

A TAXONOMIC STUDY OF SUCCULENTS, EXCLUSIVE  
OF CACTI, OCCURING NATIVE OR CULTIVATED  
IN SOUTHWESTERN GARDENS

by

Mary Aileen Murray

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A Thesis

submitted to the faculty of the

Department of Botany

in partial fulfillment of  
the requirements for the degree of

Master of Science

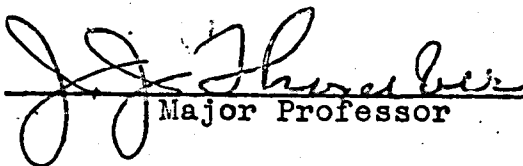
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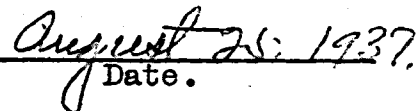
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This paper consists of a taxonomic study of succulents, exclusive of cacti. The plants were found in southwestern United States, growing native or cultivated.

A succulent in this study is considered to be a plant with thick fleshy leaves or stems. They take on many fantastic shapes, and it is for their curious appearance rather than for their flowers that they are most often grown.

The characteristic of succulence occurs in various groups throughout the flowering plants, and cannot be depended upon to differentiate plant into families. The tall columnar growth of the Euphorbias and a somewhat similar growth in the Stapelias causes them to resemble closely the columnar cacti, but here their likeness ceases. The real key to the families is found in the flower. Some families, such as the Crassulaceae, are made up almost exclusively of succulents, while in other families there may be only one or two genera. The Stapelias in the Asclepidaceae and the Kleinias in the Compositae are examples of succulents in large families of otherwise non-succulents.

Succulents are usually indigenous to arid or desert regions, but may be found wherever it is difficult for the plant to obtain moisture. This would include saline or alkaline areas where the osmotic value of the soil water is very high, and high alpine crags where the water is unavailable because it

is frozen. Because of the arid alkaline condition of the soil, succulents are peculiarly adapted to growth in the Southwest. Many of them, such as Agaves, Sedums, Dudleyas, and Portulacas, grow native. Others as exotic species, mostly from South Africa, are now cultivated in this region.

Succulents are the easiest of plants to grow. Because of their resistance to drought, they will grow and even produce flowers with a minimum amount of water. They will attain their maximum growth however, if they are watered liberally during their growing season and very sparingly during their resting period. Most of them thrive in the bright sun, and may be placed out in the garden without protection. Most of them can be propagated very readily from cuttings or offsets. The Crassulaceae will even produce new plants from their leaves, if these fall on a moist sandy surface.

Many succulents rarely blossom, and exact identification is impossible without the flower. The species descriptions were limited to flowering specimens of as many families as could be obtained. The species lists at the end of each genus were compiled for the plants that were studied and did not flower, or that have been authentically reported for this region.

Commelinaceae.

Leaves simple, alternate, parallel-veined, usually sheathing the stem; flowers in cymes subtended by leafy bracts or spathes; sepals and petals 3 each; stamens 6 usually; ovary 2-3 carpellary, superior; fruit a capsule or berry-like.

Inflorescence umbellate, concealed by 2 boat-shaped bracts.....1. Rhoeo.

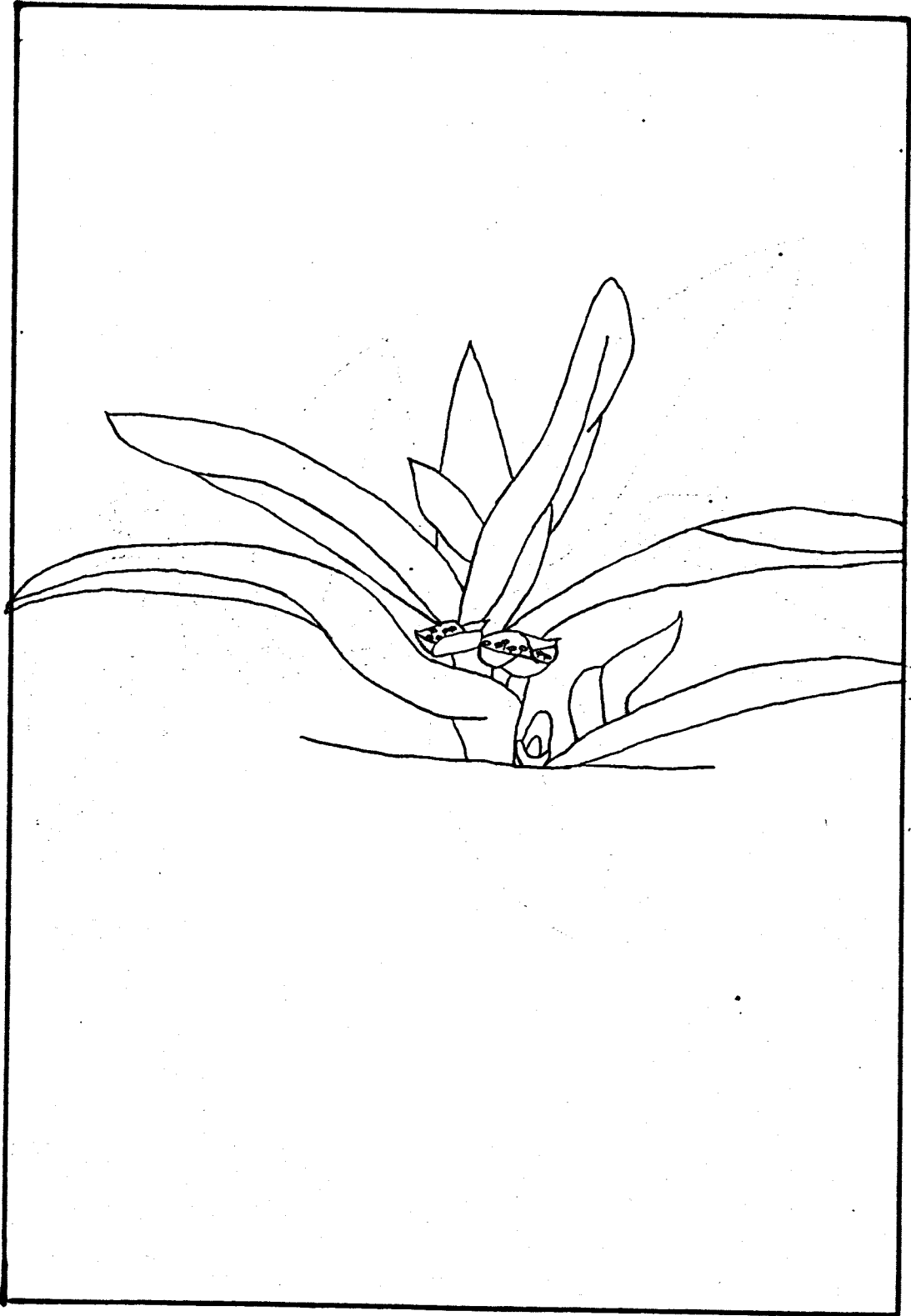
Inflorescence not concealed by bracts.....2. Tradescantia.

