8504 (PRE); Versfeld Pass (-DC), Tölken 1557 (BOL); Piketberg, Drège s.n. (E-GL, P, K, S). 3219 (Wuppertal): Pakhuis Pass (-AA), Thompson 322 (PRE, STE); Barker 1330 (NBG); Clanwilliam Warm Bath (-CA), Stephens 7221 (NBG, PRE); Krom River (-CB), Esterhuysen 20 451 (NBG); Boplaas (-CD), Tölken 4148 (BOL). 3318 (Cape Town): Contraberg (-AD), Pillans 6909 (BOL); Kasteelberg (-BD), Marsh 1059 (PRE, STE); Mamre (-CB), Barker 1603 (NBG); Camp's Bay (-CD), Zeyher 5073 (SAM); Kirstenbosch (-CD), Esterhuysen 19 183 (BOL); Table Mountain (-CD), Marloth 7250 (PRE); Stellenbosch (-DD), Strey 713 (PRE). 3319 (Worcester): near Gouda (-AC), Esterhuysen 18 809 (BOL); Tulbaghkloof (-AC), Stokoe in SAM 66 652; near Ceres (-AD), Bolus 8381 (PRE); Karoo Poort (-BC), Hafström & Acocks 550 (PRE); Theron's Pass (-BC), Walgate 294 (NBG); near Matroosberg Station (-BD), Tölken 3501 (BOL); near Worcester (-CB), Tölken 3493 (BOL); French Hoek (-CC), Phillips 1119 (SAM); Wemmershoek (-CC), Wasserfall 521 (NBG). 3320 (Montagu): 10 Km south-east Touwsrivier (-AC), Tölken 4062 (BOL); Whitehill (-BA), Compton 8061 (NBG); Montagu Bath (-CA), Page 104 (PRE). 3418 (Simonstown): Simonsbay (-AB), Wright 560 (TCD); Rooihoogte (-AB), Taylor 7123a (PRE); Karbonkelberg (-AB), Leighton 721 (BOL); Compton 15 395 (NBG); Seekoewlei (-BA), Schlechter 8508 (GRA, PRE); Helderberg (-BB), Parker 4245 (BOL, NBG). 3420 (Bredasdorp): Hasquaspoort (-AA),

Acocks 22 704 (PRE); Kykkoedie (-AC), Acocks 22 714 (PRE). Caput.  
Bonae Spei, sine leg. in Herb. Burmann (G).

7. C. numaisensis Friedr. in Mitt. Bot. Staatssamml. München 6 : 642,  
fig. 12 (1967) et in Prodr. Fl. S. W. Afr. 52 : 33 (1968).  
Type: South West Africa, Farm Spitzkop, Merxmüller & Gies  
3389a (M, holo; WIND!).

Annuals with spreading branches up to 8 cm long, soft and often translucent, glabrous, with leaves at about equal distances from one another. Leaves sessile to subpetiolate, obovate, 0,6 - 1,5 (-1,8) cm long, 0,4 - 1 cm broad, obtuse, glabrous, dorsiventrally flattened and almost membranous, green; sheath c. 0,05 cm long and membranous. Hydathodes few along the margin, inconspicuous. Inflorescence with several terminal cymes with 5-merous flowers with pedicels up to 2 cm long. Sepals oblong-lanceolate, 2 - 2,5 mm long, bluntly acute, glabrous, slightly fleshy, green. Petals lanceolate, c. 2 mm long, bluntly acute and without dorsal appendage, fused into a tube c. 0,2 mm long, spreading, white. Stamens c. 1,4 mm long, with yellow anthers 0,2 mm long, with filaments slightly broadened towards the base and somewhat constricted where fused to the petal tube. Squamae narrowly oblong-cuneate, 0,3 - 0,4 x 0,5 - 0,1 mm, truncate, at first abruptly later gradually constricted, membranous, white. Carpels with oblong-reniform ovaries abruptly constricted into thin styles about a quarter of the length of the ovaries and with terminal stigmas; ovary smooth and with 6 - 8 elongate ovules which are faintly papillose.

In shaded places usually under overhanging granite rocks and recorded only from the type locality in the Numais Mountains.

Flowering Period: August, September.

Diagnostic Features:

C. numaisensis is very similar to C. lambertiana together with

which grows at the type locality, but the former has much larger leaves and its squamae are narrowly oblong-cuneate.

Variation and taxonomic Notes:

Not much is known about this species as it has been only once recorded, but the fact that it was growing together with C. lambertiana and C. tenuipedicellata without showing intermediates with one of these species indicates that it is a fully distinct taxon.

Specimen examined:

SOUTH WEST AFRICA. - 2716 (Witpütz): Spitskop (-DD), Merxmüller & Giess 3389a (WIND).

8. C. lambertiana Schonl. & Bak.f. in J. Bot., Lond. 36 : 371 (1898);

Schonl. in Ann. Bolus. Herb. 2 : 58 (1916) et in Trans. Roy. S. Afr. 17 : 186 (1929); Friedr. in Prodr. Fl. S. W. Afr. 52 : 31 (1968).

Type: Cape, Lamberts Bay, Schlechter 85 39 (GRA, holo!; BM!; BOL!; E!; G!; GRA!; P!; PRE!; S!; Z!).

C. oblanceolata Schonl. & Bak. f. in J. Bot., Lond. 36 : 365 (1898); Schonl. in Ann. Bolus Herb. 2 : 58, plate 3, fig. 10 (1916) et in Trans. Roy. Soc. S. Afr. 17 : 186 (1929); Friedr. in Garcia de Orta, ser. Bot. 1 : 52 (1973).

Type: Cape, Karesbergen, Schlechter 8306 (GRA, holo!; BM!; BOL!; G!; PRE!).

C. tenuis Wolley Dod in J. Bot., Lond. 39 : 399 (1901); Schonl. in Ann. Bolus Herb. 2 : 57, fig. 7 & plate 3, fig. 9 (1916) et in Trans. Roy. Soc. S. Afr. 17 : 186 (1929); Adamson, Fl. Cape Penins. 431 (1950).

Syntypes: Camp's Bay, Wolley Dod 3369 (BOL!; GRA); Signal Hill, Wilms 3252 (BM!).

Annuals 6 - 12 cm high, with erect to rarely decumbent branches which are soft and translucent, glabrous and with leaves at about equal distances from one another. Leaves sessile, oblanceolate to narrowly elliptic, (0,3-) 0,5 - 0,8 (-1) cm long, 0,1 - 0,4 cm broad, obtuse to rarely bluntly acute, dorsiventrally flattened, glabrous, soft and slightly fleshy; sheath c. 0,02 cm long, membranous. Hydathodes a few along the margin, inconspicuous. Inflorescence with terminal cymules with 4 or 5-merous flowers each with a pedicel which elongates very much after flowering (1,5 - 2 (-3) cm). Sepals lanceolate-oblong, 1,5 - 3 mm long, and elongating after flowering bluntly acute, glabrous, somewhat fleshy, green to brown. Petals oblong to elliptic, 2 - 3 mm long, bluntly acute to obtuse and without dorsal appendage, fused into a tube 0,2 - 0,3 mm long, spreading, white or often tinged red. Stamens 1,5 - 2 mm long, with yellow anthers c. 0,2 mm long and broad, with filaments slightly broadened towards the base and abruptly constricted where fused to the petal tube. Squamae oblong-cuneate to T-shaped, 0,3 - 0,4 x 0,1 - 0,4 mm, truncate, at first abruptly later gradually constricted towards the base, membranous, white. Carpels with reniform ovaries more or less abruptly constricted into thin styles up to half as long as the ovaries and with terminal stigmas; ovary smooth and with (6-) 8 - 16 elongate ovules covered with rows of papillae and releasing the seeds through an apical pore.

Usually in dense stands under rocks or in shaded positions rarely singly on moist slopes or depressions but usually associated with dry vegetation and not in areas with fynbos vegetation; occurring in the Little and the western Great Karoo through the Roggeveld and eastern Cedarberg to the Namaqualand and sporadically along the western coast to the Cape Peninsula.

Flowering Period: August - October.

Diagnostic Features:

C. lambertiana is distinguished from the very similar species C. strigosa by its broadly cuneate squamae, the glabrous leaves and sepals which do not even produce a terminal seta and its flowers are predominantly 4-merous. Plants of C. lambertiana grown in full sunshine are often similar to C. dodii and C. roggeveldii, but they are distinguished by the basal leaves being without a petiole and ultimately the pedicels elongate very much (0,6 - 2 (-3) cm long).

Variation and taxonomic Notes:

A very common and very often misinterpreted species because it varies so much with a change in the habitat. For instance, plants growing under exposed conditions in moist depressions (Tölken 4107) are often almost decumbent and much branched tufts. Also, their leaves become quite fleshy particularly under slightly alkaline conditions which this species seem to be able to tolerate.

In contrast to this, the internodes of plants growing in the shade elongate up to 5 cm long so that the habit becomes a straggling soft herb with few spreading branches. The leaves do not vary as much as those of C. strigosa, so that the much larger leaves of C. numaisensis can be attributed much greater significance. At the same time the fact that the latter species was found growing together with the typical C. lambertiana, indicates that it can hardly be interpreted as just a local form.

However, in deep shaded areas with permanent moisture on Lion's Head and the north-western parts of Table Mountain a slightly different form of C. lambertiana occurs. In these plants the calyx elongates very much as in the rest of the species, but the pedicels are rarely longer than 0,8 cm which is unusually short for C. lambertiana. Also it has only 6 - 8 ovules and will not grow in exposed sunny conditions.

It is not clear why Friedrich (1973) suddenly preferred the name C. oblanceolata when it cannot receive preference to C. lambertiana, because they were published in the same part of the journal.

Specimens examined:

SOUTH WEST AFRICA. - 2716 (Witpötz): Spitskop, Merxmüller & Giess 3391 (PRE).  
 CAPE. - 2816 (Oranjemund): Groenkloof (-DB), Pearson 6620 (BOL).  
 2817 (Violsdrif): 9 Km north-west Stinkfontein (-CC), Tölken 3425 (BOL). 2917 (Springbok): Karruchab Poort (-AA), Tölken 3578 (BOL);  
 Wolfberg (-CB), Tölken 3585 (BOL). 3017 (Hondeklipbaai): I'Aus (-BB),  
Schlechter 11 213 (BOL, GRA, PRE). 3118 (Van Rhynsdorp): Kareeberg (-AB), Schlechter 8306 (BM, BOL, G, GRA, PRE). 3119 (Calvinia):  
 Lokenburg (-CA), Barker 1215 (NBG); Acocks 17 006 (PRE); Botterkloof (-CC), Schlechter 10 886 (BOL, GRA, PRE). 3120 (Williston): 72 Km Sutherland to Calvinia (-CD), Tölken 3560 (BOL). 3218 (Clanwilliam):  
 Lambert's Bay (-AB), Schlechter 8539 (BM, BOL, E, G, GRA, F, PRE, S, Z); Vogelfontein (-BA), Schlechter 8523 (BOL); Piëkenier's Kloof (-DB), Schlechter 4920 (BOL, GRA). 3219 (Wuppertal): 48 Km north-east Karoo Poort (-DD), Tölken 3538 (BOL). 3220 (Sutherland): Sutherland (-BC),  
Marloth 9791 (PRE); Klipbankrivier (-CB), Acocks 16 948 (PRE); near junction of Ceres Matjesfontein and Sutherland road (-CB), Tölken 3550 (BOL). 3318 (Cape Town): Camps Bay (-CD), Wolley Dod 3369 (BOL, GRA);  
 Lions Head (-CD), Wolley Dod 3676 (GRA); Tölken 1576 (BOL). 3319 (Worcester): 18 Km north-east Karoo Poort (-BC), Tölken 3536 (BOL);  
 Matroosberg station (-BD), Tölken 3502 (BOL); Worcester (-CB), Olivier 175 (PRE, STE); De Hoek (-CD), Barker 2559 (NBG); 3581 (NBG). 3320 (Montagu): 11 Km south Laingsburg (-BA), Tölken 4094 (BOL); Montagu Bath (-CA), Page in BOL 16 647; Tölken 3524 (BOL); 3525 (BOL). 3321 (Ladismith): west of Bosluis-kloof (-AD), Tölken 4107 (BOL). 3418 (Simonstown): Hout Bay (-AB), Schlechter 1011 (GRA).

9. C. dodii Schonl. & Bak. f. in J. Bot. , Lond. 36 : 372 (1898);

Schonl. in Ann. Bolus Herb. 2 : 70, fig. 16 & plate 6, fig.

21 (1916) et in Trans. Roy. Soc. S. Afr. 17 : 190 (1929).

Type: Cape, near Vanrhynsdorp, Schlechter 10 994 (GRA, holo!;

BM!; BOL!; E!; G!; P!; Z!).

Annuals with decumbent rarely prostrate branches 1 - 5 cm long, soft and more or less translucent, glabrous, with lower leaves usually clustered into groups of four. Leaves with a petiole up to 0,3 cm long at the base of the plant; lamina ovate to elliptic, 0,2 - 0,4 cm long, 0,2 - 0,3 cm broad, obtuse, glabrous, dorsiventrally flattened but often slightly convex on the upper surface, slightly fleshy, green to brown; sheath 0,01 cm long and membranous. Hydathodes a few along the margin, inconspicuous. Inflorescence terminal cymes with 4-merous flowers loosely arranged, but pedicel even in fruiting stage rarely longer than 0,3 cm. Sepals lanceolate, c. 1,5 mm long, obtuse or bluntly acute, fleshy, green to brown. Petals oblong-elliptic, 1,4 - 1,7 mm long, bluntly acute and without dorsal appendage, fused into a tube 0,2 - 0,3 mm long, spreading, white. Stamens c. 1,2 mm long, with yellow anthers 0,1 - 0,2 mm long and broad, with filaments slightly broadened towards the base and somewhat constricted where fused to the petal tube. Squamae oblong-cuneate, 0,3 - 0,5 x 0,1 - 0,3 mm, truncate, gradually constricted towards the base, slightly fleshy, white. Carpels with oblong-reniform ovaries with thin styles up to a quarter of the length of the ovaries and with terminal stigmas; ovary smooth and with 8 - 12 elongate ovules covered with faintly papillose ridges.

Usually in mud around standing water or in moist depressions; occurring near Vanrhynsdorp but also recorded from the Little Karoo and the adjoining arid areas.

Flowering Period: September - October.

Diagnostic Features:

C. dodii is distinguished by its long petiole which is often longer than the lamina at the base of the plant. Also, the lower leaves occur in clusters of four, while in C. roggeveldii and C. lambertiana all the leaves are spaced at about equal distances. C. lambertiana has sessile oblanceolate leaves even in depauperate plants.

Variation and taxonomic Notes:

Plants from near Vanrhynsdorp can be distinguished from those found in the Little Karoo by their pedicels which do not elongate very much after flowering and also by the squamae are more abruptly constricted towards the base. However, plants from the Little Karoo are not merely depauperate forms of C. lambertiana as their stems will not elongate when placed into moist shaded conditions (Tölken 1553) apart from the fact that C. dodii always has petiolate leaves.

It is interesting that some specimens of Schlechter 11 213 from L'Aus must also be identified as C. dodii and this would extend the distribution area much further north. However, most of the specimens investigated of this collection must be identified as C. lambertiana, so that it seems more likely that it represents a confusion of specimens.

Specimens examined:

CAPE. - 3118 (Vanrhynsdorp): Vanrhynsdorp (-DA), Schlechter 10 994 (BM, BOL, E, G, GRA, P, PRE, S, Z); Skaapvlei (-AD), Watermeyer sub Marloth 13 707 (GRA, PRE). 3320 (Montagu): Matjesfontein (-BA), Schlechter 10 931 (PRE); 5 Km east Montagu (-CC), Tölken 1553 (BOL). 3419 (Caledon): near Rietpoel station (-BB), Adocks 22 590 (PRE).

10. C. roggeveldii Schönl. in Trans. Roy. Soc. S. Afr. 17 : 183 (1929).

Type: Caps, farm Uitkyk, Marloth 9910 (GRA, lecto!).

Annuals with decumbent or sometimes prostrate branches 1 - 4 cm long,

soft and more or less translucent and often with adventitious roots, covered with fine papillae when young, with leaves at about equal distances from one another. Leaves with a petiole up to 0,1 cm long towards the base of the plant; lamina obovate 0,1 - 0,2 (-0,3) cm long, 0,1 - 0,2 cm broad, obtuse to sometimes truncate, with fine papillae, dorsiventrally flattened but slightly convex on the upper and lower surfaces, fleshy, green to red; sheath 0,02 cm long and membranous. Hydathodes a few along the margin, inconspicuous. Inflorescence terminal cymes with 4-merous flowers loosely arranged but pedicels even in fruiting stage rarely longer than 0,2 cm. Sepals broadly ovate, c. 1,5 mm long, obtuse, fleshy, green to red. Petals broadly triangular, 1,5 - 2 mm long, obtuse and without dorsal appendage, fused into a tube 0,3 - 0,4 mm long, spreading, white. Stamens c. 1,5 mm long, with yellow anthers 0,2 - 0,3 mm long, with filaments slightly broadened towards the base and abruptly constricted where fused to the petal tube. Squamae transversely oblong and with a cuneate base, 0,3 - 0,4 x 0,6 - 0,8 mm, truncate and abruptly constricted towards the base, slightly fleshy, white. Carpels with oblong-reniform ovaries with thin styles which are about a quarter of the length of the ovaries and with terminal stigmas; ovary smooth and with 6 - 8 ovules which are almost spherical and covered with faintly papillose ridges.

In moist places and usually among rocks or often under overhanging rocks; recorded only from the vicinity of Sutherland.

Flowering Period: August - October.

Diagnostic Features:

Schonland (1929) compared this species with C. decumbens, but C. roggeveldii has obovate leaves and broadly ovate sepals. However, as its habit is decumbent to prostrate it could easily be confused with C. dodii, but it is distinguished by its leaves being spaced at about equal distances along the stems which often produce adventitious roots

and the flowers are rather open cup-shaped and at least 2 mm across.

C. lambertiana is distinguished by its oblanceolate to linear-elliptic leaves.

Variation and taxonomic Notes:

Plants of C. roggeveldii usually have a half-erect habit under dry sunny conditions and resemble superficially C. decumbens particularly as the whole plant becomes similarly brown to red under those conditions. However, in moist shaded areas the branches are prostrate and often form rather sparse mats under overhanging rocks. Such plants produce many adventitious roots along the stems.

Among the specimens cited by Schonland (1929) only Marloth 9910 was regarded as typical by the author, so that it was chosen as the lectotype.

Specimens examined:

CAPE. - 3119 (Calvinia): Hantamsberg, Acocks 18 626 (PRE). 3220 (Sutherland): 40 Km north-west Sutherland (-AB), Tölken 3558 (BOL); Farm Uitkyk (-AD), Marloth 9910 (GRA); 16 Km south-east Sutherland (-BC), Acocks 16 933 (PRE); near Sutherland (-BC), Marloth 10 413 (GRA, PRE).

11. C. pageae Toelken, nom. nov.

Pagella archeri Schonl. in Ann. Bolus Herb. 3 : 67, t. 3A (1921); Berger in Pflanzenfam. ed. 2, 18a : 400 (1930); Compton in Trans. Roy. Soc. S. Afr. 19 : 292 (1931).

Type: Cape, near Montagu Bath, Page in BOL 16 645 (GRA, holo!; BOL!; PRE).

Annuals with a very condensed stem which is partly fused to the leaf bases so as to form a dorsiventrally flattened crust-like body. Leaves sessile, usually angular-obovate to spatulate, 0,2 - 0,5 cm long, 0,15 - 0,3 mm broad, obtuse and more or less cuneate towards the base,

dorsiventrally flattened but slightly convex above, minutely papillose, slightly fleshy, green to yellow; sheath fused to the central axis.

Hydathodes few along the margin of the leaves, inconspicuous. Inflorescence a terminal cyme with 4-merous flowers partly fused to the central axis. Sepals obovate-oblong, 0,5 - 1 mm long, obtuse, minutely papillose towards the apex and along the margins, slightly fleshy, green to red. Petals oblong-lanceolate, 1,2 - 2 mm, obtuse and without dorsal appendage, fused into a tube c. 0,1 mm long, with lobes erect, brown to red. Stamens c. 0,8 mm long, with yellow anthers 0,1 - 0,2 mm long, with filaments not broadened downwards and slightly constricted where fused to the petal tube. Squamae oblong-oblongate, 0,6 - 0,8 x 0,1 - 0,2 mm, with rounded apices, gradually and slightly constricted towards the base, membranous, usually pale red. Carpels with almost cylindrical ovaries with truncate apices and with thin almost ventrally placed styles which are less than a quarter as long as the ovaries and with terminal stigmas; ovary smooth and with 8 - 16 ovules covered with faint ridges.

Usually in shallow depressions or on south facing aspects and often in the shade of karroid shrublets; occurring in the western Little Karoo and northwards to near Calvinia.

Flowering Period: July - October.

Diagnostic Features:

Plants of this species are never taller than 0,3 cm and the stems are to a greater or lesser degree fused to the leaf bases. Young plants can be distinguished from those of C. umbellata as soon as the first flowers have developed, because the receptacles are partly fused to the central axis in C. pageae. Later the indehiscent fruits of C. pageae distinguish the species clearly.

Variation and taxonomic Notes:

This species shows little variation although it has been recorded

from widely separated localities over a large area. The stem is somewhat fleshy at the base where it has fused to the leaf bases. However, a carrot-like base as illustrated in the one specimen with the type description has not been found in the field. The plants may vary somewhat in the degree of succulence but they tend to be dorsiventrally flattened and adpressed to the soil.

Also, only a ventral placenta could be found in all the plants investigated while the dorsal part of the ovary is merely swollen and becomes slightly spongy in mature fruits. In other words the plants resemble the depauperate form of C. umbellata rather closely and is only distinguished by its indehiscent fruits.

Specimens examined:

CAPE. - 3119 (Calvinia): Nieuwoudtville (-AC), van der Schijff & Schweickerdt 5782 (PRE); Akkerendam (-AC), Leistner 371 (PRE); Lokenburg (-CA), Acocks 18 473 (PRE). 3220 (Sutherland): 40 Km north-west Sutherland (-AB), Tölken 3556 (BOL). 3319 (Worcester): 18 Km north-east Karoo Poort (-BB), Tölken 3537 (BOL); Matroosberg station (-BD), Tölken 3498 (BOL). 3320 (Montagu): 11 Km south-east Touws River (-AC), Tölken 4069 (BOL); Whitehill (-BA), Compton s.n. (BOL); Matjesfontein (-BA), Archer in BOL 16 646; Montagu Bath (-CA), Page in BOL 16 645 (BOL, GRA, PRE); Tölken 1587 (BOL).

12. C. umbellata Thunb., Prodr. 54 (1794) et Fl. Cap. ed. Schultes 279 (1823); DC., Prodr. 3 : 389 (1928); Schonl. in Ann. Bolus Herb. 2 : 71 (1916); et in Ark. Bot. 21A, 16 : 12 (1927) et in Trans. Roy. Soc. S. Afr. 17 : 190 (1929); Adamson, Fl. Cape Penins. 432 (1950).

Type: Cape, without exact locality, Thunberg in Herb. Thunberg 7804 (UPS, holo!).

--- var. nana (Schonl. & Bak. f.) Schonl. in Ann. Bolus Herb.

2 : 72 (1916).

Type: Cape, Zuurfontein, Schlechter 8560 (GRA, holo!).

Tillaea umbellata (Thunb.) Willd., Sp. Pl. 1, 2 : 721 (1798).

Petrogeton alpinum Eckl. & Zeyh., Enum. 291 (1837).

Type: Cape, Table Mountain, Ecklon & Zeyher 1858 (S!; SAM!).

Crassula alpina (Eckl. & Zeyh.) Walp., Repert. 2 : 253 (1843).

Bullardia alpina (Eckl. & Zeyh.) Harv., Fl. Cap. 2 : 330 (1862).

Crassula nana Schonl. & Bak. f. in J. Bot., Lond. 36 : 372 (1898).

Annuals with spreading branches 2 - 4 cm long and rarely only 0,2 - 0,6 cm high, with branches soft but becoming wiry, glabrous, with pairs of leaves at about equal distances from one another but often all internodes not elongated. Leaves with a petiole up to 0,2 cm long; lamina rhombic to triangular to obovate, 0,2 - 0,4 cm long, 0,2 - 0,4 cm broad, obtuse, abruptly constricted into a short petiole, covered with papillae on the upper surface, dorsiventrally flattened and often convex above, green to reddish-brown; sheath up to 0,1 cm long and fleshy. Hydathodes a few along the margin, inconspicuous. Inflorescence a terminal cyme with few to many 4-merous flowers each sessile at first but pedicel becoming up to 1 cm long when fruiting. Sepals broadly oblong, 0,6 - 1 mm long, covered with papillae towards the apex, fleshy green to brown. Petals ovate rarely lanceolate, c. 1 mm long, bluntly acute and without dorsal appendage, fused into a tube c. 0,2 mm long, erect and slightly recurved at the apex, cream but often tinged red. Stamens c. 1 mm long, with yellow anthers 0,2 mm long and broad, with filaments slightly broadened towards the base and somewhat constricted where fused to the petal tube. Squamae narrowly oblong-cuneate, 0,3 - 0,4 x 0,05 - 0,15 mm rounded or truncate at the apex, usually gradually but slightly constricted towards the base, almost membranous, white. Carpels with broadly oblong-reniform ovaries abruptly constricted into thin styles about a quarter of the length of the ovaries and with terminal stigmas; ovary smooth

and with 6 - 8 elongate ovules which are faintly papillose.

Usually on sandy soil or gravelly slopes or often in pockets of sand on rocks but rarely in shaded positions; occurring in the south-western Cape, western parts of the Little and Great Karoo, through the Roggeveld and eastern Cedarberg into south-eastern Namaqualand.

Flowering Period: July - October.

Diagnostic Features:

C. umbellata is rather similar to C. roggeveldii with its shortly petiolate obovate leaves but the former has its flowers rather clustered at the end of the branches and its squamæ are narrowly oblong.

Variation and taxonomic Notes:

This species does not show a great range of variation, except that under dry conditions the internodes do not elongate and plants will only be a few millimeters high. It can be clearly shown that this condition is due to adverse conditions, if such a small plant is grown with so little water that it will constantly show signs of desiccation, the plant will remain stunted and only at the fruiting stage the pedicels will elongate. After the seeds of the first flower were distributed the same plant was grown with a constant surplus of water which resulted in an elongation of the stems within two days. After one and a half weeks the plant had changed its appearance drastically. The extreme small plants were described as C. nana but only represent growth form.

Specimens examined:

CAPE. - 3120 (Williston): 70 Km from Sutherland to Calvinia (-CD), Tölken 3559 (BOL). 3124 (Hanover): Carlton Hills (-BD), Acocks 15 930 (PRE). 3218 (Clanwilliam): Lamberts Bay (-AB), Schlechter 8560 (BOL); Zuurfontein (-BA), Schlechter 8560 (GRA). 3219 (Wuppertal): Tafelberg (-AC), Esterhuysen 13 043 (BOL); Sneekup (-AC), Esterhuysen 20 629a (BOL); Middelberg hut (-AC), Barnes s.n. (BOL); Sneeberg (-CA),

Taylor 5132 (PRE, STE); Kromrivier (-CB), Esterhuysen 20 473 (BOL).  
 3220 (Sutherland): 40 Km north-west Sutherland (-AB), Tölken 3555  
 (BOL); Verlatenkloof (-DA), Tölken 3553 (BOL); 32 Km south-east  
 Sutherland (-DD), Acocks 16 934 (PRE). 3318 (Cape Town): near Hope-  
 field (-AB), Leighton 576 (BOL); Table Mountain (-CD), Ecklon & Zeyher  
 1858 (S, SAM); Esterhuysen 14 619 (BOL, PRE); Kirstenbosch (-CD),  
Compton s.n. (GRA); Kuilsriver (-DC), Strey 537 (PRE); Stellenbosch  
 (-DD), Duthie s.n. (GRA). 3319 (Worcester): Chavonnes Mountains  
 (-CB), Stokoe sub Marloth 10 578 (PRE); Du Toit's Peak (-CC), Ester-  
huysen 18 917 (BOL, NBG); Wemmershoek Tafelberg (-CC), Esterhuysen  
 17 737 (BOL); between Worcester and Robertson, Leipoldt s.n. (BOL).  
 3320 (Montagu): 11 Km south-east Touws River (-AC), Tölken 4066 (BOL);  
 Matjesfontein (-BA), Archer s.n. (BOL); Whitehill (-BA), Compton  
 5318 (BOL); Witteberg, Compton 2544 (BOL). 3321 (Ladismith): Bos-  
 luiskloof (-AD), Tölken 4113 (BOL). 3325 (Port Elizabeth): Redhouse  
 (-DC), Paterson 2105 (BOL). 3418 (Simonstown): Orange Kloof (-AB),  
Wolley Dod 3366 (BOL, GRA); Elsie's Peak (-AB), Pillans 3941 (GRA, PRE);  
 Muizenberg (-AB), Schlechter 1150 (SAM); 560 (BOL). Batsata rock  
 (-AD), Wolley Dod 2878 (GRA); 2979 (BOL). 3419 (Caledon): Victoria  
 Peak (-AA), Esterhuysen 17 587 (BOL). Cape, Thunberg in Herb. Thun-  
 berg 7804 (UPS).

13. C. tenuipedicellata Schonl. & Bak. f. in J. Bot., Lond. 40 : 288  
 (1902); Schonl. in Ann. Bolus Herb. 2 : 62, fig. 12, plate  
 4, fig. 15 (1916); in Trans. Roy. Soc. S. Afr. 17 : 188 (1929);  
 Friedr. in Prodr. Fl. S. W. Afr. 52 : 36 (1968).  
 Type: Cape, near Arakup, Schlechter 11 247 (GRA, holo!; BM!;  
 BOL!; G!; K!; PRE!; Z!).

Annuals with stiff erect branches, glabrous, often with the two pairs  
 of leaves below the inflorescence hardly separated by an indistinct

internode. Leaves elliptic to obovate 0,6 - 1,2 (-1,5) cm long, (0,3-) 0,4 - 0,6 cm broad, obtuse and abruptly constricted into a cuneate base, dorsiventrally flattened to almost membranous, spreading, green; sheath 0,02 - 0,05 cm long and membranous. Hydathodes few along the margin, inconspicuous. Inflorescence with a terminal flower and one to four much-branched axillary dichasia, with each flower with a thread-like but stiff pedicel 0,2 - 0,5 mm long. Sepals lanceolate to almost elliptic, 0,7 - 1 mm long, obtuse but often with a terminal papilla, glabrous, very fleshy, green. Petals narrowly oblong-elliptic, c. 1 mm long, with a more or less acute apex, hardly fused into a tube, erect, white. Stamens 0,5 - 0,8 mm long, with yellow anthers c. 0,15 mm long and usually slightly broader, with filaments becoming broader towards the base and hardly fused to the petal tube. Squamae narrowly T-shaped, 0,2 - 0,3 x 0,5 - 0,6 mm, truncate at the apex, slightly fleshy, white. Carpels with reniform ovaries abruptly constricted into short thin styles with terminal stigmas; ovary with papillae towards the apex and with two ovules with faintly papillose ridges, with one ovule half sunk into the fleshy receptacle and fruit releasing the lower seeds by a basal abscission while the upper one remains in the pericarp.

Usually in dense stands in shaded places under rocks or dense shrubs; occurring from the southern Roggeveld to south-western South West Africa.

Flowering Period: August - October.

Diagnostic Features:

The flowers of C. tenuipedicellata are rarely longer than 1 mm and are born on a thread-like pedicel 2 - 5 mm long and they do not elongate appreciably after flowering.

Variation:

Although this species is widespread in the Cape Province and southern South West Africa it shows little variation.

Specimens examined:

SOUTH WEST AFRICA. - 2716 (Witpöitz): Namuskluft (-DD), Mittendorf 40 (BOL, WIND); Farm Spitzkop (-DD), Merxmüller & Giess 3392 (PRE); 3393b (PRE).

CAPE. - 2817 (Violsdrif): 9 Km north-west Stinkfontein (-CC), Tölken 3425 (BOL). 2917 (Springbok): Karruchab Poort (-AA), Tölken 3576 (BOL); 1 Km west of Steinkopf (-BA), Tölken 3567 (BOL); Wolf-berg station (-CB), Tölken 3584 (BOL). 3017 (Hondekclipbaai): Arakup (-BB), Schlechter 11 247 (BM, BOL, G, GRA, K, PRE, Z). 3018 (Kamies-berg): 56 Km north-west Loeriesfontein (-CC), Tölken 3561 (NBG). 3119 (Calvinia): Akkerendam (-AC), Acocks 18 517 (PRE). 3219 (Wuppertal): 72 Km north-east Karoo Poort (-DD), Tölken 3543 (BOL). 3319 (Worcester): 48 Km north-east Karoo Poort (-BB), Tölken 3539 (BOL). 3320 (Montagu): south of Laingsburg (-BB), Tölken 4087 (BOL).

14. C. glomerata Berg., Descr. Pl. Cap. 85 (1767): L., Mantissa 60 (1767); Lam., Encycl. 2 : 174 (1786); Willd., Sp. Pl. 1 : 1556 (1798) a & b; Ait., Hort. Kew. ed. 2, 2 : 195 (1811), a & b; DC., Hist. Pl. Grass. t. 67 (1801); et Prodr. 3 : 389 (1828); Thunb., Fl. Cap. ed. Schultes 281 (1823); Harv., Fl. Cap. 2 : 352 (1862); Schonl. in Ann. Bolus Herb. 2 : 59, fig. 18 & plate 4, fig. 11 (1916) et in Trans. Roy. Soc. S. Afr. 17 : 187 (1929); Adamson, Fl. Cape Penins. 432 (1950); Tölken in J. S. Afr. Bot. 38 : 70 (1970).

Type: Caput Bonae Spei, Grubb s.n. (STE, holo!).

--- var. patens (Eckl. & Zeyh.) Harv., Fl. Cap. 2 : 353 (1862).

Type: Cape, near Agulhas, Ecklon & Zeyher 1930 (S!; SAM!).

Thisantha glomerata (Berg.) Eckl. & Zeyh., Enum. 302 (1837).

C. scleranthoides Burman f., Fl. Cap. 8 (1768).

Type: Cape, Burman Herbarium (G, holo!).

C. glabra Haw., Syn. Pl. Succ. 58 (1812); Rev. Pl. Succ. 2, 12 (1821); Harv., Fl. Cap. 2 : 353 (1862).

Type: unknown.

Thisantha glabra (Haw.) Eckl. & Zeyh., Enum. 302 (1837).

Thisantha patens Eckl. & Zeyh., Enum. 302 (1837).

Thisantha strigosa (L.) Eckl. & Zeyh., Enum. 302 (1837), partly as per specimen cited.

Crassula capillacea E. Mey. ex Drège, Zwei Pfl. Doc. 113 (1843), nom. nud.

Annuals with stiff erect branches up to 15 cm high and often slightly woody, glabrous or with recurved papillae and with leaves at about equal distances along the stem. Leaves sessile, narrowly triangular to lanceolate, 0,6 - 1 (-1,5) cm long, 0,1 - 0,2 (-0,3) cm broad, subulate and often with a terminal seta, glabrous or with a few marginal papillae, dorsiventrally flattened and slightly convex on the upper and lower surface slightly fleshy and leathery, green to brown, sheath 0,05 cm long, membranous. Hydathodes few along the margins, inconspicuous. Inflorescence a terminal rounded thyrse with several dichasia with a few to many 5-merous flowers which are usually sessile. Sepals triangular to lanceolate 1 - 2,5 mm long and becoming somewhat longer after flowering, acute and usually with a terminal awn, glabrous and somewhat fleshy, green to brown. Petals oblong-lanceolate, 1 - 1,3 mm long, obtuse and without dorsal appendage, fused into a tube 0,3 mm long, erect, minutely papillose towards the apex, white. Stamens c. 1,2 mm long, with brown anthers 0,1 - 0,2 mm long and broad, with filaments slightly broadened towards the base and not constricted where fused to the petal tube. Squamae oblong-cuneate, 0,4 - 0,5 x 0,2 - 0,3 mm, usually with rounded apex, at first abruptly later gradually constricted towards the base, almost membranous, pale yellow. Carpels

with reniform ovaries abruptly constricted into thin styles about one-third of the length of the ovaries and with terminal stigmas; ovary with pointed papillae mainly towards the apex and with 2 elongate ovules which are almost smooth.

On sandy soil in open patches between vegetation or often found on pockets of sand on rocks; occurring mainly in the coastal strip from near Port Elizabeth to the south-western Cape.

Flowering Period: August - November.

Diagnostic Features:

The terminal round-topped thyse with almost sessile flowers distinguishes this species from others with papillose ovaries such as C. hirsuta and C. bergoides.

Variation and taxonomic Notes:

C. glomerata is very variable in the size of its leaves and the plants vary from glabrous to densely papillose. However, the variation in the inflorescence is often more striking as the species is so well known by its dense terminal round thyres, but in early stages of flowering the inflorescence is rather loosely arranged and often only a few flowers in the dichasia have developed. Also, in these first flowers the calyx usually elongates considerably and becomes twice or three times the length of the petals.

In spite of all this variation it is difficult to reconcile this species with the description of the leaves of C. pulchella Dryand. in Ait., Hort. Kew. (1789), namely "foliis ovato-oblongis ..... reflexis". However, no specimen of this species could be traced and the description is too vague to permit identification with certainty. However, the fact that it was left out of the second edition of Hortus Kewensis might indicate that it was not even a species of Crassula.

Specimens examined:

CAPE. - 3218 (Clanwilliam): near Clanwilliam (-BB), Leipoldt 531 (NBG, SAM); Alexanderhoek (-BD), Schlechter ~~5183~~<sup>5138</sup> (BOL, GRA, PRE); Papkuil Valley (-CB), Barker 2645 (NBG). 3219 (Wuppertal): Driehoeksvally (-AD), Esterhuysen 22 481 (BOL); Dasklip Pass (-CC), Tölken 3597 (BOL). 3318 (Cape Town): Yzerfontein (-AC), Hall 2578 (NBG); Darling (-AD), Barker 8650 (NBG); Tölken 1556 A & B (BOL); Moreesburg (-BA), Uys in STE 17 170; Salt River (-CD), Zeyher 5075 (SAM); Blouberg (-CD), Stokoe in SAM 68 019; Robben Island (-CD), Walgate 640 (NBG); Rapenberg (-CD), Guthrie 731 (NBG); Stellenbosch (-DD), Smith 4677 (PRE). 3320 (Montagu): Tweedside (-AB), Compton 3055 (BOL). 3324 (Steytler-ville): Kabeljou River (-DD), Gillett 2328 (BOL, STE). 3325 (Port Elizabeth): Doornhoogde (-BB), Zeyher 5074 (SAM); Humewood (-DC), Daly 1078 (GRA); Driefontein, Zeyher 636 (GRA). 3418 (Simonstown): Fish Hoek (-AB), Marloth 3471 (PRE); 5808 (PRE, STE); near Hout Bay (-AB), Werdermann & Oberdieck 787 (PRE); near Pegrans Point (-AD), Taylor 6523 (PRE, STE); Buffels Bay (-AD), Whellon 1792 (PRE); Sandvlei (-BA), Edwards s.n. (BOL); Wolley Dod 1813 (BOL); Strand (-BB), Parker 3943 (BOL, NBG); Sir Lowrie Pass (-BB), Diels 1422 (GRA); Hangklip (-BD), Barker 6085 (NBG). 3419 (Caledon): Caledon (-AB), Bolus s.n. (BOL); Onrust River (-AC), Willem 59 (NBG); Hermanus (-AC), Rogers 26 521 (PRE); Walker Bay (-AD), Walsh s.n. (NBG); near De Kelders (-CB), Taylor 4101 (PRE, STE); Franskraal (-CB), Maguire 2629 (NBG). 3420 (Bredasdorp): De Hoop (-AD), van der Merwe 1093 (PRE); Die Poort (-CA), Leighton s.n. (BOL); Cape Agulhas (-CC), Ecklon & Zeyher 1930 (S, SAM); Brandfontein (-CC), Esterhuysen 19 044 (BOL, PRE). 3421 (Riversdale): near Stillbay (-AD), Muir 3739 (GRA, PRE); 3785 (PRE); Albertinia (-BA), Compton 23 160 (NBG). 3424 (Humansdorp): Slang River Mouth (-BA), Fourcade 1829 (GRA); 3425 (Skoenmakerskop): Skoenmakerskop (-BA), Holland 3717 (BOL, GRA). Cape, Grubb s.n. (STB); sine leg. in Herb. Burmann (G).

15. C. thunbergiana Schult., Syst. Veg. 6 : 733 (1820).

Type: Cape, Thunberg in Herb. Thunberg 7750a (UPS, lecto!; G!).

Annuals with decumbent and rarely erect branches up to 8 cm long usually more or less translucent and often rooting at the nodes, glabrous, much branched and with short branches or clusters of flowers in each axil of the leaves which are equally spaced along the stem. Leaves sessile, lanceolate to narrowly elliptic, 0,2 - 0,6 (-0,8) cm long, 0,1 - 0,15 cm broad, with blunt apex covered with blister-like papillae, flat on top and convex below, fleshy, yellowish-green to brownish-red; sheath c. 0,01 cm long, membranous. Hydathodes a few along the margin, inconspicuous. Inflorescence mainly axillary cymes and usually with a 3-flowered cyme but often a monochasium continues in the place of one of the lateral flowers and continues to produce flowers, with 5-merous flowers with a short pedicel i.e. 0,1 - 0,3 cm long. Sepals lanceolate, up to 1 mm long with blunt apex and usually covered with blister-like papillae, fleshy, green to brown. Petals oblong, c. 1 mm long, obtuse and without dorsal appendage but usually folded at the apex when old and then they appear to be sharply pointed, fused into a tube c. 0,1 mm long, spreading, white becoming brown. Stamens c. 0,5 mm long, with yellow anthers c. 0,1 - 0,2 mm long and broad, with filaments becoming broader towards the base and slightly constricted where fused to the petal tube. Squamae T-shaped, 0,2 - 0,3 x 0,1 - 0,2 mm, truncate or usually somewhat rounded towards the apex, white to red. Carpels with reniform ovaries abruptly constricted into thin styles often about half as long as the ovaries and with terminal stigmas; ovary smooth or slightly papillose around the lower ovule and with 2 ovules which are almost smooth.

Diagnostic Features:

The delicate leaves which are almost terete usually shrivel to an unrecognizable form in herbarium material. C. thunbergiana is dis-

tinguished from C. decumbens by its smaller flowers (up to 1,5 mm across), 2 ovules per carpel and the seeds are released through an apical pore as well as by the carpels breaking off at their base by developing an abscission layer. Small erect plants of C. thunbergiana and C. campestris are very similar but the latter always produce a terminal seta on the sepals.

The subsp. minutiflora is distinguished from the subsp. thunbergiana by its pedunculate axillary inflorescences.

Variation and taxonomic Notes:

Small plants are often erect and when grown under adverse conditions the calyx clasps the fruits a character also seen in C. campestris. However, usually the branches of C. thunbergiana are decumbent and often with adventitious roots. The size of the flowers vary considerably and those north of Vanrhynsdorp are distinctly smaller. However, the subsp. minutiflora which is mainly distinguished by its pedunculate inflorescence is very similar to the typical subspecies and it is known only from two collections. The type specimens of the subsp. minutiflora from near Steinkopf shows much shorter peduncles and often fewer flowers, so that it is dubious whether it can be upheld as a separate taxon and not part of a cline.

The typification of C. thunbergiana presents a problem because there is no specimen of Tillaea decumbens Willdenow, on which the species is based, preserved in his herbarium. However, when Willdenow (1798) described this species he referred to "Crassula decubens a Thunb. Prodr. 54", but in this later publication, and in fact, in none of his works Thunberg distinguished forms of that species. Thunberg annotated in his herbarium four sheets as C. decumbens a, b, c, d and of these the sheet of C. decubens a also bears the inscription "pet. 4. calyce longiora. Stam 4 capsula 4". Although Thunberg did not publish these diagnostic characters in his Prodr. Willdenow distinguishes his

Tillaea decumbens as follows " ... foliis subulatis, petalis calyce brevioribus" and which could very well apply to the top specimen of sheet 7750 in Thunberg's Herbarium. Also, the coincidence in the wording seem to indicate that Willdenow had seen this specimen so that it was chosen as the lectotype.

Thunberg (1823) described C. debilis probably based on this specimen but there is a much more typical specimen of this species deposited in Burman's Herbarium (G).

15a. subsp. thunbergiana

C. thunbergiana Schult., Syst. Veg. 6 : 733 (1820).

Tillea decumbens Willd., Sp. Pl. 1 : 721 (1798).

Type: same as for C. thunbergiana.

C. debilis Thunb. in Fl. Cap. ed. Schultes 280 (1823);

DC., Prodr. 3 : 388 (1828); Harv., Fl. Cap. 2 : 367 (1862);

Tölken in J. S. Afr. Bot. 38 : 80 (1972).