1. Rhoeo discolor Hance. Plate 1. Leaves 6 cm. long, 2.5 cm. wide, dark green above, purple below; flowers in umbels concealed by 2 boat-shaped bracts; sepals 3-4, petal-like, 5 mm. long, 3 mm. wide, white, translucent, glabrous, and glossy, ovate-lanceolate in shape; petals 3-4, 8 mm. long, 6 mm. wide, white, glabrous, ovate and glossy, edges crisped; stamens 6. (Tradescantia discolor and versicolor).--Mexico.

2. Tradescantia which may be found here.

Tradescantia Reginae Plate 2. Plant trailing and creeping along ground for 60 cm. or more; leaves 5-6 cm. long, 2.5 cm. wide, under surface purple, upper surface purplish-green along margins and midrib, silvery between, simple shape, sheathing stem, sheaths pubescent.

Tradescantia sp. Stems suspended 120 cm.; leaves alternate, sheathing stem at base, 30 cm. or more long, up to 6 cm. wide, linear-ovate; medium green, lighter along edges; venation parallel.



Platel. *Rhoecia discolor.*

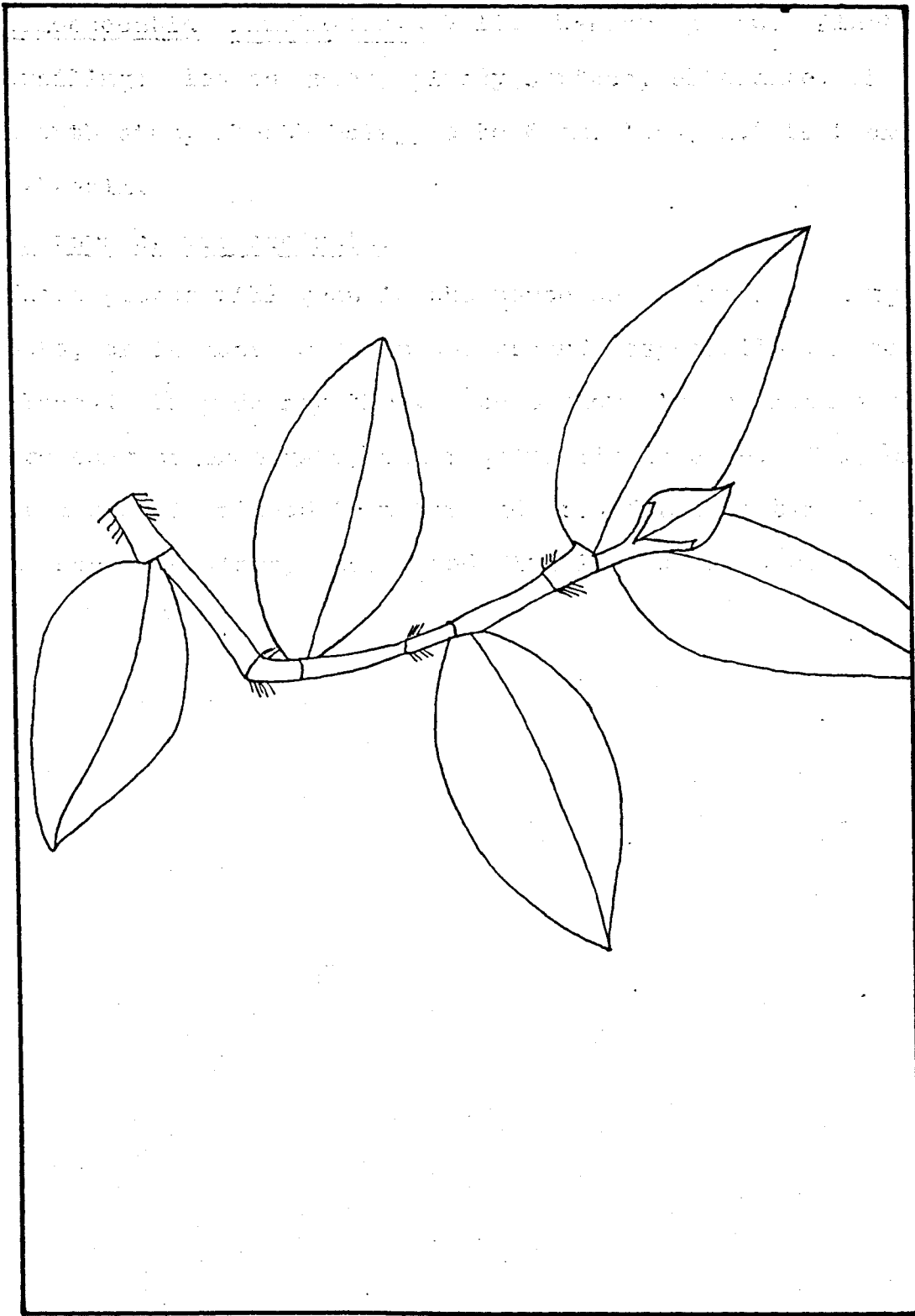


Plate 2. *Tradescantia Reginae*.