Type: same as for C. thunbergiana.

Thisantha decumbens (Thunb.) Eckl. & Zeyh., Enum. 302 (1837).

Crassula decumbens sensu Harv., Fl. Cap. 2 : 353 (1862),

non Thunb.

C. zeyheriana Schönl. in Ann. Bolus Herb. 2 : 60, fig. 9

& plate 4, fig. 12 (1916); et in Trans. Roy. Soc. S. Afr.

17 : 187 (1929); Adamson, Fl. Cape Penins. 432 (1950).

Syntypes: Cape, near Greenpoint and Saldanha Bay, Ecklon &

Zeyher 1933 (S!; SAM!); Simons Bay, Wright 552 (TCD!);

561 (TCD!); Green Point, Zeyher 651 (BM!; G!; GRA!; K!;

P!; S!; TCD!).

Annuals erect or decumbent with soft herbaceous and rarely wiry branches.

Inflorescence sessile axillary dichasia with few to many flowers and usually with indistinct bracts at the base.

On sandy soils and often on dunes but usually not in shaded places; occurring from the south-western Cape to Garies and also in the eastern Cedarberg.

Flowering Period: August - November.

Diagnostic Features:

See under the species.

Specimens examined:

CAPE. - 3017 (Hondeklipbaai): Bajavlei (-BB), Tölken 3490 (BOL). 3118 (Vanrhynsdorp): near Vaalvlei (-CD), Tölken 3489 (BOL); Sandkraal (-DA), Acocks 14 834 (PRE); 56 Km south of Vanrhynsdorp (-DC), Tölken 3486 (BOL). 3119 (Calvinia): near Nieuwoudtville (-AC), Maquire 2675 (NBG). 3218 (Clanwilliam): Papkuil's Vlei (-CB), Barker 2644 (NBG); Piketberg, Pillans 7958 (BOL). 3219 (Wuppertal): Brandewyn River (-AA), Barker 4737 (NBG); Olifant's River Cave (-CC), Steyn 514 (NBG); Boplaas (-CD), Tölken 4147 (BOL); Skurweberge, Esterhuysen 20 612 (BOL). 3317 (Saldanha): Saldanha Bay (-BB), Ecklon & Zeyher 1933 (S, SAM). 3318 (Cape Town): near Langebaan (-AA), Lewis 1671 (SAM); near Hopefield (-AB), Bolus s.n. (BOL); Groenkloof (-AD), Bolus 4276 (BOL); Porterville (-BB), Schlechter 4880 (BOL, GRA); 10 739 (BOL, GRA, PRE); Kamp's Bay (-CD), Zeyher 5077 (SAM); Green Point (-CD), Zeyher 651 (BM, G, GRA, K, P, S, TCD); Platteklip (-CD), MacDwan s.n. (GRA); Rondebosch (-CD), Wolley Dod 459 (GRA); 460 (BOL, GRA, PRE); east of Cape Town (-DC), Young in TRV 26 923 (PRE); Stellenbosch (-DD), Taylor 6372a (STE). 3319 (Worcester): near Gouda (-AC), Esterhuysen 18 811 (BOL); Hex River Valley (-BC), Tyson 639 (PRE); Hottentotskloof (-BC), Barker 1217 (NBG), near Worcester (-CB), Zeyher s.n. (GRA). 3320 (Montagu): Whitehill (-BA), Compton 11 229 (NBG). 3418 (Simonstown): Simons Bay (-AB), Wright 552 (TCD); 561 (TCD); near Hout Bay (-AB), Acocks 672 (PRE); near Wynberg (-AB), Schlechter 1529 (GRA). 3419 (Caledon): near De Kelders (-CB), Taylor

4094 (PRE, STE); de Dam (-DC), Acocks 22 769 (PRE). 3420 (Bredasdorp): Die Poort (-CA), Leighton s.n. (BOL). Cape, Thunberg in Herb. Thunberg 7750a (G, UPS).

15b. subsp. minutiflora (Schonl. & Bak. f.) Toelken, comb. nov. et stat nov.

*C. minutiflora* Schonl. & Bak. f. in J. Bot., Lond. 40 : 288 (1902); Schonl. in Ann. Bolus Herb. 2 : 62 (1916) et in Trans. Roy. Soc. S. Afr. 17 : 187 (1929); Friedr. in Prodr. Fl. S. W. Afr. 52 : 32 (1968).

Type: Cape, Steinkopf, Schlechter 11 496 (GRA, holo!; BM!; BOL!).

Annuals with decumbent and wiry branches. Inflorescence with peduncle 0,1 - 1 cm long on which the axillary inflorescences are born and with ovate to lanceolate bracts below the flowers.

In sandy soils in open arid vegetation; recorded only from near Steinkopf and near Aus.

Flowering Period: August - October.

Diagnostic Features:

See under the species.

Specimens examined:

SOUTH WEST AFRICA. - 2612 (Aus): Kubub (-CB), Giess & Van Vuuren 863 (PRE).

CAPE. - 2719 (Springbok): Steinkopf (-BB), Schlechter 11 496 (BM,

BOL, GRA); near Buffelsrivier Mine (-DA), Toelken 3582 (BOL).

16. C. decumbens Thunb., Prodr. 54 (1794) et Fl. Cap. ed. Schultes 280

(1823); DC., Prodr. 3 : 389 (1828); Schonl. in Ann. Bolus Herb. 2 : 53, fig. 4, plate 2, fig. 5 (1916) et in Trans.

Roy. Soc. S. Afr. 17 : 183 (1929); Adamson in Fl. Cape Penins. 431 (1950).

Type: Cape, near Cape, near Cape Town, Thunberg in UPS 7751  
(UPS, lecto!; BM!; STB!).

Annuals with erect or decumbent branches 4 - 12 cm long, soft, brown and translucent when young, glabrous with internodes of varying length. Leaves sessile, linear-lanceolate, elliptic or oblanceolate, 0,3 - 0,8 (-1) cm long, 0,05 - 0,2 cm broad, acute or obtuse, usually slightly constricted towards the base, more or less flat on top and convex below, glabrous, very fleshy, green to reddish-brown; sheath 0,1 - 0,2 cm long, membranous. Hydathodes few along the margin, inconspicuous. Inflorescence terminal and lateral 4 or 5-merous flowers with short pedicel which elongates slightly when the fruit are mature. Sepals lanceolate, 1 - 2 (-3) mm long, acute, glabrous or with denticulate margin, slightly fleshy, green. Petals lanceolate to broadly ovate, 2 - 3 (-5) mm long, acute to acuminate and without a dorsal appendage, spreading, white or cream. Stamens 0,8 - 2 mm long, with yellow anthers 0,1 - 0,2 mm long and broad, with filaments slightly broadened downwards and scarcely fused to the petal tube. Squamae T-shaped to transversely oblong-cuneate, 0,2 - 0,3 x 0,1 - 0,5 mm, usually truncate, more or less abruptly constricted towards the base and length of narrow base half the width of the broad apical portion, almost membranous and slightly thickened towards the apex, pale yellow or white. Carpels with reniform ovaries gradually constricted into short styles with terminal stigmas; ovary smooth or with a few papillae and with (2-) 4 - 8 (-12) elongate ovules with a minutely papillose surface.

Diagnostic Features:

C. decumbens is similar to C. thunbergiana but is distinguished by its more robust habit, longer petals (2 - 4 (-5) mm long) and usually more than 4 ovules per carpel.

The var. brachyphylla is distinguished from the var. decumbens by its almost terete leaves with an obtuse apex and its petals are usually ovate and 3,5 - 5 mm long.

Variation and taxonomic Notes:

C. decumbens is a very variable species with a number of local variants and two varieties. It is the var. decumbens, which shows such a wide range of variation and under extreme conditions the whole plant does not become bigger than 1 cm high (Tölken 4145). These plants have also unusual squamae, which are oblong-cuneate and seem to be commonly found in plants from the Bokkeveld and the Kamiesberg (Tölken 2917). The type plant of C. leipoldtii shows an intermediate range of squamae which links up with those of the typical var. decumbens.

The leaves and sepals of the var. decumbens are usually slightly papillose towards the apex when young, but in plants from the Langeberg mountains this is also visible in mature leaves and sepals, but this does not seem to warrant taxonomic rank, as this phenomenon becomes less distinct westwards.

The var. brachyphylla shows very little variation except for that induced by environmental conditions. Its characteristic leaves with an obtuse apex vary somewhat, and in the vicinity of Bredasdorp the two varieties cannot be clearly distinguished. Also, the leaves of the var. brachyphylla shrivel usually very much when dried, so that the two varieties can mainly be distinguished by the size of the flowers. However, in the Kamiesberg even this character becomes less distinct (cf. Tölken 2917 & 3669), but because the typical C. decumbens has oblong-cuneate squamae in this area, the two taxa can still be identified. The two varieties are maintained because of the distinct preference by the var. brachyphylla for marshy areas with signs of high salinity. On the Cape Flats the two varieties are often found within a hundred meters of one another, and while the var. brachyphylla occurs

in depressions or around vleis, the var. decumbens grows in the sandy soils nearby.

Thunberg (1794) described C. decumbens with the diagnostic character "foliis subulatis". There are four specimens identified as this species in Thunberg's herbarium. Of those sheets 7752 and 7753 must be identified as C. filiformis, and sheet 7750 consists of three specimens of C. decumbens var. brachyphylla and a specimen of C. thunbergiana. Sheet 7751 was selected as the type of C. decumbens, as it contains three specimens that agree with the original diagnosis. The annotation of the sheets as C. decumbens a, b, c, d seems not to refer to different taxa envisaged but rather represents Thunberg's system of numbering the specimens. He did not describe any subspecific taxa.

16a var. decumbens

C. decumbens Thunb., Prodr. 54 (1794) et Fl. Cap. ed. Schultes 280 (1823); DC., Prodr. 3 : 389 (1828); Schonl. in Ann. Bolus Herb. 2 : 53, fig. 4, plate 2, fig. 5 (1916) et in Trans. Roy. Soc. S. Afr. 17 : 183 (1929); Adamson in Fl. Cape Penins. 431 (1950).

Tillaea decumbens (Thunb.) Willd., Syst. Veg. 1, 2 : 721 (1798).

Bullardia trichotoma Eckl. & Zeyh., Enum. 290 (1837); Harv. Fl. Cap. 2 : 330 (1862).

Type: Cape, Table Mountain, Ecklon & Zeyher 1851 (S!; SAM!).

Tillaea trichotoma (Eckl. & Zeyh.) Walp., Rep. 2 : 251 (1843).

C. leipoldtii Schonl. & Bak. f. in J. Bot. 40 : 288 (1902).

Type: Cape, Clanwilliam, Leipoldt 392 (GRA, holo!; PRE!).

C. langebergensis Schonl. in Trans. Roy. Soc. S. Afr. 17 : 184 (1929).

Type: Cape, Langeberg, Muir 3354 (GRA, holo!).

Plants usually decumbent and rarely in dense stands. Leaves subulate and with a terminal pointed papilla, 0,4 - 0,8 (-1) cm long. Petals lanceolate, acute and rarely much longer than the sepals. Squamae oblong-cuneate to broadly T-shaped and with narrow base half as long as the upper portion wide.

On sandy soils or gravelly slopes; occurring mainly in the south-western Cape Province but extending its distribution to the Kamiesberg in the north and Port Elizabeth in the east.

Flowering Period: September - November.

Diagnostic Features:

See under the species.

Specimens examined:

CAPE. - 3018 (Kamiesberg): near Leliesfontein (-AC), Tölken 3669 (BOL).  
 3118 (Vanrhynsdorp): Sandkraal (-DA), Acocks 14 832 (PRE). 3119  
 (Calvinia): Oorlogskloof (-AC), Diels 621 (GRA). 3217 (Vredenburg):  
 Witteklip (-BB), Leighton 594 (BOL). 3218 (Clanwilliam): Clanwilliam  
 (-BB), Leipoldt in SAM 35 953; 392 (GRA); Papkuil Valley (-CB), Barker  
 2643 (NBG). 3219 (Wuppertal): Krom River (-CB), Esterhuysen 20 489  
 (BOL); Wydekloof (-CC), Esterhuysen 33 010 (BOL); Boplaas (-CD),  
Tölken 4145 (BOL). 3318 (Cape Town): Langebaan (-AA), Leighton s.n.  
 (BOL); Groenkloof (-AD), Bolus 4277 (BOL); Darling Reserve (-AD),  
Barker 8649 (NBG); Lewis 5045 (NBG); Porterville (-BB); Schlechter  
 2163 (PRE); Table Mountain (-CD), Ecklon & Zeyher 1851 (S, SAM);  
Zeyher 2511 (SAM); Sea Point (-CD), MacDwan s.n. (GRA); Klipfontein  
 road (-DC), Tölken 4217 (BOL); Pinelands (-DC), Salter s.n. (NBG).  
 3321 (Ladismith): Kamscheberg (-CD), Muir 3354 (GRA, PRE). 3325  
 (Port Elizabeth): Swartkops River (-DC), Zeyher 5071 (SAM); Humewood  
 (-DC), Paterson 2298 (GRA); Rodin 1083 (BOL, PRE). 3418 (Simonstown):  
 Wynberg (-AB), Schlechter 1527 (GRA); Hout Bay (-AB), Acocks 671 (PRE);  
 Somerset West (-BB), Parker 3865 (BOL, NBG). 3419 (Caledon): Rivier-

sonderend (-BB), Zeyher 2511 (SAM); Pearly Beach (-CB), Acocks 22 976 (PRE). 3420 (Bredasdorp): Bontebok Park (-AD), Taylor 311 (NBG). 3421 (Riversdale): Riversdale (-AB), Rust 269 (GRA); Albertinia (-BA), Muir 1639 (BOL); Kleinberg (-BB), Galpin 4014 (PRE).

16b. var. brachyphylla (Adamson) Toelken, comb. nov. et stat. nov.

C. brachyphylla Adamson in J. S. Afr. Bot. 8 : 276 (1942)  
et Fl. Cape Penins. 431 (1950).

Type: Cape, slopes of Devil's Peak, Ecklon & Zeyher 1852  
(G!; GRA!; K!; S!; SAM!).

Bullardia brevifolia Eckl. & Zeyh., Enum. 290 (1837); Harv.  
Fl. Cap. 2 : 330 (1862).

Type: same as for C. brachyphylla.

Tillaea brevifolia (Eckl. & Zeyh.) Walp., Rep. 2 : 251 (1843).

Crassula brevifolia (Eckl. & Zeyh.) Schonl. in Ann. Bolus Herb.  
2 : 54, plate 3, fig. 6 (1916) et in Trans. Roy. Soc. S. Afr.  
17 : 184 (1929), nom. illeg. - non Herv.

Plants erect and usually in dense stands. Leaves almost cylindrical to club-shaped, with blunt and rounded apex, 0,3 - 0,5 cm long. Petals usually broadly ovate, acute to acuminate and often twice as long as the sepals. Squamæ broadly T-shaped with narrow base half as long as the upper portion wide.

In saline salt marshes and usually along the sea; locally common along the coast from Namaqualand to near Bredasdorp.

Flowering Period: September - November.

Diagnostic Features:

See under the species.

Variation and taxonomic Notes:

In contrast to the var. decumbens, the var. brachyphylla shows little variation and only the size of the plant and leaves vary with environmental conditions (see also under the species).

Specimens examined:

CAPE. - 2917 (Springbok): 27 Km south Springbok (-DD), Toelken 2917 (BOL). 3218 (Clanwilliam): Alexander Hoek (-BD), Schlechter 5140 (BOL, GRA, PRE); Sour (-DC), Compton 15 137 (NBG); Steyn 554 (NBG). 3318 (Cape Town): Langebaan (-AA), Lewis & Leighton s.n. (BOL); near Hopefield (-AB), Bolus 12 677 (BOL, GRA, NH, PRE); Darling (-AD), Axelson 521 (NBG); Darling Reserve (-AD), Lewis 5046 (NBG); Porterville (-BB), Schlechter 4888 (BOL, GRA); Bokbaai (-CB), Esterhuysen 3807 (BOL, PRE); Barker 1211 (NBG); Mamre (-CB), Compton 9822 (NBG); base of Devil's Peak (-CD), Ecklon & Zeyher 1852 (G, GRA, K, PRE, S, SAM); Three Anchor Bay (-CD), Woolley Dod 1535 (GRA, PRE)<sup>BOL</sup>; Kenilworth (-CD), Bolus 7215 (BOL, NH, PRE). 3418 (Simonstown): Wynberg (-AB), Wilms 3202 (GRA); Kommetjie (-AB), Toelken 1596 (BOL); between Strand and Gordon's Bay (-BB), Parker 4444 (BOL, NBG, SAM). 3419 (Caledon): Stanford Lagoon (-AD), Compton 19 931 (NBG); Frikkies Bay (-CB), Compton 22 139 (NBG). 3420 (Bredasdorp): Bredasdorp (-CA), Esterhuysen 19 036 (BOL, PRE); Die Poort (-CA), Wasserfall 394a (NBG).

17. C. minuta Toelken, sp. nov. ab C. vaillantio sepalis petales

aequantibus et squamis transverse oblongis et abrupte

cuneatis; ab C. decumbenti foliis ad 3 mm longes et flori-

bus terminalibus differt.

Herbae annuae ramis erectis 1 - 3 cm longis leviter rigidis, glabrae, internodiis aequalibus. Folia sessilia, linearia vel elliptica, 0,1 - 0,2 (-0,3) cm longa, 0,05 - 0,1 cm lata, plerumque obtusa, plus minusve plana supra et convexa subtus, glabra, succulenta, viridia vel testacea; vagina c. 0,05 cm longa, membranacea. Hydathodi paucae secus marginem, inconspicuae. Inflorescentia plerumque flores singulares terminales et pedicellis brevibus. Sepala elliptico-lanceolata, 1 - 1,5 mm longa, acuta, glabra, viridia vel testacea. Petala lanceolata, 1 - 1,5 mm

longa, obtusa et sine appendicibus dorsalibus, connata tubo ad 0,3 mm longam, effusa, alba vel eburnea et saepe rubroincta. Stamina c. 1 mm longa, antheris flavis c. 0,1 mm longis et latis, filamentis vix latis factis ad bases. Squamae transverse oblongatae et abrupte cuneatae, 0,4 - 0,5 x 0,5 - 0,6 mm, truncatae abrupte constrictae ad bases, paene membranaceae, pallide flavae vel albae. Carpella ovariis oblongo-reniformibus gradate constrictis ad styles breves et stigmatibus terminalibus; ovarium leve et 2 - 4 ovulis elongatis leviter papillois.

Type: Cape, Scorpionsberg, Esterhuysen 12 233 (BOL, holo!; PRE!).

Annuals with erect branches 1 - 3 cm long and usually more or less wiry, glabrous, with pairs of leaves at about equal distances from one another. Leaves sessile, linear-elliptic, 0,1 - 0,2 (-0,3) mm long, 0,05 - 0,1 cm broad, usually obtuse, more or less flat above and convex below, glabrous, fleshy, green to reddish-brown; sheath c. 0,05 cm long, membranous. Hydathodes few along the margin, inconspicuous. Inflorescence usually single 4-merous flowers on short pedicels at the end of the branches. Sepals elliptic-lanceolate 1 - 1,5 mm long, bluntly acute, glabrous, green to reddish-brown. Petals lanceolate, 1 - 1,5 mm long, obtuse and without dorsal appendage, fused into a tube 0,3 mm long, spreading, white or cream and often tinged red. Stamens c. 1 mm long and broad, with filaments scarcely broadened downwards and hardly fused to the tube. Squamae transversely oblong and abruptly cuneate, 0,4 - 0,5 x 0,5 - 0,6 mm, truncate, abruptly constricted towards the base, almost membranous, pale yellow or white. Carpels with oblong-reniform ovaries gradually constricted into short styles and with terminal stigmas; ovary smooth and with 2 - 4 elongate ovules which are faintly papillose.

In rock basins at the summit of mountains in the northern Cedarberg.

Flowering Period: September, October.

Diagnostic Features:

Plants of C. minuta are not taller than 3 cm and have leaves 1 - 2 (-3) mm long. The sepals are as long as the petals, a character which places the species into the sect. Glomeratae in spite of its superficial resemblance to C. vaillantii. The flowers are similar to C. decumbens, but the whole plant is smaller.

Variation and taxonomic Notes:

This species is known only from two localities and does not show much variation. Plants brought into cultivation did not thrive nor flower.

Specimens examined:

CAPE. - 3219 (Wuppertal): Scorpionsberg (-AC), Esterhuysen 12 233 (BOL, PRE); Tafelberg (-AC), Esterhuysen 13 854 (BOL).

18. C. hirsuta Schonl. & Bak. f. in J. Bot., Lond. 36 : 365 (1898);

Schonl. in Ann. Bolus Herb. 2 : 62, fig. 11 & plate 4, fig. 13 (1916) et in Trans. Roy. Soc. S. Afr. 17 : 187 (1929).

Type: Cape, Mesklip, Schlechter 11 283 (GRA, holo!; BM!;

BOL!; G!; PRE!; Z!).

C. guilelmi trollii Stopp in Beitr. Biol. Pfl. 34 : 174, fig. 8 (1959).

Type: Cape, Aalwynsfontein, Stopp M 7322 (BOL, iso!).

Annuals with stiffly erect branches up to 6 cm long and brown, with most parts covered with spreading hairs, more or less branched and leaves more or less evenly spaced on the branches. Leaves sessile, linear-triangular, 0,3 - 0,8 (-1,2) cm long, 0,05 - 0,2 cm broad, dorsiven-

trally flattened and often more or less cymbiform, acute and drawn into a terminal hair, usually glabrous above but with spreading hairs below and with marginal cilia, slightly fleshy but leathery, green becoming reddish-brown; sheath 0,05 - 0,1 cm long and membranous. Hydathodes a few along the margin, inconspicuous. Inflorescence terminal and lateral dichasia with 5-merous flowers each on a short pedicel rarely longer than 0,2 cm. Sepals broadly triangular, 1 - 1,5 mm long, obtuse, with scattered spreading hairs and marginal cilia, carnose, green to brown. Petals oblong-elliptic, 1 - 1,5 mm long, obtuse and without dorsal appendage, fused into a tube 0,1 - 0,2 mm long, erect, white. Stamens up to 1,2 mm long, with brown anthers 0,1 - 0,2 mm long and broad, with filaments becoming somewhat broader towards the base but slightly constricted where fused to the petal tube. Squamae narrowly oblong-cuneate, 0,2 - 0,3 x 0,05 - 0,1 mm, truncate or rounded at the apex, first abruptly then slightly constricted towards the base, almost membranous, yellow. Carpels with broad reniform ovaries abruptly constricted towards the thin styles up to one-third of the length of the ovaries and with terminal stigmas; ovary with sharply pointed papillae mainly towards the apex and with two ovules covered faintly with ridges.

Usually on bare patches on sandy or gravelly slopes; occurring from near Montagu along the Tanqua Karoo and widespread in the eastern parts of Namaqualand.

Flowering Period: July - September.

Diagnostic Features:

C. hirsuta is distinguished by its hairy leaves and branches as well as its terminal and lateral inflorescences. It shows superficial resemblance to C. bergoides, but the latter has leaves at least 0,2 cm broad and more than ten ovules per carpel.

Variation and taxonomic Notes:

Schonland (1898 and 1916) described the species as having only one ovule but all plants investigated including several specimens of the type specimen have two ovules. Usually the lower ovule is aborted and under those conditions the lower part of the carpels does not swell up but remains stalk-like. It seems that generally under dry conditions only one ovule develops in all carpels but the lower aborted ovule is clearly visible at the base (Tölken 1569). This finding is of particular interest as the lower ovule, which is half-embedded in the receptacle, is released when the carpel breaks off along an abscission at its base. The upper seed is never released and remains enclosed in the pericarp which becomes particularly thick and hard around it.

C. guilelmi trollii was described under the impression that C. hirsuta was uniovulate and thus must be relegated to the synonymy of the latter species.

Specimens examined:

CAPE. - 2817 (Violsdrif): near Stinkfontein (-CD), Mathews in NBG 2158/29 (BOL). 2917 (Springbok): Mesklip (-DD), Schlechter 11 283 (BM, BOL, G, GRA, PRE, Z). 3018 (Kamiesberg): near Aalwynfontein (-BC), Stopp M 7322 (BOL). 3118 (Vanrhynsdorp): Sandkraal (-DA), Acocks 14 833 (PRE). 3119 (Calvinia): Top of Vanrhyn's Pass (-AC), Tölken 1568 (BOL). 3219 (Wuppertal): Middelberg (-AC), Pocock 735 (STE); Krom River (-CB), Esterhuysen 20 589 (BOL); Boplaas (-CD), Tölken 4146 (BOL). 3318 (Cape Town): Malmesbury (-BC), Schlechter 1587 (BOL). 3319 (Worcester): Lakensvlei (-BC), Barker 1212 (NBG).

19. C. bergioides Harv., Fl. Cap. 2 : 352 (1862); Schonl. in Ann.

Bolus Herb. 2 : 67, plate 6, fig. 20 (1916); in Trans. Roy. Soc. S. Afr. 17 : 189 (1929).

Type: Cape, Breede River near Kenkø, Zeyher 2575 (S, holo!;

FI!; SAM! ).

C. aristata Schonl. in Bot. Jahrb. 43 : 362 (1909); in Ann. Bolus Herb. 2 : 68, fig. 14 (1916) et in Trans. Roy. Soc. S. Afr. 189 (1929).

Type: Caput bonae spei, sine leg. (B, holo ).

C. pusilla Schonl. in Rec. Albany Mus. 2 : 451 (1913).

Type: Cape, near Worcestor, Schonland s.n. (GRA, holo!; BOL!).

Annuals with erect branches 2 - 6 cm high, little branched and with wiry brown branches glabrous and with internodes of about equal length. Leaves sessile lanceolate to narrowly triangular, 0,4 - 0,8 (-1,2) cm long, 0,2 - 0,4 cm broad, with pointed apex and terminal seta, glabrous, with a horny-papillose margin, dorsiventrally flattened or rarely slightly convex below, slightly fleshy but leathery, green to brown; sheath up to 1 mm long, membranous. Hydathodes few along the margin of the leaf, inconspicuous. Inflorescence consisting of lateral cymes with 3 - 5 (-8) flowers which are 5-merous and usually sessile or nearly so. Sepals triangular, 2 - 3 mm long, sharply acute and with a terminal awn and about as long as the petals, papillose-scabrid, somewhat fleshy, green. Petals triangular-lanceolate, bluntly acute and more or less distinctly keeled towards the apex, fused into a tube up to 0,8 mm long, white becoming brown. Stamens c. 2 mm long with yellow anthers 0,2 - 0,3 mm long, with filaments slightly broadened towards the base and considerably constricted where fused to the petal tube. Squamae broadly oblong-cuneate 0,4 - 0,7 x 0,3 - 0,5 mm, truncate or slightly emarginate, abruptly constricted below the apex into a thin stalk, membranous, pale yellow. Carpels with reniform ovaries, gradually constricted into short styles with insignificant terminal stigmas; ovary with sharp papillae towards the apex and fine cilia along the suture and with 10 - 14 elongate ovules with faint ridges almost glabrous.

On gravelly slopes usually in open places in fynbos vegetation; occurring in the mountains between Worcester and Caledon.

Flowering Period: September, October.

Diagnostic Features:

C. bergioides is a more robust plant than C. hirsuta and the former is distinguished from other species in this group by the cilia and the terminal awn on the leaves and sepals in addition to its sessile axillary inflorescences.

Variation and taxonomic Notes:

The size of the plants and the leaves varies considerably with conditions. However, the petals are rarely only half the length of the sepals and therefore C. aristata for which the sepals are described as being three times as long as the petals seems quite distinct. However, some plants of the collection Esterhuysen 32 490 fit the description of C. aristata even in that respect, in fact, a full range from sepals just longer than the petals to three times their length can be observed in that collection. Also, the terminal awn on the leaves is particularly long in plants with very long sepals, so that the two characters by which Schonland (1913) distinguished C. aristata from C. pusilla, a species which he himself (1916) placed into the synonymy of C. bergioides, cannot be upheld. The type of C. aristata was destroyed in Berlin Herbarium.

Specimens examined:

CAPE. - 3319 (Worcester): Lakensvlei (-BC), Barker 1213 (NBG); near Worcester (-CB), Schonland s.n. (BOL, GRA); Olivier 289 (PRE, STE); Villiersdorp (-CD), Esterhuysen 32 060 (BOL). 3419 (Caledon): Houw-Hoek (-AA), Esterhuysen 32 490 (BOL); Steenboksberg (-AD), Esterhuysen 32 298 (BOL); Greytown (-BA), Esterhuysen 32 292 (BOL). 3420 (Bredasdorp): Kenko (-BA), Zeyher 2575 (FI, S, SAM). 3421 (Riversdale): Riversdale (-AB), Schlechter 1805 (BOL, GRA, PRE).

20. C. campestris (Eckl. & Zeyh.) Endl. ex Walp., Repert. 2 :

253 (1843); Harv., Fl. Cap. 2 : 351 (1862); Schonl. in Trans. Roy. Soc. S. Afr. 17 : 188 (1929); Friedr. in Prodr. Fl. S. W. Afr. 52 : 25 (1968).

Type: Cape, Swartkops River, Ecklon & Zeyher 1873 (FI!; G!; S!; SAM!; TCD!).

Tetraphyle campestris Eckl. & Zeyh., Enum. 294 (1837).

Sedum campestre Kuntze, Rev. Gen. Pl. 2 : 83 (1898).

Annuals with erect rarely decumbent stems up to 10 cm long, little branched and with branches brown or translucent, with internodes unequally long and without adventitious roots. Leaves sessile, lanceolate to narrowly triangular, (0,2-) 0,4 - 0,6 (1) cm long, 0,1 - 0,2 (-0,3) cm broad, bluntly acute and with papillae or ending in a colourless awn, flat above and more or less convex below, glabrous or rarely denticulate along the margin towards the base, green to brown; sheath up to 0,02 cm long, membranous. Hydathodes few along the margin, inconspicuous. Inflorescence axillary dichasia sessile or pedunculate and with few to many 5-merous flowers densely clustered, but often with elongating pedicels when fruiting. Sepals narrowly triangular to lanceolate, 1 - 1,5 mm long, acute and ending in a colourless awn, slightly fleshy, green to brown. Petals triangular 0,5 - 0,8 mm long, acute acuminate and usually folded at the apex after flowering, but without a dorsal appendage, fused into a tube up to 0,2 mm long, erect, pale yellow to brown. Stamens c. 0,5 mm long, with yellow anthers 0,1 - 0,2 mm long, with filaments slightly broadened towards the base and abruptly constricted where fused to the petal tube. Squamae oblong-cuneate, 0,25 - 0,4 x 0,1 - 0,15 mm, rounded or truncate at the apex, first more or less abruptly but later gradually constricted towards the base. Carpels with oblong-reniform ovaries gradually constricted into thin styles about a quarter of the length

ditions but such plants have in contrast to the subsp. pharnaceoides a decumbent habit. In other words, the two subspecies can only be distinguished with certainty by the elongate seeds and the northern distribution of the subsp. pharnaceoides.

20a. subsp. campestris

C. campestris (Eckl. & Zeyh.) Endl. ex Walp., Rep. Bot. Syst. 2 : 253 (1843); Harv., Fl. Cap. 2 : 351 (1862); Schonl. in Ann. Bolus Herb. 2 : 64 (1918) et in Trans. Roy. Soc. S. Afr. 17 : 188 (1929); Friedr. in Prodr. Fl. S. W. Afr. 52 : 25 (1968).

Tetraphyle campestris Eckl. & Zeyh., Enum. 294 (1837).

Sedum campestre Kuntze, Rev. Gen. Pl. 2 : 83 (1898).

Plants usually each with an erect brown stem rarely partly translucent and decumbent. Leaves often bluntly acute and papillose at the apex. Squamae oblong-cuneate, usually rounded at the apices and gradually constricted towards the base. Seeds ovoid and usually slightly longer than broad.

Usually on gravelly slopes or rarely on shallow soil on rocks; occurring in most parts of the Cape Province except in the central Great Karoo, but also occasionally found in the southern Orange Free State and southern South West Africa.

Flowering Period: August - November.

Diagnostic Features:

See under the species.

Variation and taxonomic Notes:

The leaves of this subspecies vary greatly from narrowly to broadly lanceolate and with or without colourless apex (see also under the species).

Tetraphyle lanceolata is often included in the synonymy of this taxon, but the type specimen reveals that it is a shade form of C. pentandra.

Specimens examined:

ORANGE FREE STATE. - 2925 (Jagersfontein): Fauresmith (-CB), Smith 466 (PRE); Pole Evans & Smith 1800 (PRE). 2926 (Bloemfontein): Tempe Farm (-AA), Potts 2568 (PRE).

CAPE. - 2823 (Griekwastad): 33 Km east of Postmansburg (-AD), Acocks 603 (BOL, PRE). 2917 (Springbok): Karruchab Poort (-AA), Tölken 3577 (BOL); near Buffels River Mine (-DA), Tölken 3583 (BOL); Arakup (-DB), Schlechter 11 250 (GRA, PRE). 2924 (Hope Town): Orange River Station (-CA), Acocks 8776 (PRE). 3017 (Hondeklipbaai): near Hondeklipbaai (-AD), Pillans in BOL 18 016; near Wallekraal (-BC), Tölken 3483 (BOL). 3218 (Clanwilliam): Elandsberg (-AD), Pillans 8081 (BOL); Versveld Pass (-DC), Tölken 1558 (BOL). 3219 (Wuppertal): Pakhuisberg (-AA), Schlechter 8651 (GRA, PRE); Elandskloof (-CA), Stokoe in SAM 69 670; Krom River (-CB), Esterhuysen 20 509a (BOL); 20 462 (BOL). 3225 (Somerset East): Cradock Bergsebra Park (-AB), Brynard 95 (PRE). 3227 (Stutterheim): King William's Town (-CB), Sim 1766 (GRA, PRE); Komga (-DB), Flanagan 889 (PRE, SAM); 1795 (SAM); Prospect Siding (-DB), Flanagan s.n. (PRE). 3318 (Cape Town): Signal Hill (-CD), Guthrie in BOL 16 767; Platteklip (-DC), Zeyher 5076 (SAM); Table Mountain (-DC), Marloth 8205b (PRE). 3319 (Worcester): Hottentotskloof (-BC), Barker 1216 (NBG); Hex River Valley (-BC), Iyson 639 (SAM); near De Doorns (-BC), Tölken 3494 (BOL); Worcester (-CB), Olivier 176 (PRE, STE). 3320 (Montagu): Whitehill (-BA), Compton 12 294 (NBG); Montagu Bath (-CA), Tölken 3526 (BOL). 3321 (Ladismith): near Bosluiskloof (-AD), Tölken 4108 (BOL); Top of Rooibergpas (-CB), Acocks 20 767 (PRE). 3325 (Port Elizabeth): near Kirkwood (-AD), Tölken 5014 (BOL); Swartkops River (-DC), Zeyher 2516 (SAM); Ecklon & Zeyher 1873 (FI, G, S, SAM, TCD); Redhouse (-DC), Paterson 1153 (BOL); Perseverance (-DC), Rodin 1251 (BOL, PRE). 3326 (Grahamstown): Port Alfred (-DB), Schonland 1556 (GRA, PRE). 3327 (Paddie): near Port Elizabeth (-BB), Rattray 214 (PRE). 3418 (Simons-

town): Orange Kloof (-AB), Schlechter 1321 (BOL); Kalk Bay (-AB), Adamson 3381 (SAM); 3383 (BOL). 3420 (Bredasdorp): Bontebok Park (-BA), Liebenberg 6486 (PRE, STE); Kenko (-BA), Zeyher 2514 (SAM). 3421 (Riversdale): near Riversdale (-AB), Muir 3353 (GRA, PRE); Bolus 11 278 (BOL). 3423 (Knysna): Knysna Heads (-AA), Schonland s.n. (GRA); Keurboomsrivier (-AB), Barnard in SAM 49 260. 3424 (Humansdorp): Kabeljou Rivier (-BB), Toelken 1251 (PRE).

20b. subsp. pharnaceoides (Hochst. ex Steud.) Toelken, comb.nov. et stat.nov.

C. pharnaceoides (Hochst. ex Steud.) Fischer & C.A. Mey.

in Ind. Sem. Hort. Petrop. 8 : 56 (1841); Walp., Rep. 2 : 254 (1843) Friedr. in Prodr. Fl. S. W. Afr. 52 : 33 (1868).

Type: Abyssinia, near Adoa, Schimper s.n. (B!; G!; GRA!; P!; S!).

Tillaea pharnaceoides Hochst. ex Steudel, Nomencl. Bot. ed. 2, 2 : 687 (1841); Britt., Fl. Trop. Afr. 2 : 387 (1871).

Combesia abyssinica Rich., Tent. Fl. Abyss. 1 : 307 (1848), nom. illeg.

Tillaea pentandra sensu Hiern, Cat. Afr. Pl. Welw. 1 : 324 (1896).

Crassula muscosa sensu Dinter in Fedde Repert 16 : 243 (1919).

Plants with erect translucent stems, i.e. on either side of the vascular strand is a membranous margin in herbarium material. Leaves more or less papillose towards the apex and usually ending in a colourless terminal awn. Squamae oblong-cuneate, first abruptly then gradually constricted towards the base. Seeds elongate, about twice as long as broad.

Usually in moist shaded positions under rocks or under plants but usually in coarse sandy soils and often in association with granite; occurring in central and northern South West Africa, but also widespread in Tropical East Africa and into Abyssinia.

Flowering Period: December - March.

Diagnostic Features:

See under the species.

Variation and taxonomic Notes:

The flowering period of this species is somewhat different from the subsp. campestris, but this must probably be attributed to the fact that the subsp. pharnacioides occurs in summer rainfall areas.

Combesia abyssinica is an illegitimate name because it is based on Tillaea pharnaceoides, but there is no reason why it should change its name when the species is transferred to this new genus.

Specimens examined:

SOUTH WEST AFRICA. - 2115 (Karibib): Ameib (-DC), Giess, Volk & Bleissner 5830 (PRE, WIND). 2117 (Otjosondu): Otjisazu (-CC), Dinter 960 (SAM); Grünfelde (-CC), Giess 11 266 (WIND). 2118 (Steinhausen): Sturmfeld (-DB), Tölken 4331 (BOL). 2217 (Windhoek): Avis Dam (-CA), Kers 1093 (WIND).

21. C. pentandra (Royle ex Edgew.) Schonl. in Pflanzenfam., 3, 2a : 37 (1890); Brenan et al. in Mem. New York Bot. Gard. 8 : 433 (1954).

Type: India, Himalaya Mountains, Royle s.n. (K, holo!).  
Perennials 5 - 15 cm high, with decumbent spreading or fastigiate branches, irregularly branching or mainly from the base, with main branch and/or the main roots becoming fleshy and covered with dark brown peeling bark, with internodes usually visible between the leaves and young branches glabrous or sometimes covered with fine papillae and with old leaves usually remaining attached to the branches. Leaves sessile, triangular to lanceolate, (0,4-) 0,5 - 1,2 cm long, 0,15 - 2 (-0,3) cm broad, subulate and often with short colourless awn at the apex, sometimes shorter and broader towards the base of the stems, glabrous or with a few marginal teeth, more or less flat on both surfaces, fleshy

or leathery, green to grey-green or brown; sheath 0,05 - 0,2 cm long often with a few marginal teeth. Hydathodes few along the margins, inconspicuous. Inflorescence lateral cymules with 3 - 12 flowers usually sessile and in dense clusters with the subtending leaf being 2 - 4 times longer. Sepals narrowly triangular c. 1 mm long, acute but usually not awned, scarcely fleshy and usually as long or slightly longer than the petals. Petals narrowly triangular, up to 1 mm long, sharply acute and keeled towards the apex at least when old and without a dorsal appendage, fused into a tube 0,1 - 0,2 mm long, erect and folding along the midrib when fruiting, membranous, pale yellowish-green turning brown. Stamens 0,5 - 0,7 mm long, with yellow anthers 0,1 - 0,2 mm long and broad, with filaments slightly broadened downwards and scarcely fused to the petal tube. Squamae oblong-cuneate, 0,2 - 0,3 x 0,07 - 0,15 mm, truncate, at first abruptly constricted then more gradually, almost membranous, pale yellow or white. Carpels with oblong-reniform ovaries gradually constricted into short styles about a quarter of the length of the ovaries and with terminal stigmas; ovary smooth and with 2 glabrous, almost ovoid ovules.

Diagnostic Features:

The two perennial species C. pentandra and C. muscosa in this section are distinguished by the herbaceous or carnose stems and the sepals which are the same length as the petals in C. pentandra. Small plants of C. pentandra start branching from the soil level in contrast to plants of C. campestris which have a stalk with usually two to three internodes before they start branching. The filamentous shade-form of C. pentandra is distinguished from C. campestris by its internodes which are of equal length on the whole plant and the presence of adventitious roots where the branches touch the soil.

The var. pentandra is distinguished from the var. transvaalensis by its internodes which are of equal length on the whole plant and the stems are often rooting at the nodes.

Variation and taxonomic Notes:

C. pentandra is an extremely variable species complex which occurs in many parts of Africa and the type was collected in the western parts of the Himalaya mountains. This typical form has a tufted habit and its leaves are about 2 mm broad and usually the leaf sheath is 1,5 - 2 mm long. Plants of this form are also found westwards to Abyssinia, but then the leaves become more slender towards Tropical East Africa. In the latter region a few forms occur and among them one with decumbent branches which often roots at the nodes and its internodes are of equal length along the entire stem, is found. These plants are indistinguishable from the one form commonly found on Southern Africa.

From the Soutpansberg to the Cape Peninsula this form, the var. pentandra, is more or less commonly found and it usually grows in association with rock outcrops. When it grows in exposed positions the short branches are erect and the plant is more or less tufted, but in contrast to the var. transvaalensis the plants are irregularly branched. Shade forms vary from plants with decumbent branches to those slender, elongated branches which form dense mats in deep shade and in moist places. Herbarium material is superficially similar to that of C. campestris, but this form of the var. pentandra is very little branched, the internodes are more or less equal in length and the branches usually produce some adventitious roots. In the field plants of C. campestris are recognized by their erect habit and, in fact, the main branches start branching two to three nodes above the soil level. In the south-western Cape plants in exposed positions often have a carnose main stem. Such specimens should not be confused with those of C. muscosa, because the latter has woody stems and the sepals are two-thirds of the length of the petals. C. muscosa var. parvula is a rather delicate plant which has scarcely woody branches and often is decumbent under shady condition, so that

herbarium specimens of it can be distinguished from those of the var. pentandra only by the petals which are longer than the sepals and by bare stems at the base, because the leaves wear off soon. Young plants without flowers of the two taxa cannot be distinguished.

In the north-eastern parts of Rhodesia the second form, the var. transvaalensis, occurs. These plants have very short internodes at the base and also shorter leaves both of which become longer towards the middle of the stems, but the typical fleshy roots were not observed. Also, in South Africa sometimes plants without the conspicuously thickened roots are sometimes found in high rainfall areas such as the north-eastern Transvaal. This and the fact that plants grown in the glasshouse rarely develop tuberous roots indicates that these tubers are a response to adverse conditions at least during some time of the year. Under dry conditions and/or in areas with heavy frost the branches of the previous year die and the plants perennates in dense clusters of buds immediately above the soil surface. Even in plant where the aerial branches remain intact these buds are formed at the base of the stems.

21a. var. pentandra

C. pentandra (Royle ex Edgew.) Schonl. in Pflanzenfam. 3, 2a : 37 (1890); Brenan et al. in Mem. New York Bot. Gard. 8 : 433 (1954).

Tillaea pentandra Royle ex Edgew. in Trans. Linn. Soc. 20 : 50 (1846); Royle, Illustr. Bot. Himmel. Mtns 222 (1835), nom. nud.; Britten in Fl. Trop. Afr. 2 : 384 (1871), partly.

Crassula muscosa sensu Harv., Fl. Cap. 2 : 351 (1862), non L.

Tetraphyle muscosa (L.) Eckl. & Zeyh., Enum. 294 (1837), partly excl. specimens cited.

Sedum muscosum (L.) Kuntze, Rev. Gen. 3, 2 : 85 (1898),

partly, excl. specimen cited.

Tetraphyle lanceolata Eckl. & Zeyh., Enum. 294 (1837).

Type: Cape, Krakakamma, Ecklon & Zeyher 1874 (S!).

Crassula lanceolata (Eckl. & Zeyh.) Fischer & C.A. Mey.

in Ind. Sem. Hort. Petrop. 8 : 56 (1841); Walp., Rep.

2 : 254 (1843).

Tillaea subulata (Hook.f.) Britten var. illecebrioides Welw.

ex Hiern, Cat. Afr. Pl. Welw. 1 : 325 (1896).

Type: Angola, mountains of Morro de Monino, Welwitsch 2477

(BM, holo!; K!).

Crassula filamentosa Schonl. in Ann. Bolus Herb. 2 : 63

(1916) et in Trans. Roy. Soc. S. Afr. 17 : 188 (1929);

Burt Davy, Fl. Pl. Transv. 1 : 141 (1926); Friedr. in

Prodr. Pl. S. W. Afr. 52 : 28 (1968).

Type: Cape, Majuba, Hepburn 150 (GRA, holo!).

C. parvula sensu Schonl. in Ann. Bolus Herb. 2 : 66 (1916)

et in Trans. Roy. Soc. S. Afr. 17 : 188 (1927); Adamson

in Fl. Cape Penins. 432 (1950); Jacot Guill., Fl. Lesotho

182 (1971), non (Eckl. & Zeyh.) Endl. ex Walp.

Perennial rarely higher than 10 cm, spreading or decumbent, freely branching and if with fleshy roots then also with a carnose stem, with branches often rooting at the nodes. Leaves lanceolate or more or less sharply acute and often papillose towards the apex, with all leaves about equal in length. Cymules with 1 - 4 (-8) flowers, sessile and the whole inflorescence as long as or rarely up to half as long as the subtending leaf, not all branches with flowers. Sepals about the same length as the petals, acute and not awned.

In rock crevices or on shallow soil on rocks in full sunlight or in shade; occurring from the Cape Peninsula all along the mountains east of the Karoo and Kalahari into tropical Africa and Abyssinnia

and extending its distribution through Arabia into the south-western parts of the Himalaya mountains.

Flowering Period: December - July.

Diagnostic Features:

See under the species.

Variation and taxonomic Notes:

The variation was discussed under the species.

Harvey (1862) placed C. lanceolata into the synonymy of C. campestris, but the type specimen indicates that it is a branch of the filamentose shade form of the var. pentandra, and already the description of its habit as "caule decumbente filiformi, ramis diffusis" by Ecklon & Zeyher (1837) clearly indicates its identity. Two specimens of this collection in the South African Herbarium must be identified as C. campestris, and their branches are clearly not decumbent and filiform.

Specimens examined:

TRANSVAAL. - Soutpansberg (-DD), Compton 18 056 (NBG); 10 Km north-east of Louis Trichardt (-DD), Tölken 1211 (PRE). 2329 (Pietersburg): Blouberg (-AA), Codd 8776 (PRE); Esterhuysen 21 509 (BOL). 2330 (Tzaneen): Duiwelskloof (-CA), Scheepers 1127 (PRE). 2427 (Thabazimbi): Groothoek (-BC), Codd 3970 (PRE). 2429 (Zebediela): Chuniespoort (-AB), Tölken 3138 (BOL). 2430 (Pilgrims Rust): Mariepskop Reserve (-DB), van der Schijff 6458 (PRE); Strey 7915 (NH); Origstad (-DC), Jacobsen 2316 (PRE). 2527 (Rustenburg): Rustenburg Nature Reserve (-CA), Jacobsen 923 (PRE). 2528 (Pretoria): Fairy Glen (-CD), Leendertz 1121 (GRA, PRE); Trichardt's Poort (-DB), Repton 872 (PRE). 2529 (Witbank): Doornkop Watervæl (-CB), du Plessis 267 (PRE). 2530 (Lydenburg): Waterval Boven (-CB), Tölken 3127 (BOL); Maid of the Mist Mine (-DD), Thorncroft 1037 (PRE). 2627 (Potchefstroom): Vereeniging (-DB), Leslie 6296 (PRE). 2628

(Johannesburg): Johannesburg (-AA), Holden in TRV 21 454 (PRE);  
Repton 5357 (PRE); Suikerbosrand (-CB), Bredenkamp 601 (PRE). 2629  
 (Bethal): Breyton (-BD), Steyn 792 (NBG); Standerton (-CD), Rogers  
 18 769 (NH); Roodepoort (-CD), Moss 8140 (PRE). 2725 (Bloemhof):  
 S.A. Lombard Nature Reserve (-CB), Leistner 93 (PRE). 2730 (Vryheid):  
 near Wakkerstroom (-AC), Devenish 1361 (PRE); TBlken 1140 (PRE); 1141  
 (PRE).

SWAZILAND. - 2631 (Mbabane): near Mbabane (-AC), Compton 27 540  
 (NBG, PRE); Dlamini s.n. (NBG).

NATAL. - 2730 (Vryheid): near Utrecht (-CB), Thode A 377 (PRE).  
 2828 (Bethlehem): Tugela Valley (-DD), Bayer & McClean 53 (GRA, PRE);  
 Mount Aux Sources (-DD), Schelppe 1337 (NH). 2829 (Harrismith):  
 Oliviershoek (-AC), Strey 9527 (PRE); Van Reenen (-AD), Schlechter  
 6911 (BOL, GRA, PRE); Cathedral Peak (-CC), Killick 1346 (BOL, NH,  
 PRE); Mnweni area (-CC), Esterhuysen 21644 (BOL, PRE). 2831 (Nkandla):  
 Nhlazatshe (-AA), Ward 3401 (PRE). 2929 (Underberg): Giant's Castle  
 Game Reserve (-AB), Sim s.n. (GRA); Injasuti source (-AB), Evans 639  
 (GRA, NH); Thabamhlope (-BA), Miller 466 (PRE); West 170 (PRE);  
 Underberg (-CD), McClean 605 (NH, PRE). 2930 (Pietermaritzburg):  
 Meteor Ridge (-AA), Mogg 3342 (PRE); Noodsberg (-BD), Wood in TRV  
 12 834 (PRE); Little Noodsberg (-BD), Strey 7520 (NH, PRE). 3029  
 (Kokstad): Weza (-DA), Strey 10 906 (PRE). 3030 (Port Shepstone):  
 Dumisa (-AD), Rudatis 976 (PRE); Ellesmere (-BC), Rudatis 724 (STE);  
 Horseshoe farm (-CA), Strey 8104 (PRE).

ORANGE FREE STATE. - 2727 (Kroonstad): near Vals River, Pont 423  
 (PRE). 2827 (Senekal): Doornkop (-DA), Zeyher 646 (GRA, SAM). 2828  
 (Bethlehem): Bethlehem (-AB), Phillips 3136 (PRE); Potgieter in TRV  
 21 892 (PRE); 6 Km south-east of Bethlehem (-AC), Scheepers 1421  
 (PRE); Paterima (-AD), Stam 142 (PRE); Golden Gate Park (-DA),  
Liebenberg 7531 (PRE); Witziesshoek (-DB), Thode 5608 (STE). 2829

(Harrismith): near Harrismith (-AC), Wood 4762 (NH). 2926 (Bloemfontein): Bloemfontein (-AA), Potts 485 (BOL); Thaba Nchu (-BB), Roberts 2285 (PRE); 2689 (PRE); Dewetsdorp (-DA), Steyn 911 (NBG).

LESOTHO. - 2828 (Bethlehem): Leribe (-CC), Dieterlen 166b (NH, PRE); Phillips 686 (SAM); 980 (SAM); Khatebe camp (-DB), Jacot Guillarmod 4116 (RUH); Oxbow, Roberts 3548 (PRE). 2927 (Maseru): Maseru (-AD), Compton 22 542 (NBG); Mazenod (-CB), Jacot Guillarmod 811 (PRE); Mamathes (-CC), Jacot Guillarmod 851 (PRE); 6493 (RUH); Sebala bala hill (-CC), Jacot Guillarmod 1539 (RUH); Moriija (-DA), Page in BOL 15 963. 2928 (Marakabei): Mamalapi mountains, Jacot Guillarmod 725 (RUH); 783 (PRE, RUH); between Matsuka & Khube rivers, Coetzee 539 (PRE). 2929 (Underberg): Mokhotlong (-AC), Jacot Guillarmod 1159 (GRA, PRE); Compton 21 526 (NBG). 3028 (Matatiele): Quacha's Nek (-CC), Jacot Guillarmod 6478 (RUH).

CAPE. - 2525 (Mafeking): Koopfontein (-DB), Burger in TRV 23 251 (PRE). 2625 (Delareyville): 25 Km north-east Setlagodi (-AA), Acocks 18 777 (PRE). 3026 (Aliwal North): Burgersdorp (-CD), Flanagan s.n. (PRE). 3027 (Lady Grey): Buffalo River Waterfall (-BD), Galpin 6618 (BOL, GRA, PRE, SAM); Hershel (-CA), Briggs s.n. (PRE); Majuba (-CA), Hepburn 150 (GRA). 3029 (Kokstad): Weza (-DA), Strey 10 906 (BOL, NH, PRE). 3125 (Steynsburg): Grootfontein (-AC), Theron 451 (PRE); 5 Km south-west Steynsburg (-BD), Tölken 4366 (BOL); Steynsburg (-BD), du Plessis in NBG 1997/29 (BOL); Kivorschberg, Dyer 1903 (GRA); Hutchinson 3089 (BOL). 3126 (Queenstown): Molteno (-AD), Flanagan 1695 (BOL, PRE, SAM); Queenstown (-CC), Galpin 1795 (GRA, PRE). 3127 (Lady Frere): Cala (-DA), Pegler 1532 (GRA, PRE). 3128 (Umtata): Ugie (-AA), Gill 196 (BOL). 3219 (Wuppertal): Sneeuberg (-CA), Pocock 374 (STE); Krom River (-CB), Esterhuysen 25 538 (BOL). 3225 (Somerset East): Bergkwagga Park (-AD), Liebenberg 7595 (PRE). 3227 (Stutterheim): Waqu River (-AA), Tölken 4043 (BOL); 17 Km south

Stutterheim (-CA), Tölken 4038 (BOL); near Keiskamma Hoek (-CA), Story 3395 (PRE); King William's Town (-CD), Sim 1773 (GRA, PRE); 1154a (PRE). 3318 (Cape Town): Lions Head (-CD), Zeyher 638 (GRA, SAM); Table Mountain (-CD), Marloth 8205a (PRE); Camps Bay (-CD), Zeyher 5079 (SAM). 3319 (Worcester): Inkruip (-AA), Esterhuysen 25 768 (BOL); Bainskloof (-CA), Esterhuysen 25 631 (BOL). 3322 (Oudtshoorn): northern Swartberg Pass (-AC), Dyer 97 (GRA). 3326 (Grahamstown): near Grahamstown (-BC), MacDwan in SAM 15 722; Kowie East (-DB), Dyer 2013 (GRA). 3418 (Simonstown): Muizenberg (-AB), Bolus 4882 (BOL); Chapmans Peak (-AB), van Niekerk 459 (NBG); Clencairn (-AB), Levyns in BOL 17 553; Lourensford (-BB), Parker 4336 (BOL). 3419 (Caledon): Genadendal (-BA), Moss 18 745 (J); Weder in STE 18 336. 3420 (Bredasdorp): Potberg (-BC), Taylor 4351 (PRE). 3421 (Riversdale): near Albertinia (-BA), Muir 789 (GRA, PRE).

21b. var. transvaalensis (Kuntze) Toelken, comb. nov. et stat. nov.

Sedum transvaalense Kuntze, Rev. Gen. 3, 2 : 85 (1898),

'transvalense'.

Type: Transvaal, Johannesburg, Kuntze s.n. (NY, holo!).

Crassula transvaalensis (Kuntze) K. Schum. in Just's Jahresb.

26, 1 : 347 (1900); Schonl. in Ann. Bolus Herb. 2 : 66

(1916) et in Trans. Roy. Soc. S. Afr. 17 : 188 (1929); Burt Davy,

Fl. Pl. Transv. 1 : 141 (1926); Friedr. in Prodr. Fl.

S. W. Afr. 52 : 36 (1968).

Thysanthe subulata Hook.f. in Hook. Ic. 6, t 590 (1843).

Type: Orange Free State, Caledon River, Burke s.n. (K, holo!).

Crassula subulata (Hook.f.) Harv., Fl. Cap. 2 : 352 (1862),

nom. illeg. - non L.

Tillaea subulata (Hook.f.) Britten, Fl. Trop. Afr. 2 : 387

(1871); Hiern, Cat. Pl. Afr. Welw. 1 : 325 (1896).

Crassula selago Dinter in Fedde Rep. 16 : 243 (1919).

Syntypes: South West Africa, Gaub, Dinter 2428 (SAM!);

Guchab, Dinter 742 (SAM!).

Perennials rarely taller than 15 cm, erect to fastigiate and branching mainly from the base and usually with fleshy roots from which each year new branches are produced, with branches not rooting at the nodes.

Leaves lanceolate, acute and with terminal colourless awn, short at the base becoming somewhat longer towards the middle but shorter again towards the apex (not including young leaves at the apex), rarely papillose. Cymules with (2) 3 - 5 (-10) flowers, often shortly pedunculate but without pedicel and whole inflorescence 3 - 4 times smaller than the subtending leaf, all branches with some flowers. Sepals about the same length as the petals or sometimes longer and shortly awned.

Usually in sandy soils in grassland or open savanna or on gravelly slopes; occurring from the north-eastern Cape Province through many parts of the Orange Free State and Transvaal into Rhodesia and northern Natal, but into northern and central South West Africa.

Flowering Period: January - April.

Diagnostic Features:

See under the species.

Variation and taxonomic Notes:

If plants are grown under extremely moist conditions in a glass house the soft stems will also become decumbent, but have not been observed to root at the nodes, and the aerial branches will stay intact for more than a year. Plants from frost-free areas, such as the north-eastern Transvaal, often also do not lose their previous years branches but a number of short buds will develop at the base and from which new branches will sprout in spring. In contrast to this, plants of the var. pentandra do not have similar clusters of buds at

the base of the branches, but these will be scattered over the whole plant and rarely remain latent for a long time.

The combination Tillaea subulata was published validly by Britten (1871) and not by Betham and Hooker (1865), who just insinuated this combination.

Kuntze's (1898) spelling of the epithet 'transvalense' is taken as a typographic error because in the citation of the type specimen at the end of the description 'Transvaal' is correctly spelled.

Specimens examined:

SOUTH WEST AFRICA. - 1917 (Tsumeb): Auros (-DA), Dinter 5603 (BOL, PRE, SAM); Gaub (-DA), Dinter 2428; Guchab (-DB), Schoenfelder 915 (PRE); Dinter 742 (SAM). 2216 (Otjimbingwe): Keres (-DB), Giess, Volk & Bleissner 5644 (WIND). 2217 (Windhoek): Nabitsaus (-CC), Schwartfeger 2/302 (WIND). 2218 (Gobabis): Schellenberg (-DA), Schliehen 10 335 (PRE). 2316 (Nauchas): 38 Km south-west of Windhoek (-BB), Tölken & Hardy 708 (PRE); 48 Km south-west of Windhoek (-BB), de Winter & Hardy 7949 (PRE, WIND). 2616 (Aus): Frisgewaagd (-BA), Giess 10 300 (WIND).

TRANSVAAL. - 2231 (Pafuri): near Punda Milia (-CA), Codd 5300 (PRE). 2229 (Waterpoort): Soutpansberg (-DD), Tölken 3161 (BOL). 2328 (Baltimore): near Leipzig (-BB), Bremekamp & Schweickerdt 143 (PRE); Polala River, Breyer in TRV 25 243 (PRE). 2329 (Pietersburg): Blouberg (-AA), van der Schijff 5365 (PRE); near Pietersburg (-CD), Bolus 10 896 (BOL, GRA, NH, PRE, SAM); Houtbosdorp (-DD), Wager in TRV 23 090 (PRE). 2427 (Thabazimbi): Kransberg (-BC), Werdermann & Oberdieck 7674 (PRE). 2428 (Nylstroom): Nylstroom (-CB), Prosser 1693 (PRE); Naboomspruit (-DA), Galpin M120 (PRE); Middelkop (-DD), Smith 2117 (PRE); Springbokflats, Burt Davy 1733 (PRE). 2429 (Zebediela): near Potgietersrust (-AA), Maquire 1284 (BOL, NBG); Schoonoor (-DD), Barnard & Mogg 881 (PRE). 2431 (Acornhoek): near Skukuza (-DC),

Schlieben 9408 (PRE). 2526 (Zeerust): Tarrington (-AC), Knobel in TRV 29 901 (PRE); Zeerust (-CA), Jenkins in TRV 11 690 (PRE); near Koster (-DD), Liebenberg 137 (PRE). 2527 (Rustenburg): Rustenburg (-CA), Nation 144 (BOL); Rustenburg Nature Reserve (-CA), Jacobsen 765 (PRE); Uitkomst (-DD), Coetzee 65 (PRE); Scheerpoort (-DD), van Vuuren 479 (PRE). 2528 (Pretoria): Pinaarsrivier (-AB), Repton 805 (PRE); 4314 (PRE); Hammanskraal (-AD), Hutchinson<sup>r m o g g</sup> 2911 (BOL); Riviera (-CA), Smith 1824 (PRE); Wonderboom (-CA), Leendertz 473 (PRE); Silverton (-CB), Obermeyer in TRV 27 705 (BOL, PRE); Rietvlei (-CD), Acocks 11 238 (PRE). 2529 (Witbank): Middelburg (-CD), Hewitt in TRV 8249 (GRA, PRE). 2530 (Lydenburg): Lydenburg (-AB), Jenkins in TRV 10 332 (PRE); Pretoriuskop (-AB), van der Schijff 3377 (PRE); Plaston (-AC), Holt 180 (NH, PRE); Godwane River (-DA), Rogers 19 366 (PRE). 2531 (Komatipoort): near Klokwene (-AD), Ihlenfeldt 2369 (PRE). 2626 (Klerksdorp): Lichtenburg (-AA), Jenkins in TRV 11476 (PRE); Sutton 424 (PRE). 2627 (Potchefstroom): Krugersdorp (-BB), Wells 2536 (PRE); Elandsfontein (-BD), Theron 1006 (PRE); Klipdrif (-CA), Theron 1265 (NH, PRE); Coalbrook (-DD), Gilmore 2124 (PRE). 2628 (Johannesburg): Jeppe's Town (-AA), Galpin 1393 (BOL, GRA, PRE, SAM); Milner Park (-AA), Young in TRV 32 975 (PRE); Benoni (-AB), Bradfield 382 (PRE); Burttholm (-CA), Burt Davy in PRE 17 534 (PRE). 2629 (Bethal): near Ermelo (-DB), Leendertz in TRV 7794 (PRE); Burt Davy 8087 (PRE); 9260 (PRE). 2725 (Bloemhof): Wolmaransstad (-BB), Rogers 22 710 (GRA). 2730 (Vryheid): Oshoek (-AC), Devenish 832 (PRE); near Wakkerstroom (-CA), Galpin 9858 (PRE); Beeton 242 (SAM).

SWAZILAND. - 2631 (Mbabane): Umbeluzi Poort (-AA), Hall 2319 (NBG). 2632 (Bella Vista): Blue Jay Range (-AA), Compton 29 952 (NBG, PRE).

NATAL. - 2632 (Bella Vista): Ndumi Hill (-CD), Pooley 288 (NH); Kosi (-DD), Sibayi Project 124 (GRA). 2730 (Vryheid): Altemooi (-AD), Thode 3634 (STE); Retirement (-AD), Devenish 1448 (PRE). 2732 (Ubombo):

24 Km east Josini (-AC), Tülken 3103 (BOL); Maputa Road (-BA), Moll 4904 (NH, PRE). 2829 (Harrismith): Van Reenen (-AD), Wood 9806 (BOL); Cathedral Peak (-CC), Esterhuysen 12 924 (BOL). 2830 (Dundee): near Weenen (-CC), Acocks 11 411 (NH). 2831 (Nkandla): Umfolozi Game Reserve (-BD), Ward 3309 (PRE). 2832 (Mtubatuba): near Charters Creek (-AB), Ward 2767 (PRE); Richard's Bay (-CC), Venter 5006 (PRE). 2929 (Underberg): Estcourt (-BB), Schlechter 3386 (BOL); Strey 9746 (NH, BOL); Giant's Castle (-BC), Tinley 625 (NH); Mpendle (-DB), Gordon Gray s.n. (NH, PRE). 2930 (Pietermaritzburg): near Mooi River (-AA), Mogg 6952 (PRE).

ORANGE FREE STATE. - 2727 (Kroonstad): Groenebloem (-AC), Potts in BLFU 2669 (PRE); Middenspruit Noord (-CA), Scheepers 1653 (PRE). 2827 (Senekal): Doornkop (-DA), Zeyher s.n. (SAM); Burke s.n. (K). 2828 (Bethlehem): Witzieshoek (-DD), Junod in TRV 17 378 (PRE); Thode 5606 (STE). 2829 (Harrismith): Harrismith (-AC), Smit 92 (PRE); Swinburne (-AD), Jacobsz 30 (PRE); 194 (PRE). 2925 (Jagersfontein): Petrusburg (-AB), Henrici 4295 (PRE). 2926 (Bloemfontein): Grant's Hill (-AA), Wasserfall 845 (NBG).

LESOTHO. - 2828 (Bethlehem): Leribe (-CC), Dieterlen 166a (PRE, SAM). 2927 (Maseru): Roma (-BC), Schmitz 201 (PRE); Mamathes (-CC), Jacot Guillarmod 1559 (RUH); Lawson 787 (NH). 3028 (Matatiele): Quacha's Nek (-CC), Jacot Guillarmod 6486 (RUH).

CAPE. - 2822 (Glen Lyon): Bergenaarspad (-BC), Acocks 2213 (PRE). 2824 (Kimberley): Newlands (-AD), Lewis in SAM 53 439; Esterhuysen 1186 (BOL); 48 Km west of Kimberley (-CA), Tülken & Schlieben 1164 (PRE); 3028 (Matatiele): 25 Km north-east of Mount Fletcher (-DA), Acocks 22 034 (PRE). 3125 (Steynsburg): 5 Km south-west of Steynsburg (-BD), Tülken 4363 (BOL). 3126 (Queenstown): near Queenstown (-DD), Galpin 2584 (GRA, PRE). 3127 (Lady Frere): Indwe (-CB), Sim 2952 (GRA, PRE); Tsomo River (-DD), Pegler 1531 (GRA, PRE). 3128

(Umtata): Tsitsa River, Schlechter 6380 (GRA, PRE). 3224 (Graaff Reinet): Graaff Reinet (-BC), Bolus 804 (BOL). 3227 (Stutterheim): Kei River Bridge (-DB), Flanagan 2224 (BOL, PRE, SAM).

22. C. muscosa L., Pl. Rar. Afr. 10 (1760) et Sp. Pl. ed. 2 : 405 (1765) et Mantissa altera 361 (1771); Thunb., Fl. Cap. ed. Schultes 281 (1823), partly, excl. specimen 7771; Tölken in J. S. Afr. Bot. 38 : 70 (1972).

Type: Cape, sine leg. in Herb. Burmann (G, holo!).

Perennials 10 - 40 (-80) cm high with erect or decumbent branches or often scrambling, more or less branching, with woody main branches, with internodes of equal length along the branches and usually not visible between the leaves, with old leaves usually remaining attached to the stem. Leaves sessile, triangular to ovate 0,2 - 0,8 cm long, 0,1 - 0,4 cm broad, acute or obtuse and of equal length on the whole plant, glabrous, more or less flat on both surfaces, fleshy and leathery, green to grey-green to yellowish-green or brown, sheath up to 0,15 cm long and formed by the partial fusion of the leaf bases. Hydathodes few along the margin and often more than one row, sometimes conspicuous. Inflorescence lateral inflorescences with 1 - 5 (-8) flowers usually in dense clusters and protruding above the subtending leaf. Sepals narrowly triangular c. 1 mm long, acute but not awned, fleshy and usually half to two-thirds of the length of the petals. Petals narrowly triangular, c. 1 mm long, sharply acute and more or less keeled towards the apex but without dorsal appendage, fused into a tube c. 0,2 mm long, erect, membranous, pale yellowish-green to brown. Stamens 0,5 - 0,7 mm long, with yellow anthers 0,1 - 0,2 mm long and broad, with filaments slightly broadened downwards and scarcely fused to the petal tube. Squamae oblong-cuneate, 0,2 - 0,3 x 0,04 - 0,1 mm, truncate or emarginate, at first abruptly later more gradually constricted, almost membranous to slightly fleshy, pale yellow or white.

Carpels with oblong reniform ovaries gradually constricted into short styles about a quarter of the length of the ovaries and with terminal stigmas; ovary smooth and with two almost glabrous ovules.

Diagnostic Features:

C. muscosa is a perennial species which is distinguished from C. pentandra by its woody main stems at least at the base and the sepals are half to two-thirds as long as the petals while the flowers usually protrude above the subtending leaves.

Both the var. rigida and the var. parvula are small plants and have a tufted erect habit in contrast to the irregular branching of the other two varieties, but var. rigida is distinguished from the var. parvula by its obtuse leaves and rigid branches with usually a peeling bark at least at the base. The var. sinuata has slender decumbent branches and distinctly emarginate squamae, which distinguish it from other varieties. Small plants of the latter variety may be confused with those of the var. parvula, which under dry conditions has more or less adpressed leaves. The var. muscosa is usually a robust plant which is branching irregularly and in the axils of each leaf a short axillary branch is found.

Variation and taxonomic Notes:

The variation of each of the varieties is extensive so that it is discussed under the individual varieties. Many horticultural varieties have been described, but they are not assessed here, because no records of their origin is available.

As pointed out earlier (Tölken, 1972) Linnaeus's original description had little in common, except the name, with Herman's description which seems to refer to C. campestris. The fact that Linnaeus refers to the punctate margin of leaves in exsiccata indicates that he was using a herbarium specimen. In Burmans Herbarium, on which Linnaeus was working at the time, a specimen is found with clear

hydathodes along the margin of the leaves and a few single flowers in the axils of the leaves, which is unusual for this species as well as similar species but both Linnaeus (1760) and Burmann (1768) mentioned this fact. Linnaeus did not mention that his description was based on a specimen received from Burman. However, Barnard (manuscript in BQL) noted that Linnaeus in his manuscript description in the interleaves copy of the Species Plantarum first named this species C. imbricata, the name under which Burmann described the plant with a similar description. This name change then indicates that the description was probably drawn up from the specimen and Linnaeus later added Herman's reference and name to it.

The names of the species C. polpodacea and C. propinqua which seem to refer to the var. sinuata and var. rigida respectively were not adopted, because their diagnoses are so vague that the taxa concerned cannot be recognized. In addition, some of the specimens with Ecklon & Zeyher's type number, which were investigated during the present study, did not agree with the concepts of the above varieties.

22a. var. muscosa

C. muscosa L., Pl. Rar. Afr. 10 (1760) et Sp. Pl. ed. 2, 405 (1762) et Mantissa altera 361 (1771); Thunb., Prodr. 54 (1794), partly, et Fl. Cap. ed. Schultes 281 (1823), partly, excl. specimen 7771; Harv., Fl. Cap. 2 : 351 (1862), partly, excl. specimens cited; Tölken in J. S. Afr. Bot. 38 : 70 (1972).  
Tetraphyle muscosa (L.) Eckl. & Zeyh., Enum. 294 (1837), partly, excl. specimens cited.

C. imbricata Burm. f., Fl. Cap. 8 (1768); Ait., Hort Kew. ed. 1, 1 : 393 (1789) et ed. 2, 2 : 192 (1811); Willd., Sp. Pl. 1 : 1553 (1798).

Type: same as for C. muscosa.

C. lycopodioides Lam., Dict. 2 : 173 (1786); DC., Prodr. 3 : 385 (1826); Harv., Fl. Cap. 2 : 351 (1862); Dinter, D. S. W. Afr., Fl. Forst & Landw. Fragm. 71 (1909); Schönl. in Ann. Bolus Herb. 2 : 69 (1916) et in Trans. Roy. Soc. S. Afr. 17 : 189 (1929); Adamson, Fl. Cape Penins. 433 (1950); Jacobsen, Handb. Succ. Pl. 1 : 317, fig. 322 - 9 (1960) et Sukk. Lex. 144, T. 44, 5 & 6 (1970); Higgins, Crass. Cult. 53, fig. 53 (1964); Friedr. in Prodr. Fl. S. W. Afr. 52 : 31 (1968).

Type: Africa, sine leg. in Herb. Lamarck (P-LA, holo!).

--- var. pseudolycopodioides (Dinter) Walth. ex Jacobsen in Kakteen 6 : 148 (1955).

Type: South West Africa, Tsirub Pass, Dinter s.n. (B, holo!).

Tetraphyle lycopodioides (Lam.) Eckl. & Zeyh., Enum. 294 (1837).

Sedum lycopodioides (Lam.) Kuntze, Rev. Gen. 3, 2 : 85 (1898).

Tetraphyle littoralis Eckl. & Zeyh., Enum. 293 (1837).

Type: Cape, between Buckbay & Saldanha Bay, Ecklon & Zeyher 1867 (G!; S!; SAM!).

Crassula littoralis (Eckl. & Zeyh.) Endl. ex Walp., Reperit.

2 : 25 (1843).

C. anguina Harv., Fl. Cap. 2 : 350 (1862).

Syntypes: Cape, Grootriet, Zeyher s.n. (K!; SAM!); Modderfontein, Whitehead (TCD!).

C. pseudolycopodioides Dinter & Schinz in Dinter, D.S.W. Afr.

Fl., Forst & Landw. Fragm. 71 (1909) et in Fedde Reperit. 16 :

243 (1919).

Plants erect, rarely decumbent or rather somewhat scrambling, with branches 20 - 40 (-80) cm long, (0,3-) 0,5 - 1 cm in diameter with leaves, woody, with internodes usually not visible between the leaves, often with short axillary buds in each axil of the leaves along the stem, with old leaves remaining attached to the branches. Leaves lanceolate to

ovate, 0,2 - 0,4 (-0,6) cm long, 0,15 - 0,2 (-0,3) cm broad, acute or obtuse, more or less adpressed to each other and the stem, greyish-green to brown. Squamae truncate, rarely slightly emarginate.

Usually in and under shrubs in karroid vegetation; occurring in most parts of the Karoo and Namaqualand and the adjoining areas.

Flowering Period: Mainly October to February, but flowers can be produced throughout the year after sporadic rains.

Diagnostic Features:

See under the species.

Variation and taxonomic Notes:

Generally the var. muscosa is distinguished from the other varieties by its robust habit and its irregular branching. This variety is the most variable in the species and a number of local forms are found. For instance, plants in the north-eastern Cape have very fine and slender branches and herbarium specimens might be confused with those of the var. sinuata, except that the latter does not bear short axillary branches along the stem and the squamae are distinctly emarginate. Whenever short axillary branches are found on plants this does not mean that it is found on all the plants within a population, and often local variation can be observed. Therefore, not much significance can be attributed to C. pseudolycopoides from South West Africa when similar plants are common in the northern parts of the Little Karoo and the mountains around Beaufort West. In all these plants this characteristic seem to have developed independantly as it is linked with different characters in each case.

Attention must also be drawn to the fact that plants which sprout after a long dry period will develop an excessive number of these axillary buds, a phenomenon that can rarely be observed on plants in a glass house.

Plants from the Knersvlakte and especially from the vicinity of Lutzville have their leaves very much adpressed to the stems, which gives the grey stems a lizard-like appearance, but northwards a complete range of intermediates from this extreme form, that was described as C. anguina to the typical plants of C. muscosa can be found.

Similarly, the Cape Sandveld form which seems to be distinct near Saldanha Bay, because of its rather long internodes which are visible between the leaves, also shows a range of intermediates northwards towards Vanrhynsdorp.

Specimens examined:

SOUTH WEST AFRICA. - 2615 (Lüderitz): Lüderitzbucht (-CA), Range 1680 (SAM); Marloth 4606 (PRE). 2616 (Aus): Aus (-CB), Dinter 6091 (BOL, PRE, SAM); 9646 (STE). 2716 (Witpütz): Witpütz (-DA), Tölken 3984 (BOL); Witpütz-Süd (-DA), Merxmüller & Giess 3209 (PRE); Tölken 3327 (BOL). 2718 (Grunau): Klein Karas (-CA), Ortendahl 592 (PRE). 2816 (Oranjemund): Obib (-BA), Range 576 (PRE); Schakalberge (-BA), de Winter & Giess 6169 (PRE); Merxmüller & Giess 2329 (PRE).

ORANGE FREE STATE. - 2925 (Jagersfontein): Fauresmith (-CB), Smith 4391A (PRE).

CAPE. - 2816 (Oranjemund): Buchu Twins (-DC), Tölken 3376 A (BOL); Witbank (-DC), Pillans 5122 (BOL); Annisfontein (-BD), Pillans 5534 (BOL); Hellskloof (-BD), Tölken 1906 (BOL); De Koei (-BD), Wisura 2517 (NBG). 2817 (Violsdrif): Paradysberg (-AC), Tölken 3292 (BOL); Springbokvlakte (-AD), Tölken 3263 (BOL); 32 Km south Stinkfontein (-CD), Tölken 3930 (BOL); Stinkfontein (-CD), Tölken 3417 (BOL); 32 Km Violsdrif to Stinkfontein (-CD), Werger 399 (PRE); 9 Km north-west Stinkfontein (-CC), Tölken 3428 (BOL). 2818 (Warmbad): 15 Km south Goodhouse (-CC), Barker 6288 (NBG); Henkries (-CC), Phillips 1590 (SAM). 2820 (Kakamas): Vaalhoek (-DA), Barnard in SAM 32 378; Keimoes (-DB), Barnard in SAM 32 379; Kakamas (-DC),

Wasserfall 1064 (PRE). 2822 (Glen Lyon): Bergenaarspad (-BC),  
Acocks sub Hafström 1108 (PRE). 2823 (Griekwastad): Postmansburg  
 (-AC), Hutchinson 3036 (BOL, PRE). 2916 (Port Nolloth): Port Nol-  
 loth (-BD), Roux 313 (BOL). 2917 (Springbok): Kliphoogte (-BA),  
Schlieben 11 541 (PRE); Steinkopf (-BB), Herre 5745 (GRA); Eenriet  
 (-BB), Pearson 3100 (STE). 2918 (Gamoep): 48 Km south Goodhouse  
 (-BB), Tölken 3686 (BOL). 2922 (Prieska): near Prieska (-DA), Bryant  
 105 (PRE); 315 (PRE); Smith 2383 (PRE); Hardcastle (-BD), Bryant  
 J 105 A (PRE). 3018 (Kamiesberg): Grootriet (-CB), Zeyher 641 (K,  
 SAM). 3019 (Loeriesfontein): Loeriesfontein (-CD), Pearson 4888  
 (BOL). 3022 (Carnavan): Krantzfontein (-BC), Wilman in SAM 26 251.  
 3118 (Vanrhynsdorp): Strandfontein (-CC), Hall 4232 (NBG); Klawer  
 (-DC), Mathews s.n. (BOL); Heerenlogement (-DC), Zeyher 643 (SAM),  
 3119 (Calvinia): Van Rhyns Pass (-AC), Maquire 136 (NBG); Tölken  
 3998 (BOL); Skilpadbos (-BD), Schmidt 42 (PRE); 129 (PRE); Doring  
 Rivier (-CC), Hugo s.n. (GRA, PRE); Botterkloof Pass (-CD), Maquire  
 200 (BOL, NBG). 3125 (Steynsburg): Conway (-CB), Galpin 5715 (GRA,  
 PRE). 3218 (Clanwilliam): Clanwilliam (-BB), Rogers 16 776 (PRE);  
 Krakadouw Pass (-BB), Thorne in SAM 52 492; de Kruis (-BC), Stephens  
& Glover in BOL 87 111; Kapitein's Kloof (-DC), Pillans 8061 (BOL);  
 Dasklip Pass (-DD), Tölken 4034 (BOL). 3219 (Wuppertal): Pakhuis  
 (-AA), Leipoldt 1309 (BOL, NH); Bidouw (-AA), Middlemost 1739 (NBG);  
 near Algeria (-AC), Story 2954 (PRE); Matjesrivier (-AD), Wagener 72  
 (NBG); Warm Bath (-CC), Stephens sub Pearson 7321 (SAM). 3222  
 (Beaufort West): 16 Km north Beaufort West (-BA), Tölken s.n. (BOL);  
 Nieuweveld, Marloth 2145 (PRE). 3223 (Rietbron): near Nelspoort  
 (-AA), Pearson 1488 (SAM). 3224 (Graaff Reinet): Graaff Reinet (-BC),  
Liebenberg s.n. (PRE); Thode A560 (PRE); van Rhyneveld Pass (-BC),  
Theron 1025 (PRE); Aberdeen Road (-CD), sine leg. in NH 16 131. 3225  
 (Cradock): near Cradock (-AB), Muller 691 (PRE). 3226 (Fort Beau-

fort); Adelaide (-CB), Hutton s.n. (GRA). 3318 (Cape Town): Geel-  
 bek (-AA), Walgate 1018 (BOL); Rapenburg (-CD), Bolus s.n. (BOL);  
Melkbostrand (-CD), Compton 9853 (NBG); between Bokbaai & Saldanha,  
Ecklon & Zeyher 1862 (G, S, SAM). 3319 (Worcester): Saron (-AA),  
Steyn 619 (NBG); Karoo Poort (-BC), Marloth 9075 (PRE); Worcester  
 (-CB), Rogers in TRV 23 549 (PRE); Olivier 201 (PRE, STE); near  
Robertson (-DD), Hutchinson 1084 (BOL). 3320 (Montagu): 23 Km  
 south-east of Touwsrivier (-AC), Tölken 4074 (BOL); Matjesfontein  
 (-BA), Foley 76 (PRE); Gill 36 (BOL); Laingsburg (-BB), Smith 2496a  
 (PRE); Purcell s.n. (GRA); south-east Laingsburg (-BD), Tölken 4097  
 (BOL); Montagu Bath (-CA), Page 78 (PRE); Baden (-CA), Walgate s.n.  
 (PRE); Cogmanskloof (-CC), Michell 39 (PRE); Montagu (-CC), Taylor  
 4033 (NBG); Dobbelaarskloof (-DA), Esterhuysen 1870 (BOL, PRE);  
Barrydale (-DC), Galpin 4021 (GRA, PRE); Witteberg, Barker 4884 (NBG).  
 3321 (Ladismith): near Ladismith (-AD), Bond 296 (NBG); Garcia's  
Pass (-CC), Smith 2748 (PRE); Thorne in SAM 38 967; Calitzdorp (-DA),  
Steyn 281 (NBG); Radleigh (-DA), Steyn 258 (NBG). 3322 (Oudtshoorn):  
 near Prince Albert (-AA), Bolus 11 481<sup>7</sup> (BOL). 3323 (Willowmore):  
Willowmore (-AB), Smith 2798 (GRA, PRE); Swanepoelspoort (-BB), Holland  
 590 (GRA, PRE). 3324 (Steytlerville): Campher's Poort (-AA), Bar-  
 ker 5016 (NBG). 3325 (Port Elizabeth): Perseverance (-DC), Rodin  
 1286 (BOL, PRE); Redhouse (-DC), Paterson 89 (GRA); 1082 (PRE);  
Aloes (-DC), Drège 3094 (PRE). 3326 (Grahamstown): Pluto's Vale  
 (-BA), Tölken 1503 (BOL); Botha's Hill (-BA), Schonland 797 (NH, PRE);  
 near Breakfast Vlei (-BB), Acocks 11 872 (PRE). 3419 (Caledon):  
 Genadedal (-BA), Prior s.n. (PRE). 3420 (Bredasdorp): Stormsvlei  
 (-AA), Compton 5961 (NBG); Vrolikheid Nature Reserve (-CA), Jooste 36  
 (STE); Potberg (-BC), Taylor 4351 (STE). 3421 (Riversdale): near  
Riversdale (-AB), Bolus 11 279 (BOL); Valsch River at Middeldrift (-BA),  
Muir 896 (PRE); Gauritz River (-BC), Ecklon & Zeyher 1870 (SAM).  
 3424 (Humansdorp): Jeffrey's Bay (-BB), Duthie in STE 29 355.

22b. var. sinuata Toelken, var. nov. ab varietatibus aliis ramis gracilibus sinuatis et squamis emarginatis.

Tetraphyle polpodacea Eckl. & Zeyh., Enum. 293 (1837).

Type: Cape, Coegakop, Swartkops River and near Grahamstown, Ecklon & Zeyher 1869 (G!; P!; S!; SAM!).

Crassula polpodacea (Eckl. & Zeyh.) Endl. ex Walp. 2 : 253 (1843).

C. lycopodioides var. polpodacea (Eckl. & Zeyh.) Harv., Fl. Cap. 2 : 351 (1862).

Plantae ramis gracilibus sinuatis vel decumbentibus 30 - 50 (-80) cm longis, 0,2 - 0,3 (-0,4) cm in diametro foliis, minute ramosis et sine ramis axillaribus brevis, tenacibus et ligneis et ligneis et internodiis non visibilibus inter folia adpressa, foliis veteribus non deciduis.

Folia lanceolata 0,2 - 0,3 cm longa, 0,1 - 0,2 cm lata, acuta. Squamae emarginatae.

Type: Cape, near Komga, Flanagan 1795 (BOL, holo!; GRA!; PRE!).

Plants with slender sinuous or decumbent branches 30 - 50 (-80) cm long, 0,2 - 0,3 (-0,4) cm in diameter with leaves, little branched and without short axillary branches, tough and woody and with internodes not visible between the adpressed leaves, with old leaves remaining attached to the stem. Leaves lanceolate 0,2 - 0,3 cm long, 0,1 - 0,2 cm broad, acute, yellowish-green rarely pale green. Squamae distinctly emarginate.

Among shrubs in river valley scrub vegetation; occurring mainly in the triangle between Willowmore, Port Elizabeth and King William's Town, but extending its distribution as far north as Graaff Reinet.

Flowering Period: December - June.

Diagnostic Features:

See under the species.

Variation and taxonomic Notes:

At times the var. muscosa produce similar thin stems as found in the var. sinuata, but in contrast to the latter variety these specimens have usually many short axillary branches, which are not found in the var. sinuata. In the field the two varieties are easily distinguished by the more erect habit with rather sparse branching of the var. muscosa while the var. sinuata forms more or less dense shrublets with decumbent branches. In the vicinity of Grahamstown the two varieties often grow close together but no intermediates have been observed.

The var. parvula also often occurs in the same area and will have more or less adpressed leaves under dry conditions. However, the long slender branches, the decumbent habit and the emarginate squamæ will distinguish the var. sinuata, but young plants without flowers of the two taxa are indistinguishable.

Specimens examined:

CAPE. - 3224 (Graaff Reinet): Graaff Reinet (-BC), Thode A 561 (NH, PRE); Bolus 384 (NH). 3225 (Somerset East): near Cradock (-BA), Tölken 4347 (BOL). 3226 (Fort Beaufort): Lovedale Brickfields (-DD), Giffen 1000 (NBG). 3227 (Stutterheim): near Komga (-DB), Flanagan 1795 (BOL, GRA, PRE); East London (-DD), Breyer in TRV 16 594 (PRE). 3323 (Willowmore): Willowmore (-AB), Smidt in TRV 25 804 (GRA, PRE); Smith 2797 (PRE); Towerwater (-AC), van Niekerk 492 (BOL); Ghwarie Poort (-AD), Tölken 3005 (BOL). 3325 (Port Elizabeth): Paardepoort (-AC), Rycroft 1881 (NBG); Tölken 4295 (BOL); Groendalkloof (-CA), Tölken 3844 (BOL); Swartkops River (-DC), Ecklon & Zeyher 1869 (G, P, S, SAM); Coega (-DC), Veitch s.n. (PRE). 3326 (Grahamstown): Alicedale (-AC), Cruden 18 (GRA); Hellsport (-BA), MacOwan 2294 (GRA); between Committee's and Hunts's Drift (-BB), Dyer 895 (GRA); Alexandria (-CB), Barnard 564 (PRE); near de Kol (-CB), Grant 9 (GRA);

Port Alfred (-DB), Tyson in TRV 17 238 (PRE); in PRE 12 985; Kowie (-DB), Tyson s.n. (BOL).

22c. var. rigida Toelken, var. nov. ab varietatibus aliis foliis usque ad 2 mm longis et obtusis, cortice cadenti membranaceo differt.

Tetraphyle propinqua Eckl. & Zeyh., Enum. 293 (1837).

Type: Cape, Kamiesberg, Ecklon & Zeyher 1868 (FI!; G!; P!; S!; SAM!).

Crassula propinqua (Eckl. & Zeyh.) Endl. ex Walp., Repert.

2 : 253 (1843).

C. lycopodioides var. obtusifolia Harv., Fl. Cap. 2 : 351

(1862), partly as for Ecklon & Zeyher 1868.

Plantae erectae 10 - 15 (-30) cm altae ramis principalibus ligneis et rigidis 0,2 - 0,5 (-0,8) cm in diametro sine foliis sed cortice cadenti membranaceo, ramis multis ad basim, ramis juvenibus foliis usque ad 0,3 mm in diametro et internodiis visilibus inter folia praecipue in exsiccata sed foliis veteribus deciduis. Folia ovata vel late ovata, 0,5 - 0,1 (-0,2) cm longa et lata, obtusa, apice effuso et gemma axillare in quoque axilla. Squamae truncatae.

Type: Cape, Stinkfontein, Schlieben 11 530 (PRE, holo!; STE!).