Tradescentia fluminiensis Vell. Wandering Jew. Plant trailing; leaves green, glossy surface, alternate, their bases sheath stem, sheath hairy, 3 to 6 cm. long, 1.5 to 2 cm. wide. --Brazil.

Culture of Tradescentia.

These plants will grow in the house or outdoors in hanging pots, or in dense mats in the ground, especially in cool damp places. They do not thrive where there is too much sun. They are easy to propagate, and require little care. They will root if a stem is placed in water and grow for some time in this manner. Cuttings, seeds, and division may also be used.

Liliaceae. The Lily Family.

Herbs, shrubs, or trees; usually perennial herbs with bulbs; leaves usually basal; flowers regular and symmetrical, almost always 6-parted; perianth with 6 segments, 3 outer sepaloid, 3 inner petaloid; stamens 6, one for each perianth division; anthers 2-celled; ovary superior, 3-celled; styles 1 or 3; stigmas 3, rarely 1; fruit a capsule or berry.

Flowers trumpet-shaped.....1. Gasteria.

Flowers not trumpet-shaped.

Flowers appear to be two-lipped.....2. Haworthia.

Flowers not two-lipped in appearance.

Leaves more or less toothed.....3. Aloe.

Leaves not toothed.....4. Sansevieria.

1. Gasteria.

Leaves long or short, thick, flat, or triangular in section, or sword-shaped, light green to gray, marked in many ways, smooth or covered with rough tubercles; flowers red, green-edged, more or less trumpet-shaped; perianth short or long, curved, tube-like, lower half expanded, pale pink in color, upper portion with 6 perianth segments, tinted or striped in green.

1. Gasteria verrucosa Duval. Plate 3. Leaves single-ranked, 16 cm. long, 4 mm. wide, reddish green in color, spotted with pink; tubercles small and raised; flowers bright red with greenish segments.--South Africa.

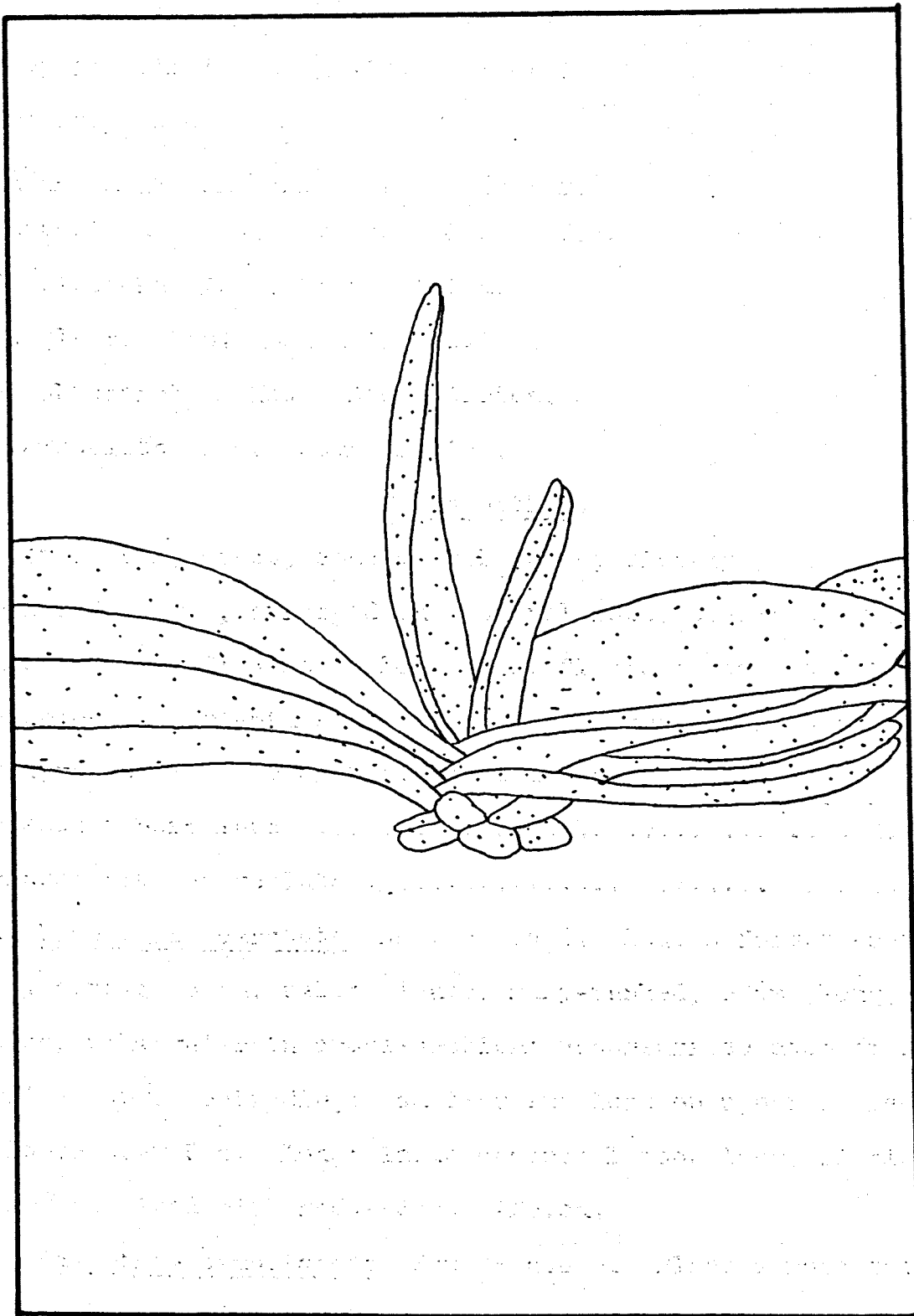


Plate 3. *Gasteria verrucosa*.