Plants erect 10 - 16 (-30) cm high with rigid woody branches 0,2 - 0,5 cm thick without leaves and with peeling bark, branching mainly from the base and much branched, with younger branches with leaves up to 0,3 cm in diameter and with internodes visible between the leaves particularly in dried specimens, with old leaves deciduous. Leaves ovate to broadly ovate 0,5 - 0,1 (-0,2) cm long and broad, obtuse, rarely more or less adpressed but with an axillary bud in the axil of all the leaves, yellowish-green. Squamae truncate.

Usually in crevices or on shallow soil on rocks of granite, sandstone or quartzite; occurring from the Cedarberg northwards through

the mountains in the Namaqualand and Richtersveld to just north of the Orange River.

Flowering Period: August - November.

Diagnostic Features:

See under the species.

Variation and taxonomic Notes:

Although the distribution of the var. rigida and the var. muscosa seem to overlap in most parts of the Namaqualand, the plants grow rarely within hundred yards of one another. In such cases no intermediates have been observed. In the field the distinction between the two varieties is even greater, as the var. rigida is usually yellowish-green, while the var. muscosa has grey-green or greyish-brown leaves. The inadequate diagnosis that Ecklon & Zeyher published for their Tetraphyle propinqua must have been the reason why Harvey (1862) combined this species with Tetraphyle littoralis, a form of the var. muscosa into C. lycopodioides var. obtusa.

Young plants of the var. rigida have a similar tufted habit as those of the var. parvula, but the leaves of the latter variety are sharply acute and even in older plants the stems become scarcely woody and do not develop the peeling bark which is characteristic of the var. rigida. However, plants from the Cedarberg often do not have the peeling bark, and in the north-eastern parts the plants do not have the erect growth and in extreme forms, such as Tölken 3795, the branches are carnose. The short obtuse leaves and the few flowers in the axils of the leaves as well as the shorter sepals leave no doubt that these plants must be identified as the var. rigida. In the Kamiesberg older plants then have the typical peeling bark except in some specimens of Ecklon & Zeyher 1868. This and the fact that the specimens often are mixed, as well as the absence of any diagnostic feature in their description, as even the obtuse leaves are also found in their Tetraphyle

littoralis, leave it uncertain whether Tetraphyle propinqua and the var. rigida are similarly delimited.

Specimens examined:

CAPE. - 2817 (Violsdrif): 9 Km north-west of Stinkfontein (-CC), Tölken 3433 (BOL); Stinkfontein (-CD), Schlieben 11 530 (PRE, STE). 2916 (Port Nolloth): near Port Nolloth (-BC), Herre in SUG 5427 (GRA); 5876 (GRA). 2917 (Springbok): Karruchab Poort (-AA), Dyer 3687 (PRE); Tölken 3405 (BOL); 11 Km south Lekkering (-AA), Tölken 3440 (BOL); 27 Km north Annenous (-BA), Tölken 3928A (BOL); Eenrietberg (-BB), Schlieben 11 555 (PRE); 9 Km north-west Komaggas (-CB), Tölken 3895 (BOL); 3 Km north Springbok (-DB), Tölken 3486 (BOL); Wildpaardehoekpas (-DC), Wisura 2559 (NBG). 3017 (Hondeklipbaai): Wallekraal (-BC), Pillans in BOL 18 014. 3018 (Kamiesberg): 16 Km north-west of Bitterfontein (-CC), Acocks 14 216 (PRE). 3118 (Vanrhynsdorp): near Nuwerus (-AB), Pearson 5542 (BOL); near Klawer Station (-DC), Smith 2612 (GRA, PRE); Heerenlogement (-DC), Zeyher s.n. (SAM); Nardouw Pass (-DD), Tölken 4245 (BOL). 3119 (Calvinia): Nieuwehoudtville (-AC), Maquire 179 (NBG). 3218 (Clanwilliam): Elandsberg (-AD), Pillans 8082 (BOL). 3219 (Wuppertal): Pakhuis Pass (-AA), Tölken 3791 (BOL); Langkloof (-CC), Schlechter 8037 (BOL, GRA, PRE).

22d. var. parvula (Eckl. & Zeyh.) Toelken, comb. nov. et stat. nov.

Tetraphyle parvula Eckl. & Zeyh., Enum. 294 (1837).

Type: Cape, Bothas Berg near Grahamstown, Ecklon & Zeyher 1871 (S, lecto!).

Crassula parvula (Eckl. & Zeyh.) Endl. ex Walp., Repert. 2 : 253 (1843); Harv., Fl. Cap. 2 : 352 (1862).

Plants erect and tufted, rarely with decumbent branches 10 - 15 cm long, 0,2 - 0,3 cm in diameter with leaves, with short woody main branches 0,3 - 0,4 cm in diameter and with flaking bark when old, with lateral branches mainly from the base, with internodes visible between the leaves

with old leaves wearing off soon. Leaves lanceolate (0,1-) 0,2 (-0,25) cm long and 0,05 - 0,1 cm broad, acute, spreading or curved upwards or adpressed under dry conditions, grey-green. Squamae truncate.

Usually associated with rocks but also often on gravelly slopes in dry sclerophyll to almost karroid vegetation; occurring mainly in the mountains between Uniondale, Grahamstown and Middelburg, but sporadic records northwards to near Prieska are found in herbaria.

Flowering Period: December - April.

Diagnostic Features:

See under the species.

Variation and taxonomic Notes:

Superficially the var. parvula is very similar to C. pentandra var. pentandra and especially the shade form of the former tends to have a decumbent habit. However, plants of the var. parvula have usually a woody base and do not root where the stems touch the ground. In general the var. parvula has an erect tufted habit somewhat like C. campestris, but the latter is distinguished by its colourless awns at the end of the leaves and the sepals.

This erect fastigiate habit as described by Ecklon & Zeyher (1837) and Harvey (1862) leaves little doubt about the identification of the species. However, as the specimen of the type number in the South African Museum Herbarium must be identified as C. pentandra var. pentandra, the specimen in Stockholm Herbarium was selected as a lecto-type.

Specimens examined:

CAPE. - 2922 (Prieska): Asbestos Hills (-AD), Esterhuysen 1187 (BOL, NBG). 3123 (Victoria West): Murraysburg (-DD), Tyson 408 (GRA). 3124 (Hanover): 7 Km north-west of Middelburg (-BD), Comins 733 (PRE); Middelburg (-BD), Crampton 139 (GRA). 3223 (Rietbron): above Nelspoort Station (-AA), Tölken 5100 (PRE). 3224 (Graaff Reinet): Graaff

Rainet (-BC), Galpin 9917 (PRE); Kitching s.n. (BOL); near Jansen-  
 ville (-DC), Acocks 17 663 (PRE). 3225 (Somerset East): Bergkwagga-  
 park (-AB), Brynard 190 (PRE); Cradock (-BA), Wisura 1045 (NBG);  
Tölken 4348 (BOL); Halesowen (-BA), James s.n. (BOL). 3226 (Fort  
 Beaufort): Fort Hare (-DD), Giffen 1002 (NBG). 3227 (Stutterheim):  
 King William's Town (-CD), Sim 1154 (PRE). 3322 (Oudtshoorn): near  
 Holgate (-CD), Tölken 1652 (BOL). 3323 (Willowmore): 12 Km south-  
 -west Uniondale (-CA), Tölken 3004 (BOL); Prince Alfred Pass (-CC),  
Tölken 4391 (BOL); Joubertina (-DD), Esterhuysen 21265 (BOL); Tölken  
 3747 (BOL). 3324 (Steytlerville): Baviaanskloof (-CB), Oliver 3132  
 (STE); Karreedouw Pass (-CD), Tölken 3222 (BOL); near Andrieskraal  
 (-DC), Tölken 3864 (BOL). 3325 (Port Elizabeth): near Uitenhage  
 (-CD), Schlechter 2583 (GRA); Port Elizabeth (-DC), Paterson 2588  
 (PRE). 3326 (Grahamstown): Coldsprings (-AD), Tölken 3057 (BOL);  
 Howieson's Poort (-AD), Schonland 3692 (PRE); Penrock (-BA), Schon-  
land 470 (GRA); Pluto's Vale (-BA), Tölken 1247 (PRE); near Gra-  
 hamstown (-BC), Schlechter 2660 (GRA); MacOwen 1806 (GRA, PRE, SAM).  
 3327 (Paddie): near East London (-BB), Rattray 285 (PRE). 3421  
 (Riversdale): Riversdale (-AB), Muir 5198 (PRE). 3422 (Mossel  
 Bay): Mosselbaai (-AA), Moran in SAM 9064; Bartlesfontein (-AA),  
Muir 1239 (BOL, PRE). 3423 (Knysna): Keurbooms River (-AB),  
Gillett 1430 (BOL).

III. Crassula sect. Dinacria (Harv.) Schonl. in Pflanzenfam. ed. 1, 3, 2a : 37 (1890).

Type species: D. filiformis (Eckl. & Zeyh.) Harv.

Dinacria Harv., Fl. Cap. 2 : 330 (1862); Benth. & Hook.f., Gen. Pl. 657 (1865); Berger in Pflanzenfam. ed. 2, 18a : 401 (1930); Adamson, Fl. Cape Penins. 436 (1950); Phill., Gen. 364 (1951).

Grammanthes DC., Prodr. 3 : 392 (1828); Eckl. & Zeyh., Enum. 302 (1837); Harv., Fl. Cap. 2 : 331 (1862); Benth. & Hook.f., Gen. Pl. 1 : 658 (1865); Schonl. in Pflanzenfam. ed. 1, 3, 2a : 37 (1890); Phill., Gen. 365 (1951).

Vauanthes Haw., Rev. Pl. Succ. 18 (1821); Berger in Pflanzenfam. ed. 2, 18a : 402 (1930); Adamson, Fl. Cape Penins. 437 (1950).

Annuals with erect habit and thin wiry stems, glabrous. Leaves sessile but with a cuneate base, dorsiventrally compressed, glabrous, with few hydathodes on the margin and membranous sheath between the leaf bases. Inflorescence with terminal 5-merous flowers pedicellate but without peduncle. Sepals 1,5 - 4 mm long, rarely up to half the length of the petals, obtuse, glabrous, fleshy. Petals 3 - 5 (-20) mm long, forming a tubular flower with the apices recurved, without dorsal appendages. Stamens with yellow anthers 0,5 - 1 mm long. Squamae oblong-cuneate to linear, usually truncate, fleshy white, yellow to red. Carpels with oblong-reniform ovaries with styles slender to absent and often forming a projection or a shield-like structure above the laterally placed stigma; ovary with (2-) 6 - 16 (-36) ovules. Fruit often splitting along the whole suture but releasing the seeds through an apical pore.

Mainly in the south-western Cape, but C. dichotoma extends its distribution to near Springbok, while C. sebasoides was recorded at intervals to as far east as Grahamstown.

Diagnostic Features:

Species of the sect. Dinacria are annuals which have a tubular flower borne in terminal cymes without a peduncle. More specifically species of the

sect. Dinacria are distinguished from those of the sections Tillaeoideae and Glomeratae by their tubular flowers, narrowly oblong squamae and the anthers that are 0,5 - 1,3 mm long.

Taxonomy:

The flowers of the sect. Dinacria vary greatly in size and colour, but characteristic for this section is the even greater variation of the shape and size of the styles in different species. The name Dinacria, which is based on C. filiformis, refers to the two horns on the top of the ovary found in that species. The one being the style with the terminal stigma while the second one is an anterior projection of the short style which is recurved to the outside (fig. 2.2). C. grammanthoides has an elongate style and except for its sessile laterally placed stigma this species is indistinguishable from C. depressa. The latter species is distinguished from species of the sect. Glomeratae by its tubular flowers, narrowly oblong squamae and longer anthers, which are the characteristics of the section. This shows the close similarity of some elements of the sect. Dinacria with species of Crassula, and that the species included in the genera Dinacria and Vauanthes represent divergent tendencies in the development of the flower, as discussed in chapter 2. Their flowers represent flower types and C. dichotoma simulates the Gentiana - type, C. filiformis probably the Sphaeritis - type and C. sebaeoides has its own flower type (see also under the individual species). The sect. Dinacria is thus used in a wider sense than the genus on which it is based, because C. depressa and C. dichotoma are included in the section.

23. C. dichotoma (Herm., Horti acad. Lugd.-Batavi 55, t.553 (1683)) L.,

Pl. Rar. Afr. 9 (1760); Ait., Hort. Kew. ed. 1, 1 : 392 (1789);  
Tölken in J. S. Afr. Bot. 38 : 69 (1972).

Iconotype: Horti acad. Lugd.-Batavi t. 553.

Vauanthes dichotoma (L.) Kuntze, Rev. Gen. Pl. 1 : 232 (1891);

Adamson, Fl. Cape Penins. 437 (1950); Kidd, Wild Flow. Cape Penins.  
plate 56,5 (1950); Rice & Compton, Wild Flow. Cape G. Hope, plate  
49,2 (1951); Axelson, Western Cape Sandveld Flow. plate 49,2 (1972).

Crassula retroflaxa Thunb. in Nova Acta Phys.-Med. Acad. Carol.-Leop., Nat. Cur. 6 : 329, 338 (1778), partly as for var. a, et Prodr. 55 (1794), partly, et. Fl. Cap. ed. Schultes 282 (1823), partly as for var. a; L.f., Supp. 188 (1781); Ait., Hort. Kew. ed. 1, 1 391 (1789). Willd., Sp. Pl. 1, 2 : 1555 (1798).

Type: Caps, Thunberg in Herb. Thunberg 7789 (UPS, lecto!).

Crassula gentianoides Lam., Encycl. 2 : 175 (1785); Dietr., Sp. Pl. 2 : 1032 (1840).

Type: Africa, Sonnerat s.n. (P-L, holo!).

Grammanthes gentianoides (Lam.) DC., Prodr. 3 : 393 (1828); Eckl. & Zeyh., Enum. 302 (1837); Harv., Fl. Cap. 2 : 331 (1862); Marl., Fl. S. Afr. 2, 1 24, plate 5A (1925); Jacot Guill., Fl. Lesotho 184 (1971).

--- var. vera Harv., Fl. Cap. 2 : 331 (1862).

--- var. chloraeiflora (Haw.) Harv., Fl. Cap. 2 : 331 (1862).

Iconotype: plate 760 (K, lecto!).

Vauanthes chloraeiflora Haw., Rev. Pl. Succ. 19 (1821), nom. illeg.

Grammanthes chloraeiflora (Haw.) DC., Prodr. 3 : 392 (1828), incl.

var. b; Eckl. & Zeyh., Enum. 303 (1837); Hook. in Bot. Mag. ser. 3, 8, plate 4607 (1851).

--- var. cassia (Drège) Hook.f., in Bot. Mag. ser. 3, 34, plate 6401 (1878).

Crassula chloraeiflora (Haw.) Dietr., Syn. Pl. 2 : 1032 (1840).

Grammanthes cassia E. Mey ex Drège, Zwei Pfl. Doc. 85, 102 (1843), nom. nud.

Annuals with erect wiry stems 5 - 15 (-25) cm long, more or less branched and with leaves at approximately equal distances. Leaves obovate, elliptic to linear or rarely lanceolate, 0,5 - 1,2 (-1,8) cm long, 0,1 - 0,6 (-1) cm broad, acute or obtuse, glabrous, dorsiventrally compressed and often somewhat cymbiform, slightly fleshy, green; sheath up to 1 mm long and formed by the partial fusion of the leaf bases. Hydathodes a few on the margin, often brown

or black. Inflorescence terminal cymes with 5-merous pedicellate flowers without peduncle and with leaf-like bracts. Sepals elliptic-lanceolate, 4 - 6 mm long, obtuse and more or less recurved at the apex, glabrous, fleshy, green. Petals oblanceolate to elliptic, (7-) 8 - 12 (-20) mm long, obtuse to acute and without dorsal appendage, fused into a tube 2,5 - 4 mm long, with apices of the lobes recurved, yellow to orange and often marked in a deeper colour around the throat of the tube. Stamens 5 - 8 (-12) cm long, with yellow anthers 1 - 1,5 mm long, with filaments scarcely broadened towards the base and slightly constricted where fused to the petal tube. Squamae narrowly oblong, 0,6 - 1,3 X 0,1 - 0,3 mm, truncate or slightly rounded and scarcely constricted towards the base, fleshy, yellow. Carpels oblong and gradually constricted into slender styles usually longer than half the length of the ovary and with terminal stigmas; ovary smooth and with 25 - 36 elongate ovules covered with rows of papillae.

Usually on sandy soil and in open spaces between the vegetation; occurring from the south-western Cape to near Springbok.

Flowering Period: September, October.

Diagnostic Features:

The large flowers with petals longer than 7 mm together with the terminal stigmas distinguish C. dichotoma from other species in the section. In the genus Crassula only two annual species with yellow flowers occur, and C. dichotoma is distinguished from C. sebaecides by its terminal stigmas and slightly recurved sepal apices.

Variation and taxonomic Notes:

The size of the plant and the number of flowers as well as their size varies considerably according to environmental conditions. However, some local variation can be observed in the colour of the petals, which may vary from yellow to more or less orange around the throat of the flower tube. The free lobes are rarely completely orange.

The record (Dieterlen 1001) from Basutoland must be based on a confusion of specimens, as this species was not recorded east of Caledon.

Herman's illustration, that must be taken as the type of C. dichotoma, can be recognized without difficulty by its spreading and slightly keeled sepals.

The type locality of C. retroflexa cannot be identified, because Thunberg included six different localities under his type description, but did not specify which one applied to which of the three varieties. The three varieties seem to refer to a. C. dichotoma ("Floribus aurantiacis, major"), b. C. sebaoides ("Floribus luteis, mediocris") and c. C. filiformis ("Floribus albis, minor & tenerior"). In Thunberg's herbarium there are two specimens inscribed C. retroflexa, but only in the specimen 7789 the whole flower is recurved, probably due to the way the plant was pressed. However, the phrase "pedicel retrofactis" in the type description would only apply to this specimen. The second specimen must be identified as C. sebaoides.

Linné (1781) and Thunberg in various publication used the name C. dichotoma for plants of C. pellucida.

An illustration prepared for Haworth (plate 761 in Kew Herbarium), and on which he probably based his concept of C. dichotoma in Syn. Pl. Succ. (1812, 1819) seem to be a seedling of a species of Zygophyllum. However, in the above publications he quotes only Willdenow's description, so that the suspicion cannot be confirmed. Haworth (1821) quotes C. dichotoma as a synonym of Vauanthes chloraeflora, so that the latter name is illegitimate.

#### Specimens examined:

CAPE. - 2917 (Springbok): 6 Km north of Concordia (-DB), Hardy & Bayliss 1153 (PRE); near Spektakel (-DA), Bolus 9547 (BOL). 3017 (Hondeklipbaai): near Hondeklipbaai (-AD), Pillans in BOL 18 032; L'Aus (-BB), Schlechter 11 215 (BOL, GRA, PRE); 8 Km south of Kamieskroon (-BB), Lütjeharm 7178 (PRE); Grootvallei (-BB), Thompson 445 (PRE, STE); between Garies and

Kamieskroon, de Vos 1723 (STE). 3119 (Calvinia): Vanrhynsdorp (-AC), Hutchinson 764 (PRE); Mensieskraal (-CA), Markotter in STE 18 487. 3118 (Vanrhynsdorp): Bitterfontein (-AB), Henrici 2164 (PRE); Klaver (-DC), Adendorff in TRV 17 658 (PRE); Gifberg (-DD), Phillips 7645 (BOL). 3218 (Clanwilliam): Verlorenvlei (-AD), Pillans 8048 (BOL); 8068 (BOL); Clanwilliam (-BB), Mader s.n. (GRA); Piekeniers Pass (-DB), Ihlenfeldt 1050 (PRE); near Piketberg (-DC), Schlechter 5236 (GRA); Bolus s.n. (BOL); Howes 206 (PRE). 3219 (Wuppertal): Pakhuis Pass (-AA), van Breda 556 (PRE). 3317 (Saldanha): Hoedjes Bay (-BB), Walgate s.n. (BOL). 3318 (Cape Town): Yzerfontein (-AC), van Rensburg 158 (PRE, STE); Con-treberg (-AD), Pillans 6918 (BOL); Darling (-AD), Bolus s.n. (BOL) near Hermon (-BD), Marsh 725 (PRE, STE); Oudebos (-CB), Tölkén 1556 (BOL); near Mamre (-CB), Wasserfall 981 (PRE); Camps Bay (-CD), Marloth 296 (PRE, STE); Galpin 4024 (GRA, PRE); Table Mountain (-CD), Bolus 2788 (BOL, PRE); Cape Flats, Marloth 6010 (PRE). 3319 (Worcester): Tulbagh (-AC), Andraea 661 (PRE, STE); Tyson 2295 (BOL). 3320 (Montagu): Montagu Bath (-CA), Page 109 (PRE). 3418 (Simonstown): Muizenberg (-AB), Pearson 489 (PRE); Chapman's Bay (-AB), Wolley-Dod 3669 (BOL); Buffel's Bay (-AD), Hutchinson 653 (PRE); Strandfontein (-BA), Esterhuysen s.n. (BOL); Helderberg (-BB), Parker 4256 (BOL). 3419 (Caledon): Gansbaai (-CB), Taylor 4904 (STE).

24. C. depressa (Eckl. & Zeyh.) Toelken, comb. nov.

Grammanthes depressa Eckl. & Zeyh., Enum. 303 (1837).

Type: Cape, Riviersondereinde, Ecklon & Zeyher 1937 (S!).

Grammanthes gentianoides (Lam.) DC. var. depressa (Eckl. & Zeyh.)

Harv., Fl. Cap. 2 : 331 (1862).

Crassula ecklonii Diestr., Syn. Pl. 2 : 1032 (1840), nom. illeg.

Type: same as for Grammanthes depressa.

Annuals with spreading branches up to 5 cm high, with wiry and brown branches usually much branched, glabrous, and with leaves at about equal distances from

one another. Leaves sessile, oblanceolate to elliptic, 0,4 - 1 (-1,5) cm long, 0,2 - 0,5 cm broad, bluntly acute to obtuse, dorsiventrally flattened and slightly cymbiform, glabrous, slightly fleshy, green; sheath up to 0,05 cm long and formed by the partial fusion of the leaf bases. Hydathodes a few along the margin, inconspicuous. Inflorescence terminal dichasia with few to many 5-merous flowers loosely arranged and with pedicels not elongating after flowering. Sepals broadly triangular, c. 1,5 cm long, obtuse, glabrous, fleshy, green. Petals oblong-elliptic, 3 - 4 mm long acute or obtuse and without a dorsal appendage, fused into a tube c. 1,5 mm long, erect or recurved just above the sepals, white or tinged pink. Stamens 1,5 - 2 mm long, with yellow anthers 0,5 - 0,7 mm long, with filaments slightly broadened towards the base and abruptly constricted where fused to the petal tube. Squamae oblong - oblanceolate, 0,8 - 1 x 0,01 mm, each rounded or truncate at the apex, gradually and slightly constricted towards the base from above the middle, slightly fleshy, white. Carpels with oblong - reniform ovaries gradually constricted into thin styles about half as long as the ovaries and with terminal stigmas; ovary with a few blister-like papillae towards the apex and with 14 - 16 elongate ovules covered with dense rows of papillae.

On sandy soils and usually in open patches in coastal fynbos vegetation; occurring from near Caledon to near Wilderness.

Flowering Period: September, October.

Diagnostic Features:

C. depressa is very similar to C. dichotoma but is distinguished by its white or pink petals that are up to 4 mm long. The latter is an altogether larger plant, while C. gramanthoides and C. filiformis are distinguished by laterally placed stigmas and the style continues into a separate horn.

Variation and taxonomic Notes:

The plants show little variation but only a few collections of it

are found in herbaria. However, the plant is described by some collectors as locally common.

C. ecklonii is an illegitimate name as there is no reason why Grammanthes depressa should change its epithet when transferred to the genus Crassula.

CAPE.- 3322 (Dudtshoorn): Rondevlei (-DC), van Niekerk 206 (BOL). 3419 (Caledon): Swartberg (-AB), Guthrie in BOL 17 064 (BOL); Riviersondereinde (-BB), Ecklon & Zeyher 1937 (S); Zeyher 2512 (PRE, S). 3420 (Bredasdorp): Bredasdorp (-CA), Esterhuysen 19 142 (BOL); Die Poort (-CA), Acocks 2354 (S). 3423 (Knysna): Belvidere (-AA), Duthie 1142 (STE).

25. C. grammanthoides (Schonl.) Toelken, comb. nov. et stat. nov.

Dinacria grammanthoides Schonl. in Bull. Herb. Boiss. ser. 1,5 : 859 (1897).

Type: Cape, Swartberg near Caledon, Schlechter 5570 (GRA, holo!, BOL!).

Annuals with erect branches up to 5 cm high, usually much branched, with wiry brown branches, glabrous and with leaves at about equal distances from one another. Leaves sessile, lanceolate, ovate to elliptic, 0,5 - 1 (-1,5) cm long, 0,2 - 0,6 cm broad, obtuse, dorsiventrally flattened and slightly cymbiform, glabrous, slightly fleshy, green; sheath up to 0,05 cm long and formed by the partial fusion of the leaf bases. Hydathodes a few along the margin, inconspicuous. Inflorescence terminal dichasia with few to many 5-merous flowers loosely arranged and with pedicels not elongating after flowering. Sepals oblong - triangular, 2 - 2,5 mm long, obtuse, glabrous somewhat fleshy, green. Petals oblanceolate, 4 - 5 mm long, bluntly acute, and without dorsal appendage, fused into a tube 0,3 - 0,4 mm long, erect or somewhat recurved at the apex, white to yellow. Stamens 3 - 3,5 mm long, with yellow anthers 0,5 - 0,7 mm long, with filaments somewhat broadened towards the base, and abruptly constricted where fused to the petal tube. Squamae oblong-cuneate, 0,8 - 1 x 0,2 - 0,3 mm, truncate or slightly rounded

at the apex, gradually constricted towards the base, slightly fleshy, white. Carpels with oblong-reniform ovaries gradually constricted into slender styles about as long as the ovary with dorso-laterally placed stigmas and continuing into a short horn; ovary with blister-like papillae towards the apex and with 8 - 12 ovules faintly papillose.

On sandy slopes in open vegetation; occurring between Caledon and Bredasdorp.

Flowering Period: September - October.

Diagnostic Features:

The stigma is placed laterally in C. grammanthoides but, in contrast to C. filiformis, the styles are almost as long as the ovary and the aestivation of the petals is imbricate. Although the style is sometimes slightly broadened it is never divided into two wings as in C. sebaeoides.

Variation and taxonomic Notes:

C. grammanthoides is known only from two localities. The type specimen has a slender style but in contrast to C. depressum it has a laterally placed stigma. On the other hand Esterhuysen 23 176 has the styles slightly broadened ventrally and superficially it might resemble the styles of C. sebaeoides, but they are not divided into two wings. In other words the styles of C. grammanthoides are similar to those of C. depressum, but have a laterally placed stigma and which is not as much expanded as in C. sebaeoides. C. grammanthoides forms the link between the genera Crassula and Dinacria.

Specimens examined:

CAPE. - 3419 (Caledon): Swartberg (-AB), Schlechter 5570 (BOL, GRA).

26. C. filiformis (Eckl. & Zeyh.) Dietr., Syn. Pl. 2 : 1032 (1840).

Grammanthes filiformis Eckl. & Zeyh., Enum. 303 (1837).

Type: Cape, Tulbagh Waterfall, Ecklon & Zeyher 1938 (BOL!;SAM!).

Dinacria filiformis (Eckl. & Zeyh.) Harv., Fl. Cap. 2 : 331 (1862);

Adamson, Fl. Cape Penins. 437 (1950).

Crassula capillacea E. Mey. ex Drège, Zwei Pfl. Doc. 113 (1843),  
nom. nud.

Annuals with erect branches up to 10 cm high, more or less branched, with wiry brown branches glabrous and with leaves at about equal distances from one another. Leaves sessile, lanceolate to elliptic, 0,3 - 0,7 (-1) cm long, 0,2 - 0,4 cm broad, obtuse, dorsiventrally flattened and slightly cymbiform, glabrous, slightly fleshy, green to brown; sheath up to 0,05 cm long and formed by the partial fusion of the leaf bases. Hydathodes a few along the margin, inconspicuous. Inflorescence a terminal dichasium with few to many 5-merous flowers loosely arranged and with pedicels not elongating after flowering. Sepals oblong to broadly triangular, 1 - 1,5 mm long, obtuse, glabrous, very fleshy, green. Petals oblanceolate, 2 - 3 mm long, acute and without dorsal appendage, fused into a tube up to 0,2 mm long, erect and recurved just above the sepal apex, white. Stamens 1,5 - 2 mm long, with yellow anthers 0,5 - 0,7 mm long, with filaments somewhat broadened towards the base and abruptly constricted where fused to the petal tube. Squamae oblong-cuneate, 0,4 - 0,7 x 0,2 - 0,3 mm, truncate, at first abruptly but later gradually constricted towards the base, fleshy, white to red. Carpels with oblong-reniform ovaries slightly constricted into a broad style with a dorso-laterally placed stigma and continuing ventrally into a short horn; ovary smooth and with 2 - 6 almost ovoid ovules covered with rows of papillae. Fig. 2.2.

Usually on sandy soil along the coast but also in the mountains; occurring from near Port Elizabeth to the Cape Peninsula and Saldanha Bay in the north.

Flowering Period: August - November.

Diagnostic Features:

C. filiformis is distinguished from all annual species of Crassula by the contorted aestivation of its petals and the somewhat ventrally bent horn of the short style.

Variation and taxonomic Notes:

This species is remarkably constant throughout its range.

The contorted aestivation of the petals of this species is unusual in this section but one immediately notices that the sides of the petals are unequally broad, i.e. the petals are not symmetrical. This and the laterally placed stigmas seem to be part of a pollination syndrome analogous to the Sphaeritis - type of flower as has been discussed in the introduction. At the same time it must be mentioned that C. sebaeoides has an imbricate aestivation and the pollination mechanism is analogous but much more complex in that species.

On the other hand the elongation of the style beyond the laterally placed stigma is not unique in the genus Crassula and can also often be observed in species of the sect. Globulea such as C. pubescens, C. rogersii and C. nudicaulis.

Specimens examined:

CAPE. - 3218 (Clanwilliam): Mouton's Vlei (-DB), Pillans 7443 (BOL). 3219 (Wuppertal): Pakhuis Pass (-AA), Esterhuysen 23 764 (BOL). 3318 (Cape Town): Hopefield (-AB), Bachmann in BOL 6295; Kuilsrivier (-DC), Zeyher in SAM 15 707. 3319 (Worcester): Tulbagh Waterfall (-AC), Bolus 5391 (BOL, SAM); Ecklon & Zeyher 1938 (S, SAM); Zeyher 637 (PRE, SAM); Bainskloof (-CA), Schlechter 9107 (BOL, GRA, PRE); Tölken 1601 (BOL). 3325 (Port Elizabeth): Swartkops River (-DC), Zeyher 5070 (SAM). 3418 (Simonstown); Muizenberg (-AB), Bolus 7009 (BOL); 7961 (BOL); Chapman's Bay (-AB), Wolley-Dod 3670 (BOL); near Rooi Els (-BD), Oliver 3029 (PRE, STE). 3419 (Caledon): Houwhoek (-AA), Schlechter 5498 (BOL, GRA, PRE); Caledon (-AB), Bolus 6908 (BOL, PRE); Galpin 4022 (GRA, PRE); Swart Rivier (-AD), Zeyher 5070 (SAM); Steenboksberg (-AD), Esterhuysen 32 297 (BOL). 3420 (Bredasdorp): near Bredasdorp (-CA), Esterhuysen 19 140 (BOL); Brandfontein (-CC), Esterhuysen 19 040 (BOL).

27. C. sebaeoides (Eckl. & Zeyh.) Toslken, comb. nov.

Grammanthes sebaeoides Eckl. & Zeyh., Enum. 303 (1837).

Type: Cape, near Tulbagh, Ecklon & Zeyher 1936.

Grammanthes gentianoides (Lam.) DC. var. sebaeoides (Eckl. & Zeyh.)

Harv., Fl. Cap. 2 : 331 (1862).

--- var. media Harv., Fl. Cap. 2 : 331 (1862).

Type: Cape, Riviersonderende, Zeyher 2512 (S!).

Dinacria sebaeoides (Eckl. & Zeyh.) Schönl. in Bull. Herb. Boiss.

ser. 1,5 : 859 (1897).

Grammanthes flava E. Mey. ex Drège, Zwei Pfl. Doc. 76, 110 (1843),

nom. nud.

Annuals with erect branches up to 8 cm high, more or less branched, with wiry brown branches, glabrous and with leaves at about equal distances from one another. Leaves sessile, oblanceolate to obovate to elliptic or ovate, 0,5 - 0,9 (-1,2) cm long, 0,2 - 0,4 cm broad, usually obtuse, dorsiventrally flattened and slightly cymbiform, glabrous, slightly fleshy, green; sheath up to 0,05 cm long and formed by the partial fusion of the leaf bases.

Hydathodes a few along the margin, inconspicuous. Inflorescence a terminal dichasium with few to many 5-merous flowers loosely arranged and with pedicels not elongating after flowering. Sepals usually oblong, 1,5 - 2 mm long, obtuse, glabrous, very fleshy, green. Petals oblanceolate 4 - 5 mm long, bluntly acute to obtuse, and without dorsal appendage, fused into a tube c. 2 mm long, recurved above the petal apex, yellow. Stamens 1,5 - 2 mm long, with yellow anthers 0,5 - 0,7 mm long, with filaments slightly broadened towards the base and abruptly constricted where fused to the petal tube.

Squamae oblong-cuneate, 0,6 - 0,8, x 0,2 - 0,4 mm, truncate, at first abruptly but later gradually constricted towards the base, fleshy, yellow. Carpels with oblong-reniform ovaries abruptly constricted into the styles which develop two broad wings covering the laterally placed stigmas; ovary usually covered with blister-like papillae towards the apex and with 10 - 18 ovules densely covered with rows of fine papillae.

On gravelly or somewhat clayish slopes and usually associated with arid country vegetation; recorded from a few localities from near Grahamstown along the Langkloof to the Little Karoo and the adjoining Great Karoo and along the mountains to near Calvinia in the north.

Flowering Period: September - November.

Diagnostic Features:

The yellow petals are up to 5 mm long, but C. sebaeoides differs from C. dichotoma by its adpressed petals which are up to 2,5 mm long. The two wings that develop from either side of the suture on the styles and from a shield above the laterally placed stigmas are unique in the genus Crassula.

Variation and taxonomic Notes:

As in other species in this section, C. sebaeoides shows little variation although it is wide-spread.

The floral morphology is unique with the two wing-like shields that develop above the stigmas leaving only a narrow gap between it and the petal tube immediately above the stigma. The pollinating agent has to force its way into the flower through this narrow gap to get to the nectaries at the base of the carpels. The ovaries have a more or less large spot on the upper part which seem to act as a guide line. In other words the mechanism of pollination is analogous to that of C. filiformis, but in C. sebaeoides there are five openings through which the probing pollinating agent can force its way into the flower. In other words the pollination syndromes of C. filiformis and C. sebaeoides are based on an analogous principle but represent divergent tendencies. Also, in C. filiformis the style elongates beyond the laterally placed stigmas while in C. sebaeoides the whole margin of the carpel on the style expands into a shield-like wing on either side of the style. As discussed under the sect. Dinacria one has to consider all five species incorporated in this section to evaluate the divergent tendencies rather than placing C. grammanthoides, C. filiformis and C. sebaeoides in a separate genus Dinacria, because they have a laterally placed stigma.

Specimens examined:

CAPE. - 3119 (Calvinia): Vanrhyn's Pass (-AC), Hutchinson 766 (PRE), near Nieuwoudtville (-AC), Lavis s.n. (BOL); Leistner 360 (PRE). 3219 (Wupertal): Pakhuis Pass (-AA), Galpin 11 093 (PRE); Sneeuwberg (-CA), Esterhuysen 13 067 (BOL). 3218 (Clanwilliam): Zebrakop (-DB), Pillans 7191 (BOL); Kapitein's Kloof (-DC), Pillans 7884 (BOL); Versveld Pass (-DC), Pillans 7145 (BOL). 3319 (Worcester): near Tulbagh (-AC), Ecklon & Zeyher 1936 (S); 72 Km east of Karoo Poort (-BB), Tölken 3542 (BOL). 3320 (Montagu): 5 Km north of Matjesfontein (-BA), Acocks 17 156 (PRE); Montagu Bath (-CA), Page in BOL 15 425. 3321 (Ladismith): Vanwyksdorp (-CB), Muir 3294 (GRA, PRE); Muiskraal (-CC), Galpin 4023 (GRA, PRE). 3323 (Willowmore): Uniondale (-CA), Paterson 3139 (GRA, SAM). 3324 (Steytlerville): Hankey (-DD), Paterson 3200 (BOL, GRA); Fourdade 5779 (SAM). 3325 (Port Elizabeth): Mimosa (-BD), Begley s.n. (PRE). 3326 (Grahamstown): Penrock farm (-BA), Dyer 572 (GRA); Beaconfield (-BC), Schonland 414 (GRA, PRE); 1679 (BOL, GRA, PRE); near Grahamstown (-BC), Bennie 197 (GRA). 3419 (Caledon): Riviersondereinde (-BB), Zeyher 2512 (S).

IV. Crassula sect. Filipedes (Harv.) Schonl. in Pflanzenfam. ed. 1, 3, 2a : 37 (1890), partly.

Type species: C. expansa Dryand. in Aft.

Crassula group Filipedes Harv., Fl. Cap. 2 : 335 (1862).

Crassula group Filicaulis Schonl. in Ann. Bolus Herb. 2 : 45 (1916) et in Trans. Roy. Soc. S. Afr. 17 : 161 (1929); Berger in Pflanzenfam. ed. 2, 18a : 388 (1930); Merxmüller et al. in Ann. Naturhist. Mus. Wien 75 : 112 (1971).

Perennials with decumbent or prostrate habit, with herbaceous stems rarely slightly carnosose or woody, glabrous or hairy. Leaves often with a short petiole or at least with cuneate base rarely sessile, dorsiventrally compressed to terete, glabrous to hairy, with few hydathodes mainly along the margin but also more or less spread over the upper surface, with membranous sheath between the leaf bases. Inflorescence single 5-merous flowers in the axils of the leaves but sometimes clustered at the apex of the stems and usually the pedicels elongate somewhat with the maturity of the fruits. Sepals 1 - 3 mm long, linear-elliptic to lanceolate and shorter than the petals, obtuse or bluntly acute, glabrous or hairy, fleshy. Petals 1 - 3 mm long, at first forming a tube then recurved to form a star-like flower. Stamens with yellow to brown anthers (0,3-) 0,4 - 0,6 mm long. Squamae oblong to square, truncate, usually slightly constricted towards the base, membranous, pale yellow or white. Carpels with reniform ovaries gradually constricted into thin styles usually only half as long as the ovaries and with terminal stigmas; ovary with 2 - 12 ovules. Fruit usually splitting along the whole suture but releasing the seeds through an apical pore.

The sect. Filipedes includes few species, but some of them are widespread in Southern Africa, also tropical Africa and Madagascar.

Diagnostic Features:

The perennial plants have prostrate or decumbent branches which are scarcely carnosose or woody and with single flowers in the axils of the leaves or rarely the flowers are clustered at the apex. In contrast to species of the sect. Glomeratae they are perennial species with single flowers in the axils of the leaves due to sympodial growth and the ovules as well as the seeds are densely covered with papillae (see also discussion below). C. pellucida of the sect. Anacampseroides is distinguished by its large star-like flowers with the petals spreading from the base, the long slender styles and the pink to purple anthers.

Taxonomy:

The sect. Filipedes is delimited here in a much stricter sense and most of the species included by previous authors are now transferred to different sections. For instance, species of the sect. Filipedes are in many respects similar to those of the sections Glomeratae, Anacampseroides and Deltoidea, as pointed out in chapter 6 and in the discussion of the respective sections. However, these 'similar species' are placed here into different sections, because they form part of developmental lines found in these respective sections. At the same time it is convenient to maintain the sect. Filipedes, because all the sections of the subgen. Levifolia seem to show at least in a few species great similarity to some of the species of the sect. Filipedes.

Species of the sect. Glomeratae (see also discussion under that section), which are similar to those of the sect. Filipedes have glabrous seeds and a loosely cymose inflorescence at the end of terminal and lateral branches. In the sect. Filipedes the single flowers are axillary due to sympodial growth, and even the flowers are clustered at the end of the branches they are usually alternately arranged (see also discussion under the sect. Tillaeoideae), which indicates that the apices of the branches are merely condensed, and this does not represent a cymose arrangement.

Similarly the subsect. Fasciculares (sect. Anacampseroides) was apparently artificially separated from the sect. Filipedes, but it represents a developmental line that leads up to other species of the sect. Anacampseroides. For instance, C. pellucida subsp. alsinoides which has decumbent branches and single flowers in the axils of the leaves produces open star-like flowers, styles about as long or longer than the ovaries and seeds with subdistinct papillae, which are all characteristics of the sect. Anacampseroides.

C. elsieae of the sect. Deltoidea is in vegetative characters very similar to C. papillosa of the sect. Filipedes, but has a terminal cymose inflorescence and tubular flowers typical of the sect. Deltoidea.

Within the sect. Filipedes considerable variation is found and especially the complex species C. expansa shows divergent developments. For instance, in the northern Natal, Transvaal and tropical Africa the var. browniana with its various local variations has flat leaves with scattered hydathodes over the upper surface. In contrast to this the var. pyrifolia from Namaqualand has terete leaves also with the hydathodes scattered over most parts of the leaves, while typical C. expansa has its hydathodes only along the margin.

28. C. papillosa Schönl. Bak.f. in J. Bot., Lond. 36 : 371 (1898);

Schönl. in Ann. Bolus Herb. 2 : 51, fig. 2, plate 2, 3 (1916)

et in Trans. Roy. Soc. S. Afr. 17 : 182 (1929).

Type: Cape, Matroosberg, Marloth 1999 (GRA, holo!; BM; PRE!).

C. limosa Schönl. in Rec. Albany Mus. 1 : 58 (1903).

Type: Cape, Andriesberg, Galpin 1922a (GRA, lecto!).

Perennials with prostrate herbaceous stems forming dense cushions up to 20 cm in diameter, much branched and branches repeatedly rooting at the nodes, glabrous. Leaves sometimes with a petiole up to 0,1 cm long; lamina elliptic to oblanceolate, 0,15 - 0,3 cm long, 0,05 - 0,15 cm broad,

usually obtuse, dorsiventrally flattened to somewhat convex on both surfaces, minutely papillose to almost glabrous, fleshy, green to red; sheath c. 0,02 cm long, membranous. Hydathodes few along the margin, inconspicuous. Inflorescence single 5(4)-merous flowers in the axils of the leaves and with a pedicel up to 1 cm long when fruiting. Sepals lanceolate to almost ovate, 1 - 2 mm long, acute or obtuse, minutely papillose towards the apex, fleshy green to red. Petals elliptic-oblong, 2 - 3 mm long, acute and without dorsal appendage, fused into a tube up to 0,3 mm long, with the lobes spreading, white rarely tinged pink. Stamens c. 2 mm long, with yellow anthers 0,4 - 0,6 mm long, with filaments somewhat constricted towards the base and slightly constricted where fused to the petal tube. Squamæ oblong to almost square, 0,5 - 0,6 x 0,3 - 0,5 mm, truncate and gradually constricted towards the base, almost membranous, white. Carpels with reniform ovaries abruptly constricted into the slender styles which are up to half as long as the ovaries and with indistinct terminal stigmas; ovary smooth and with 2 - 4 elongate ovules densely covered with rows of papillae.

On moist soil in deep shade under rocks or in caves and often at high altitude; recorded from scattered localities from near Queens-town to the mountains of the South-western Cape Province.

Flowering Period: December - April.

Diagnostic Features:

C. papillosa produces similar prostrate mats on moist soil as C. tenuicaulis does, but the former is distinguished by its smaller leaves (up to 3 mm long), its open cup-shaped flowers and 2 - 4 ovules per carpel.

Variation and taxonomic Notes:

The species shows little variation except in the size of the leaves with different environmental conditions. Also, plants from the Cape Peninsula have glabrous or almost glabrous leaves.

The number of the type specimen of C. limosa was changed to Galpin 1922a, so as to distinguish it from a specimen of C. vaillantii collected at the same locality in 1895. It became necessary to chose a lectotype, because Galpin recollected the same plant at the same locality in 1901 and gave this collection also the number 1922, and to which it is now referred to as 1922b.

Specimens examined:

CAPE. - 3027 (Lady Grey): Majuba's Nek (-CB), Hepburn 105 (GRA); Doodmanskrans (-DD), Galpin 6612 (BOL, GRA, SAM). 3124 (Hanover): Sneeuberge, Bolus 2061 (BOL, GRA). 3126 (Queenstown): Andriesberg (-DA), Galpin 1922a (GRA); 1922b (PRE). 3219 (Wuppertal): Sneekop (-CA), Esterhuysen 7546 (BOL, NBG, SAM); Krakadouw (-CA), Esterhuysen 15 000a (BOL); Bokkeveld Tafelberg (-CD), Esterhuysen 3972 (BOL). 3318 (Cape Town): Fernwood Peak (-CD), Esterhuysen 30 053 (BOL); Postern Buttress (-CD), Esterhuysen 23 972 (BOL). 3319 (Worcester): Great Winterhoek (-AA), Marloth 2314 (PRE); Sneeuat Peak (-AA), Esterhuysen 19 766 (BOL, PRE); Little Winterhoek (-AA), Esterhuysen 13 759 (BOL); Hansiesberg (-AB), Esterhuysen 25 719 (BOL); Milner Peak (-AD), Esterhuysen 8481 (BOL); Buffelshoek Peak (-AD), Esterhuysen 24 054 (BOL); Moster's Hoek (-AD), Esterhuysen 9854 (BOL); Baviaansberg (-BA), Compton 12 881 (NBG); Matroosberg (-BC), Marloth 1999 (BM, GRA, PRE); Slanghoek Peak (-CA), Esterhuysen 22 281 (BOL); Waalhoek (-CB), Esterhuysen 22 619 (BOL, PRE). 3320 (Montagu): Misty Point (-CD), Esterhuysen 24 599 (BOL). 3321 (Ladismith): Towerkop (-AC), Esterhuysen 18 505 (BOL); Seweweekspoort (-AD), Andraea 1343 (GRA, PRE, STE); Primos 65 (PRE, STE).

29. C. expansa Dryand. in Ait., Hort. Kew. ed. 1, 1 : 390 (1789) et ed. 2, 2 : 196 (1811); DC., Prodr. 3 : 389 (1828); Harv., Fl. Cap. 2 : 354 (1862); Schonl. in Trans. Roy. Soc. S. Afr.

17 : 184 (1929).

Type: Caput Bonae Spei, Masson s.n. (BM, holo!).

Perennials with decumbent or rarely scrambling branches 10 - 20 (-35) cm long, herbaceous, carnosose or slightly woody, with or without adventitious roots and with old leaves remaining attached to the stems. Leaves rarely with a petiole up to 0,4 cm long, but usually sessile; lamina lanceolate, elliptic to broadly obovate (0,4-) 0,6 - 2 (-3,5) cm long, (0,1-) 0,2 - 0,4 (-1,5) cm broad, subulate to obtuse, glabrous or hairy, green, yellowish-green to brown; sheath 0,1 - 0,2 cm long, membranous. Hydathodes along the margin or more or less scattered over the leaf surface, sometimes conspicuous. Inflorescence single 5-merous flowers in the axils of the leaves but sometimes clustered at the apex of the branches, with pedicels usually elongating much after flowering (up to 5 cm long). Sepals linear-oblong to linear-triangular, 2 - 3 mm long, fleshy, green to brown. Petals elliptic-oblong, 2,5 - 4 mm long, acute or obtuse or rounded but without dorsal appendage, fused into a tube 0,15 - 0,3 mm long and with lobes spreading or recurved at the apex, white often tinged red. Stamens 2 - 3 mm long, with white to black anthers 0,4 - 0,7 mm long, with filaments scarcely broadened towards the base and abruptly constricted where fused to the petal tube. Squamae transversely oblong to square, 0,3 - 0,4 x 0,5 - 0,6 mm, truncate and slightly constricted towards the base, pale yellow to orange. Carpels with oblong reniform ovaries more or less abruptly constricted into slender styles about half as long as the ovaries and with insignificant terminal stigmas; ovary smooth or rarely with a few cilia along the suture and with 6 - 12 (-16) elongate ovules covered with rows of subdistant papillae.

Diagnostic Features:

Perennial suffrutices with brittle branches with single flowers in the axils of the leaves and they are often found in dry savanna or

karroid vegetation. Both C. papillosa and C. tenuicaulis are distinguished by their softly herbaceous prostrate branches and in contrast to those of the var. peculiaris they are glabrous.

The var. fragilis and the var. peculiaris are distinguished from the other varieties by their more or less compressed leaves, which are obovate and hairy or at least the sepals are covered with hairs. The var. peculiaris is distinguished from the var. fragilis by its prostrate habit, the arrangement of the hydathodes along the margin and that it grows only in deep shade under cliffs at high altitude on the Swartberg mountain range. The var. expansa does not produce tough stilt roots along the stems as in the case of the var. fillicaulis and the var. pyrifolia, but might occasionally have soft adventitious roots which start branching immediately below the branches. The var. fillicaulis grows only in close proximity of the sea along the southern Cape coast and if the flowers are clustered towards the apex the subtending leaves are not shorter than 3 mm. In contrast to the var. pyrifolia the hydathodes are arranged in more or less clear two rows along the margin, while in the var. pyrifolia they are scattered over the upper surface. The flowers are clustered at the apex in the var. pyrifolia and it occurs mainly in the foot hills to the west of the mountains running north-south through the Namaqualand and Richtersveld.

Variation and taxonomic Notes:

The extensive variation found in this species, and much of which can be attributed to local variation is discussed under the individual varieties. C. expansa is accepted here as a species complex similar to C. tetragona, but in C. expansa varietal rank is given to the taxa recognised within it, because their ecological tolerances are so wide that often different forms grow next to one another. Direct evidence of hybridization has not been observed in the field but might have to be reinvestigated in the case of the var. fragilis and var. expansa in

the north-eastern Natal. Also, in how far the flat-leaved form of the var. expansa, which occurs usually on forest margins, and the form with the almost terete leaves, which grows in dryer scrub vegetation show a complete range of intermediates, because of extensive hybridization cannot be evaluated only in the field, because in many parts of the eastern Cape Province these two habitats occur so close to one another. Neither plants with convex leaves nor those with compressed leaves show appreciable changes when grown under similar conditions in a glass house (see also discussion under var. expansa).

29a. var. expansa

C. expansa Dryand. in Ait., Hort. Kew. ed. 1, 1 : 390 (1789) et ed. 2, 2 : 196 (1811); Willd., Sp. Pl. 1 : 1561 (1798); DC., Prodr. 3 : 389 (1828); Harv., Fl. Cap. 2 : 354 (1862); Britt. & Bak. f. in J. Bot., Lond. 35 : 483 (1897); Schonl. in Ann. Bolus Herb. 2 : 55, fig. 6, plate 3 fig. 8 (1916) et in Trans. Roy. Soc. S. Afr. 17 : 184 (1929).

Sedum expansum (Dryand.) Kuntze, Rev. Gen. Pl. 3,2 : 84 (1898).

Crassula prostrata Thunb., Prodr. 54 (1794) et in Fl. Cap. ed. Schultes 282 (1823).

Syntype: Cape, Thunberg in Herb. Thunberg 7781 (UPS!); 7782 (UPS!).

C. parviflora E. Mey. ex Drège, Zwei Pfl.Doc. 57, 66, 134 (1843), nom. nud.

C. albicaulis Harv., Fl. Cap. 3 : 353 (1862).

Type: Cape, Eselsfontein, Whitehead s.n. (TCD!).

C. peploides sensu Schonl. & Bak. f. in J. Bot., Lond. 36 : 372 (1898), non Harv.

Perennials with herbaceous branches rarely slightly woody at the base, decumbent, up to 20 cm long and without stilt roots but rarely with fine adventitious roots which branch immediately. Leaves sessile linear-

-lanceolate to elliptic, 0,15 - 0,3 (-0,4) cm broad, acute or obtuse, dorsiventrally compressed to almost terete but with a narrow flat upper surface, glabrous and with hydathodes arranged in one or two rows along the margin. Flowers single in the axils of the leaves, but often also clustered towards the apex. Sepals about half to almost as long as the petals, obtuse glabrous.

Usually on rocky slopes but showing a wide tolerance of habitats from arid regions, such as the Namaqualand and the southern parts of the Karoo to forest margins along the Natal coast.

Flowering Period: Plants are mainly flowering in summer, but flowers can be found at any time of the year after sporadic rains in arid regions.

Diagnostic Features:

The var. expansa is distinguished by its glabrous leaves and sepals as well as by the absence of stiff stilt roots. If plants of it produce adventitious roots, which has been observed in a few cases, they branch immediately and do not become woody.

Variation and taxonomic Notes:

Along the coastal foothills in Natal soft herbaceous plants with dorsiventrally compressed leaves occur, and this form is still found associated with forested areas near King William's Town and the Suurberg mountains north of Port Elizabeth. However, in the adjoining dryer valley scrub vegetation plants with leaves with more and more convex undersurface are found. The hydathodes are in a single row in Natal, but they become slightly scattered with the development of a more convex undersurface. In the vicinity of Port Elizabeth and even more so to the north and north-west of it, the plants have usually a very convex undersurface and the hydathodes are arranged in two rows. This is the form typical of the Little Karoo, the southern Great Karoo and most parts of Namaqualand. Even more characteristic of these plants are the pale yellow to almost white fleshy stems of these plants and

which seem to have induced Harvey's epithet "albicaulis". The preserved type specimen collected by Masson, and which had flowered in 1774, is also of this most commonly found type. On the other hand the two type specimens of C. prostrata Thunb., as well as most of the specimens of Drège's C. parviflora are of the finer eastern Cape form. Specimens distributed by Ecklon & Zeyher under C. filicaulis are a mixture of plants of the var. expansa and the var. filicaulis.

Another form of the var. expansa occurs on the sandy flats east of the Lebombo mountains and it is distinguished by its often rather long petals (up to 4 mm long), and the broadly elliptic leaves. However, the size and shape of the leaves of this plant vary greatly and in southern <sup>Z or S</sup>Mozambique they tend to be narrower and very similar to those of plants along the southern Natal coast.

This broad-leafed form is often confused with the var. fragilis. Typical var. fragilis occurs in the Lebombo mountains, but the two forms never occur close to one another. In the central Natal the leaves of the var. fragilis are often less hairy and at times glabrescent so that the latter variety can only be distinguished by its puberulous sepals and scattered hydathodes in <sup>live</sup> material. Herbarium material from the area between Mkuzi and Nkandla is often difficult to identify with certainty.

Two specimens from the Transvaal (Wilms 517 from Lydenburg and Galpin 12 995 from Machadodorp) must according to the above characteristics be identified as var. expansa, and are very similar to plants from the Natal coast. No recent records of similar plants have been collected nor could they be traced <sup>to</sup> at the above localities, <sup>because of the</sup> ~~which do not~~ <sup>give</sup> precise collecting data.

Specimens examined:

TRANSVAAL. - Lydenburg (-AB), Wilms 517 (K); Machadodorp (-CB), Galpin 12 995 (BOL, PRE).

NATAL. - 2632 (Bella Vista): Ndumu Game Reserve (-CC), Hancock 40 (PRE); near Makane's Pont (-CD), Ross 1964 (NH). 2731 (Louwsburg): Ingwavuma (-BB), Strey 4777 (NH); Pongola River (-AB), Moll 4623 (NH); Umpangazi (-DA), Strey 5085 (NH). 2831 (Nkandla): Babanango (-AC), Venter 2932 (PRE). 2832 (Mtubatuba): Hluhluwe Game Reserve (-AA), Ward 2665 (NH). 2929 (Underberg): Lions River (-BD), Moll 1323 (PRE). 2930 (Pietermaritzburg): Hela Hela (-CC), Strey 10 895 (BOL, NH); Byrne (-CC), Strey 10 944 (BOL, NH); Cato Ridge (-DA), Jacobsen 3336 (PRE); Drummond (-DA), Rump in NH 20 236; Inanda (-DB), Wood 172 (SAM); Durban (-DD), Wood in NH 2810. 3030 (Port Shepstone): St. Michaels-on-Sea (-CD), Nicholson 1162 (PRE).

CAPE. - 2917 (Springbok): Steinkopf (-BB), Schlechter 11 503 (BOL, GRA). 3017 (Hondeklipbaai): near Hondeklipbaai (-AD), Pillans in BOL 18 015; 8 Km north Garies (-DB), Lewis 1672 (SAM). 3018 (Kamiesberg): 7 Km north-east Garies (-AC), Leistner 736 (PRE); Garies (-CA), Marloth 12 496 (PRE, STE); Rodin 1402 (BOL, PRE); Eselsfontein (-BC), Whitehead s.n. (TCD); 25 Km north Bitterfontein (-CC), Tölken 1998 (BOL). 3019 (Loeriesfontein): near Loeriesfontein (-CD), Schlieben & van Breda 9832 (PRE, STE); Tölken 3563 (BOL). 3029 (Kokstad): Mount Currie (-AD), Sister Stephanie 643 (BOL). 3118 (Vanrhynsdorp): near Bitterfontein (-AA), Hutchinson 808 (BOL, PRE); Pearson 6816 (BOL); near Nuwerust (-AB), Pearson 5504 (GRA); 48 Km north of Vanrhynsdorp (-BC), Tölken 4221 (BOL); 25 Km north-east Vanrhynsdorp (-BC), Marsh 424 (STE); Holrivier (-CB), Pearson 4889 (BOL, NBG); Strandfontein (-CC), Wisura 305 (NBG); Klaver (-DC), Barker s.n. (BOL); Doringrivierbrug (-DC), Tölken 5147 (PRE). 3119 (Calvinia): Vanrhyns-Pass (-AC), Tölken 4000 (BOL); near Calvinia (-BD), Schmidt 561 (PRE). 3126 (Queenstown): near Queenstown (-DD), Everitt s.n. (PRE); Lesseyton Drift (-DD), Galpin 2556 (GRA). 3218 (Clanwilliam): Elandsberg (-AD), Pillans 7901 (BOL); near Clanwilliam (-BB), Diels 309 (GRA);

Bullhoekdam (-BB), Thompson 1092 (STE); 64 Km south Lambertsbay (-CB),  
Boucher 98 (STE). 3220 (Sutherland): Houthoek (-CA), Hanekom 1120  
 (PRE). 3222 (Beaufort West): Klipbank (-AD), Pillans in BOL 16 454.  
 3223 (Rietbron): above Nelspoort Station (-AA), Tölken 5101 (PRE).  
 3224 (Graaff Reinet): Graaff Reinet (-BC), Bolus 18 (BOL); Henrici  
 4932 (PRE). 3225 (Somerset East): 24 Km north of Swaarshoek Pass  
 (-AD), Tölken 3046 (BOL); Bosberg (-DA), van der Walt 295 (PRE);  
MacDwan s.n. (BOL); Somerset East (-DA), Barker 4960 (NBG). 3226  
 (Fort Beaufort): Gwatyn (-BB), Galpin 8111 (PRE); 9 Km south of Fort  
 Beaufort (-DC), Acocks 12 763 (PRE); Alice (-DD), Sidey 709 (PRE);  
Giffen 1006 (NBG). 3227 (Stutterheim): Windvoelberg (-AC), Sim s.n.  
 (GRA, SAM); near Stutterheim (-CB), Galpin 6305 (GRA); Komga (-DB),  
Flanagan 1081 (BOL, GRA, SAM); King Williams Town (-CD), Sim 1443  
 (NBG, PRE). 3228 (Butterworth): Idutywa (-AB), Pegler 545 (PRE).  
 3317 (Vredenburg): Hoedjiesbaai (-BB), Treleavan 211 (SAM); near  
 Vredenburg (-BB), Pillans s.n. (BOL). 3318 (Cape Town): near Mamre  
 (-CB), Mauve 4240 (PRE, STE). 3319 (Worcester): Matroosberg (-BC),  
Davidson s.n. (SAM); Worcester (-CB), Olivier 185 (PRE, STE); van Breda  
 s.n. (BOL); 12 Km Robertson to McGregor (-CD), Marsh 1062 (STE);  
 Langvlei (-DC), van Breda 2064 (PRE). 3320 (Montagu): Montagu Bath  
 (-CA), Tölken 4312 (BOL); Ashton (-CC), Compton 11 844 (NBG); 8 Km  
 east of Montagu (-CC), Levyne 453 (STE). 3321 (Ladismith): 8 Km south  
 of Ladismith (-CA), Tölken 5365A (PRE); van Wyksdorp (-CD), Muir 3379  
 (GRA); 3714 (GRA). 3322 (Oudtshoorn): Cango Caves (-AC), Bolus s.n.  
 (BOL). 3323 (Willowmore): Towerwater Poort (-AC), Peers sub Marloth  
 13 305 (PRE). 3324 (Steytlerville): 30 Km west of Steytlerville  
 (-AC), Tölken 5387 (PRE); Lower Baviaanskloof (-DA), Tölken 3853 (BOL);  
 near Hankie (-DD), Tölken 3851 (BOL); Gamtoos River (-AD), Barker 6899  
 (NBG); 7869 (NBG). 3325 (Port Elizabeth): near Glenconnor (-AC),  
Tölken 4298 (BOL); near Uitenhage (-CD), Zeyher 985 (GRA); Schonland

3276 (GRA); Thode A647 (NH, PRE); Addo Park (-DB), Liebenberg 6333 (PRE); 7394 (STE); Swartkops River (-DC), Zeyher 2524 (PRE, SAM); near Port Elizabeth (-DC), Galpin 6457 (GRA, PRE). 3326 (Grahamstown): Alicedale (-AC), Cruden 103 (GRA); Pluto's Vale (-BA), Tölken 1243 (PRE); 16 Km north Grahamstown (-BA), Story 2591 (PRE); Queen's Road (-BC), Schonland s.n. (GRA); near Grahamstown (-BC), MacOwan 820 (GRA); 2304 (SAM); Port Alfred (-DB), Bennie 251 (GRA); Tyson sub Marloth 8520 (PRE). 3419 (Caledon): Slangrivier (-BB), Walgate 844 (PRE); Strandkloof (-CB), Oliver 3028 (PRE, STE). 3420 (Bredasdorp): Stormsvlei (-AA), Esterhuysen 18 243 (BOL, PRE); Swellendam (-AB), Liebenberg 6435 (PRE, STE); De Hoop (-AD), van der Merwe 1175 (PRE); 1895 (STE); Potberg (-BC), Oliver 3210 (STE); Brandfontein (-CC), Esterhuysen 19 038 (BOL, PRE). 3421 (Riversdale): near Riversdale (-AB), Marloth 5805 (PRE); Bolus 11 275 (BOL); Schlechter 1979 (BOL, GRA). 3422 (Mosselbaai): near Mosselbaai (-AA), Tölken 3709 (BOL). Caput Bonae Spei, Masson s.n. (BM); Thunberg in Herb. Thunberg 7781 (UPS); 7782 (UPS).

29b. var. filicaulis (Haw.) Toelken, comb. nov. et stat. nov.

C. filicaulis Haw. in Phil. Mag. 24 : 187 (1824), 'filicaule'; DC., Prodr. 3 : 384 (1828); Eckl. & Zeyh., Enum. 295 (1837), partly.

Iconotype: plate 768 (K, lecto!).

C. maritima Schonl. in Bull. Herb. Boiss. ser. 1, 5 : 862 (1897).

Syntypes: Cape, Hawston, Schlechter 9469 (BM!; BOL!; G!; GRA!; K!; P!; PRE!; Z!); Port Elizabeth, Kemsley s.n. (GRA).

C. uniflora Schonl. in Trans. Roy. Soc. S. Afr. 17 : 186 (1929); Adamson, Fl. Cape Penins. 431 (1950).

Type: Cape, Melkhoutfontein, Muir 6740 (GRA, holo!; PRE!).

Perennials with carnose to woody branches, usually decumbent and up to 20 cm long and with several rigid stilt roots along the branches.

Leaves sessile, lanceolate 0,1 - 0,2 cm broad, subulate, more or less flat above but very convex below and rarely almost terete, glabrous and with hydathodes usually in two more or less clear rows along the margin.

Flowers single in the axils of the upper leaves which are scarcely reduced. Sepals about as long as the petals and sharply acute.

On sandy slopes and often on coastal dunes; occurring usually in close proximity <sup>to</sup> of the sea from Port Alfred to the Cape Peninsula, but sometimes slightly more inland and usually associated with surface limestone in the vicinity of Bredasdorp.

Flowering Period: Mainly June - December, but in many places flowers are found throughout the year.

Diagnostic Features:

See under the species.

Variation and taxonomic Notes:

This variety is easily recognized by its wiry woody stems and stilt roots. These roots are mentioned by Haworth in his description and are depicted in the illustration of the type plant prepared for Haworth, and which <sup>is</sup> was chosen as a lectotype in the absence a preserved specimen.

The type specimen of C. uniflora is a depauperate plant of the var. filicaulis as it is often found on calcareous outcrops between Bredasdorp and Riversdale.

A number of specimens distributed by Ecklon & Zeyher under the name C. filicaulis must be identified as var. expansa.

Specimens examined:

CAPE. - 3317 (Saldanha): Danger Bay (-BB), Compton 18 909 (NBG).  
3318 (Cape Town): Melkbosstrand (-CB), Compton 9851 (NBG). 3322  
(Oudtshoorn): Wilderness (-DC), van Niekerk 238 (BOL); Vlugge-de-

Smidt s.n. (BOL). 3325 (Port Elizabeth): Suurberg Inn (-BC), Archibald 5925 (PRE); Port Elizabeth (-DC), Kemsley s.n. (GRA); SAM 35 881; Walmer (-DC), Paterson 1076 (BOL); Humewood (-DC), West 220 (BOL, GRA). 3326 (Grahamstown): Port Alfred (-DB), Galpin 324 (PRE); Schonland 1557 (GRA); in TRV 2696 (PRE). 3418 (Simonstown): Buffel's Bay (-AD), Pillans s.n. (BOL); Salter 1845 (BOL, NBG). 3419 (Caledon): Hawston (-AC), Schlechter 9469 (BM; BOL, G, GRA, K, P, PRE, Z); Hermanus (-AC), de Villiers in STE 9045; east of Gansbaai (-CB), Oliver 3028 (PRE, STE); Stokoe 7597 (BOL). 3420 (Bredasdorp): Potberg (-BC), Esterhuysen 23 179 (BOL); Die Poort (-CA), Taylor 4314 (PRE); Wasserfall 395 (NBG); Agulhas (-CC), Pillans 8159 (BOL); Esterhuysen 5024 (BOL). 3421 (Riversdale): Melkhoutfontein (-AD), Muir 3740 (GRA, PRE); 4888 (PRE); Stillbaai (-AD), Jordaan in STE 18 486. 3422 (Mosselbaai): Goukamma (-BB), Heinecken 177 (PRE). 3423 (Knysna): near Knysna (-AA), Schonland 3408 (GRA); Peers s.n. (BOL); Keurboomstrand (-AB), Codd 3579 (PRE); Keurboomsrivier (-AB), Gillett 1328 (BOL); Plettenberg Bay (-AB), Hutchinson 1350 (BOL); Rogers 26807 (PRE). 3424 (Humansdorp): Humansdorp (-BB), Phillips 3357 (PRE); Christie 47 (GRA); Jeffrey's Bay (-BB), Taylor 5141 (NBG).

29c. var. pyrifolia (Compton) Toelken, comb. nov. et stat. nov.

C. pyrifolia Compton in J. Bot. Lond. 70 : 283 (1932).

Type: Cape, near Bitterfontein, Moller sub Compton 3954 (BOL, holo!).

C. albicaulis sensu Friedr. in Prodr. Fl. S. W. Afr. 52 : 24 (1968), non Harv.

Perennials with slightly woody to carnosely branches decumbent or scrambling and up to 40 cm long, with more or less rigid stilt roots. Leaves sessile, lanceolate to oblanceolate 0,15 - 0,3 (-0,4) cm broad, acute or obtuse, terete or almost so, glabrous and with hydathodes scattered

over the entire surface. Flowers borne mainly in terminal clusters with subtending bracts very much reduced.

On sandy depression or lower slopes and often scrambling on other shrublets; occurring mainly on the coastal side of the Namaqualand, the Richtersveld and south-western South West Africa.

Flowering Period: September - December, but somewhat dependant on rains.

Diagnostic Features:

See under the species.

Variation and taxonomic Notes:

Typical var. pyrifolia has obconical leaves and is mainly found in the southern parts of Namaqualand. Plants from near Komaggas (Tölken 5221) show a complete range of variation of the leaves from obconical to cylindrical and often have acute apices. The leaves become almost subulate under cultivation and are then indistinguishable from plants from the Karruchab Poort. However, the plants from the latter area tend to have longer branches (up to 20 cm long), a character which becomes even more pronounced northwards, so that some of the plants in the mountains just south of Sendelingsdrif have branches up to 40 cm long and 0,3 cm in diameter. This form occurs also in south-western South West Africa, and no specimens from that territory of plants of the form of the var. expansa, that was described as C. albicaulis, were seen by the present author. The specimen Dinter 8131 quoted by Friedrich (1968), must be identified as this variety.

A third form of the var. pyrifolia resembles the var. fili-caulis superficially and occurs similarly to that variety near the sea between Grootmis and Port Nolloth (Tölken 5228A). Although it is a much more delicate plant it agrees with the delimitation of the var. pyrifolia, because the plants have stilt roots, the flowers are clustered mainly at the apex of the branches and the hydathodes are scattered more or less over the surface of the leaves.

Specimens examined:

SOUTH WEST AFRICA. - 2715 (Bogenfels): Buchberge (-DD), Dinter 6480b (B). 2716 (Witpötz): 10 Km south Witpötz (-DA), Dinter 8131 (K); Giess, Volk & Bleissner 5342 (WIND); Namuskluft (-DD), Tölken 5296 (PRE).  
 CAPE. - 2816 (Oranjemund): Hellskloof (-BD), Tölken 3970 (BOL); 9 Km west of Grootderm (-DA), Tölken 5277 (PRE); Doornpoort Ravine (-DB), Pearson 6126 (GRA). 2917 (Springbok): near Karruchab Poort (-AA), Tölken 3954 (BOL); Wolfberg (-CA), Tölken 5228A (PRE); Komag-gas (-CD), Tölken 5221 (PRE); Kourkams Mountains (-CD), Tölken 5288 (PRE). 3017 (Hondeklipbaai): Kharkams (-BD), Peers s.n. (BOL); Bakhuis (-BD), Pearson 5517 (BOL, PRE); 9 Km north of Garies (-DB), Tölken 5171 (PRE). 3018 (Kamiesberg): 25 Km north of Bitterfontein (-CC), Tölken 1997 (BOL). 3118 (Vanrhynsdorp): Bitterfontein (-AB), Moller sub Compton 3954 (BOL); 9 Km north-east of Koekenaap (-AD), Tölken 5162 (BOL); 12 Km south-west of Lutzville (-CA), Tölken 1990 (BOL); Koekenaap (-CB), Herre in SUG 6167 (BOL); near Holriver Station (-CB), Tölken 5160 (PRE); Vanrhynsdorp (-DA), Herre in SUG 9689 (BOL); Klaver (-DC), Bolus s.n. (BOL).

29d. var. fragilis (Bak.) Toelken, comb. nov. et stat. nov.

C. fragilis Bak. in J. Linn. Soc. (Bot.) 22 : 469 (1887).

Type: Central Madagascar, Baron 3348 (K, holo!).

C. woodii Schonl. in Bull. Herb. Boiss. ser. 1, 5 : 863 (1897) et in Trans. Roy. Soc. S. Afr. 17 : 198 (1929).

Type: Natal, Karkloof, Wood 4485 (NH, holo!; GRA!).

C. furcata sensu Schonl. in S. Afr. J. Science 17 : 188 (1921), non (Eckl. & Zeyh.) Endl. ex Walp.

C. browniana Burt Davy, Fl. Transv. 141 (1925); Schonl. in Trans. Roy. Soc. S. Afr. 17 : 185 (1929); Compton in J. S. Afr. Bot. suppl. 6 : 44 (1966).

Type: Transvaal, near Lydenburg, Wilms 518 (K, holo!).

C. thorncroftii Burt Davy, Fl. Transv. 141 (1925).

Type: Transvaal, Reimers Creek, Thorncroft 1084 (K, holo!;  
BOL!; J!; PRE!).

Perennials rarely annuals with slightly woody branches decumbent and up to 25 cm long. Leaves shortly petiolate or a cuneate base; lamina obovate or broadly elliptic rarely oblanceolate, 0,2 - 1 (-1,5) cm broad, dorsiventrally compressed to slightly convex on both surfaces, tomentose to glabrescent, with hydathodes scattered over the upper surface. Flowers borne mainly in terminal clusters and with bracts sometimes reduced. Sepals often almost as long as the petals, obtuse, tomentose to puberulous.

Usually on rocky slopes but also in open savanna; occurring from the northern Natal through Swaziland and eastern Transvaal into Tropical Africa and Madagascar.

Flowering Period: Mainly November - April.

Diagnostic Features:

See under the species.

Variation and taxonomic Notes:

A rather variable taxon but most of the variation occurs outside the boundaries of Southern Africa. The variation within South Africa is mainly due to environmental conditions as, for instance, the leaves can vary within (0,3-) 0,6 - 1,5 (-3,5) cm long. Specimens from dry rock crevices in the Lebombo mountains (Gerstner in NH 22 849; 22 856; 22 857) are hardly recognizable as this variety, but they are very similar to plants from the dry north-eastern Cape (Brueckner 1206). On the other hand, if the leaves get larger they often become puberulous to glabrescent and this is of particular importance in the area between Pietermaritzburg and Vryheid, and the type specimen of C. woodii has glabrous leaves. However, usually the

sepals remain puberulous and only in a few specimens between Mkuzi and Nkandla, where the distribution of this variety comes close to that of the var. expansa, some difficulty in the identification of herbarium material may arise (cf. discussion under the var. expansa). In life material the hydathodes can be seen on the flat leaves of the var. expansa along the margin, while they are scattered over the upper surface of the leaves of the var. fragilis.

Also the var. peculiaris is hardly distinguishable from some plants of the var. fragilis in herbarium material, and both have often hairs along the midvein on the outside of the petals, a character unique in the genus Crassula. However, the var. peculiaris grows only at high altitude in the Swartberge in the southern Cape Province.

The type specimen of C. fragilis falls well within the range of variation of the South African plant, and as it is the oldest name for this complex taxon, the name was adopted.

Specimens examined:

TRANSVAAL. - 2229 (Waterpoort): Wyliespoort (-DD), Hall 923 (NBG); Tölken 1208 (PRE); Soutpansberg Pass (-DD), Galpin 14 867 (NH, PRE). 2329 (Pietersburg): Bandelierskop (-BD), Setterfield s.n. (PRE); 10 Km south-west Soekmekaar (-BD), Codd 8431 (PRE); Pietersburg (-CD), Rogers s.n. (GRA); 56 Km south of Louis Trichardt (-DA), Tölken 3139 (BOL). 2429 (Zebediela): 56 Km north-west Steelpoort (-BD), Tölken 3134 (BOL). 2430 (Pilgrim's Rest): The Downs (-AA), Nel 107 (STE); 8 Km north of Burgersfort (-CD), Codd 6687 (PRE); Spekboomrivier, Galpin 13 628 (BOL, PRE). 2531 (Komatipoort): Numbi (-AA), van der Schijff 2652 (PRE); Pretoriuskop (-AB), van der Schijff 2128 (PRE); Klokwani (-AD), van der Schijff & Marais 3760 (PRE); 3762 (PRE); Boulders (-CD), van der Schijff 2545 (PRE); Malelane (-CB), Codd 5265 (PRE); 13 Km south-west of Barberton (-CC), Codd 8161 (PRE); near Barberton (-CC), Thorncroft 1084 (BOL, J, K, PRE).

SWAZILAND. - 2631 (Mbabane): Stegi (-BD), Compton 29 317 (NBG, PRE); Sibowe River (-CD), Compton 30 442 (NBG); near Hlatikulu (-CD), Karsten s.n. (NBG). 2731 (Louwsberg): Gollel (-BD), Bayliss 563 (NBG).

NATAL. - 2632 (Bella Vista): Ndume Game Reserve (-CD), Tinley 511 (NH, PRE). 2732 (Ubombo): near Ubombo (-CA), Gerstner in NH 22 849; 22 856; 22 857; Tölken 3102 (BOL); Mkuzi Game Reserve (-CA), Tölken 3101 (BOL). 2830 (Dundee): near Glencoe (-AA), Acocks 11 596 (NH); Tugela Ferry (-CB), Galpin 14 805 (BOL, NH, PRE); Weenen (-CC), Codd 8601 (PRE); near Muden (-CD), Cronwright s.n. (PRE); Codd 8601 (NH). 2831 (Nkandla): Heatonville (-DB), Venter 4033 (PRE); Umhlatuzi (-DC), Gerstner in NH 22 233; Lawn 1641 (NH). 2832 (Mtubatuba): Hluhluwe Game Reserve (-AA), Dean 8 (PRE); Somhele (-AC), Harrison s.n. (PRE). 2929 (Underberg): Estcourt (-BB), West 1767 (NH); Acocks 9901 (NH); 11 361 (NH). 3029 (Pietermaritzburg): Karkloof (-AC), Wood 4485 (GRA, NH).

CAPE. - 2724 (Taungs): Buxton (-DA), Brueckner 1206 (PRE). 2824 (Kimberley): Doringbult (-AC), Esterhuysen 4909 (BOL).

29e. var. peculiaris Toelken, var. nov. ab var. expansa, var. pyrifolia et var. filicaule foliis hirsutis et radicibus graciliformibus; ab var. fragile floribus axillaribus, ramis herbaceis prostratis et habitate altitudine differt.

Herbae perennes ramis prostratis usque ad 30 cm longis et interdum radicis adventitiis gracilibus. Folia petiolis usque ad 0,3 cm longis; lamina ovata vel late elliptica (0,2-) 0,4 - 0,6 cm lata, dorso-ventraliter complanata, tecta pilis gracilibus et hydathodis paucis secus margines. Flores singulares in axillis foliorum et saepe non ad apices ramorum. Sepala longitudine c. 3/4 petalis partes aequantia, acuta vel obtusa et pubescentia.

Type: Cape, east of Olliewenberg, Esterhuysen 28 832 (BOL, holo!).

Perennials with prostrate herbaceous branches up to 30 cm long, forming irregular mats and sometimes with fine adventitious roots. Leaves with petioles up to 0,3 mm long; lamina ovate to broadly elliptic, (0,2-) 0,4 - 0,6 cm broad, dorsiventrally compressed, covered with long fine hairs and with few hydathodes along the margin, Flowers borne singly in the axils of the leaves and often not even at the apical part of the stem. Sepals three-quarters of the length of the petals, bluntly acute and covered with scattered hairs.

On moist shaded areas and usually under rock faces at an altitude above 1500 m; recorded only from the vicinity of the Swartberg Pass.

Flowering Period: November - March.

Diagnostic Features:

See under the species.

Variation and taxonomic Notes:

Plants of this variety have been recorded only a few times so that not much is known about its variation and its distribution range, Herbarium material of it is practically indistinguishable from that of the var. fragilis, but the var. peculiaris stands out among the other varieties in this species complex, because of its soft prostrate branches and its habitat in moist places at high altitude rather similar to those of C. tenuicaulis and C. papillosa,

Specimens examined:

CAPE. - 3322 (Oudtshoorn); Swartberg Pass (-AC), Esterhuysen 4569 (BOL); east of Olliewenberg (-AC), Esterhuysen 28 832 (BOL).

30. C. tenuicaulis Schornl. in Bull. Herb. Boiss. ser. 1, 5 : 864 (1897)  
et in Trans. Roy. Soc. S. Afr. 17 : 198 (1929).

Type: Natal, van Reenen, Schlechter 5964 (GRA, holo!; PRE!; Z!).

BOLUS

Plants perennials with prostrate slender branches up to 35 cm long and often forming a dense cushion, with adventitious roots at many nodes, with old leaves decaying soon. Leaves with a short petiole 0,1 - 0,7 cm long; lamina elliptic to broadly elliptic, (0,3-) 0,4 - 1 cm long, (0,1-) 0,2 - 0,4 cm broad, rounded at the apex, glabrous and hardly fleshy, grey-green to yellowish-green; sheath c. 0,5 cm long and membranous. Hydathodes rather widely spaced in one row on the upper surface towards the margin, hardly visible. Inflorescence single axillary 5-merous flowers with a pedicel 1 - 1,5 (-2) cm long. Sepals narrowly oblanceolate to almost club-shaped, 2 - 2,5 mm long, rounded at the apex, glabrous, fleshy, green. Petals elliptic-rhombic, 3 - 4 mm long, bluntly acute, without dorsal ridge or appendage, fused into a tube 0,1 - 0,2 mm long, with apices of the lobes erect or slightly spreading, white. Stamens 2,5 - 3 mm long, with white anthers 0,6 - 0,8 mm long, slender with filaments hardly broadened towards the base and not constricted where fused to the petal tube. Squamae transversely oblong to almost square, 0,2 - 0,3 x 0,4 (-0,5) mm, truncate and hardly constricted towards the base, membranous, white. Carpels with slender reniform ovaries and abruptly constricted into thin styles usually more than half as long as the ovaries and with indistinct terminal stigmas; ovary smooth except for a few cilia along the suture and with 8 - 10 elongate ovules with faint papillose ridges.

On moist soil in shaded caves or often also on stream banks; recorded only from the northern part of the Drakensberg, but then again from north-eastern Rhodesia.

Flowering Period: January - March.

Diagnostic Features:

This species is mainly distinguished from other species by its glabrous elliptic leaves and pedicel 1 - 2 cm long. Also, the oblanceolate glabrous sepals and only one row of hydathodes towards the mar-

gin of the upper surface are distinct.

Variation:

This species has been very rarely collected and is never common where it is found. In the field the leaves are rarely longer than 0,3 cm, but under cultivation they often attain double the size.

Specimens examined:

NATAL. - 2730 (Vryheid): Dumbeberg (-BD), Acocks 11 545 (NH, PRE).

2829 (Harrismith): Van Reenen (-AD), Schlechter 6964 (GRA, P, PRE, Z); Tölken 3084 (BOL); Franks sub Wood 12 009 (NH).

LESOTHO. - 2927 (Maseru): Masite Mountain (-BC), Dieterlen 1061

(PRE). 2928 (Marakabei): Ntiboho Valley (-AB), Jacot Guillarmod

302 (PRE, RUH). 2929 (Underberg): Mokhotlong (-AA), Jacot Guillarmod 1182 (PRE, RUH).

V. Crassula sect. Deltoidea DC., Prodr. 3 : 386 (1828).

Type species: C. deltoidea Thunb.

Crassula group Corallina Schonl. in Trans. Roy. Soc. S. Afr.

17 : 163, 191 (1929), partly, Berger in Pflanzenfam. ed. 2 18a, 390 (1930), partly.

Merxmüller et al. in Ann. Naturhist. Mus. Wien 75 : 113 (1971).

Perennials with erect decumbent or prostrate habit, with herbaceous, carnose to slightly woody stems completely glabrous. Leaves sessile, almost flat on the upper surface, but very much convex below and usually becoming more fleshy towards the apex, glabrous to rough or with irregular papillae and a white waxy layer on the exposed surfaces, with few hydathodes scattered over the exposed surfaces but mainly on the upper surface, with leaf bases usually fused to form the leaf sheath. Inflorescence a terminal cymose cluster of flowers produced from a fascicled apex of the branch or rarely a rounded cyme or thyrse with a peduncle not longer than 1 cm. Sepals up to 2 mm long and half to almost as long as the petals, glabrous, fleshy. Petals 2 - 5 mm long, forming a tubular flower bulging to almost saccate around the squamæ and usually with slightly recurved apices, without dorsal appendage. Stamens with yellow to brown anthers 0,4 - 1 mm long. Squamæ transversely oblong to almost square, truncate and slightly constricted to reniform towards the base, slightly fleshy. Carpels with almost pear-shaped to reniform ovaries tapering usually into short styles; ovary with 4 - 10 ovules densely covered with fine papillae often in irregular or indistinct rows. Fruits usually splitting along the suture but releasing the seeds through an apical pore.

Wide-spread through central South Africa from the southern Orange Free State through many parts of the Little Karoo and northwards to southern South West Africa.

Diagnostic Features:

Typical of this section are the angular-obovate or oblanceolate leaves which are rough and covered with flakes of a broken wax layer. However, in contrast to species in the sect. Arta where the surface is usually covered with hairs or hair-like papillae, the flowers are tubular and distinctly bulging at the base and the petals are without a distinct dorsal appendage.

Taxonomy:

The surface of the leaves of all these species is rough and the ovules are densely covered with papillae which are often not clearly arranged in rows. However, these characters are also found in C. papillaris, a species that grows in a very similar habitat and resembles C. elsieae, but it was not included in the sect. Deltoidea because of its single star-shaped flowers and elliptic leaves and sepals. These characters place C. papillaris rather into the sect. Filipedes.

C. deltoides stands out among species in the sect. Deltoidea by its distinct peduncle, but it is at times very short.

31. C. elsieae Toelken, sp. nov. ab C. corallina hydathodis marginibus, squamis oblongo-cuneatis, habitatione et ab C. papillosa foliis obovatis et sepalis oblongis differt.

Herbae perennes ramis prostratis vel decumbentibus usque ad 10 cm longis et rare 0,1 cm in diametro latoribus et non lignosis ad basim, radicibus adventiis secus ramum, foliis veteribus non caducis. Folia sessilia, obtusa et saepe aliquantum angulata, 0,2 - 0,4 cm longa, 0,2 - 0,3 mm lata et basi cuneata plana sed succulentescencia ad apicam, minute papillosa saltem ubi juvenia, viridia vel fusca; vagina circiter 0,05 mm longa et membranacea. Hydathodi aliquot plus minusve seriates in foliorum marginibus, vix visibiles. Inflorescentia dichasialis terminalis (1-) 3 - 5 floribus pedicellatis et pentameris, pedunculo indistincto

et bracteis ellipticis succulentibus. Sepala late oblonga, 1,5 - 2 mm longa, obtusa, succulenta, viridia. Petala oblonga vel oblanceolata, 2,5 - 3 mm longa, obtusa sine appendice dorsale, connata in tubum, 0,2 - 0,4 mm longem, loborum apicis recurvis, albis vel eburneis. Stamina circiter 2mm longa, antheris luteis 0,2 - 0,3 mm longis, filamentis aliquantum latentibus ad basim et vix constrictis ubi connatis petalorum tubo. Squamae oblongo-cuneatae, 0,4 - 0,6 x 0,3 - 0,4 mm, truncatae, et aliquantum constrictae ad basim, vix succulentae, pallide flavae. Carpella ovariis late reniformibus gradatim constrictis in stylos breves stigmatibus terminalibus indistinctis; ovarium laeve et 4 - 6 ovulis elongatis dense tectum papillis serialis saepe indistinctis.

Type: Cape, Krakadouw Peak, Esterhuysen 14 958 (BOL, holo!).

Perennials with prostrate or decumbent branches up to 10 cm long and rarely more than 0,1 cm in diameter and not woody towards the base, with adventitious roots along the stem, with old leaves remaining attached to the stem. Leaves sessile, obovate and often somewhat angular, 0,2 - 0,4 cm long, 0,2 - 0,3 mm broad, obtuse and with a cuneate base; flat but becoming more fleshy towards the apex, minutely papillose at least when young, green to brown; sheath c. 0,05 mm long and membranous. Hydathodes few, more or less clearly arranged in a row on the margin of the leaves, hardly visible. Inflorescence a terminal dichasium with (1-) 3 - 5 flowers pedicellate and 5-merous, with peduncle hardly distinguishable from the vegetative branches and with fleshy elliptic bracts. Sepals broadly oblong, 1,5 - 2 mm long, with rounded apex, fleshy, green. Petals oblong to oblanceolate, 2,5 - 3 mm long, obtuse and without dorsal appendage, fused into a tube, 0,2 - 0,4 mm long with apices of the lobes recurved, white or cream. Stamens c. 2 mm long, with yellow anthers 0,2 - 0,3 mm long, with filaments slightly broadened towards the base and hardly constricted where fused to the petal tube. Squamae oblong-cuneate, 0,4 - 0,6 x 0,3 - 0,4 mm, truncate and somewhat constricted

towards the base, slightly fleshy, pale yellow. Carpels with broadly reniform to almost pear-shaped ovaries gradually constricted into short styles with indistinct terminal stigmas; ovary smooth and 4 - 6 elongate ovules densely covered with often indistinct rows of papillae.

In shaded places under rocks or in rock basins and known only from the northern Cedarberg.

Flowering Period: November, December.

Diagnostic Features:

The broadly oblong sepals and the leaves which become more fleshy towards the apex show some resemblance to C. corallina. However, C. elsieae is distinguished from the latter species by its green leaves without a waxy layer, oblong-cuneate squamae, the petals being not saccate as well as its shaded mountainous habitat. C. elsieae may also be confused with C. papillosa especially because of their similar habitats, but the latter has elliptic leaves and sepals and single flowers in the axils of the leaves. For these reasons it is placed into the sect. Filipedes.

Taxonomic Notes:

This species is very rare and all the plants recorded of it were collected by the very observant collector Miss Elsie Esterhuysen in honour of whom the species is named.