Culture of Gasterias.

These are very easily grown under ordinary home conditions. They go well in the living room or in the greenhouse. They are propagated like Haworthias.

Other Gasterias which may be found here.

*Gasteria nigricans* Duval. South Africa.

*G. disticha* Haw. South Africa.

*G. glabra* Haw. South Africa.

*G. obtusifolia* Haw. South Africa.

*G. maculata* Haw. South Africa.

2. Haworthia.

Stem usually erect, concealed below by tightly packed, short pointed leaves, arranged in 3 spiral rows, overlapping to the growing tip; flowers in long thin, flexible racemes, single or branched; perianth segments 6, free, curve back at tip, 3 remain erect while 3 of them curve afterwards.

Plants tuberculate.....1. *H. coarctata*.

Plants not tuberculate.....2. *H. cymbiformia*.

1. Haworthia coarctata Haw. Plate 4. Leaves form a rosette, 8 cm. across, 6 cm. tall; leaves many-ranked, 5 cm. long, 1 cm. wide, triangular in cross-section; undersurface deep green, white marks protruding; smaller and less on upper surface; flower stem 9 cm. long; inflorescence 1 foot long, simple; flowers lined with red.--South Africa.

2. Haworthia cymbiformis Haw Plate 5. Plant a rosette; leaves very fleshy, tipped with a spine, yellowish green in color, veins deeper green and visible, 3-4 cm. long, 1-2 cm. wide; inflores-

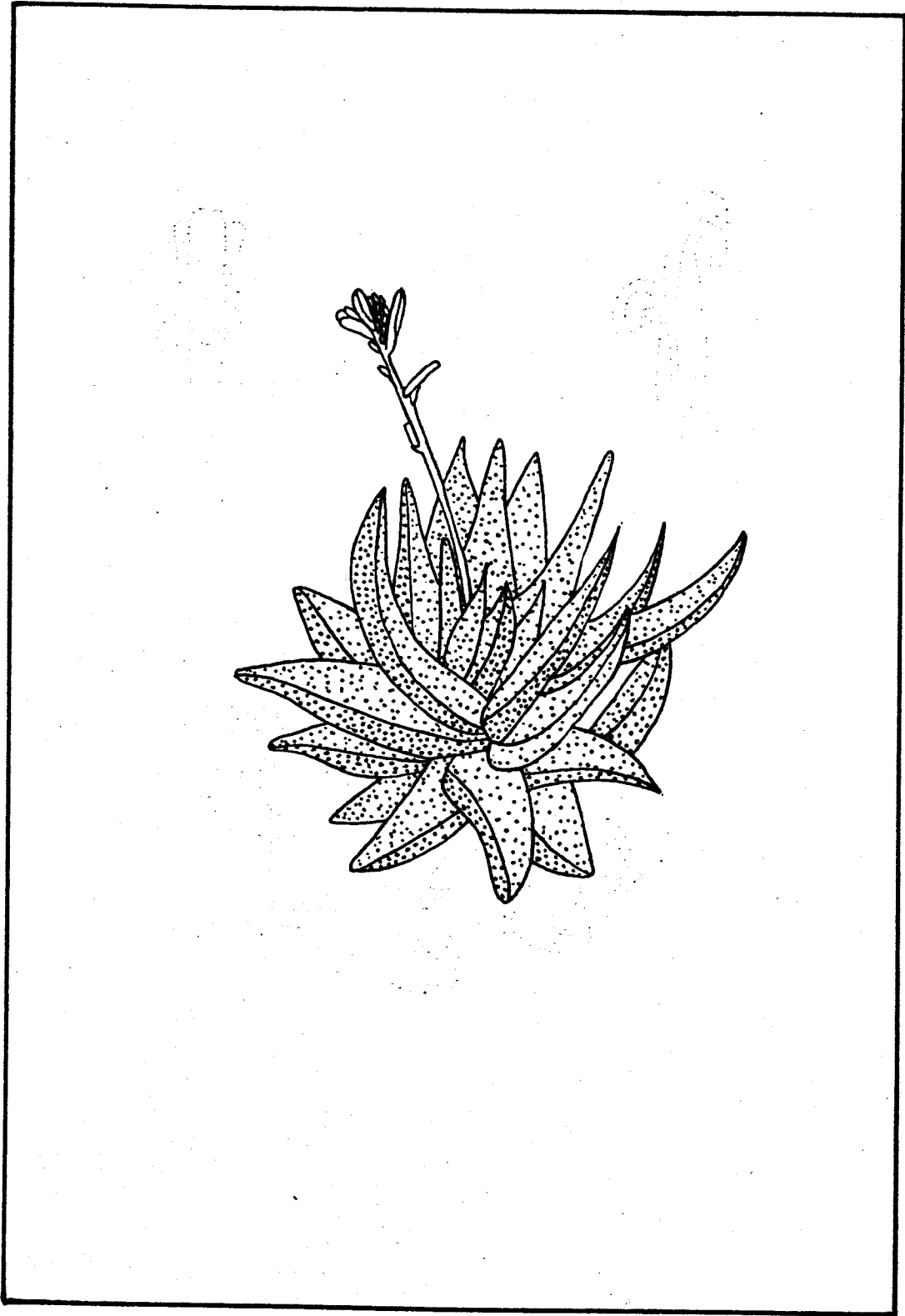


Plate 4. *Haworthia coarctata*.

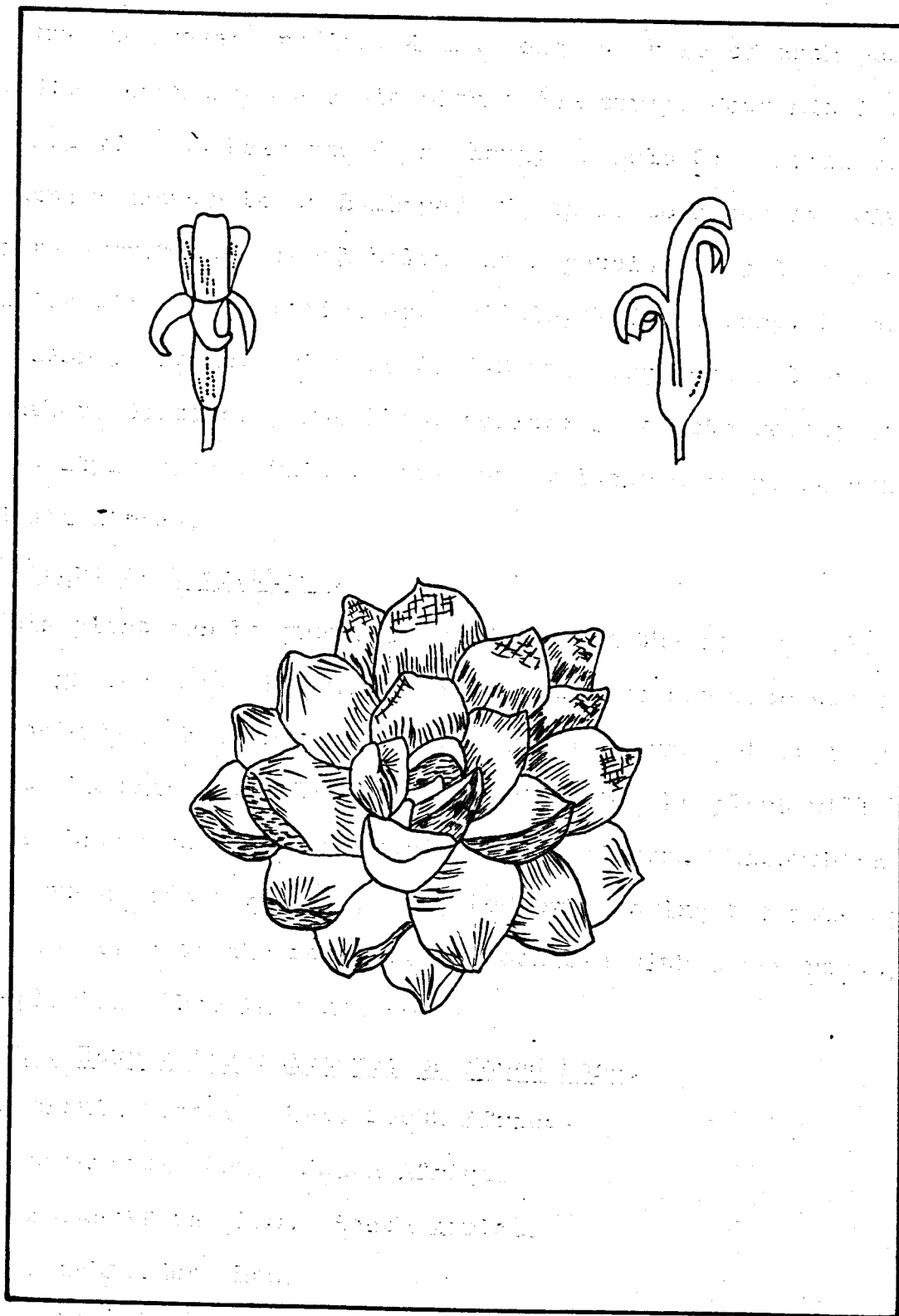


Plate 5. *Haworthia cymbiformis*.

cence racemose; pedicel 4 mm. long, at base of each pedicel white membranaceous scale with green stripe down middle, scale 5 mm. wide at base and 6 mm. long; sepals 3; petals 3, distinct; flowers appear to be 2-lipped, 2 sepals to upper lip with 1 petal between, 1 sepal below and 2 petals; sepals and petals white with green stripe down middle, 1.5 cm. long, 2 mm. wide, linear in shape; stamens 6, 7-8 mm. long, not all same length; anthers distinctly 2-celled, yellow; filaments white; stigma and style short, white, wavy; ovary 3-carpellary, superior.-- South Africa.

Culture of Haworthias.

This plant can be grown in the house on the windowsill, or in the greenhouse. Because it does not like too much water, care should be taken that the plant just fits the pot it is growing in. In this way, all the water given to the plant will be used up. Water should be withheld in the winter. Haworthias can be grown from seed, or propagated by removing the young plants at the base of the rosette, if possible with a few roots, and replanting them in a new pot.

Other Haworthias which may be found here.

Haworthia viscosa Haw. South Africa.

H. Reinwarti Haw. South Africa.

H. margarifera Haw. South Africa.

H. arachnoides Haw.

H. albicans Haw. South Africa.

H. retusa Duval. South Africa.

- H. fasciata Haw. South Africa.
- H. tessellata Haw. South Africa.
- H. Bolusi Baker. South Africa.
- H. turgida Haw. South Africa.
- H. Radula Haw. South Africa.