Specimens examined:

CAPE, - 3219 (Wuppertal): Krakadouw Peak (-AA), Esterhuysen 14 958 (BOL); Kradouwsberg (-AA), Esterhuysen (-AA), Esterhuysen 7517 (BOL).

32. C. corallina Thunb. in Nova Acta Phys.-Med. Acad. Caes. Leop.-Carol., Nat. Cur. 6 : 239, 334 (1778) et Prodr. 56 (1794) et Fl. Cap. ed. Schultes 290 (1823); L. f., Suppl. 188 (1781); DC., Prodr. 3 : 386 (1828); Schonl. in Trans Roy. Soc. S. Afr. 17 : 191 (1929).

Type: Cape, Hantum between Dannis and Roggeveldberg, Thunberg

in Herb. Thunberg 7741 (UPS, holo!)

Perennials with prostrate or decumbent branches up to 8cm long, glabrous, herbaceous, rarely somewhat woody towards the base, with thin tap root and many adventitious roots on the decumbent branches or with a swollen tuberous root, with old leaves often remaining attached to the stem for a short while. Leaves sessile, usually angular-obovate to almost rhombic, 0,3 - 0,5 (-0,6) cm long, 0,2 - 0,5 cm broad, usually abruptly tapering into a more or less bluntly acute apex, cuneate to subpetiolate at the base, more or less convex on both surfaces and thickest near the apex, minutely warted and covered with a greyish wax cover which often flakes on the exposed surfaces, grey-green to grey-brown; sheath membranous and up to 0,05 cm long. Hydathodes scattered over the exposed surfaces but mainly on the upper one, clearly visible. Inflorescence with one to many flowers in terminal clusters and often half hidden by the leaves below, each flower pedicellate. Sepals broadly triangular, 1 - 2 mm long, with obtuse or rounded apex, glabrous, slightly fleshy, grey. Petals oblong-obovate, 2 - 3,5 mm long, usually with rounded apex and without dorsal appendage, fused into a tube rarely longer than 0,2 mm bulging to almost saccate around the squamae, with apices of the lobes somewhat recurved, cream. Stamens 1,5 - 2 mm long, with yellow anthers 0,4 - 0,6 mm long and with filaments considerably broadened towards the base but not constricted where fused to the petal tube. Squamae transversely oblong, 0,4 - 0,5 x 0,5 - 0,8 mm, truncate and usually slightly constricted towards the base, somewhat fleshy, yellow to white. Carpels with almost pear-shaped ovaries gradually constricted upwards and with styles and terminal stigmas or without styles and somewhat laterally placed stigmas; ovary smooth or with few cilia along the suture and with 4 - 8 (-10) elongate ovules densely covered with fine irregular papillae.

Diagnostic Features:

C. corallina with its herbaceous branches and angular-obovate leaves not longer than 0,6 cm is distinct from any other species in the genus. Only C. elsieae resembles this species, but is distinguished by its marginal hydathodes and oblong-cuneate squamae. The subsp. corallina produces fibrous roots up to 0,2 mm in diameter and adventitious roots along the branches while the subsp. macrorrhiza has a very much swollen tap root, 0,4 - 0,8 cm in diameter, and no adventitious roots along the branches.

Variation and taxonomic Notes:

Although this species has a rather wide distribution it shows little variation. Most of this variation is due to environmental conditions, as for instance plants grown under very humid conditions will produce internodes much longer than the leaves and thus give the plant a much more herbaceous appearance. Also, the stems tend to be more prostrate even in the subsp. macrorrhiza, which tends to have short erect branches.

However, two subspecies can be recognised. The subsp. corallina has roots rarely thicker than 0,2 cm in diameter and produces many adventitious roots along the prostrate or decumbent stems. Also, in young flowers the carpels have distinct styles with terminal stigmas. In contrast to this, the subsp. macrorrhiza produces a very much swollen tap root, (0,3 -) 0,4 - 0,8 cm in diameter, and will produce adventitious roots on the stems only when broken or damaged. The ovary is gradually constricted into a somewhat laterally placed stigma. The presence or absence of the styles can at times be confusing, as old carpels of the subsp. corallina recurve and the styles dry up from the apex, so that it often looks similar to those of the subsp. macrorrhiza.

The two subspecies are geographically isolated from each other, i.e. the subsp. macrorrhiza occurs in the Bushmanland and south-eastern South West Africa, while the subsp. corallina is widely distributed

through karoid areas from the southern Orange Free State to Laingsburg and Calvinia in the north. Then it shows a discontinuity and is again found in the western Richtersveld and south-western South West Africa. The two subspecies were not found at a single locality close to one another.

32a. subsp. corallina

C. corallina Thunb. in Nova Acta Phys. -Med. Acad, Caes, Leop. -Carol., Nat. Cur. 6 : 329, 334 (1778) et Prodr. 56 (1794) et Fl. Cap. ed. Schultes 290 (1823); L. f., Suppl. 188 (1781); DC., Prodr. 3 : 386 (1828); Harv., Fl. Cap. 2 : 366 (1862); Britt. & Bak. f. in J. Bot., Lond. 35 : 480 (1897); Dinter, Neue Pfl. S. W. Afr. 26, fig. 51 (1914); Schonl. in Ann. Bolus Herb. 2 : 74 (1916) et Schonl. in Bot. Ark. 21A, 16 : 5 (1927) et in Trans. Roy. Soc. S. Afr. 17 : 191 (1929).

C. dasyphylla Harv., Fl. Cap. 2 : 355 (1862); Higgins in J. S. Afr. Bot. 24 : 115 - 118, fig. 2B (1958) et Crass. Cult. 39, fig. 14 (1964); Jacobsen, Handb. Succ. Pl. 309, fig. 309 (1960); Friedr. in Prodr. Fl. S. W. Afr. 52 : 27 (1968).

Syntypes: Cape, Winterveld between New Year's Fountain and Eselsfontein, Drège 6885 (BM!; P!; S!; TCD!); Between Cradock & Gamke River, Zeyher s.n. (S!).

C. simiana Schonl. in J. Linn. Soc. (Bot.) 31 : 552 (1897).

Type: Cape, Stormberg, Sim s.n. (GRA, holotype!).

Plants usually prostrate with adventitious roots often produced and usually at a number of nodes in succession, with main roots rarely thicker than 0,2 cm. Leaves obovate to almost elliptical, 0,3 - 0,5 cm long, 0,2 - 0,3 (-0,35) cm broad, sometimes covered with a white waxy layer on the exposed surfaces. Carpels with distinct erect styles 0,3 - 0,6 mm long and with terminal stigmas, but styles recurving and drying up

from the apex as the fruit develops.

In sandy soil often with surface lime intrusions or in shallow pockets of sand on granite rocks and usually between scattered karoid shrublets; occurring from the southern Orange Free State through the eastern Cape to near Laingsburg in the west, Calvinia in the north and again in the western Richtersveld and south western South West Africa.

Flowering Period: (December) January - April.

Diagnostic Features:

See under the species.

Variation and taxonomic Notes:

Harvey (1862) pointed out already that the thick root of some plants might be of taxonomic significance. However, Higgins (1958) was the first to separate the two groups on a similar basis as is done here, but attributed specific rank to each of the groups. C. corallina was interpreted as the plant with very much thickened roots and this was mainly based on Thunberg's description, namely "Radix fusiformis, fibrosa, perennis". However, the type specimen does not show this typical thickened root which is distinctly thicker than the lower stems in subsp. macrorrhiza, but in the Thunberg specimen it was just relatively thick. This can clearly be seen in one of the many specimens existing of Dinter 6106(B) which must be just a very old plant which has a root up to 0,3 mm and the stem above it is similarly thick. Although the holotype does not bear any young flowers, it has, similarly to the Dinter specimen, many adventitious roots, which leave no doubt about its identification. Also, the type plant must have been growing under adverse conditions, as the internodes are shorter than the leaves and this might explain why the terminal branchlets are described as being erect. Both subspecies will usually produce decumbent branches with erect ends and with erect leaves more or less adpressed to one another when growing under dry conditions. However, in contrast to subsp. corallina the branches of subsp. macrorrhiza

are often so short that the whole branch is erect.

Specimens examined:

SOUTH WEST AFRICA. - 2616 (Aus); Aus (-CB), Dinter 3583 (BOL, PRE); 6106 (BOL, PRE).

ORANGE FREE STATE. - 2727 (Kroonstad): Kroonstad district, Pont 345 (PRE). 2825 (Boshof): Boomplaats (-AB), Verdoorn 1396 (PRE). 2925 (Jagersfontein): Jagersfontein (-CD), Smith 5236 (PRE); 4390 (PRE). 2926 (Bloemfontein): Bloemfontein (-AA), Potts s.n. (GRA).

CAPE. - 2723 (Kuruman): Kuruman (-AD), Lawson s.n. (BOL). 2724 (Taung): Klein Boetsap (-CD), Pocock s.n. (BOL). 2820 (Kakamas): Kakamas (-CD), Fuller 72A (BOL); Archer 587 (BOL); 2824 (Kimberley): Koopmansfontein (-AA), Brückner 220 (PRE). 2922 (Prieska): Prieska (-DA), Bryant 899 (K); 1027 (BOL); 3022 (Carnavon): Carnavon (-CC), Smith 2441 (PRE). 3024 (De Aar): near De Aar (-CA), Herre s.n. (PRE). 3027 (Lady Grey): 18 Km south east Lady Grey (-CB), Gerstner 70 (BOL). 3122 (Loxton): Pampoenpoort (-BA), Roux s.n. (BOL). 3123 (Victoria West): Victoria West (-AC), Witlock 540 (PRE); Jansen in NBG 928/13 (BOL). 3124 (Hanover): Hanover (-AB), Sim s.n. (GRA); Rogers 16 374 (K); Noupoot (-BB), Dyer s.n. (GRA). 3125 (Steynsburg): Bangor (-AC), Bolus 14 105 (BOL); Rooispruit (-AD), Theron 733 (PRE). 3126 (Queenstown): Patriotsklip (-BA), Wood sub Galpin 2316 (BOL,PRE). 3222 (Beaufort West): Nieuweveld, Marloth 5822 (PRE). 3224 (Graaff Reinet): Aberdeen (-AC), Barker 7105 (NBG); near Graaff Reinet (-BC), Bolus 620 (BOL, GRA); Kendrew (-DA), Galpin 10 044 (PRE); 40 Km south of Graaff Reinet (-DA), Codd 3547 (PRE). 3225 (Somerset East): Cradock (-BA), Wisura 1042 (NBG); Holland s.n. (GRA); near Mortimer (-BC), Kensit sub Bolus 9254 (BOL); near Pearston (-CA), Dyer 2339 (GRA); Brintjieshoogte (-CB), Compton 20 242 (NBG). 3321 (Ladismith): Koup (-AB), Archer 513 (BOL); 3323 (Willowmore): near Willowmore (-AD),

Crampton 30 (GRA); Bayliss 4976 (NBG). 3324 (Steytlerville):  
Klipplaat (-AB), Thode A 565 (PRE); Wolwefontein (-BD), Drège  
s.n. (GRA). Roggeveld Mountains, Thunberg s.n. (UPS).

32b. Subsp. macrorhiza Toelken, subsp. nov.

C. corallina sensu Higgins in J. S. Afr. Bot. 24 : 115 - 118,  
fig. 2A (1958) et in Crass. Cult. 36, fig. 11 (1964); sensu  
Jacobsen. Handb. Succ. Pl. 308, Fig. 305 (1960) et Sukk. Lex.  
141, T, 43, 2 (1970); sensu Friedr. in Prodr. Fl. S. W. Afr.  
52 : 26 (1868), non Thunb.

Plantae caulibus brevis erectis vel longioribus decumbentibus et sine r  
radicibus adventiis vel rare solum in node singulare, radicibus principal-  
ibus tuberosis 0,3 - 0,8 (-1,2) cm diametro. Folia angulato-obovata  
fere obtriangularia, 0,4 - 0,5 cm longa, (0,35-) 0,4 - 0,5 cm lata,  
plerumque obtusa, tecta strato cerae in paginis expositis. Carpella  
stylis distinctis ovariis recurvis ad apicem et stigmatibus sessilibus  
lateralibus.

Type: South West Africa, Klein Karas, Dinter 4773 (PRE, holo!; K!).

Plants with short erect, or longer decumbent or prostrate stems which are  
usually without adventitious roots or if present then only at a single  
node at the time, with tuberos main roots 0,3 - 0,8 (-1,2) cm in  
diameter. Leaves angular-obovate to almost obtriangular, to almost  
obtriangular, 0,4 - 0,5 cm long, (0,35) 0,4 - 0,5 cm broad and usually  
with rounded apex, covered with a white waxy layer on the exposed surfaces.  
Carpels with indistinct styles and broad upper part of the ovary recurved  
at the apex and with sessile lateral stigmas.

Usually in coarse sandy soils and usually on bare patches;  
occurring in the Bushmanland and south-eastern South West Africa.

Flowering Period: October - January.

Diagnostic Features:

See under the species.

Variation and taxonomic Notes:

The branches of this subspecies are often described as erect, but if they become long enough they will adopt a decumbent or prostrate habit. This depends entirely on how much moisture is available as plants of the subsp. marcorhiza often produce prostrate soft herbaceous stems when grown in the glass house.

Specimens examined:

SOUTH WEST AFRICA. - 2718 (Grunau): Klein Karas (-CA), Dinter 4773 (PRE, K); Herre 24 (BOL); 16 Km north-west of Grunau (-CA), Tolken 3811 (BOL). 2818 (Warmbad): Warmbad (-BC), Herre in SUG 5773 (GRA).

CAPE. - 2717 (Violdrif): Stinkfontein Plateaux, Pearson 6204 (GRA). 2818 (Warmbad): 20 Km east-south-east of Goodhouse (-CD), Tolken 3681 (BOL). 2820 (Kakamas): Kakamas (-DC), Fuller 32 (BOL). 2821 (Upington): Upington (-AC), Simpson s.n. (NBG). 2917 (Springbok): 40 Km north of O'Okiep (-BD), Horrocks 17 (NBG); near Springbok (-DB), Gill in SAM 54 559. 2918 (Gamoup): Aggenys (-BB), Pearson 2945 (BOL, GRA, SAM); Ratelkraal (-CA), Pearson 6211 (PRE); Barker 6628 (NBG); 2919 (Pofadder): near Pofadder (-AB), Barker 8357 (NBG); Archer 512 (BOL). 2921 (Kenhardt): 4 Km west of Kenhardt (-AC), Acocks 16 507 (PRE); Putsonderwater, Martin 988 (NBG).

33. C. vestita Thunb. in Nova Acta Phys. -Med. Acad. Caes. Leop. -Carol., Nat. Cur. 6 : 329, 335 (1778) et Prodr. 56 (1794) et Fl. Cap. ed. Schultes 290 (1820); L. f., Suppl. 188 (1781); DC., Prodr. 3 : 385 (1828); Harv., Fl. Cap. 2 : 366 (1862); Schonl. in Bot. Ark. 21A, 16 : 12 (1927) et in Trans. Roy. Soc. S. Afr. 17 : 285 (1929).
- Type: Cape, Lower Roggeveld, Thunberg in Herb. Thunberg 7807

(UPS, holo!; G!; G-DC!; S!; STB!).

Perennials with erect and spreading branches up to 8 cm long and completely covered with the leaves forming a column 0,5 - 0,8 cm in diameter, entirely glabrous, with branches somewhat woody towards the base but bare stems rarely thicker than 0,4 cm in diameter and with hardly thickened tap root, with old leaves remaining attached to the stem for a long time. Leaves sessile, broadly obovate or rhombic-obovate, 0,5 - 0,6 cm long, 0,3 - 0,4 cm broad, with bluntly acute to obtuse apex, concave above and convex below and very fleshy, adpressed to the stem, glabrous but usually covered with a greyish flaking wax layer on the exposed surfaces, green to grey-green; sheath about 0,1 cm long and formed by the partial fusion of the leaf bases. Hydathodes scattered over the exposed surfaces, conspicuous. Inflorescence terminal, with 1,8 (-14) sessile 5-merous flowers in a dense dichasia and hardly protruding from the dense envelope of leaves below. Sepals oblong-triangular, 1 - 1,5 mm long, with rounded apex, fleshy towards the apex, glabrous, green. Petals oblong-obovate 2 - 3 mm long, abruptly constricted into a narrower apex but rounded, without dorsal ridge or appendage, fused into a tube up to 0,2 mm long, bulging around the squamae, with apices of the lobes slightly recurving, cream. Stamens 2 - 2,5 mm long, with yellow anthers 0,8 - 1 mm long and with filaments becoming broader towards the base and constricted where fused to the petal tube. Squamae transversely oblong, 0,4 - 0,5 x 0,5 - 0,7 mm, truncate, hardly constricted towards the base, somewhat fleshy, yellow. Carpels with almost conical ovaries gradually constricted into slender styles with terminal often laterally placed stigmas; ovary smooth with 6 - 8 elongate ovules densely covered with rows of faint papillae.

Among low shrublets and apparently associated with rock outcrops and recorded only from the southern Roggeveld mountains.

Flowering Period: October, November.

Diagnostic Features:

C. vestita is obviously very similar to C. corallina, but has erect stems completely covered by the leaves which are fused around the stem. Superficially, C. vestita resembles C. rupestris subsp. marnierana, because it produces similar clasping leaves which form an almost complete disc around the stem. However, the leaves of C. vestita are rough and often covered with irregular papillae on the exposed surfaces and also the flowers are born in a terminal cluster formed by the fascicled apex of the branch and thus does not produce a peduncle as in C. rupestris subsp. marnierana.

Variation and taxonomic Notes:

This species is rather rare and was collected only a few times, but this might be partly due to its habit of growing among other shrublets. In cultivation it grows well but will not flower and it seems that it requires the stimulus of snow and ice around it, as plants collected under those conditions flowered well in the first season, but not since.

Specimens examined:

3220. (Sutherland): Verlatenkloof (-DA), Tolken 3551 (BOL).  
Lower Roggeveld Mountains, Thunberg s.n. (G, G-DC, S, STB, UPS).

34. C. deltoidea Thunb. in Nova. Acta Phys. -Med. Acad. Caes. Leop. -Carol., Nat. Cur. 6 : 329, 334 (1778) et Prodr. 56 (1794) et Fl. Cap. ed. Schultes 288 (1829); L. f., Suppl. 189 (1781); DC., Prodr. 3 : 286 (1828); Schonl. in Bot. Ark. 21A, 16 : 7 (1927) et in Trans. Roy. Soc. S. Afr. 17 : 211 (1929); Friedr. in Prodr. FL. S. W. Afr. 52 : 27 (1968).

Type: Cape, along the Olifantsrivier, Thunberg in Herb. Thunberg 7754 (UPS, holo!; G-DC!; S!).

C. rhomboidea N. E. BR. in Gard. Chron. ser. 2, 26 : 712 (1886).

Type: Transvaal? Dunn s.n. (K, holo!).

Perennials with erect or spreading branches rarely longer than 8 cm, entirely glabrous, with fleshy branches up to 1 cm in diameter at the base and usually continued into a thick root, with old leaves deciduous. Leaves sessile, narrowly to broadly rhombic to oblanceolate, 1 - 1,5 (-2) cm long, 0,4 - 1 (-1,5) cm broad, with bluntly or sharply acute apex and usually gradually tapering towards the base, flat to concave above, very much convex and usually keeled below and usually covered with a grey flaking wax layer on the exposed surfaces, grey-green to almost grey; sheath 0,1 - 0,2 cm long and formed by the partial fusion of the leaf bases. Hydathodes scattered over the exposed thyrse with several dichasia with pedicellate 5-merous flowers, with a peduncle not longer than 1 cm, with usually blunt scale-like bracts on the dichasia. Sepals broadly triangular, 0,5 - 2 mm long, with rounded apex, glabrous, fleshy, grey-green. Petals oblong-elliptic to oblanceolate, 3,5 - 5 mm long, with rounded apex and without distinct dorsal appendage, fused into a tube 0,3 - 0,4 mm long, usually bulging around the squamae, with apices of lobes erect and hardly recurving at the apex, cream rarely white. Stamens 3 - 4,5 mm long, with black anthers 0,8 - 1 mm long, with filaments becoming broader towards the base and not constricted where fused to the petal tube. Squamae transversely oblong to almost square, 0,4 - 0,6 x 0,5 - 0,8 mm, truncate, and slightly constricted towards the base, somewhat fleshy, yellow. Carpels with narrowly reniform ovaries gradually constricted into styles at least half as long as the ovaries and with often laterally placed stigmas; ovary with a few cilia along the suture and with 6 - 10 elongate ovules densely covered with irregularly arranged papillae.

Usually on bare gravelly soil in depressions or on lower slopes in karoid vegetation; occurring from near Prins Albert through many parts of the southern Karoo, Tanqua Karoo, Bushmanland and south-eastern South West Africa.

Flowering Period: October, November.

Diagnostic Features:

Although C. deltoidea obviously belongs into this section, it differs from the other species in that it produces a definite inflorescence separated from the leaves by a peduncle. Plants without flowers are very similar to species of the section Arta, but its leaves are rough and not covered with hairs or globular papillae. Flowering specimens of C. deltoidea are distinguished by its peduncle that is not longer than 1 cm and petals that are usually longer than 3 mm.

Variation and taxonomic Notes:

The shape and the size of the leaves vary considerably from locality but in general become much longer and narrower towards the north while they are rather broad east of Laingsburg.

Specimens examined:-

SOUTH WEST AFRICA. - 2618 (Keetmanshoop): Keetmanshoop (-AC), Smithers s.n. (BOL). 2718 (Grunau): Klein Karas (-CA), Dinter 3244 (B); Tölken 3813 (BOL).  
 cape. - 2820 (Kakamas): Kakamas (-DC), Fuller 72B (BOL). 2922 (Prieska): Prieska (-DA), Bryant 847 (PRE). 3018 (Kamiesberg): 9 Km north-west of Kliprand (-BC), Tölken 3646 (BOL). 3119 (Calvinia): near Calvinia (-BD), Schmidt 32 (PRE). 3122 (Loxton): Meltonwold (-BD), Thorne in SAM 52 100. 3123 (Victoria West): near Murraysburg (-DD), Iyson 437 (SAM). 3219 (Wuppertal): Matjesrivier, Wagener 239 (NBG). 3220 (Sutherland): between Hottentots Kloof and Sutherland, Leipoldt 3090 (BOL). 3222 (Beaufort West): Beaufort West (-BC), de Jager s.n. (K). 3225 (Somerset East): Halesowen (-BA), James s.n. (BOL). 3319 (Worcester): Ceres Karoo, Herre in SUG 8674 (GRA); van Breda 268 (PRE). 3320 (Montagu): Sterkfontein (-AA), Barker 6842 (NBG); Patats River (-AB), Esterhuysen 23 543 (BOL); Hardy 55 (PRE); near Whitehill (-BA),

Barker 4879 (NBG); Matjesfontein (-BA), Macowan 1856 (GRA, SAM);  
between Montagu and Touws River, Lewis s.n. (BOL). 3321 (Ladismith):  
Koup (-AB), Archer 842 (BOL); near Ladismith (-AD), Zinn in SAM  
66 659; Adamskraal (-CC), Muir s.n. (GRA). 3322 (Oudtshoorn):  
near Prince Albert (-AA), Bolus 11 658 (BOL, PRE); Pillans sub  
Bolus 6886 (BOL); Herre in SUG 8622 (GRA). 3323 (Willowmore):  
Uniondale (-CA), Paterson 3114 (GRA); Willowmore (-AD), Smith  
2799A (GRA).  
Along Olifantsrivier, Thunberg s.n. (G-DC, S, UPS).

VI. Crassula sect. Anacampseroides Haw., Rev. Pl. Succ. 2 : 9 (1821).

Type species: C. telephioides Haw.

Perennials with prostrate to erect habit with herbaceous, carnosose to slightly woody stems and usually glabrous. Leaves petiolate to sessile, usually flat rarely somewhat convex on the upper and lower surface, glabrous, with hydathodes arranged in more or less dense rows along the margin and sometimes scattered over the upper and lower surface, with membranous sheath between the leaf bases but often reduced to a stiff ridge. Inflorescence varying from a single flower to terminal cymes or elongate to flat-topped thyrses with or without peduncle. Sepals 1 - 5 mm long and varying from longer than to less than a quarter of the length of the petals, glabrous, fleshy and often ridged towards the apex. Petals 2 - 8 (-10) mm long, spreading from the base to form a star-shaped flower, with a dorsal ridge continued into a sharply pointed terminal appendage. Stamens with white, pink or purple anthers 0,5 - 1,5 mm long. Squamae transversely oblong, usually truncate or slightly constricted towards the base, fleshy. Carpels with oblong-reniform ovaries with slender styles at least half as long as the ovaries; ovary with 8 - 30 (-50) ovules covered with rows of pointed papillae. Fruit splitting along the suture but releasing the seeds through a broad apical slit.

Common in the eastern Cape and Natal but also westwards to the south-western Cape.

Diagnostic Features:

Plants of the sect. Anacampseroides are distinguished from most other perennial species of Crassula by their star-shaped flowers and their slender styles which arise from the posterior apex of the ovary while in other sections the styles are in line with the erect anterior ovary wall. Also, the seeds are covered with pointed widely spaced papillae. More specifically, this section is distinguished from the often very similar sect. Filipedes by its linear or linear-triangular sepals which are often

ridged towards the apex, and the pedicels do not elongate after flowering.

Taxonomy:

The sect. Anacampseroides is a heterogenous group which is divided into three subsections. Of these the subsections Fasciculares and Latifolia contain only a few species and appear more homogenous than the subsect. Petiolares. However, in the latter subsection only two species, namely C. cordata and C. lactea show no obvious similarities to the rest of the group. However, C. cordata produces 4 or 5-merous flowers and adventitious buds on the inflorescence similar to those of C. multicava which in turn resembles closely C. streyi. Both C. cordata and C. multicava have hydathodes scattered over both surfaces while C. streyi produces only marginal ones.

On the other hand, C. lactea is somewhat intermediate between the two subsections Petiolares and Latifolia in that it produces firm fleshy leaves and carnose stems similar to those found in the subsect. Latifolia. However, it has the decumbent habit, the long linear-triangular sepals and old leaves are not deciduous as in the subsect. Petiolares. Also, the hydathodes are arranged in two marginal rows, so that it seems a more natural grouping to include C. lactea in the subsect. Petiolares contrary to the recent decision by Merxmüller et al. (1971) to incorporate this species in the group Arborescens which is similarly delimited as the subsect. Latifolia.

Haworth (1821) had envisaged to include only one species, C. telephioides in this section, and this species automatically becomes the type. In the treatments of both Haworth (1812) and De Candolle (1828) the first species listed under the subsect. Latifolia is C. arborescens, which, in the absence of any special directive, was designated as the type of this subsection. In the case of the subsect. Petiolares C. cordata must be selected as the type as "frutescentes", added by De Candolle, does not apply to C. spathulata.

Via. Crassula subsect. Fasciculares Toelken, subsect. nov.

Crassula group Pellucida Schonl. in Trans. Roy. Soc. S. Afr.

17 : 164, 191 (1929); Berger in Pflanzentam. ed. 2, 18a :

(1930); Merxmüller et al. in Ann. Naturhist. Mus. Wien 75 : 113

(1971).

Herbae ramis prostratis vel decumbentibus et usque ad 40 cm longis, foliis veteribus non deciduis. Flores singulares in axillis foliorum vel plus minusve fasciculatae in cyma terminale. Sepala lineo-triangularis et saltem 2 mm longa.

Type species: C. pellucida L.

Herbs with prostrate or decumbent branches up to 40 cm long and with old leaves not deciduous. Flowers single in the axils of the leaves or more or less clustered in a terminal cyme. Sepals linear-triangular and at least 2 mm long.

35. C. pellucida [Dillenius, Hort. Elth. 119, t. 100, fig. 119 (1732);]

L., Sp. Pl. ed. 1 : 283 (1753); DC., Prodr. 3 : 386 (1828);

Eckl. & Zeyh., Enum. 297 (1827); Schonl. in Trans. Roy. Soc.

S. Afr. 17 : 193 (1929).

Iconotype: Dillenius, Hort. Elth. t. 100, fig. 119.

Perennials rarely annuals with herbaceous decumbent stems up to 60 cm long, more or less rooting at the nodes with old leaves remaining attached to the stem for some time. Leaves usually sessile but sometimes with a petiole up to 0,8 cm long; lamina lanceolate, ovate to elliptic or oblanceolate, 1 - 2,5 (-3,5) cm long, (0,3-) 0,5 - 1,2 (-2) cm broad, usually sharply acute and with a short, sharp, colourless point at least when young, more or less abruptly constricted towards the base, sometimes cuneate to sub-petiolate, glabrous except for minute papillae along the margin, dorsiventrally flattened and slightly fleshy, green sometimes with brown stripes and with a colourless or red margin; sheath 0,1 - 0,2 (-0,4) cm

long, usually membranous and rarely formed by the partial fusion of the leaf bases. Hydathodes few in a row on the margin or along the margin of the upper surface, more or less conspicuous. Inflorescence a single flower in the axils of leaves due to sympodial growth or terminal cymes more or less fascicled, with pedicellate 5-merous flowers, without peduncle and often half hidden by the terminal leaves, with lanceolate to triangular often membranous bracts. Sepals linear-triangular 2,5 - 5 (-6) mm long, sharply acute and drawn into a colourless awn, glabrous, fleshy but often with a membranous margin, green to almost colourless. Petals usually oblanceolate to almost oblong, 3 - 5 mm long, with dorsal ridge continued into a sharp terminal point, slightly fused and free lobes spreading from just above the base, white but often tinged pink. Stamens 3 - 5 mm long, with white to pale purple anthers 0,6 - 0,9 mm long, with filaments slightly broadened towards the base and slightly constricted where fused to the petal tube. Squamae transversely oblong, 0,1 - 0,2 x 0,3 - 0,5 mm, truncate and slightly constricted towards the base, slightly fleshy, pale yellow to white. Carpels with oblong-reniform ovaries abruptly constricted into slender styles about half to three-quarters the length of the ovaries and with insignificant terminal stigmas; ovary smooth and with 8 - 16 ovules with rows of distinct papillae.

#### Diagnostic Features:

C. pellucida is distinguished from species of the sect. Filipedes which have similar flat leaves with marginal hydathodes by its sharply acute sepals and distinct distant papillae on the ovules, as in other members of the sect. Anacampseroides. However, C. pellucida is distinguished from other members of the latter section by the absence of a peduncle.

The subsp. spongiosa is very similar to the subsp. pellucida, but is distinguished from all the other subspecies by the tough spongy base of the mature flower including the outer wall of the ovary. The sessile ovate leaves which are more or less fused to one another as well

as with its glabrous stems will distinguish the subsp. marginalis. The subsp. alsinoides produces single flowers in the axils of the leaves but in contrast to the subsp. pellucida which has occasionally also single flowers, the stems are hairy at least below the leaf sheath, as well as the pedicels. The latter two characters are also found in the subsp. brachypetala but this subspecies produces a terminal cyme.

Taxonomic Notes:

C. pellucida is seen here as a complex species comparable to C. tetragona and C. capitella. This fact lays stress rather on the similarities especially as the distinguishing features between the five subspecies are in places small, as for example in the case of the subsp. marginalis which almost merges into the subsp. brachypetala between King William's Town and East London.

The first four subspecies are geographically isolated, except that the subsp. brachypetala occurs near to the subsp. marginalis in the vicinity of King William's Town and Somerset East as is discussed under the subsp. marginalis. The subsp. brachypetala and the subsp. alsinoides are ecologically isolated in that the latter usually grows on the forest floor, while the former is usually associated with rock outcrops in moist grassveld or on the border of forested areas.

It is interesting that the latter two subspecies which occur in the eastern high rainfall areas of Southern Africa are also widespread in tropical Africa. In contrast to this the first three subspecies are restricted to areas with predominantly winter rainfall.

35a. subsp. pellucida

C. pellucida [Dillenius, Hort. Elth. 119, t, 100, fig. 119 (1732)]  
L., Sp. Pl. ed. 1 : 283 (1753); Jacq., Frag. Bot. 39, t. 44,  
 3 (1809); DC., Prodr. 3 : 386 (1828); Eckl. & Zeyh., Enum.  
 197 (1837); Schonl. in Trans. Roy. Soc. S. Afr. 17 : 193 (1929);

Adamson, Fl. Cape Penins. 433 (1950); Rice & Compton, Wild Flow. Cape G. H. 47, 1 (1950); Kidd, Wild Flow. Cape. Penins. plate 92, 8 (1951); Tölken in J. S. Afr. Bot. 38 : 71 (1972).

C. dichotoma sensu L. f., Suppl. 188 (1781); Thunb., Prodr. 56 (1794) et Fl. Cap. ed. Schultes 286 (1823), non L.

C. centauroides sensu Ait., Hort. Kew. ed. 1, 1 : 392 (1789); sensu Sims in Bot. Mag. plate 1765 (1805); sensu Eckl. & Zeyh., Enum. 296 (1837); sensu Drège, Zwei Pfl. Doc. 78, 80, 84 (1844); sensu Harv., Fl. Cap. 2 : 354 (1862), non L.

C. marginata Thunb., Prodr. 56 (1794); Fl. Cap. ed. Schultes 287 (1823).

Type: Cape, Thunberg s.n. in Herb. Thunberg 7764 (UPS, holo!).

C. minima sensu Eckl. & Zeyh., Enum. 297 (1837), non Thunb.

Perennials with decumbent glabrous branches, rarely rooting at the nodes.

Leaves obovate to broadly elliptic, usually with rounded or apiculate apex, usually distinctly cuneate towards the base to often subpetiolate, and with irregularly papillose margin; sheath glabrous. Inflorescence usually a terminal dichasium more or less branched, or rarely a terminal flower which might be born in the axils of the lower leaves due to sympodial growth. Sepals two-thirds or as long as the petals, fleshy. Carpels with ovary wall becoming membranous when mature.

Growing usually associated with rock outcrops in shaded moist places under rocks or in forests; occurring from the Swartberg and Swellendam westwards to the Cape Peninsular and as far north as the Winterhoek mountains.

Flowering Period: November - February.

Diagnostic Features:

See under the species.

Variation and taxonomic Notes:

According to environmental conditions the size of the whole plant

and its leaves will vary greatly, but also the number of flowers varies from many to one. In fact, specimens from inland localities often show only one flower in the axils of the lower leaves, but similarly to the case in subsp. alsinoides these flowers are terminal, as can be seen from the fact that the axillary bud between the flower and the subtending leaf will develop when the stem is cut above that node. Some of these variations were recognised as separate species, as for instance the single-flowered C. marginata Thunb. In the case of the latter species Thunberg gives no indication that he refers to C. marginalis Dryand. in Ait., unlike in C. lactea, so that C. marginata is treated here as a new species.

Among others C. pellucida was often interpreted as C. centauroides a species that most botanists found difficult to interpret as Linnaeus provided only a very short description (cf. Tölken, 1972). It is, however, of interest that Thunberg records that his plants were collected on Table Mountain but all three sheets annotated as such by him must be identified as subsp. marginalis, a form that does not occur in the south-western Cape Province.

Specimens examined:

CAPE. - (Clanwilliam): near Zebrakop (-DB), Pillans 7569 (BOL), 3219 (Wuppertal): Apollo Peak (-CA), Esterhuysen 18 057 (BOL). 3318 (Cape Town): Table Mountain (-CD), Marloth 8204 (PRE); Ecklon & Zeyher 1893 (SAM); 1896 (S); Devils Peak (-CD), Wolley Dod 811 (BOL); Kirstenbosch (-CD), Esterhuysen 22 392 (BOL, PRE); Liesbeek River (-CD), Salter s.n. (NBG); Jonkershoek (-DD), Kerfoot 5309 (PRE, STE); Simonsberg (-DD), Compton 14 197 (NBG). 3319 (Worcester): Great Winterhoek Mountains (-AA), Galpin 12 590 (PRE); Ecklon & Zeyher 1895 (SAM); Sneeuwberg (-AA), Thorne in SAM 50 390; Matroosberg (-BC), Phillips 11 821 (SAM); Witteberg (-CA), Esterhuysen 22 285 (BOL); Waaihoek (-CB), Esterhuysen 15 081 (BOL), Frenchhoek (-CC), Schlechter 9269 (BOL, GRA, PRE); Wemmerhoek Peak (-CC), Esterhuysen

11 279 (BOL); Stettynsberg (-CC), Esterhuysen 11 209 (BOL); Onklaarberg (-CD), Stokoe 1111 (PRE). 3320 (Montagu): Montagu (-CC), Rogers 26 608 (PRE). 3321 (Ladismith): Klein Swartberg, Stokoe 1906 (GRA, PRE, STE). 3322 (Oudtshoorn): Swartberg Pass (-AC), Bolus 11 488 (BOL, NH, PRE); Silver River ? (-DC), Schlechter 5876 (BOL, PRE). 3418 (Simonstown): near Constantia (-AB), MacOwan 1849 (GRA, PRE, SAM); Simons Bay (-AB), Prior s.n. (PRE); near Somerset West (-BB), Parker 4820 (BOL, NBG, SAM); Somerset Sneekop (-BB), Esterhuysen 2838 (BOL); Landroskop (-BB), Thorne in SAM 51 565. 3419 (Caledon): Victoria Peak (-AA), Esterhuysen 9731 (BOL); Guardian Peak (-AA), Esterhuysen 24 131 (BOL). Cape, Thunberg s.n. (G, S, STB, UPS).

**35b.** subsp. spongiosa Toelken, subsp. nov. ab subsp. pellucida sepalis et receptaculo spongiosentibus in fructu et florescentia praecoci differt.

Herbae annuae ramis glabris decumbentibus saepe nodis radicanibus. Folia elliptica et plerumque apicibus terminalibus incoloratis et cuneata ad basim; vagina glabra vel 1 - 3 ciliis marginalibus. Inflorescentia cymus terminalis saepe ramosus vel fasciculatus et partim occultata foliis subtentis, pedicellis glabris. Sepala circiter petala aequantia, spongiosentia in fructu. Carpella basibus ovariis et receptaculo spongiosentibus in fructu.

Type: Cape, Uitkomst, Barker 10 739 (NBG, holo!).

Annuals with decumbent glabrous stems often rooting at the nodes. Leaves elliptic and usually with colourless terminal apex and cuneate base; sheath glabrous or with 1 - 3 marginal cilia. Inflorescence a terminal cyme often slightly branched or densely clustered and partly hidden by the leaves subtending it, with glabrous pedicels. Sepals about as long as the petals and becoming spongy after flowering. Carpels with lower parts of ovaries and the receptacle becoming spongy when mature.

In sheltered kloofs between Nieuwoudtville and Calvinia.

Flowering Period: October, November.

Diagnostic Features:

See under the species.

Variation and taxonomic Notes:

Not much variation has been recorded for this subspecies which resembles subsp. pellucida rather closely. However, the latter subspecies has only once been recorded north of the Winterhoek Mountains (Esterhuysen 18 057), but it is a depauperate specimen with single flowers and it flowers in December.

It is interesting that the fleshy calyx and the receptacle become stiff and spongy when the fruit becomes mature. In this way the fruits are hidden in a cup-shaped structure and the seeds are not easily dispersed.

Specimens examined:

CAPE. - 3119 (Calvinia): between Nieuwoudtville and Oorlogkloof (-AC), van Breda 1406 (PRE); 10 Km from Nieuwoudtville to Clanwilliam (-AC), Hardy 791 (PRE); Oorlogskloofrivier, McGregor in Galpin 10 512 (PRE); top of Vanrhyn's Pass (-AC), Barker 9422 (NBG); 8 Km from Nieuwoudtville to Grasberg (-AC), Barker 9562 (NBG); Uitkomst (-AC), Barker 10 739 (BOL).

35c. subsp. marginalis

C. marginalis Soland. in Ait., Hort. Kew. ed. 1, 1 : 396 (1789); Jacq., Hort. Schönbr. 36, t. 47 (1805); DC., Prodr. 3 : 385 (1828); Eckl. & Zeyh., Enum. 297 (1837); Britten & Bak. f. in J. Bot., Lond. 35 : 483 (1898); Schonl. in Trans. Roy. Soc. S. Afr. 17 : 194 (1929); Higgins, Cress. Cult. 53, plate 4b (1964).

Type: Caput Bonae Spei, Masson s.n. (BM, holo!).

C. lineolata Soland. in Ait., Hort. Kew. ed. 1, 1 : 391 (1789); Schonl. in Trans. Roy. Soc. S. Afr. 17 : 195 (1929).

Type: Caput Bonae Spei, Masson s.n. (BM, holo!).

C. centauroides sensu Thunb., Fl. Cap. ed. Schultes 287 (1823).

— var. marginalis (Soland.) Harv., Fl. Cap. 2 : 354 (1862).

C. profusa Hook, f. in Bot. Mag. plate 6044 (1873).

Iconotype: Bot. Mag. plate 6044 (original in K, lecto!).

Perennials with glabrous stems prostrate or scrambling and sometimes rooting at the nodes. Leaves broadly ovate with pointed apices, abruptly constricted towards the base and more or less fused to one another forming a disc up to 1 cm in diameter, with horny epapillate margin which is slightly recurved in dried material; sheath glabrous or with more or less marginal cilia. Inflorescence terminal with 1 - 3 umbellate part-inflorescences, with glabrous pedicels. Sepals usually about half or rarely as long as the petals, fleshy. Carpels with ovary wall becoming membranous when mature.

Usually associated with rock outcrops in shaded moist places in forests or under rocks; occurring along the coast from George to East London.

Flowering Period: September - December.

Diagnostic Features:

See under the species.

Variation and taxonomic Notes:

The subsp. marginalis is rather variable and in addition a cline can be traced more or less clearly through the whole distribution range. In the vicinity of Knysna the leaves are typically broadly ovate and the whole plant is completely glabrous. Some local variation in the amount of fusion of the leaf bases can be noticed, but it is interesting that plants which grow on rock faces where they are often more exposed, have red leaf margins. A more delicate prostrate form with leaf margins which are always white occurs in shaded areas in Baviaanskloof and the surrounding mountains. However, this form merges into the more robust coastal form at various points.

A few plants with marginal papillae on the leaf sheath have been recorded from near Humansdorp and to the east of this a gradual increase in the number of the papillae occurs and which eventually turn into hairs can be observed between Port Elizabeth and East London. The type specimen of C. lineolata was probably collected in this area as it has definite cilia on the leaf sheath.

North of Port Elizabeth and even more pronounced between East London and King William's Town plants become very variable. The leaves are often lanceolate with a dense tuft of hairs along the margin of the leaf sheath and in many plants the sepals are as long as the petals. These characters are more typical of the subsp. brachypetala which has been recorded from the vicinity of King William's Town, but here shows also considerable variation of the cuneate leaf base and the length of the sepals. Both these incidences of intense variation in a small area indicate hybridization or allopatric introgression as described in C. alpestris, except that the phenomenon is much more complex in the case of C. pellucida because populations of the two subspecies occur close to one another over a wide area. However, it seems significant that a complete range of intermediates, as one would expect with ordinary hybridization, could not be found. The subsp. brachypetala grows mainly in moist grassveld or along forested areas, while the subsp. marginalis is associated with rock outcrops mainly along the river valleys.

The three specimens of C. centauroides in Thunberg's Herbarium must be identified as subsp. marginalis, although Thunberg stated in his Flora Capensis that they were collected on Table Mountain.

Specimens examined:

CAPE. - 3225 (Somerset East): Halesowen (-BA), James 164 (BOL); Somerset East (-DA), Wisura 1060 (NBG); Boschberg (-DA), Scott-Elliot 495 (NH). 3226 (Fort Beaufort): Mount Hopley (-BA), Galpin 2643 (GRA, PRE); Katberg (-BC), Shaw sub Bolus 2002 (BOL).

3227 (Stutterheim): Keiskama Hoek (-CA), Gonlimis s.n. (BOL); Komga (-DB), Flanagan 1079 (BOL, GRA, PRE, SAM); near East London (-DD), Hall 227 (BOL, NBG); Galpin 1863 (GRA, PRE).

3228 (Butterworth): Gonubi (-AC), Bokelmann s.n. (NBG); Compton 13 110 (NBG), 3321 (Ladismith): Seweweekspoort (-BC), Wurts 1651 (NBG); Melkhoutessenbosch (-CD), Muir 1052 (PRE). 3322 (Qudtshoorn) : George (-CD), Hall 205 (NBG); Touws River (-DC), Martin 19 (NBG); 50 (NBG); Swartberg, Stokoe in NBG 12 /27 (BOL).

3323 (Willowmore): Smutsberg (-DA), Esterhuysen 10 708 (BOL); Braamrivier (-DC), Esterhuysen 16 289 (BOL). 3324 (Steytlerville): Campher's Kloof (-AA), Compton s.n. (NBG); Baviaanskloof (-CA), Wisura 1841 (NBG); Cockscorb (-CB), Esterhuysen 28 021 (PRE).