3. Aloe.

Plants usually succulent, small to large; stem tall, short, or none; leaves mostly fleshy, usually more or less strongly toothed, rarely entire, often blotched; inflorescence racemose, many flowered, only very rarely 1-sided; flowers large, pendulous or spreading, more or less colored red, yellow, orange, or very rarely white, usually cylindrical, rarely inflated at the base; never with apex recurved as well; perianth segments free, more or less connate; fruit dry, dehiscent capsule.

Plant with long trailing stems.....1. A. ciliaria.

Plants not with trailing stems.

Flower stem 6-8 inches tall.....2. A. variegata.

Flower stem 1 foot or more tall.

Leaves dark green with lighter blotches.....3. A. succotrina.

Leaves pinkish purple.....4. A. Schinoperi.

Flower stem 2 to 3 feet tall.

Flowers orange.....5. A. serrulata.

Flowers coral to red.....6. A. distans.

1. Aloe ciliaris Haw. Climbing Aloe. Plate 6. Plant 30-100 cm. long, erect-ascending, in need of some support; lower part



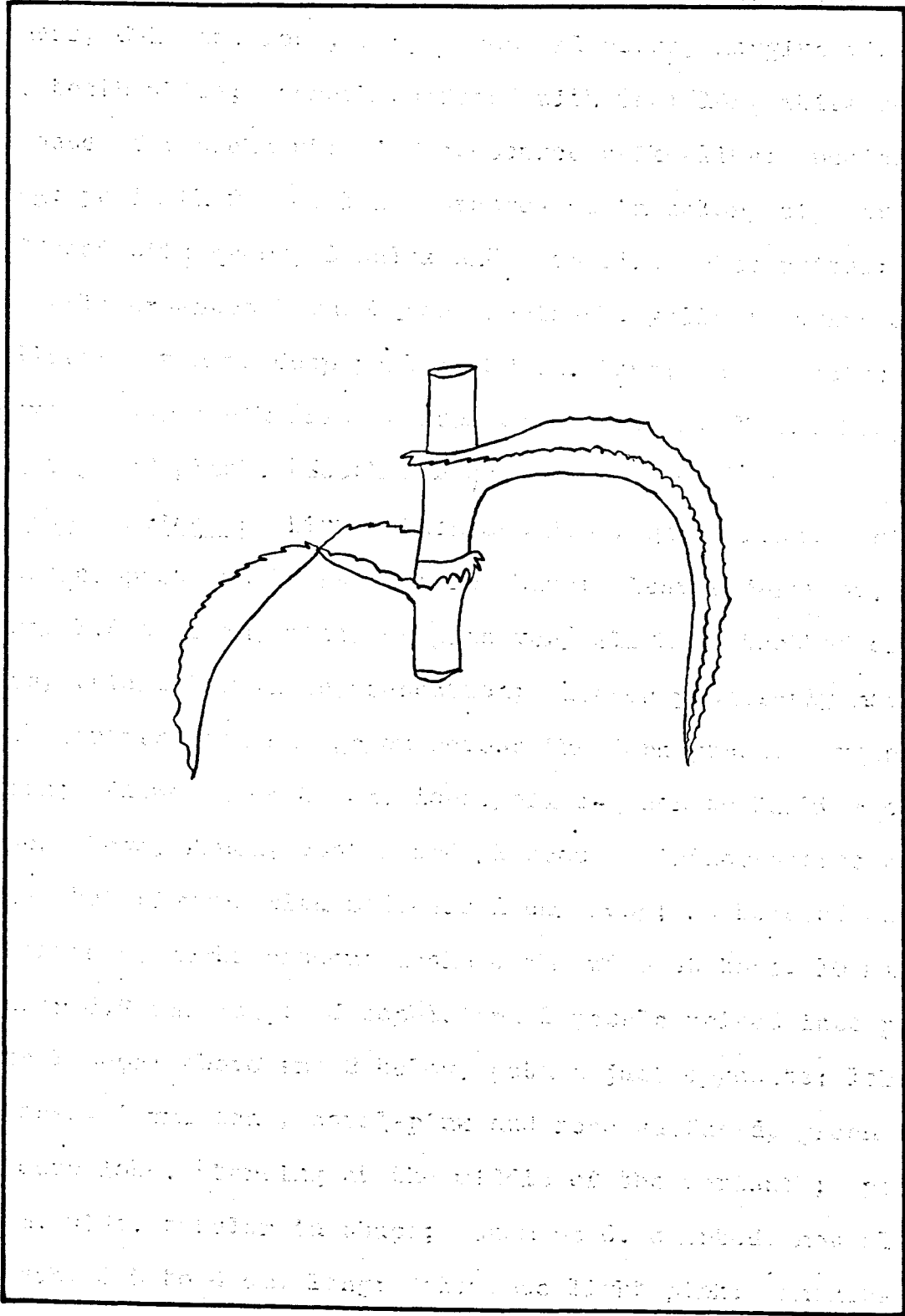


Plate 6. *Aloe ciliaris*.

of stem woody when old; leaves sessile, whorled, ovate-linear, 6-18 cm. long, deep green, glaucous, margins finely toothed, teeth white; sheath suffused with red; long white teeth at base of attachment; inflorescence spike-like; pedicels 6 mm. long; perianth 27 mm. long, orange-red in color, tips of lobes suffused with green; 3 calyx and 3 corolla lobes united; stigma 1; style exerted 5 mm. beyond perianth, yellow; ovary 3-carpellary; stamens deep yellow, 20 mm. long; seeds several to many; flower stalk arising from axil of leaf, 25 cm. long; climbing type of plant.--South Africa.

2. Aloe variegata Linn. Pheasant Aloe, Quail Plant. Plate 7. Plant compact and triangular in shape; leaves 3-ranked, 5-13 cm. long, 1.5 to 4 cm. wide, margins very slightly toothed or roughened, triangular in cross-section; leaves peculiarly marked with stripes of light green across the dark green, margins light green; flower stem 35 cm. long, olive-green to lighter olive-green above, finely dotted and glaucous; inflorescence spike-like, but flowers with pedicels 1 cm. long; at base of each flower is dried up membranaceous scale 4 mm. wide at base, 10 mm. long; flower 3.9 cm. long; 3 sepals and 3 petals united into perianth with 1 sepal above and 2 below, petals just opposite; lobes 5 mm. at base, 1 mm. long, coral-pink and rose suffused, green veins at each lobe, starting at the middle of the perianth; perianth 7 mm. wide, tubular in shape; stamens 6, exerted, not all same length, 3.5 to 4 cm. long; filaments light pink; anthers deep reddish-orange, distinctly 2-celled; stigma 1; style 1, exerted; ovary 3-carpellary, superior, deeply 3-ridged, each

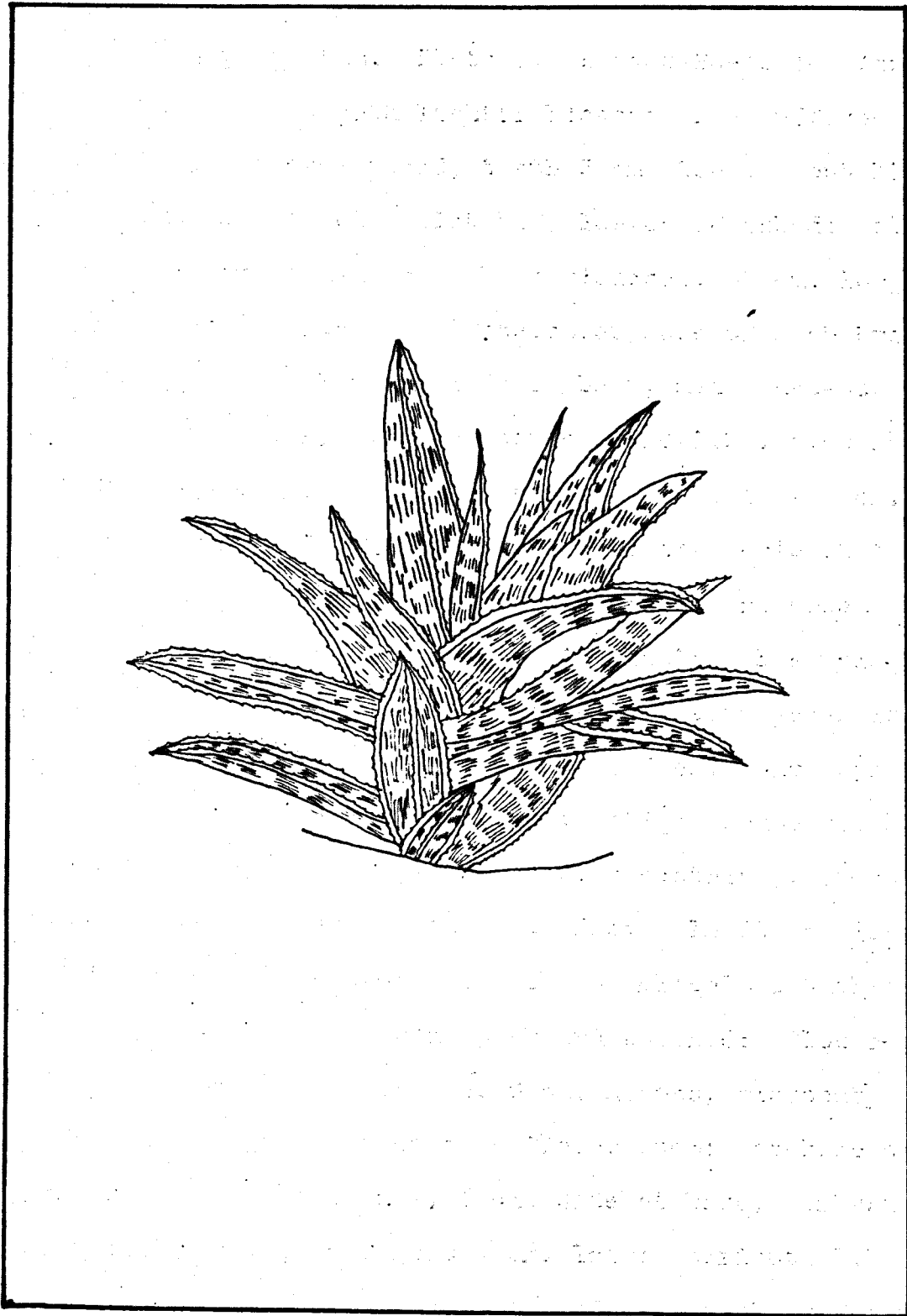


Plate 7. *Aloe variegata*.

ridge slightly 1-ribbed; plant very drought-resistant.--South Africa.

3. Aloe succotrina Lam. Plate 8. Leaves 20-30 cm. long, 4-5 cm. wide, dark green with lighter blotches and suffused with reddish-purple, sword-shaped, teeth 3 mm. long, about 10-16 mm. apart, under surface also blotched, leaves 3-ranked; flower stem very sturdy, brownish-green, white glaucous, 55 cm. long, 10 cm. wide, top forms 3 branches, 2 scales at base of each branchlet, scale 1-3 cm. long, 1.5 cm. wide at base, membranaceous with reddish-purple veins; inflorescence spike-like, flowers in pedicels 3 cm. long, at base of pedicel is scale 2.5 cm. long, 5 mm. wide, purple veins and membranaceous; perianth 4 cm. long, 1 cm. wide at widest part, pale orange and cream, tubular; lobes cream on margin and greenish in middle; 3 sepals and 3 petals, lobes 1 cm. long, inside each lobe very green in middle; stamens 6, of varying lengths, from 4-4.5 cm. long, upper half crinkled, anther deep dark red; stigma and style 1; ovary 3-carpellary and superior. (*A. succotrina*).--South Africa.