3325 (Port Elizabeth): near Sapskamma Station (-AC), Tölken 4117 (BOL); Enon (-BC), Thode A2648 (NH, PRE); Groendal (-CA), Sellick sub Long 1076 (PRE); 8 Km north of Uitenhage (-CB), Dahlstrand 810 (GRA); Vanstadenspas (-CC), de Winter 7621 (PRE); Komachs (-CD), Paterson 381 (GRA); Theecombe (-CD), Long 1102 (GRA, PRE); Krakakama (-CD), Zeyher 2527 (SAM); Redhouse (-DC), Paterson 2649 (BOL); Bethelsdorp (-DC), Paterson 381 (GRA); Swartkops River, Ecklon & Zeyher 1894 (SAM); Suurberge, Acocks 20 290 (PRE). 3326 (Grahamstown): Alice-dale (-AC), Rogers 12 001 (PRE); Howieson's Poort (-AD), Schonland 462 (GRA); 724 (GRA); near Grahamstown (-BC), Daly & Sole 520 (GRA); Trappes Valley (-BD), Daly 554 (GRA); Southwell (-DA), Acocks 12 059 (PRE); Bushmans River (-DA), Archibald 48 41 (PRE); Bennie 740 (GRA); Port Alfred (-DB), Galpin 3020 (BOL, GRA, PRE); Tyson 168 (PRE); Dixon's Bush (-DB), Schonland 383 (GRA). 3327 (Peddie): Peddie (-AA), Edwards in NBG 129/21 (BOL); Kidds Beach (-BB), Taylor 5593 (NBG). 3420 (Bredasdorp): Potberg (-BD), Pillans 9457 (BOL); Esterhuysen 23 180 (BOL). 3422 (Mosselbaai): 7 Km north of Mosselbaai (-AA), Tölken 3711 (BOL). 3423 (Knysna): Plettenberg Bay (-AB),

Rogers 26 808 (PRE); Keurboomstrand (-AB), Taylor 4420 (PRE, STE).  
 3424 (Humansdorp): Clarkson (-AB), Thode A 839 (NH, PRE); Humansdorp  
 (-BB), Galpin 4019 (PRE).  
 Caput Bonae Spei, Masson s.n. (BM).

35d. subsp. brachypetala (Drège ex Harv.) Toelken, comb. nov.

C. brachypetala Drège ex Harv., Fl. Cap. 2 : 354 (1862); Drège,  
 Zwei Pfl. Doc. 151 (1844), nom. nud.

Type: Cape, between Umzimvubu & Umzimkaba Rivers, Drège s.n.  
 (S, lecto!; G!; P!).

— var. parvisepala Schonl. in Rec. Albany Mus. 1 : 116 (1904).

Type: Cape, Bedford, Nicol 93 (GRA, lecto!).

C. prostrata E. Mey. ex Drège. Zwei Pfl. Doc. 151 (1844) nom.  
 nud. et nom. illeg. — non Thunb.

Bullardia dregei Harv., Fl. Cap. 2 : 330 (1862).

Type: Cape, between Umzimvubu & Umsimkaba Rivers, Drège s.n.  
 (S, lecto!; G!; P!).

Crassula dregei (Harv.) Schonl. in Ann. Bolus Herb. 2 : 73 (1916).

C. elongata Schonl. in J. Linn. Soc. (Bot.) 31 : 552 (1897).

Type: Cape, near Queenstown, Galpin 2021 (GRA, holo!; PRE!).

C. involucrata Schonl. in Bull. Herb. Boiss. ser. 1, 5 : 863  
 (1897) et in Trans. Roy. Soc. S. Afr. 17 : 198 (1929).

Type: Cape, Insiswa Mountains, Schlechter 6448 (GRA, holo!;  
 BOL!; NH!; PRE!; SAM!).

C. tysonii Schonl. in J. Bot., Lond. 40 : 289 (1902) et in Trans.  
 Roy. Soc. S. Afr. 17 : 198 (1929).

Type: Cape, near Kokstad, Tyson 1342 (GRA, holo!; BOL!; SAM!;  
 STE!).

C. diabolica N. E. Br. in Burt Davy, Trans. Pl. 140, 141 (1926).

Type: Transvaal, Lydenburg, Wilms 521 (K, holo!).

C. lineolata sensu Schonl. in Trans. Roy. Soc. S. Afr. 17 : 195 (1929); sensu Batten & Bokelman, Wild Flow. East. Cape 74, plate 62, 7 (1966); sensu Jacot Guill., Fl. Lesotho 182 (1971).

— var. petiolata Schonl. in Trans. Roy. Soc. S. Afr. 17 : 196 (1929).

Type: not quoted.

— forma magna Schonl. in Trans. Roy. Soc. S. Afr. 17 : 196 (1929).

Type: Cape, near Grahamstown, MacOwan 299 (GRA, holo!).

— forma gracilis Schonl. in Trans. Roy. Soc. S. Afr. 17 : 196 (1929).

Syntypes: Cape, Suurberg Sanatorium, Schonland 3245 (GRA);

Katberg Pass, Galpin 2392 (GRA, PRE); Cathcart, Hart 7 (GRA);

Woodvale, Galpin 2021 (GRA, PRE); Potriviersberg, Galpin 6620

(BOL, GRA, NH, PRE, SAM); Port St. Johns, Schonland 4257 (GRA);

Pondoland, Bachman 532 (B ).

— forma natalensis Schonl. in Trans. Roy. Soc. S. Afr. 17 : 197 (1929).

Syntypes: Natal, Ingolweni, Wood 3054 (GRA!, NH!); Ulundi,

Evans 641 (GRA!).

— var. pilosa Schonl. in Trans. Roy. Soc. S. Afr. 17 : 197 (1929), nom. nud.

Perennials with decumbent or rarely short erect stems, rarely rooting at the nodes, with internodes hairy at least in a line on either side of the stem basipetally from the area where the leaf bases have fused to form the sheath. Leaves with a lanceolate to ovate rarely elliptic lamina, acute more or less cuneate to petiolate with irregularly spreading papillae along the margin; sheath with hairs at least on the area where the leaf bases have fused and along the margin. Inflorescence a terminal dichasium often slightly irregularly branched rarely subumbellate, and often half hidden by the subtending leaves, with pedicels more or less hairy. Sepals

usually about as long as or longer than the petals, fleshy. Carpels with membranous ovary walls when mature. Fig. 1.2.

Usually in moist areas in grassveld but often also associated with rock outcrops; occurring and often locally common north-eastwards from a line between Queenstown and East London, in most parts of Natal and southern and eastern Transvaal and into tropical Africa.

Flowering Period: December - April.

Diagnostic Features:

See under the species.

Variation and taxonomic Notes:

The subsp. brachypetala is one of the most widespread taxa in the genus Crassula and it is not surprising to find some local variation. For instance, some plants are densely hairy as in the type specimen of C. tysonii, which also has rather short petals, but again a complete range of intermediates can be found. On the other hand, although the distinguishing characters of this subspecies are the hairy stems and pedicels, these might be absent or almost so along the Natal coast and often in tropical Africa but the leaves are always with a cuneate base in contrast to the sessile ovate leaves of the subsp. marginalis. Also the shape of the leaves varies considerably from the narrowly lanceolate ones as found in the type specimens of C. dregei to the ovate-elliptic ones of the type of C. lineolata forma magna. However, the leaves are always cuneate or even petiolate in some specimens. In depauperate plants this cuneate base may be rather short and often in such plants the inflorescence is hidden by the leaves below, as the upper internodes do not elongate very much, an extreme form seen in the type specimen of C. involuocrata. However, plants of the subsp. alsinoides have also often such congested apices and are easily confused particularly as they have similar hairy stems and pedicels but can be identified by their single flowers in the axils of the leaves.

In addition to all this variation it is interesting to note that

plants growing in grassveld produce predominantly a somewhat swollen underground rhizome which bears fleshy scale-like leaves. In contrast to this plant growing in rock crevices, particularly those in the Eastern Cape, have their branches all above the soil level.

Schonland's (1929) interpretation of C. lineolata is not synonymous with the subsp. brachypetala, because he included all plants with "leaves....pilose at the base" in this species. In other words he includes also a number of plants which are now placed into the var. marginalis, including the type specimens of C. lineolata, as a continuous range from the typical glabrous form of subsp. marginalis to such plants with a tuft of hairs along the margin of the leaf sheath can be found, as has been discussed under the subsp. marginalis. The only character that will separate the subsp. marginalis from subsp. brachypetala is the presence of hairs on the stems and pedicels.

Among the specimens Schonland enumerated under C. brachypetala var. parvisepala he identified only one of these sheets as such, namely Nicol 93. Also, as much of the description is based on that specimen it must be chosen as the lectotype.

Both the Drège specimens of C. brachypetala and C. dregei in Stockholm Herbarium are accompanied by a drawing of the dissection of the flower by Harvey, and for that reason were chosen as the lectotypes.

Specimens examined:

TRANSVAAL. - 2229 (Messina): 10 Km north-east of Louis Trichardt (-DD), Tölken 1209 (PRE). 2329 (Pietersburg); Blouberg (-AA), Codd & Dyer 9038 (PRE). 2330 (Tzaneen): 2 Km east of Steilkop (-CC), Muller & Scheepers 96 (PRE). 2428 (Nylstroom): Zwagershoek (-AD), Obermeyer 234 (PRE). 2430 (Pilgrim's Rest): Wolkberg (-AA), Muller & Scheepers 155 (PRE); Mariepskop (-DB), Meeuse 9968 (PRE); van der Schijff 4393 (PRE). 2730 (Vryheid): Wakkerstroom (-AC), van Dam in TRV 24 308 (PRE); Oshoek (-AD), Devenish 591 (PRE); Galpin 10 020 (PRE).

SWAZILAND. - 2631 (Mbabane): near Forbes Reef (-AA), Schlieben 9530 (PRE); Ngwenya Mountains (-AA), Compton 26 686 (NBG, PRE); Hulls Farm, Compton 25 608 (NBG); 27690 (NBG, PRE).

NATAL. - 2729 (Volksrust): Majuba (-BD), Rogers 3328 (GRA, PRE). 2730 (Vryheid): Klipspruit (-CD), Breyer in TRV 16 976 (PRE); Kambula (-DA), Gerstner 4616 (PRE). 2731 (Louwsburg): Mgotsche (-CB), Hall in NBG 524/56 (NBG). 2732 (Ubombo): near Josini (-AC), Tolken 4383 (BOL). 2828 (Bethlehem): Mount Aux Sources (-DB), McClellan & Bayer 6 (BOL, GRA, PRE); Lewis 1689 (SAM); Steyn 1023 (NBG); Tugela Valley, Bayer & McClellan 51 (GRA). 2829 (Harrismith): Olivershoek (-AC), Strey 9516 (NH, PRE); Van Reenen (-AD), Wood 10 759 (BOL, PRE); Wylie in NH 30 096; Bergville (-CB), Rehm s.n. (BOL); Cathedral Peak (-CC), Killick 1368 (PRE). 2830 (Dundee): Indumeni Mountains (-AA), Truscott 91 (PRE); Jameson's Drift (-DD), Strey 9309 (NH). 2831 (Nkandla): 8 Km south of Nkandla (-CA), Wisura 1173 (NBG); Eshowe (-CD), Lawn 2224 (NH); Hlinza Forest (-CD), Strey 4580 (NH, PRE); Ngoya Forest (-DC), Sim s.n. (GRA). 2832 (Mtubatuba): Hluhluwe Game Reserve (-AA), Hitchins 4 (NH, PRE); Mtubatuba (-AC), Lawn 1589 (NH); Dukuduku Forest (-AD), Strey 5743 (NH, PRE); Ward 7073 (PRE); Richards Bay (-CC), Venter 6442 (PRE). 2929 (Underberg): Injasuti area (-AB), Esterhuysen 20 280 (BOL); Giant's Castle (-AD), Trauseld 607 (PRE); Tabamhlope (-BA), O. West 1110 (PRE); near Estcourt (-BB), O. West 223 (PRE); South Downs (-BB), Evans 524A (NH); Underberg (-CD), McClellan 604 (NH); Himeville (-DC), Bews 2 (GRA); Bews 3 (GRA); Bulwer (-DD), Marais 1453 (PRE). 2930 (Pietermaritzburg): Mooirivier (-AA), Wood 5321 (PRE, SAM); Mogg 7004 (PRE); Lidgetton (-AC), Mogg 6734 (PRE); Howick (-AC), Wood s.n. (BOL); Kolbe in BOL 13 017; 34 Km north of Howick (-AD), Ross 2065 (NH, PRE); Greytown (-BA), Cronwright 34 (PRE); near Noodsberg (-BD), Moll 1490 (PRE); Baynes Drift (-BD),

Huntley 182 (PRE); Hilton (-CB), Dimock-Brown 214 (NH); Hela Hela  
 (-CC), Strey 10 868 (NH, PRE); Drummond (-DA), Lawson 423 (NH);  
Table Mountain (-DA), Killick 312 (PRE); Inanda (-DB), Wood 496  
 (NH, SAM); Tala Farm (-DC), Noll 3040 (NH, PRE); Krantzkloof (-DD),  
Wood 1105 (NH, SAM); Isipingo (-DD), Ward 4972 (NH). 3028  
 (Matatiele): Ulundi (-CA), Erens 641 (GRA, NH); 3029 (Kokstad);  
Weza (-DA), Strey 10 911 (PRE). 3030 (Port Shepstone): near  
Dumisa (-AD), Rudatis 357 (STE); 1364 (PRE); Izingolweni (-CC),  
Wood 3054 (GRA, NH). 3130 (Port Edwards): Umtamvuma River (-AA),  
Nicholson 968 (PRE); Port Edward (-AA), Bayliss 556 (NBG).  
 ORANGE FREE STATE. - 2828 (Bethlehem): Bester's Vlei (-BD), Bolus  
 s. n. (BOL); Witzieshoek (-DB), Junod in TRV 17 333 (PRE); Thode  
 5605 (STE). 2829 (Harrismith): Harrismith (-AC), Smit 113 (PRE);  
Sankey s.n. (BOL).  
 CAPE. - 3028 (Matatiele): Mvenyane Mountain (-BD), Bandert 176 (GRA);  
Pot River Berg (-CD), Galpin 6620 (BOL, GRA, NH, PRE, SAM); 28 Km south  
 of Mount Fletcher (-CD), Marais 864 (GRA, PRE); near Mount Frere (-DD),  
Barker 6160 (NBG). 3029 (Kokstad): New Amalfi (-AC), Forbes 1121  
 (NH); Mount Currie (-AD), Tyson 1787 (BOL, SAM); Clydesdale (-BD),  
Tyson 3087 (PRE, SAM); Kakas Hill (-CA), Strey 10 836 (PRE);  
Cedarville (-CA), Strey 10 808 (PRE); Iniswa Mountains (-CB),  
Schlechter 6448 (GRA, BOL, PRE); Kokstad (-CB), Tyson 1342 (BOL,  
 GRA, SAM STE); Mnentu Bridge (-DC), Strey 10 642 (PRE). 3125  
 (Steynsburg): Steynsburg (-BD), Schonland 3245 (PRE). 3126  
 (Queenstown): near Lesseyton (-DA), Galpin 2021 (PRE); near Queenstown  
 (-DA), Galpin 8114 (GRA, PRE). 3127 (Lady Frere): Barkly Pass (-BB),  
Rattray sub Galpin 7296 (PRE); Cala (-DA), Pegler 1529 (PRE);  
Encobo (-DB), Flanagan 2655 (PRE). 3128 (Umtata): Baziya (-CB),  
Baur 774 (SAM); Kwaaiman Post Office (-DD), Lewis 3411 (SAM); near  
Lutubeni Store (-DD), Barker 8251 (NBG). 3129 (Port St. John's):

Egossa (-BC), Sim 2548 (PRE); Port St. John's (-DA), Schonland 4257 (GRA); Manteku (-DA), Strey 8928 (NH, PRE). 3226 (Fort Beaufort); Katberg Pass (-BC), Galpin 2392 (GRA, PRE); Bedford (-CA), Nicol 93 (BOL, GRA). 3227 (Stutterheim): Windvogelberg (-AC), Roberts 1799 (PRE); Waqua River (-AC), Tölken 4041 (BOL); Stutterheim (-BC), Acocks 9680 (PRE); Dohne (-CB), Sim 1201 (GRA); 1218 (PRE); 1162 (PRE); King William's Town (-CD), Sim 1202 (PRE); 17 Km south of Stutterheim (-DA), Tölken 4039 (BOL); Kouga (-DB), Flanagan 1079 (PRE). 3228 (Butterworth): Idutywa (-BB), Galpin 10 450 (PRE); Kentani (-CB), Pegler 474 (BOL, GRA, PRE). 3325 (Port Elizabeth): Suurberg Sanatorium (-BD), Schonland 3245 (GRA); Surrberg, Paterson 14 (GRA); Archibald 7288 (PRE). 3326 (Grahamstown): near Grahamstown (-BD), MacOwan 299 (GRA), 3325 (Peddie): Line Drift (-AA), Sim s.n. (GRA); Mount Coke (-AB), Sim 1416 (GRA).

35e. subsp. alsinoides (Hook. f.) Toelken, comb. nov. et stat. nov.

C. alsinoides (Hook. f.) Engl. in Abh. Preuss. Akad. Wiss. (1891) 231 (1892); Hutch. & Dalz., Fl. W. Trop. Afr. 1: 103 (1928).

Syntypes: Fernando Po, Mann s.n. (K!); Abyssinia, near Ankobar, Roth, (K!).

Tillaea alsinoides Hook. f. in J. Linn. Soc. (Bot.) 7: 192 (1864); Britten in Fl. Trop. Afr. 387 (1871).

Perennials decumbent, rarely rooting at the nodes and with stems hairy at least in a line on either side of the stem continuing downwards from where the leaves have fused to one another. Leaves ovate or lanceolate-spathulate, acute with sharply pointed apex and abruptly constricted towards the petiole, with flat rather elongate papillae giving the leaf a serrulate margin when seen under the microscope; sheath with some hairs and with some longer ones along the margin. Inflorescence one terminal flower which appears to

be axillary because of sympodial growth. Sepals two-thirds as long as the petals, fleshy. Carpels with membranous ovary wall when mature.

In moist shaded places and often found on the forest floor along swamps or streams in dense forests; occurring sporadically from the Knysna forests to central and northern Natal and eastern Transvaal, but widespread through most parts of tropical Africa.

Flowering Period: October - March.

Diagnostic Features:

See under the species.

These plants are very similar to those of the subsp. brachypetala, but are distinguished by its usually regularly serrulate leaf margin and a single flower in the axils of the leaves.

Variation and taxonomic Notes:

This subspecies is never common in Southern Africa and shows little variation here as well as in tropical Africa.

Specimens examined:

TRANSVAAL. - 2229 (Waterpoort): Wyllie's Poort (-DD), Hafstrom & Acocks 554 (PRE). 2230 (Messina): Entabene (-CC), Obermeyer 911 (PRE). 2329 (Pietersburg): Houtbosdorp (-DD), Jenkins in TRV 7422 (PRE); Codd 9418 (GRA). 2330 (Tzaneen): Duiwelskloof (-CA), Scheepers 230 (PRE); New Agatha Forest (-CC), McCullum 137 (PRE). 2430 (Pilgrim's Rest): Mariepskop Forest Reserve (-DB), van der Schijff 4995 (PRE); Killick 2411 (PRE); 2419 (PRE); Blyderivier (-DD), van der Schijff 5526 (PRE). 2530 (Lydenburg): Kaapsehoop (-DB), Rogers 21 414 (NH); Gilmore 2270 (PRE). 2531 (Komatipoort): near Barberton (-CC), Thorncroft 2148 (PRE).

SWAZILAND. - 2631 (Mbabane): Kopola (-AC), Ben Dlamini s.n. (PRE); Hlatikulu (-CD), Compton 26 354 (PRE); Killick & Strey 2411 (PRE).

NATAL. - 2731 (Louwsburg): Ngome (-CD), Strey 9384 (NH, PRE). 2930 (Pietermaritzburg): Karkloof (-AD), Moll 2873 (PRE).

CAPE. - 3323 (Willowmore): Diepwalle Forest (-CC), Bos 758 (PRE, STE).  
 3423 (Knysna): Knysna Heads (-AA), Williamson 121 (PRE).

**VIb.** Crassula subsect. Petiolares (DC.) Toelken, comb. nov. et **stat. nov.**

Crassula sect. Petiolares Haw. ex DC., Prodr. 3 : 386 (1828).

Type species: C. cordata Thunb.

Crassula group Petiolares (DC.) Harv., Fl. Cap. 2 : 334 (1862);

Schonl. in Pflanzenfam. ed. 1, 3, 2a : 36 (1891).

Crassula group Spathulata Schonl. in Trans. Roy. Soc. S. Afr.

17 : 164, 198 (1929); Berger in Pflanzenfam. ed. 2, 18a : 390

(1930). Merxmüller et al. in Ann. Naturhist. Mus. Wien. 75 : 113

(1971).

Crassula group Lactea Schonl. in Trans. Roy. Soc. S. Afr. 17 :

165, 199 (1929); Berger in Pflanzenfam. ed. 2, 18a : 391 (1930).

Crassula group Cordata Schonl. in Trans. Roy. Soc. S. Afr. 17 :

165, 202 (1929); Berger in Pflanzenfam. ed. 2, 18a : 391 (1930).

Herbs with decumbent or prostrate branches rarely broader than 2 cm in diameter and with flaking bark, up to 40 cm high, and with old leaves remaining attached to the stem for some time. Flowers born in a terminal thyrse with several to many dichasia and with a peduncle (1-) 3 - 15 cm long. Sepals linear-triangular, at least 2 mm long and one-third to half the length of the petals.

**36.** C. inandensis Schonl. & Bak. f. in J. Bot., Lond. 36 : 364 (1898)

et Schonl. in Trans Roy. Soc. S. Afr. 17 : 199 (1929).

Type: Natal, Inanda, Wood 764 (BM, holo!; SAM!).

C. wyliei Schonl. in Rec. Albany Mus. 2 : 456 (1913); et in

Trans. Roy. Soc. S. Afr. 17 : 199 (1929).

Type: Natal, Nkandhla, Wylie sub Wood 8830 (GRA, holo!).

Perennials decumbent or scrambling with branches rarely longer than 60 cm and up to 0,3 cm diam., little branched and then mainly from the base, occasionally rooting at the nodes, with old leaves remaining attached to the stem. Leaves with a petiole up to 1,5 cm long on the lower leaves but with a gradual decrease to sessile leaves below the inflorescence; lamina usually broadly elliptic or elliptic-ovate, 2 - 5 (-8) cm long, 1,5 - 3 (-5) cm broad, with the biggest leaves at the top, acuminate to abruptly constricted into a blunt point in the lower leaves which have a cuneate base while they are abruptly constricted at the top, usually with irregular dentate margin which is recurved, not fleshy, dark green on top and lighter green below; sheath up to 0,1 cm long. Hydathodes arranged in a single row on the lower surface of the leaf and always situated in the centre of the rounded teeth often found on the margin, more or less conspicuous. Inflorescence a rounded thyrses consisting of one to several dichasia and often half hidden by the large leaves below, with shortly pedicellate 5-merous, with a peduncle 1 - 3 cm long, with small subulate bracts. Sepals obovate-oblong, 1 - 2 mm long, very much swollen at the apex so that they appear recurved, glabrous, green. Petals linear-lanceolate, 3,5 - 5 (-6) mm long, hardly hooded, with pointed dorsal appendage in terminal position, spreading to recurved later, cream, rarely white. Stamens 3 - 4 mm long, with white anthers, 0,8 - 1,2 mm long, with filament hardly broadened towards the base and little fused to the petal tube. Squamae transversely oblong, 0,3 - 0,4 x 0,5 - 0,8 mm, hardly emarginate, little constricted towards the base, fleshy, white to pale yellow. Carpels with oblong-reniform ovaries with slender styles about as long as the ovary and with small terminal stigma; ovary glabrous, with 6 - 9 ovules each almost spherical and covered with rows of bulging papillae.

In moist areas, often along streams in forests or rather along shaded road sides or open spaces in dense forest; recorded from isolated localities in the coastal mountains from the northern Transkei to Eshowe.

Flowering Period: November -- January.

Diagnostic Features:

The most characteristic feature of this species is the very much swollen apex of the calyx so much so that it appears to be recurved. Also, the two pairs of leaves below the inflorescence are usually largest, sessile, and with a very short internode between them. The leaves of this species are distinguished from those of C. crenulata in having the hydathodes situated in the centre of the teeth which are often found on the leaves.

Variation:

C. inandensis shows a wide range in the size of the leaves.

The margin of the leaves may vary from dentate to entire.

Specimens examined:

NATAL. - 2830 (Dundee): Ntunjambili (-DD), Codd 9658 (PRE). 2831 (Nkandla): Nkandla Forest (-CA), Wylie sub Wood 8830 (GRA); Gerstner 589 (PRE); Tölken 3096 (BOL); Eshowe (-CD), Gerstner 2401 (NH, PRE); Lawn 1319 (NH); 1787 (NH); Ngoya Forest (-DD), Venter 6436 (PRE). 2930 (Pietermaritzburg): Howick (-AC), Evans in NH 19 1961; Karkloof (-AC), Moll 2871 (PRE); Inanda (-DB), Wood 764 (SAM). 2931 (Stanger): Mapumulo (-AA), Strey 9477 (NH).<sup>BOL</sup> 3030 (Port Shepstone): Dumisa (-AD), Rudatis 844 (PRE); Izingolweni (-CC), Ward 3054 (GRA). CAPE. - 3128 (Umtata): Nquadu Forest (-BD), Pegler & Kolbe 1522 (GRA, PRE); 3129 (Port St. John's): near Umtata River Mouth (-CC), Lewis 4904 (SAM).

37. C. spathulata Thunb., Nova Acta Phys.- Med. Acad. Caes. Leop. -Carol., Nat. Cur. 6 : 328, 330 (1778) et Prodr. 57 (1794) et Fl. Cap. ed. Schultes 293 (1823); Dryand. in Ait., Hort. Kew. ed. 1, 1 : 395 (1789); DC., Pl. Hist. Succ. t. 49 (1800) et Prodr. 3 : 386 (1828); Eckl. & Zeyh., Enum. 297 (1837); Harv., Fl. Cap. 2 : 348 (1862); Schonl. in Bot. Ark. 21, 16.: 9 (1927) et

in Trans. Roy. Soc. S. Afr. 17 : 198 (1929); Higgins, Crass. Cult. 66, fig. 36 (1964).

Type: near Seekoerivier, Thunberg in Herb. Thunberg 7795 (UPS, holo!).

C. lucida Lam., Encycl. 2 : 173 (1786).

Type: Africa, sine leg. (P-LA, holo!).

C. cyclophylla Schonl. & Bak. f. in J. Bot., Lond. 36 : 363 (1898); Schonl. in Trans. Roy. Soc. S. Afr. 17 : 198 (1929).

Type: Cape, Perie Bush, Schonland 847 (GRA, holo!).

C. lathispathulata Schonl. & Bak. f. in J. Bot., Lond. 36 : 364 (1898); Schonl. in Trans. Roy. Soc. S. Afr. 17 199 (1929).

Type: Cape, Suurberg, Wood in NH 457 (BM, holo!; NH!; SAM!). <sup>304.</sup>

C. cordata sensu Lodd., Bot. Cab. 4, plate 359 (1819) non Thunb.

Perennials prostrate or scrambling with branches often up to 60 cm long, little branched, occasionally rooting at the nodes, with branches often quadrangular. Leaves with a short petiole 0,3 - 1,8 cm long; lamina ovate rarely elliptic, 2 - 2,5 (-3) cm long, 1,5 - 2 (-2,5) cm broad, bluntly pointed or with a rounded apex, cordate, truncate or slightly cuneate at the base, serrate rarely crenate, slightly fleshy, green to yellowish-green often tinged red along the margin; sheath up to 0,1 cm long but usually only a stiff ridge. Hydathodes arranged in one row along the margin of the under-surface of the leaves and situated between the teeth of the serrations, so that they are often difficult to see. Inflorescence usually one dichasium with pedicellate 5-merous flowers spreading at about right angles, with indistinct peduncle 3 - 7 cm long, with linear to subulate bracts. Sepals linear-triangular, 1 - 2 mm long, abruptly ending in a blunt point, ridged and very fleshy, glabrous, green often tinged red. Petals linear-lanceolate 3,5 - 5 mm long, slightly hooded and with sharply pointed dorsal projection in terminal position, fused into a tube, 0,2 - 0,4 mm long, spreading, white or tinged pink towards the apex and along the main vein.

Stamens 3 - 4 mm long, with pink to purple anthers 0,6 - 1 mm long, with filaments becoming broader towards the base and not constricted where fused to the petal tube. Squamae transversely oblong, 0,2 - 0,4 x 0,5 - 0,6 mm, truncate or slightly emarginate, hardly constricted towards the base, fleshy, pale yellow to white. Carpels with oblong-reniform ovaries with slender styles about as long as the ovaries and with insignificant terminal stigma; ovary glabrous with 6 - 8 ovules each almost spherical and with rows of conspicuous papillae.

Usually associated with forested areas and often found in rock outcrops usually along the margin of forests; occurring from Knysna to the Transkei.

Flowering Period: March - May.

Diagnostic Features:

Usually this species can be recognised by its small flowers, i.e. the petals rarely longer than 4,5 mm. This and the petiolate leaves with a short lamina about as long as broad distinguishes C. spathulata from C. sarmentosa and C. renulata both of which have also a crenulate or serrate leaf margin. In plants of these three taxa the hydathodes occur between the individual teeth in contrast to C. inandensis where they are found in the centre of the rounded teeth.

Variation and taxonomic Notes:

Usually the lamina of the leaf is cordate or truncate at the base but occasionally one finds leaves on the same plant or branch even, that have a cuneate base (e.g. MacOwan 558). In other words the leaf shape of both C. cyclophylla and C. latispathulata fall within the range of variation of C. spathulata.

The collector's number of the type of C. latispathulata is repeatedly cited as Wood 457, but should really read Wood 3054a in NH 457.

Specimens examined:

CAPE. - 3030 (Port Shepstone): Suurberg (-CC), Wood 3054 (BM, NH, SAM). 3128 (Umtata): Umtata (-DB), Waddell in BOL 13 397; Umtata Waterfall (-DB), Tölken 3069 (BOL). 3225 (Somerset East): Bosberg (-DA), Bolus 1810 (BOL); Somerset East (-DA), Rogers 167 (GRA). 3226 (Fort Bedford): Junction Farm (-BB), Galpin 8113 (PRE); Katberg Forest (-BC), Garabedian in SAM 49 895; Bedford (-CA), Vaughan 72 (GRA); Brambledene (-DA), Barker 2909 (NBG). 3227 (Stutterheim): near Keiskamahock (-CA), Stayner 94 (GRA); Hogback (-CA), Dahlstrand 2897 (PRE, STE); Evelyn Valley (-CA), Compton 15 169 (NBG); Perie Bush (-CB), Schonland 847 (GRA); near Stutterheim (-CB), Leighton 2699 (PRE); Acocks 9779 (PRE); Perie (-CD), Sim 1215 (PRE); King William's Town (-CD), Sim 1214 (PRE); Tyson 1002 (SAM); Prospect Farm (-DA), Flanagan 544 (GRA, PRE, SAM); near Komga (-DB), Flanagan 543 (PRE, SAM); near East London (-DD), Compton 16 986 (NBG); Galpin 1866 (GRA, PRE); Nahoon River (-DD), Gane 317 (GRA). 3326 (Port Elizabeth): Addo Park (-BC), Liebenberg 6224 (PRE); Uitenhage (-CD), Prior s.n. (PRE); Long 1295 (GRA, PRE); Bakens River (-DC), Esterhuysen 27 555 (BOL, PRE); Despatch (-DC), Holland 348 (PRE); Swartkops River, Zeyher 2529 (GRA); Ecklon & Zeyher 1899 (SAM). 3326 (Grahamstown): near Grahamstown (-BC), MacOwan 558 (GRA, NH, SAM); Barker 687 (NBG); Oatland's Park (-BC), Daly & Sole 180 (GRA); Alexandria (-CB), Galpin 10 833 (PRE); Port Alfred (-DB), Potts 177 (BOL); Bushmans River (-DC), Zeyher 2529 (PRE). 3424 (Humansdorp): Geelhout (-AB), Fourcade 2117 (GRA); Humansdorp (-BB), Christie 2 (GRA); near Jeffery's Bay (-BB), Duthie in STE 29 351 (STE).  
Cape, Seekoei Rivier, Thunberg s.n. in Herb. Thunberg 7795 (UPS).

38. C. sarmentosa Harv., Fl. Cap. 2, 348 (1862); Schönl. in Trans. Roy. Soc. S. Afr. 17 : 199 (1929).

Type: Natal, near Omblas, Drège s.n. (S, lecto!).

C. ovata E. Mey. ex Drège, Zwei Pfl. Doc. 158 (1844), nom. nud. et nom. illeg. - non (Mill.) Druce.

Perennials with irregularly shaped tubers at the base of the stem producing a number of stems up to 1 m long, little branched and mainly from the base, scrambling or hanging from rock faces, with old leaves wearing off soon.

Leaves with or without petiole up to 1,5 cm long; lamina elliptic to ovate, 2 - 4 (-6) cm long, 1 - 2,5 (-3,5) cm broad, with acute or acuminate apex, more or less abruptly constricted into the petiole, often varying from ovate at the inflorescence and elliptic towards the base, with entire or serrate margin, flat and little fleshy, green or yellowish-green and often with red margin; sheath a short fleshy ridge between the leaf bases. Hydathodes arranged in one row along the margin of the undersurface, but often between the individual serrations, usually easily visible. Inflorescence terminal, a rounded to flat-topped thyrse with pedicellate 5-merous flowers usually spreading at almost right angles to one another, with peduncle usually not distinguishable from the vegetative branches, with subulate bracts on the dichasia. Sepals linear triangular, 1 - 3 mm long, sharply acute, glabrous, fleshy, green. Petals linear-lanceolate (4-) 5 - 8 mm long, with pointed dorsal appendage in terminal position, fused into a tube 0,3 - 0,5 mm long, with lobes spreading from the base but with apices not recurved, white or cream rarely tinged red. Stamens 4 - 6 mm long, with white to pink anthers 0,8 - 1,3 mm long, with filaments hardly broadened towards the base and hardly constricted where fused to the petal tube. Squamae transversely oblong, 0,2 - 0,3 X 0,6 - 0,8 mm, hardly emarginate, somewhat constricted towards the base, fleshy, pale yellow or white. Carpels with slender ovaries and with thin styles often longer than the ovaries and with insignificant terminal stigmas; ovary smooth and with 12- 16 ovules each more or less spherical and covered with rows of rounded papillae.

Diagnostic Features:

See under the individual varieties.

Variation and taxonomic Notes:

The var. integrifolia is described from the central Natal because it forms a distinct entity morphologically from plants of the typical variety. The two might have been linked by a cline, as the leaves of the specimen (Strey 5895) show slight indentations of the margin of the leaves, but the irregular teeth so formed are rounded and cannot be confused with the serrations of the typical subspecies.

It is interesting that the base of the stem is also swollen in this species, but it does not form an underground tuber as in the case of the very similar species, C. crenulata. Also, C. sarmentosa is contrary to the former not a geophyte and its aerial branches do not die down after flowering. The two species are also separated by their different flowering periods.

38a. var. sarmentosa

C. sarmentosa Harv., Fl. Cap. 2, 348 (1862); Schonl. in Trans. Roy. Soc. S. Afr. 17 : 199 (1929).

C. ovata E. Mey. ex Drège, Zwei Pfl. Doc. 158 (1844), nom. illeg.

Leaves with petiole rarely longer than 0,3 cm, with lamina elliptic on lower parts becoming ovate to lanceolate and acuminate below the inflorescence and upper leaves usually without petiole, with serrated margin and hydathodes between the teeth. Inflorescence with flowers usually spreading at about right angles to one another.

Usually in rock outcrops and often in crevices on rock faces or in kloofs; occurring in the coastal area of central Natal and in the vicinity of Knysna.

Diagnostic Features:

This variety is usually recognized by its very much spreading flowers and the sharp serrations of the leaf margin. The leaves are shortly petiolate

or sessile but differ from those of C. crenulata because they are rarely up to twice longer than broad. C. spatulata is distinguished from this species by its shorter petals, 3 - 4 mm long, and the leaves are always petiolate and with crenate margin. The var. integrifolia has always elliptic leaves with an entire margin.

Variation and taxonomic Notes:

It is interesting that the leaves of this plant are described as ovate but this refers only to the one on the upper parts of the stems, which are usually collected with the terminal inflorescence. The leaves become gradually more elliptic downwards and are often broadly elliptic at the base.

The Drège collection cited by Harvey was selected as the type, because a drawing of the dissection of the flower accompanying this specimen indicates that Harvey did use the material in his work. However, some of the characters in his description must be ascribed to observations made of cultivated plants, but no herbarium specimens have been preserved of it.

The occurrence of this variety in the vicinity of Knysna does not seem to be natural, even if one compares it with the wide distribution of the very similar species, C. crenulata, which is found throughout this range. However, the fact that the subsp. sarmentosa occurs only in the immediate vicinity of Knysna indicates that it must rather be interpreted as a garden escape in this area.

Specimens examined:

NATAL. - 2830 (Dundee): Dundee (-AA), Becker s.n. (GRA). 2831 (Nkandla): Entumeni (-CC), Wood 11 913 (PRE); Gerstner 3100 (BOL); Eshowe (-CD), Lawn 2035 (NH). 2832 (Mtubatuba): 6 Km north of Mtubatuba (-CA), Strey 7361 (PRE, NH). 2930 (Pietermaritzburg): near Hilton College (-AD), Bews A (GRA); Inchanga (-DA), Sim s.n. (GRA); Inanda (-DB), Wood 10 941 (BOL, GRA, NH); Isipingo Flats (-DD), Ward 6228 (PRE); Isipingo (-DD), Forbes & Obermeyer 33 (NH); near Cato Manor (-DD), Tölken 4048A (BOL, NBG), 2931 (Stanger): Oquaqeni (-AA), Edwards 1837 (PRE); Durban Bluff (-CC), sine leg.

Diagnostic Features:

C. corallina with its herbaceous branches and angular-obovate leaves not longer than 0,6 cm is distinct from any other species in the genus. Only C. elsieae resembles this species, but is distinguished by its marginal hydathodes and oblong-cuneate squamae. The subsp. corallina produces fibrous roots up to 0,2 mm in diameter and adventitious roots along the branches while the subsp. macrorrhiza has a very much swollen tap root, 0,4 - 0,8 cm in diameter, and no adventitious roots along the branches.

Variation and taxonomic Notes:

Although this species has a rather wide distribution it shows little variation. Most of this variation is due to environmental conditions, as for instance plants grown under very humid conditions will produce internodes much longer than the leaves and thus give the plant a much more herbaceous appearance. Also, the stems tend to be more prostrate even in the subsp. macrorrhiza, which tends to have short erect branches.

However, two subspecies can be recognised. The subsp. corallina has roots rarely thicker than 0,2 cm in diameter and produces many adventitious roots along the prostrate or decumbent stems. Also, in young flowers the carpels have distinct styles with terminal stigmas. In contrast to this, the subsp. macrorrhiza produces a very much swollen tap root, (0,3 -) 0,4 - 0,8 cm in diameter, and will produce adventitious roots on the stems only when broken or damaged. The ovary is gradually constricted into a somewhat laterally placed stigma. The presence or absence of the styles can at times be confusing, as old carpels of the subsp. corallina recurve and the styles dry up from the apex, so that it often looks similar to those of the subsp. macrorrhiza.

The two subspecies are geographically isolated from each other, i.e. the subsp. macrorrhiza occurs in the Bushmanland and south-eastern South West Africa, while the subsp. corallina is widely distributed

as the var. sarmentosa, but is distinguished by its entire leaves.

Variation:

The leaves vary from narrow to broadly elliptic and are usually acute. At times the leaves are slightly indented immediately to the outside of the hydathodes and thus might be faintly irregularly crenated.

Specimens examined:

NATAL. - 2930 (Pietermaritzburg): Inanda (-DB), Wood 597 (SAM). 2931 (Stanger): Umhloti rocks (-CA), Wood 597 (NH). 3030 (Port Shepstone): Ixopo (-AA), Acocks 13 781 (PRE); Paddock (-CA), Strey 5895 (NH, PRE); Izotsha Ravine (-CB), Strey 7630 (NH, PRE).

39. C. crenulata Thunb. in Nova Acta Phys.-Med. Acad. Caes. Leop.-Carol., Nat. Cur. 6 : 330, 339 (1778); et Prodr. 56 (1794) et Fl. Cap. ed. Schultes 287 (1823); L.f., Suppl. 189 (1781); DC., Prodr. 3 : 388 (1828); Harv., Fl. Cap. 2 : 344 (1862); Schonl. in Trans. Roy. Soc. S. Afr. 17 : 231 (1929); Merxmüller et al. Naturhist. Mus. Wien 75 : 113 (1971).

Type: Caput Bonae Spei, Thunberg in Herb. Thunberg 7745d (UPS, lecto!; S!).

C. telephioides Haw., Rev. Pl. Succ. 2 : 9 (1921); DC., Prodr. 3 : 384 (1824).

Iconotype: Illustration No. 777 (K, lecto!).

C. caerulata J.F. Gmelin, Syst. 1 : 518 (1791).

Type: unknown.

Perennials with finger-like underground tubers producing each year one, rarely two or three erect branches which are not branched and up to 40 cm high when flowering, with old leaves not deciduous. Leaves sessile oblong, 3 - 6 (-8) cm long, (0,5-) 1 - 1,8 (-2,5) cm broad, with bluntly acute to rounded or almost obtuse apex, varying from oblong lanceolate below the inflorescence to elliptic and oblanceolate towards the apex, with almost entire to crenulate

margin and cymbiform, slightly fleshy and glabrous, green or glaucous; sheath a short fleshy ridge between the leaf bases. Hydathodes arranged in a single row along the margin and usually between the individual teeth, so that they are often difficult to see. Inflorescence terminal flat-topped thyrses with pedicella to 5-merous flowers in dense dichasia and facing upward, with peduncle usually not distinguishable from the vegetative branches and with subulate bracts on the dichasia. Sepals linear-triangular, 1 - 3 mm long sharply acute, glabrous, fleshy, green. Petals linear-lanceolate, 5 - 8 mm long, with pointed dorsal appendage in terminal position, fused into a tube 0,3 - 0,7 mm long, with apices of the lobes erect and somewhat spreading but not recurved, white to cream and sometimes tinged pink. Stamens 4 - 6 mm long, with purple anthers 0,8 - 1,5 mm long, with filaments slightly broadened towards the base and hardly constricted where fused to the petal tube. Squamae transversely oblong, 0,2 - 0,4 X 0,6 - 0,8 mm, hardly emarginate and slightly constricted towards the base, slightly fleshy, pale yellow or white. Carpels with slender ovaries and with thin styles often longer than the ovaries and with insignificant terminal stigmas; ovary smooth with 10 - 16 ovules each more or less spherical and covered with distinct rows of rounded papillae.

On grassy slopes but often in the shade of trees or rarely in sheltered kloofs; occurring along the coast from near Mosselbaai to central Natal.

Flowering Period: January - April.

Diagnostic Features:

This species is distinguished from both C. spathulata and C. sarmentosa by its sessile leaves which are at least four times as long as broad. C. sarmentosa subsp. integrifolia often also produces rather long leaves, but they have an entire margin and are always petiolate.

Variation and taxonomic Notes:

The size and shape of the leaves are very variable with ecological

conditions and also the shape of the leaves depends on the part of the stem on which it was born. The first leaves are often very short and broad and do not comply with the above diagnosis that they are at least four times longer than broad.

Also, the length of the petals varies very much with environmental conditions. However, on the type specimen in Thunberg's Herbarium the two specimens on the left show very much shorter petals with bluntly acute apex and saccate base. These are part-inflorescences of C. deltoides it seems, which have been stuck into the apex of a vegetative branch of C. crenulata. The two specimens on the right must be identified as C. crenulata, but the extreme right one is most typical of the species and was therefore selected as the lectotype.

The illustration of C. telephioides prepared for Haworth and now housed in the Kew Herbarium, leaves no doubt about its identification. Haworth also refers to J. Burman, Rar. Afr. Pl. T. 24, fig. 2, but that plant looks more like a dried specimen of C. perfoliata that had been illustrated here, but there are no definite characters by which the plant can be identified.

Specimens examined:

NATAL. - 2731 (Louwsburg): near Nongoma (-DC), Gerstner 4410 (NH). 2828 (Bethlehem): Royal National Park (-DB), Galpin 10 142 (PRE). 2829 (Harrismith): Cathedral Peak (-CC), Killick 1283 (PRE); 2831 (Nkandla): Nkandla (-CA), Lawn 521 (NH); Melmoth (-CB), Lawn 929 (NH); Entumeni (-CC), Wood 11 913 (BOL, SAM); Gerstner 3100 (BOL); Eshowe (-CD), Lawn 1613 (NH). 2929 (Underberg): Cathkin Peak (-AB), Galpin 11 776 (PRE); Hawlett 71 (NH). 2930 (Pietermaritzburg): Dalton (-BC), Acocks 10 770 (NH, PRE); Inanda (-DB), Wood 497 (NH, SAM); Ismont (-DC), Strey 9057 (BOL, NH). 3030 (Port Shepstone): Dumisa (-AD), Rudatis 773 (STE); 1069 (PRE); Ifafa (-BC), Rudatis 168 (STE).

CAPE. - 64 Km north of Kokstad (-BB), Taylor 5520 (NBG); Clydesdale (-BD),

Tyson 2977 (BOL, SAM). 3127 (Lady Frere): Cala Pass (-BC), Acocks 21 896 (PRE); Cala (-DA), Pegler 1524 (PRE); Engcobo (-DB), Bolus 8907 (BOL, GRA). 3128 (Umtata): 16 Km south of Qumbu (-BB), Barker 9168 (NBG); Tsolo (BC), Payne 18 (GRA); Dyer 4719 (PRE): Baziya (-CB), Baur 587 (BOL, SAM); Umtata Falls (-DB), Wisura 1126 (NBG); Schonland 3802 (GRA). 3227 (Stutterheim): Windvoelberg (-AC), Sim s.n. (GRA); Waqua River (-AC), Tölken 4300 (BOL); Fort Cunynghame (-AD), Schonland 54 (GRA); King William's Town (-CD), Sim 1767 (PRE); Ranger 14 (PRE); Kei Road (-DA), Sim 1213 (GRA); Komga (-DB), Flanagan 221 (GRA, PRE); 763 (GRA, PRE); East London (-DD), Galpin 3258 (PRE). 3228 (Butterworth): Fort Pato (-BB), Galpin 7835 (PRE); Kentani (-CB), Pegler 1167 (BOL, GRA, PRE); Great Kei River Mouth (-CB), Flanagan 221 (NH). 3321 (Ladismith): Cloete's Pass (-DD), Hall in NBG 523/52 (NBG); Middlemost 2014 (NBG). 3322 (Oudtshoorn): Robinson Pass (-CC), Taylor 317 (GRA). 3323 (Willowmore): Prince Alfred Pass (-CC), Tölken 3862 (BOL); Walletjies (-DD), Tölken 3729 (BOL). 3324 (Steytlerville): Assegaaibos (-CD), Fourcade 2187 (GRA); Britten 1246 (GRA, PRE). 3325 (Port Elizabeth): Suurberg Pass (-BC), Archibald 5449 (PRE); Thorn Hill (-CA), Paterson 1998 (BOL); Cherry 907 (GRA); Van Staden's Mountains, Zeyher 319 (SAM); 980 (SAM); 2530 (SAM). 3326 (Grahamstown): Stones Hill (-BC), Gibbs s.n. (GRA); near Grahamstown (-BC), MacOwan 777 (GRA). 3327 (Peddie): East London (-BB), Mattray s.n. (GRA). 3422 (Mosselbaai): near Mosselbaai (-AA), Muir 1298 (PRE). 3424 (Humansdorp): Humansdorp (-BD), West 89 (GRA).  
Caput Bonae Spei, Thunberg in Herb. Thunberg 7745d (UPS).

40. C. streyi Toelken in Flow. Pl. Afr. 42, plate 1672 (1973).

Type: Natal, forested slopes near Umtamvuna River bridge, Streya 10 958 (PRE, holo!; BOL!; K!; NH!).

Perennials with decumbent branches up to 30 cm long, 0,5 - 1,5 cm in diameter, with nodes usually slightly swollen and pink when young or with flaking bark

when older. Leaves sessile, elliptic, 4 - 6,5 cm long, 2,5 - 4 cm broad, abruptly constricted into a short point at the apex and into a broad sheath 0,5 - 1 cm broad, with recurved margin which is slightly crenulate when young, often with two pairs of leaves with a very short internode between below the inflorescence, slightly fleshy, glabrous, dark green with white spots mainly along the veins on the upper surface and dark purplish-maroon below; sheath 0,2 - 0,4 cm broad. Hydathodes arranged in a double row, usually in pairs of one larger outer and a smaller inner one along the margin of the undersurface, more or less conspicuous. Inflorescence a rounded or slightly elongate thyse consisting of several dichasia, with pedicellate 5- or 4-merous flowers usually spreading at about right angles to one another, with peduncle 4 - 8 cm long and with linear bracts. Sepals linear-triangular, 1,5 - 2 mm long, pointed, very fleshy and almost terete, glabrous, green often tinged red. Petals lanceolate, 3 - 4,5 mm long, with pointed dorsal appendage in terminal position, fused into a tube c. 0,2 mm long, with lobes spreading, pale yellow-green with brownish-red mid-vein on the outside. Stamens 2 - 3 mm long with pale yellow anthers 0,8 - 1,2 mm long, with filaments hardly broadened towards the base and not constricted where fused to the petal tube. Squamae transversely oblong, 0,3 - 0,4 X 0,6 - 0,7 mm, truncate and somewhat constricted towards the base. Carpals straight erect and with slender style as long as or longer than the ovary and with indistinct terminal stigma; ovary smooth, with 4 - 6 elongate ovules each with rows of rounded papillae.

On steep slopes in forests and forest glades above the Umtamvuma River near Port Edward.

Flowering Period: May, June.

Diagnostic Features:

Although this species is superficially similar to C. multicava, it has only two rows of hydathodes on the margin of the lower leaf surface. Also, the leaves of C. streyi often produce a cuneate leaf base 0,5 - 1 cm

broad, somewhat like a petiole, but these show a continuation of the flat lamina on either side of the mid-vein.

Specimens examined:

NATAL. - 3130 (Port Edward): Umtamvuma bridge (-AA), Strey 5859 (NH); Strey 6517 (NH, PRE); 10 958 (BOL, K, NH, PRE); Beacon Hill (-AA), Strey 7272 (PRE).

41. C. cordata Thunb. in Nova Acta Phys.-Med. Acad. Caes. Leop.-Carol., Nat. Cur. 6 : 328, 330 (1778) et Prodr. 57 (1794) et Fl. Cap. ed. Schultes 293 (1823); L.f., Suppl. 189 (1781); Dryand. in Ait., Hort. Kew. ed. 1, 1 : 396 (1789); DC., Pl. Hist. Succ. t. 121 (1803) et Prodr. 3 : 386 (1828); Jacq., Hort. Schoenbr. 4 : 15, t. 431 (1804); Eckl. & Zeyh., Enum. 297 (1837); Harv., Fl. Cap. 2 : 347 (1862); Schonl. in Bot. Ark. 21, 16 : 16 (1927) et in Trans. Roy. Soc. S. Afr. 17 : 202 (1929); Higgins, Crass. Cult. 36, fig. 12 (1964).

Type: Cape, Swartkops saltpan, Thunberg in Herb. Thunberg 7742 (UPS, holo!).

C. neglecta Schultes, Syst. Veg. 6 : 722 (1820), nom. superfl.

Type: same as for C. cordata.

C. perfossa sensu Drège, Zwei Pfl. Doc. 138, 140 (1844), non Lam.

C. aitonii Britt. & Bak. f. in J. Bot., Lond. 35 : 480 (1898).

Type: Caput Bonae Spei, Masson s.n. (BM, holo!).

C. glauca Schonl. in Trans. Roy. Soc. S. Afr. 17 : 202 (1929).

Type: Natal Herbarium Garden 46, sine leg. (GRA, holo!).

Perennials erect or decumbent, with branches up to 30 cm long and up to 0,8 cm in diameter, little branched and rooting where it touches the ground. Leaves with petiole 0,2 - 0,5 (-0,8) cm long; lamina broadly ovate 1 - 2,5 cm long, 0,8 - 1,5 (-2) cm broad, with blunt or rounded leaf apex, with cordate to truncate base, entire, slightly fleshy, grey-green and often with red margin; sheath usually a mere ridge. Hydathodes arranged in a

row along the margin and scattered over the upper leaf surface, often conspicuous and red. Inflorescence a rather loose and more or less rounded thyrses, with 5-merous flowers on a thread-like pedicel and arranged in several dichasia, with peduncle 3 - 15 cm long, with bracts usually narrowly spatulate or leaf-like below, with adventitious buds developing in their axils. Sepals narrowly triangular, 1 - 2 mm long, with blunt to pointed apex, slightly fleshy, glabrous, grey-green often tinged red. Petals lanceolate-elliptic, 4 - 5 mm long, drawn into a point which seem to represent the terminal appendage, fused into a tube c. 0,2 mm long, with lobes spreading, cream to pale yellow and often tinged red. Stamens 2 - 3,5 mm long, with yellow anthers 0,8 - 1 mm long, with filaments hardly broadened towards the base and not constricted where fused to the petal tube. Squamae transversely oblong, 0,1 - 0,2 X 0,4 - 0,5 mm, truncate and not constricted towards the base, slightly fleshy pale yellow. Carpels straight erect and with slender style about as long as the ovary, with insignificant terminal stigma; ovary smooth with 6 - 8 elongate ovules each with rows of papillae. Fig. 2.1.

In the shade of trees or shrubs usually in tall shrub vegetation in sheltered areas or kloofs, rarely on steep slopes or rock outcrops; occurring from near Port Elizabeth to King William's Town and then in isolated populations up to near Port Shepstone.

Flowering Period: July - October.

Diagnostic Features:

The cordate leaves covered with hydathodes on the upper surface and a rather woody stem is sufficient to separate C. cordata from other species in this section. The soft herbaceous form occurring in the eastern parts of the distribution area could be confused with C. nemorosa from the sect. Tuberosae, but again the scattered hydathodes on the upper leaf surface will distinguish C. cordata.

Variation and taxonomic Notes:

On investigating this species at first it seemed that the very robust form with leaves up to 2 cm in diameter and with stems up to 1 cm in diameter, must be separated from the form occurring in the eastern parts and which produces leaves up to 1 cm in diameter and soft decumbent stems rarely broader than 0,3 cm. However, in the valley of the lower Kowie and Fish River a range of intermediate forms occur and often slightly westwards a gradual change to a more robust plant can be noticed. Even variation from the erect to a more decumbent habit of C. glauca, as what the small form has been described, are found in this area (e.g. Tölken 3721).

The confusion that Thunberg had started with his description of C. cordata seem to be based on a misunderstanding of the specimen he collected. The specimen is from a plant that was obviously at the end of its flowering period, so that the inflorescence contains mainly developing adventitious buds and only here and there a solitary flower. Hence Thunberg described the plant as having a leavy part below and a branched part with much smaller sessile leaves at the top. Without seeing the type specimen the authors of C. neglecta and C. aitonii, who pointed out this discrepancy, could not appreciate Thunberg's interpretation of the species.

Specimens examined:

NATAL. - 2930 (Pietermaritzburg): Kranskloof (-DD), Moonsamy in NH 16 073.  
3030 (Port Shepstone): Ifafa River (-AD), Lansdell in NH 16 117; Umlazi Location (-BA), Wood 3399 (NH); Amanzimtoti (-BB), Franks 10 (NH); Oribi George (-CA), Nicholson 1050 (PRE); Gibraltar (-CB), Strey 9668 (BOL, NH, PRE); Horseshoefarm (-CD), Strey 5937 (NH, PRE).  
CAPE. - 3128 (Umtata): Mquanduli (-DD), Walker in NBG 2272/27 (BOL).  
3226 (Fort Beaufort): Lovedale (-DD), Bennie 537 (GRA). 3227 (Stutterheim): near King William's Town (-CD), Galpin 5956 (GRA, PRE); near Komga (-DB), Flanagan 1228 (PRE, SAM). 3325 (Port Elizabeth): Suurberg

(-BC), Long 1086 (PRE); Barker 4934 (NBG); Enon (-BC), Thode (NH, PRE); Redhouse (-CC), Paterson 535 (GRA, SAM); Uitenhage (-CD), Barker 4977 (NBG); Blue Krantz (-CD), Bolus 40 (BOL); Zeyher 2528 (PRE); Addo Park (-DB), Liebenberg 7701 (PRE); Swartkops River (-DC), Ecklon & Zeyher 1898 (GRA, SAM); Zeyher 2528 (PRE, SAM). 3326 (Grahamstown); Alicedale (-AC), Roger 3674a (BOL); Currie Kloof (-AD), MacOwan 561 (GRA); Howleson's Poort (-AD), Dyer 53 (PRE); Ecca Pass (-BA), Schonland 770 (GRA, PRE); Pluto's Vale (-BA), Wisura 3326 (NBG); Fish River (-BB), Schlechter 6106 (GRA, PRE); Marloth 10 879 (PRE); near Grahamstown (-BC), Glass 718 (SAM); Bushmans River Mouth (-DA), Archibald 5426 (PRE); Port Alfred (-DB), Salisbury 129 (GRA); Burt Davy in PRE 7936 (BOL). 3327 (Peddie): Peddie (-AA), Edwards in NBG51/21 (BOL); Keiskama Valley (-AB), Acocks 11 858 (PRE); Gwanga River (-AB), Tölken 3063 (BOL); Kaffir Drift (-AC), Tölken 3061 (BOL); 3721 (BOL). Caput Bonae Spei, Masson s.n. (BM).

42. C. multicava Lem. in Rev. Hort., Paris (1862) 97 et in Illustr. Hort. 9, Misc. 40 (1862); Schonl. in Trans. Roy. Soc. S. Afr. 17 : 200 (1929).

Type: Cape, Komga, Flanagan 161 (BOL, neo!; GRA!, SAM!).

Perennials decumbent to somewhat erect, with branches rarely longer than 40 cm and often 0,5 - 1 cm in diameter and with swollen nodes, little branched, sometimes rooting at the nodes and with flaking bark on the older stems. Leaves with petiole 0,5 - 2 cm long; lamina broadly elliptic to oblong-obovate, 2 - 5 (-6,5) cm long; 1,5 - 4 cm broad, with rounded or emarginate apex, more or less abruptly constricted into the petiole, with recurved margin, entire, slightly fleshy, green or often yellowish-green; sheath 1 - 2 cm long, spreading, fleshy but tough. Hydathodes arranged in one more or less clear row along the upper and lower margins, as well as scattered over both surfaces, conspicuous on the upper surface, but often much less visible on the lower surface. Inflorescence thyrsoid,

rounded or elongate with few to many dichasia, with pedicellate 4- or 5-merous flowers, with peduncle 3 - 8 (-10) cm long, with bracts narrowly oblong or subulate. Sepals triangular, 1 - 2 mm long, ridged on the free lobes and very fleshy, glabrous, green, or tinged red. Petals lanceolate, 3 - 6 mm long, acute, with pointed dorsal projection in terminal position, fused into a tube up to 0,5 mm long, with lobes spreading or sometimes recurved, cream or white and usually tinged red towards the apex. Stamens 3 - 5 mm long, with purple anthers 1 - 1,4 mm long, with filaments hardly broadened towards the base and not constricted where fused to the petal tube. Squamae transversely oblong, 0,2 - 0,3 X 0,4 - 0,6 mm, truncate and not constricted towards the base, white or cream. Carpels straight erect with slender style about as long as the ovary, with inconspicuous terminal stigma; ovary smooth, with 12 - 20 ovules each almost spherical or elongate with rows of rounded or pointed papillae.

Diagnostic Features:

This species is easily identified by the obvious pits or hydathodes which are arranged in a row along the margin and scattered over the upper and lower surface. This will immediately distinguish it from C. streyi and C. sarmentosa var. integrifolia both of which are rather similar to C. multicava.

Variation and taxonomic Notes:

Plants of this species fall into two clear groups. Firstly, there is the more delicate typical form from the eastern Cape with predominantly 4-merous flowers and spherical ovules covered with rounded papillae. The second form, subsp. floribunda from Natal is more floriferous and with pentamerous flowers and with elongate seeds which are covered with pointed papillae. The plants of the latter are generally more robust and the stems are often short and erect.

However, except for these two distinct subspecies not much variation within the species has been recorded.

42a. subsp. multicava

C. multicava Lem. in Rev. Hort., Paris (1862) 97 et in Illustr. Hort. 9, Misc. 40 (1862); Schonl. in Trans. Roy. Soc. S. Afr. 17 : 200 (1929); Jacobsen, Handb. Succ. pl. 1 : 321, fig. 332 (1960); Higgins, Crass. Cult. 55, fig. 26 (1964).

C. quadrifida Bak.f. in Saund. Bot. Ref. 5 t. 298 (1873); Trelease in Ann. Rep. Missouri Bot. Gard. 5 : 157, plate 28 (1894).

Iconotype: Saund. Bot. Ref. 5, t. 298 (original K, lecto!).

Plants with soft decumbent branches, rarely thicker than 0,3 cm when with leaves and the whole plant glabrous. Inflorescence elongate with part inflorescences often condensed into umbels with several pairs of subulate bracts at their base, or often producing pairs of bracts with no flowers in their axils, with adventitious buds developing in the axils of their bracts and with flowers predominantly 4-merous. Petals 3 - 4 mm long, spreading, but closing up again after flowering, cream tinged red. Ovules spherical or almost so and with rows of rounded papillae. Fig. 1.3.

In shaded areas, but usually associated with rock outcrops among dense shrub or dry forests along river valleys; occurring along the coast from Port Elizabeth to near Port Shepstone.

Flowering Period: May - August.

Diagnostic Features:

This subspecies is easily distinguished from subsp. floribunda by its 4-merous flowers and the production of vegetative buds, which will develop into new plants, on the inflorescence.

Specimens examined:

NATAL. - 3030 (Port Shepstone): Paddock (-CA), Strey 8806 (NH, PRE).  
 CAPE. - 3129 (Port St. John's): near Port St. John's (-DA), Codd 9752 (PRE); Wisura 1132 (NBG). 3227 (Stutterheim): Komga (-DB), Flanagan 161 (BOL, GRA, SAM); Nahoon River (-DD), Gane 318 (GRA); East London (-DD), Galpin 1864 (BOL, GRA). 3228 (Butterworth): Cats Pass (-AD), Strey 6705 (NH); Kentani (-CB), Pegler 829 (GRA); 1205 (BOL); near

Kei River Mouth (-CB), Flanagan 161 (GRA); Nxaxo River Mouth (-DA); Strey 6694 (NH). 3325 (Port Elizabeth); Van Stadens (-CC), Paterson 19 (BOL); Redhouse (-DC), Paterson 19 (GRA). 3326 (Grahamstown): near Grahamstown (-BC), Horseshoe (-DA), Barker 9266 (NBG); Blaauwkratz (-DA), MacDwan 1911 (BOL); Port Alfred (-DB), Schonland 746 (GRA, NH, PRE); Burt Davy 7917 (BOL). 3422 (Mosselbaai): near Mosselbaai (-AA), Moran in NBG 185 18 (BOL); Kaaimans River Mouth (-BA), Marsh 1303 (STE).

42.b. subsp. floribunda Friedr. ex Toelken, subsp. nov. ab subsp. multicava inflorescentia floribus pentameris et sine gemmis adventitis differt.

C. multicava sensu Wood and Evans, Natal Plants 4, 2, t. 326 (1904), non Lem.

Plantae rectae ramis rigidis 0,3 - 0,6 cm in diametro ubi foliis et glabrae vel hirsutae. Inflorescentia dichasiis floribus multis, bracteis linearibus apicibus obtusis, sine gemmis adventitis et floribus pentameris. Petala 5 - 6 mm longa et remanentia post florescentiam, alba vel eburnea. Ovula elongata et circiter dupla longiora suo diametro, tacta seriebus papillarum acutarum.

Type: Natal, Old Tugela bridge (-AB), Strey 4209 (PRE, holo!; NH!).

Plants erect with stiff branches 0,3 - 0,6 cm in diameter when with leaves, and the whole plant glabrous to hairy. Inflorescence with many-flowered dichasia with narrowly oblong bracts with blunt apex, without adventitious buds, with 5-merous flowers. Petals 5 - 6 mm long, recurved and remain so after flowering, white or off-white. Ovules elongate to about twice as long as broad, covered with rows of pointed papillae.

Growing in shaded places, usually associated with rocky outcrops and often in sheltered kloofs; occurring in the coastal mountains of central Natal.

Flowering Period: June - August.

Diagnostic Features:

This subspecies is a much more robust plant and has often been associated with C. lactea, but in that species the hydathodes occur only in two rows along the margin. Also, the leaves are always sessile.

Variation:

Some plants which are densely hairy have been recorded from the vicinity of Durban, but they do not differ in any other character from glabrous plants of this subspecies.

Specimens examined:

NATAL. - 2931 (Stanger): Old Tugela bridge (-AB), Strey 4209 (NH, PRE); Umhloti rocks (-CA), Wood 5973 (NH); Umgeni (-CC), sine leg. in NH 16 006. 2930 (Pietermaritzburg): Inanda (-DB), Wood 597 (BOL, SAM); Krantzkloof (-DD), sine leg. in NH 16 008; Cato Ridge (-DD), MacClean & Ogilvie in NH 27 903. Durban Botanic Gardens, Wood 10 519 (PRE); 10979 (NH, SAM); 11 744 (NH, PRE, SAM).

43. C. lactea Soland. in Ait., Hort. Kew. ed. 1, 1 : 396 (1789); DC., Pl. Hist. Succ. t.37 (1800) et Prodr. 3 : 383 (1828); Jacq., Hort. Schoenbr. 4 : 15, t. 430 (1804); J.E.Sm., Ex. Bot. 1 : 63, t. 33 (1804); Sims, Bot. Mag. ser. 2, 1 plate 1771 (1815); Thunberg, Fl. Cap. ed. Schultes 289 (1823); Eckl. & Zeyh., Enum. 295 (1837); Harv., Fl. Cap. 2 : 337 (1860); Schonl. in Trans. Roy. Soc. S. Afr. 17 : 199 (1929); Jacobsen, Handb. Succ. Pl. 1 : 316, fig. 320 (1960) et Sukk. Lex. 144, T. 46, 1 (1970); Higgins, Crass. Cult. 47, fig. 21 (1964).

Type: Caput Bonae Spei, Masson s.n. (BM, holo!).

Perennials decumbent rarely scrambling, little branched, with branches up to 40 cm long and rarely broader than 1 cm, with old leaves remaining attached to stem but ultimately with flaking bark. Leaves sessile,

elliptic to oblanceolate, (2,5) 3 - 5 (-7) cm long, (1-) 1,5 - 2,5 (-3) cm broad, abruptly constricted into a pointed apex, with cuneate base, entire but with a horny margin, more or less convex on both sides, fleshy to very fleshy, usually dull green but often with a yellowish margin; sheath 0,1 - 0,2 (0,3) cm long, somewhat spreading. Hydathodes arranged in a row along the margin of the upper and lower leaf margin. Inflorescence an elongate or rounded thyrse consisting of many dichasia, with pedicellate 5-merous flowers, with peduncle (2-) 4 - 10 cm long, with triangular to subulate bracts. Sepals linear-subulate, 1,5 - 3 mm long, pointed, fleshy to almost terete at the apex, glabrous, green. Petals lanceolate (4-) 5 - 8 mm long, with pointed dorsal appendage in terminal position, fused into a tube 0,5 - 0,8 mm long, with lobes spreading, white to off-white and sometimes tinged red towards the apex. Stamens 4 - 5,5 mm long, with purple anthers 0,8 - 1,3 mm long, with filaments somewhat broadened towards the base but hardly constricted where fused to the petal tube. Squamae transversely oblong, 0,2 - 0,3 X 0,5 - 0,7 mm, truncate and hardly constricted towards the base, fleshy, white to pale yellow. Carpels straight erect with slender style as long as or longer than the ovary, with insignificant terminal stigma; ovary smooth, with 16-24 elongate ovules each with a row of more or less sharply pointed papillae.

On slopes or in rock outcrops, usually in the shade of shrubs and trees and often associated with Fish River Scrub; occurring often only in isolated populations from near Mosselbaai mainly along the coast to southern Natal.

Flowering Period: May - July.

Diagnostic Features:

The fleshy leaves without petiole and with only one row of hydathodes on the margin of the upper and lower leaf surface distinguished this species from others in the section. Particularly in southern Natal C. lactea could easily be confused with C. sarmentosa var. integrifolia but the latter

produced hardly fleshy leaves and the hydathodes are arranged in one row along the margin of the undersurface.

Variation:

The shape and size of the leaves vary considerably with conditions under which the plant is growing. Under dry conditions the leaves are usually elliptic with pointed to acuminate apex and more or less abruptly constricted towards the base. However, when grown under moister and especially shaded conditions the leaves become oblanceolate with a short blunt apical point and a very long cuneate base.

Specimens examined:

CAPE. - 3227 (Stutterheim): Nandes Hoek (-CC), Giffen 1030 (NBG); King William's Town (-CD), Sim 1180 (PRE); near Komga (DB), Flanagan 1273 (BOL, PRE, SAM); near East London (-DD), Galpin 1865 (PRE). 3322 (Oudtshoorn): Kaaimans River Mouth (-CC), Tölken 1715 (BOL); Truter in BOL 24 050. 3323 (Willowmore); Keurbooms River Nature Reserve (-CD), Heineken K112 (PRE). 3325 (Port Elizabeth): Van Stadens Pass (-CC), MacOwan s.n. (GRA); Swartkops River (-DC), Zeyher 311 (GRA); Soutpan (-DC), Zeyher 2540 (GRA, PRE); Ecklon & Zeyher 1877 (SAM). 3326 (Grahamstown): Alicedale (-AC), Cruden 258 (GRA); 259 (GRA); Pluto's Vale (-BA), Britten in PRE 27 041; Bothas Hill (-BA), Schonland in NH 5487; near Grahamstown (-BC), Schonland 12 (GRA); Linstedt 4 (PRE); MacOwan 613 (BOL, GRA, SAM, STE); Kowie (-DB), Salisbury 135 (GRA). 3327 (Peddie): East London (-BB), Galpin 1865 (GRA). 3421 (Riversdale): Still Bay (-AD), Muir 97 (PRE); Aasvogelberg (-BA), Muir s.n. (BOL); 3422 (Mosselbaai): 6 Km north of Mosselbaai (-AA), Tölken 3712 (BOL).

XIc. Crassula subsect. Latifolia (DC.) Toelken, comb. nov. et stat nov.

Crassula sect. Latifolia DC., Prodr. 3 : 383 (1828), partly excl.

C. telephioides and C. rotundifolia.

Type species: C. arborescens (Mill.) Willd.

Crassula group Latifolia (DC.) Harv., Fl. Cap. 2 : 332 (1862);  
Schonl. in Pflanzenfam. ed. 1, 3, 2a : 36 (1891).

Crassula group Arborescens Schonl. in Trans. Roy. Soc. S. Afr.  
17 : 165, 201 (1929); Berger in Pflanzenfam. ed. 2, 18a : 391  
(1930); Merxmüller et al. in Ann. Naturhist. Mus. Wien 75 :  
113 (1971).

Shrubs up to 1,5 m high with carnose stems up to 12 cm in diameter at the base and with peeling bark, with old leaves deciduous. Flowers born in a terminal thyrse with several to many dichasia and with a peduncle at least 3 cm long. Sepals shortly triangular up to 2 mm long and one fifth or less of the length of the petals.

44. C. ovata (Mill.) Druce in Rep. Bot. Soc. Exch. Club. Br. Isl. 617 (1917).

Cotyledon ovata Mill., Dict. ed. 8 (1768).

Type: Cape, 1,5 Km south of Mount Steward, Tölken 1772 (BOL, neo!).

C. argentea Thunb. in Nova Acta Phys.-Med. Acad. Caes. Leop.-  
Carol., Nat. Cur. 6 : 329, 337 (1778) et Prodr. 56 (1794) et Fl.  
Cap. ed. Schultes 289 (1823); L.f., Suppl. 188 (1781); DC.,  
Prodr. 3 : 383 (1828); Schonl. in Bot. Ark. 21 : 4 (1927)  
et in Trans. Roy. Soc. S. Afr. 17 : 201 (1929).

Type: Cape, garden in Rondebosch, Thunberg in Herb. Thunberg 7730  
(UPS, holo!).

C. portulacea Lam., Encycl. 2 : 172 (1786); DC., Pl. Hist. Succ.  
t. 79 (1801); et Prodr. 3 : 383 (1828); Harv., Fl. Cap. 2 : 337  
(1862); Nash in Addsonia 3, t. 109 (1918); Phillips, Fl. Pl.  
S. Afr. 4 : 156 (1924); Higgins in J. S. Afr. Bot. 24 : 111 - 115  
(1958) et Crass. Cult. 60, plate 6a (1964); Jacobsen, Handb.  
Succ. Pl. 1 : 325, fig. 333 & 340 (1960) et Sukk. Lex. 146,  
t. 46, 2 (1970); Batten & Bokelmann 75, palte 63 : 6 (1966).  
Type: sine loc. et sine leg. (P-LA, holo!).

--- var. obliqua (Soland. in Ait.) Higgins in J. S. Afr. Bot. 24 : 115 (1958), nom. illeg.; Crass. Cult. k57, fig. 30 (1964), nom. illeg.

C. obliqua Soland. in Ait., Hort. Kew, ed. 1 : 393 (1789); Higgins in J. S. Afr. Bot. 24 : 111 - 115 (1958); Jacobsen, Handb. Succ. Pl. 1 : 322, fig. 333 (1960); Sukk. Lex. 145, T. 455 (1970), nom. superfl.

Type: Cape, garden in Rondebosch, Masson s.n. (BM, holo!).

C. articulata Zuccagni, Synops. Pl. Hort. Reg. Flor. 1782, nom. nud.; Centuria 1. Observ. Bot. 24 (1806),

Type: in Herb. Zuccagni (Fl†).

C. nitida Schonl. in Rec. Albany Mus. 1 : 54 (1903).

Type: unknown.

C. arborescens sensu Marloth, Fl. S. Afr. 2, plate 6 (1926).

Perennials 1 - 1,5 (-2,5) m high, with fleshy stems often up to 20 cm in diameter at the base and with peeling bark, much branched, with old leaves deciduous. Leaves usually sessile or with a petiole up to 0,4 cm long; lamina elliptic to elliptic-oblongate, 2 - 3 (-4) cm long, 1 - 1,8 (-2,2) cm broad, with pointed or mucronate apex, cuneate towards the base, glabrous and with a horny margin, green and with or without a red margin, usually not covered with a bloom; sheath rarely more than a tough ridge, often very indistinct. Hydathodes arranged in one row along the upper and lower margin, but also scattered over both surfaces, conspicuous. Inflorescence a round-topped thyrse with one to many dichasia, with pedicellate, usually 5-merous flowers, with a peduncle 1 - 3 (-4) cm long, with subulate bracts usually longer than 0,2 cm on the dichasium. Sepals broadly triangular, 1 - 2 mm long, pointed and with a distinct ridge on the free lobes, fleshy, glabrous, green. Petals elliptic-lanceolate (5-) 7 - 10 mm long, pointed, with dorsal appendage in the terminal position, fused into a tube 0,5 - 1 mm long, with lobes spreading, white often tinged pink. Stamens 5 - 8 mm long, with purple anthers 0,8 - 1,2 mm long,

with filaments becoming broader towards the base and hardly fused to the petal tube. Squamae transversely oblong, 0,2 - 0,5 X 1 - 1,5 mm, truncate or emarginate, hardly constricted towards the base, fleshy, pale yellow. Carpels with narrow ovary which is abruptly continued into a slender style half as long to almost as long as the ovary, with an inconspicuous terminal stigma; ovary smooth with 30 - 50 oblong ovules covered with rows of pointed papillae.

On rocky slopes usually in somewhat sheltered kloofs and often associated with Fish River Scrub; occurring, often locally common, from near Willowmore to East London, but also in scattered localities north to near Queenstown as well as in central and northern Natal.

Flowering Period: June - August.

Diagnostic Features:

In contrast to C. arborescence the leaves of C. ovata are usually elliptic and shiny green in spite of their specific epithet. The bracts on the dichasia are usually subulate and longer than 2 mm, while the petals are not wider than 2 mm. The flowering times of the two species are distinct in the field, but this is often not found in cultivation.

Variation and taxonomic Notes:

This species shows several variations which are of particular interest as populations of this species are often geographically isolated. For instance the red margin of the leaves is found in some populations on all plants in others it is completely absent.

Also, the size and shape of the leaves varies considerably apart from that due to environmental conditions. For instance the leaves of plants growing near Queenstown are unusually large and are at times difficult to distinguish from C. arborescence when one is dealing with herbarium material. Under such circumstances the silvery scales coming off the epidermis of leaves of C. ovata tend to be a useful character. Also in Natal the leaves tend to be larger, but as they are not broader this should not produce any difficulties in the identification. This also applies

to some plants from central Natal which, in fact, produce a similar bloom on the leaves as found in C. arborescens. Even more forms are known in cultivation, but as their origin is unknown they cannot be evaluated here.

Although the name C. ovata was never taken up, there is little doubt that Miller (1768) in his description of Cotyledon ovata referred, in fact, to this species. This can be seen in the following phrases, which exclude any species of Cotyledon from the Cape: "succulent stalk near three feet high" and "oval succulent leaves". Also, the leaves are described as being "lively green" and this excludes the only similar species Crassula arborescens, which Miller also described in the same publication under the genus Cotyledon. Miller did not prepare a herbarium specimen of it, presumably because it had not flowered for him and therefore a neotype is selected.

Cotyledon ovata is cited in Aiton's first edition of Hortus Kewensis as a synonym of Crassula obliqua, and thus making the latter a superfluous name. It is interesting that Solander mentions in his manuscript of C. obliqua that the specimen was obtained from a garden in Rondebosch and is thus probably from the same source as Thunberg's specimen of C. argentea.

The combination var. obliqua was never validly published as in both cases that it was used, the basionym was not cited (Int. Code Bot. Nomencl. 1972, Art. 33).

Specimens examined:

NATAL. - 2632 (Bella Vista): Ndumo Game Reserve (-CD), Ward 3155 (NH). 2830 (Dundee): Weenen (-CC), Pentz 269 (PRE); Ndumbeni (-CD), Wood 4489 (NH); Keate's Drift (-DC), Tülken 4049 (BOL). 2831 (Nkandla): White Umfolozi River (-AD), Venter 3005 (PRE); Umfolozi Game Reserve (-BD), Ward 2646 (NH). 2929 (Underberg); Estcourt (-BB), Plowes s.n. (NBG); near Greytown (-BA), Acocks 11 608 (NH); Inchanga (-DA), Pole Evans 343 (GRA); Shongweni Dam (-DC), Morris 967 (PRE). 3030 (Port Shepstone): Alexandra City (-BC), Rudatis 2266 (STE); Gibraltar (-CB),

Stray 10 997 (PRE); Oribi Nature Reserve (-CB), Moll 5030 (NH).  
 CAPE. - 3126 (Queenstown): near Queenstown (-DD), Galpin 1533 (GRA, PRE);  
Applegreen sub MacOwan 726 (BOL, PRE, SAM). 3224 (Graaff Reinet):  
 Graaff Reinet (-BC), Rattray s.n. (GRA); Bolus 3 (BOL); Jansenville  
 (-DC), Theron 301 (PRE). 3225 (Somerset East): near Biesjesfontein  
 (-CB), MacOwan 567 (GRA); Cookhouse (-DB), Bokelmann s.n. (NBG). 3226  
 (Fort Beaufort): Bedford (-CA), Story 1316 (PRE); Sandile Kop (-DD),  
Giffen 994 (NBG). 3227 (Stutterheim): Windvoalberg (-AC), Baur 880  
 (GRA); Cathcart (-AC), Roberts 1741 (PRE) 1828 (PRE); Stutterheim (-CB),  
Rogers 12 799 (GRA); Nahoon River (-DD), Glane 316 (GRA). 3228  
 (Butterworth): Butterworth (-AC), Pegler 1759 (PRE); Tyityaba River (-CA),  
Flanagan 839 (GRA, PRE, SAM). 3323 (Willowmore): 16 Km north of Willow-  
 more (-AB), Tölken 5000 (BOL) near Willowmore (-BC), Herre s.n. (BOL);  
 Kouga River (-CB), Esterhuysen s.n. (BOL). 3324 (Steytlerville): 1,5 Km  
 south of Mount Stewart (-AB), Tölken 1772 (BOL); 9 Km east of Wolwefon-  
 tein (-BD), Tölken 4118 (BOL). 3325 (Port Elizabeth): near Sapskamma  
 Station (-CA), Tölken 4292 (BOL); Uitenhage (-CD), Thode A 2650 (NH, PRE);  
 Addo Bush (-DB), Urton 15 (GRA); Perseverance (-DC), Long 689 (GRA, PRE);  
 Swartkops River (-DC), Ecklon & Zeyher 1875 (SAM). 3326 (Grahamstown):  
 Howieson's Poort (-AD), Schonland 537 (NH, GRA); Botha's Hill (-BA),  
MacOwan in NH 1105; Hellsport (-BA), MacOwan 567 (GRA); 727 (BOL):  
 Queens Road (-BC), Story 650 (PRE); Schonland s.n. (GRA, SAM); Port  
 Alfred (-DB), Salisbury 105 (GRA).

45. C. arborescens (Mill.) Willd., Syst. Pl. 1, 2 : 1554 (1798); DC.,  
 Prodr. 3 : 383 (1828); Harv., Fl. Cap. 2 : 337 (1862), partly  
 excl. specimens cited; Schonland in Trans. Roy. Soc. S. Afr.  
 17 : 201 (1929).

Type: Cape, 50 Km north of Vanrhynsdorp, Tölken 4220 (BOL, neo!).  
Cotyledon arborescens Mill., Dict. ed. 8 (1768).

Perennials 1 - 1,5 (-2) m high, with fleshy stems c. 20 cm diameter at the base and with peeling bark, much branched, with old leaves deciduous. Leaves with or without short petiole up to 0,5 cm long; lamina obovate to orbicular rarely lanceolate, 2 - 4 (-5) cm long, (0,8-) 2 - 3 (-4) cm broad, with rounded apex and usually not mucronate, more or less abruptly tapering into a short petiole, glabrous, covered with a grey bloom and with a horny purplish margin; sheath usually shorter than 1 mm or just a ridge. Inflorescence a round-topped thyse with one to several dichasia, with pedicellate 5 - 7-merous flowers, with a peduncle 3 - 7 (-10) cm long, with short scale-like bracts up to 2 mm long and usually as long as broad found on the dichasia. Sepals triangular, 1 - 1,5 mm long, pointed and with a ridge on the free lobes, grey-green often tinged red. Petals elliptic to lanceolate, 7 - 10 mm long, slightly hooded and with a sub-terminal dorsal appendage, fused into a tube 0,5 - 0,7 mm long, with lobes spreading, white or cream often tinged red towards the apex. Stamens 4,5 - 6 mm long, with purple anthers 1 - 1,5 mm long, with a filament becoming broader towards the base and hardly fused to the petal tube. Squamæ transversely oblong, 0,3 - 0,4 X 1 - 1,4 mm, usually truncate and hardly constricted towards the base, fleshy, pale yellow. Carpels with narrowly kidney-shaped ovary and abruptly continued into a slender style about half as long as the ovary and with insignificant terminal stigma; ovary smooth and with about 70 elongate ovules each with rows of papillae.

Diagnostic Features:

C. arborescens is distinguished from C. ovata by its broadly obovate leaves which are covered with a grey bloom and the triangular bracts on the individual dichasia are rarely as long as 2 mm. Also, the petals are at least 2 mm broad in the subsp. arborescens. The subsp. undulatifolia has narrower leaves but similarly to the typical C. arborescens can also be distinguished in the field by its distinct flowering period in December and January.

The subsp. undulatifolia is distinguished from the typical subspecies by its narrower elliptic leaves with an undulate margin.

Variation and taxonomic Notes:

C. arborescens is a species that shows remarkably little variation and this in spite of its often widely scattered and isolated localities. It is interesting, however, that throughout its range plants often produce 5.- 7-merous flowers, a character only recorded for C. capensis.

In Miller's (1768) description the "leaves spotted on their upper side" can only refer to the hydathodes of a Crassula species, and because he had not seen the flowers he placed it in the genus Cotyledon, because the leaves resemble those of Cotyledon orbiculata, as, in fact, he noted. Among the South African species of Crassula a shrubby plant with obovate leaves and which are often indented the apex can only refer to the above species, as Willdenow already recognized.

45a. subsp. arborescens

C. arborescens (Mill.) Willd., Syst. Pl. 1, 2 : 1554 (1798); DC., Prodr. 3 : 383 (1828); Eckl. & Zeyh., Enum. 294 (1837), partly excl. specimen cited; Harv., Fl. Cap. 2 : 337 (1862), partly, excl. specimen cited, Schonl. in Trans. Roy. Soc. S. Afr. 17 : 201 (1929); Jacobsen, Handb. Succ. Pl. 1 : 303, fig. 294 (1960) et Sukk. Lex. 139, t. 42, 1 (1970); Higgins, Crass. Cult. 24, fig. 3 (1964).

Cotyledon arborescens Mill., Dict. ed. 8 (1768).

Crassula cotyledon Jacq., Misc. 2, 295, t. 19 (1781); Collect. 4, t. 2, fig. 4 (1790); Lam., Encycl. 2 : 173 (1786); Dryand. in Alt., Hort. Kew. ed. 1, 1 : 393 (1789); Curtis, Bot. Mag. 11 : 384 (1797).

Type: Sine loc., Jaquin s.n. (BM!, W).

C. arborea Med., Beob. 304 (1783).

C. cotyledonifolia Salisb., Prodr. 309 (1796), nom. superfl.

Leaves obovate to almost orbicular 2 - 3 (-4) cm broad, entire, carnose and somewhat convex on the upper and lower surface, spreading.

On rocky slopes, but usually associated with rock outcrops, mainly on sandstone but also on quartzite, commonly on north facing slopes, but also often in kloofs; occurring locally common in the little Karroo and the adjoining mountains from near Prince Albert to the Hex River Valley and one record from the southern Namaqualand.

Flowering Period: October - December.

Diagnostic Features:

See under the species.

Variation and taxonomic Notes:

Unusual is the one population of this subspecies on some hills north of Vanrhynsdorp and thus showing a gap to the main distribution of it in the Little Karroo. No indications of human influence could be detected nor could the northern plants be distinguished in a single character from the southern ones.

Specimens examined:

CAPE. - 3118 (Vanrhynsdorp): 50 Km north Vanrhynsdorp (-DA), Tölken 4220 (BOL). 3319 (Worcester): Hex River Valley (-BC), Davidson 15 (SAM); near Worcester (-CB), Olivier 238 (STE, PRE); Rogers in TRV 24 ; 634 (PRE). 3320 (Motagu): Wittepoort (-AD), Walgate 319 (NBG); near Matjesfontein (-BA), Marloth 10 796 (PRE); Montagu Bath (-CA), Page in BOL 15 429 (BOL, PRE); Baden (-CA), Walgate in BOL 24 052 (BOL); near Montagu (-CC), Mitchell 28 (PRE); Kogmans Kloof (-CC), Hutchinson 1092 (BOL); Anysberg (-DA), Barker 5081 (NBG); Piksteelkuil (-DA), Kotze 22 (STE). 3321 (Ladismith): Seweweekspoort (-AD), Tölken 4101 (BOL); near Ladismith (-AD), Zinn in SAM 66 653; 9 Km west of Calitzdorp (-DA), Marsh 1418 (STE, PRE). 3322 (Oudtshoorn): near Prins Albert (-AA), Bolus s.n. (BOL); Swartberg Pass (-AC), Stokoe 8709 (BOL); Werdermann & Oberdieck 848 (PRE); south of Oudtshoorn (-CA), Barker 785 (NBG); Tölken 3720 (BOL).

45b. subsp. undulatifolia Toelken, subsp. nov. ab subsp. arborescens  
foliis ellipticis et undulatis differt.

Folia elliptica vel elliptico-oblancoolata, 0,8 - 1,5 (-2) cm lata,  
undulata, leviter succulenta et recta.

Type: Cape, 1 Km north of Sapkamma Station, Tölken 4290 (BOL,  
holo!).

Leaves elliptic to elliptic-oblancoolate, 0,8 - 1,5 (-2) cm broad,  
undulata, slightly fleshy, erect.

On rocky slopes in sheltered kloofs in the southern parts of  
the Klein Winterhoek Mountains.

Flowering Period: December - January.

Diagnostic Features:

See under the species.

Variation and taxonomic Notes:

This subspecies is common in a few kloofs in the close vicinity  
of the type locality. Plants of the typical C. ovata occur on the  
higher slopes and on the northern part of the Klein Winterhoek mountains,  
in fact, only a few kilometers away from the type locality of the subsp.  
undulatifolia. These plants of C. ovata had already shed their in-  
florescences when C. arborescens subsp. undulatifolia was in full flower.  
As this subspecies has a similar flowering period and a similar bloom on  
the leaves as C. arborescens it was rather placed into that species.

Specimens examined:

CAPE. - 3325 (Port Elizabeth): 1 Km north of Sapkamma Station (-AC),  
Tölken 4290 (BOL); Paardepoort near Glenconnor Station (-AC), Tölken  
4299 (BOL).