4. *Aloe Schimperii* Tod. Plate 9. Leaves 15-35 cm. long, 25 cm. wide, crisped somewhat, sessile and closely attached to stem, pinkish-purple, margins pink and toothed; flower stem 40 cm. long, succulent, terete, 6 cm. across, glaucous, orange-purple; many branches from main flower stem; at base of each, scale-like leaf, 2 cm. long, 2 cm. wide at base, membranaceous, veins orange-brown; pedicels 3 cm. long; perianth 2.5 cm. long, 4 mm. wide, base orange, tip suffused with green; stamens 6; anthers 2-celled; ovary 3-carpellary. (*A. Schimperii*).--Abyssinia.

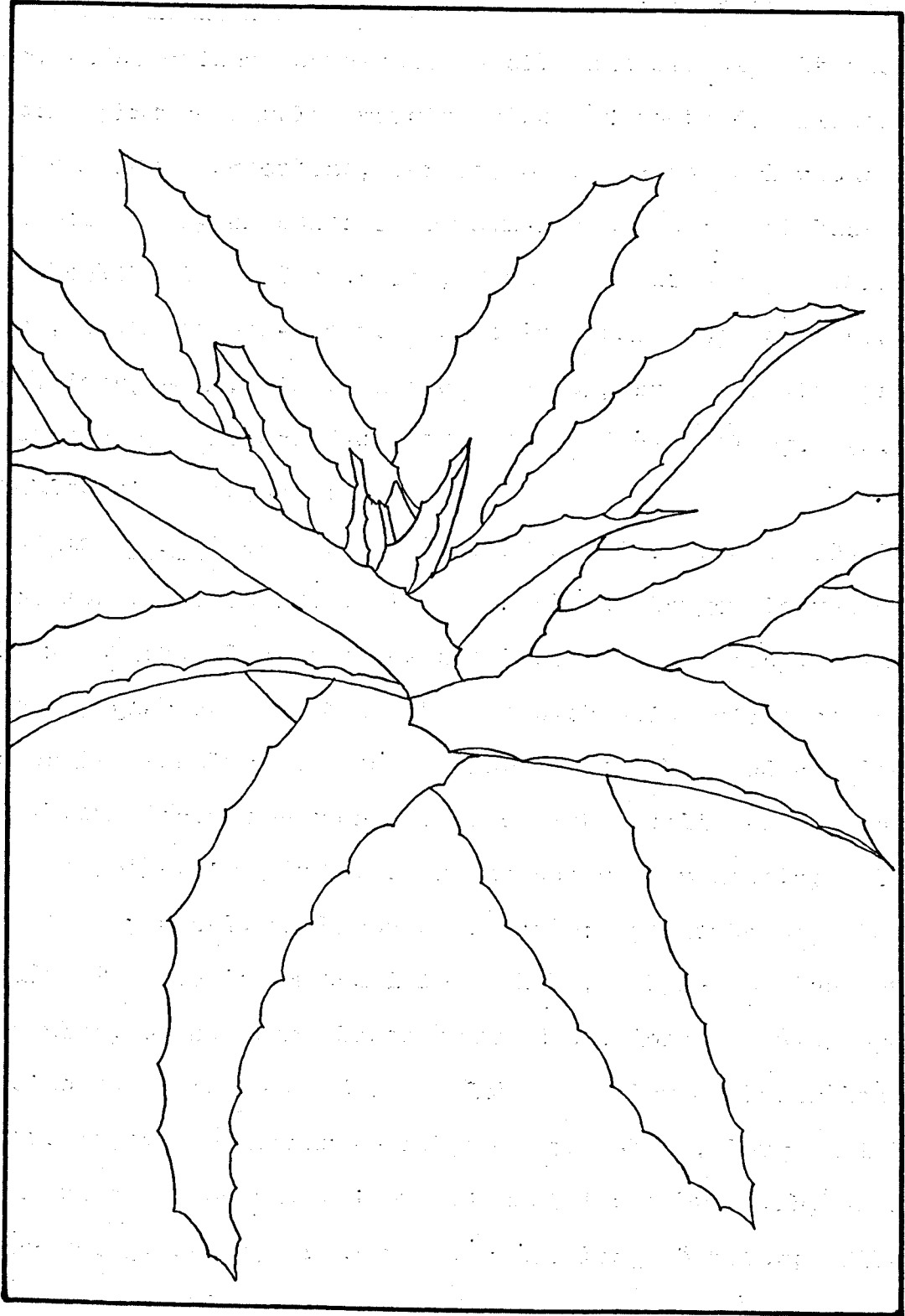


Plate 8. *Aloe succotrina*.

4. Aloe Schimperii Tod. Plate 9. Leaves 15-35 cm. long, 25 cm. wide, crisped somewhat, sessile and closely attached to stem, pinkish-purple, margins pink and toothed; flower stem 40 cm. long, succulent, terete, 6 cm. across, glaucous, orange-purple; many branches from main flower stem; at base of each, scale-like leaf, 2 cm. long, 2 cm. wide at base, membranaceous, veins orange-brown; pedicels 3 cm. long; perianth 2.5 cm. long, 4 mm. wide, base orange, tip suffused with green; stamens 6; anthers 2-celled; ovary 3-carpellary. (A. Schimperii).--Abyssinia.

5. Aloe serrulata Haw. Plate 10 and 11. Leaves 10-30 cm. long, 1.5 to 5 cm. wide, succulent, larger leaves over 1 cm. thick, along margins short teeth 3 mm. long, yellowish green, glabrous, dotted with greenish white blotches, sessile, closely clasping the stem; flower stem about 90 cm. long, glabrous, grayish-green suffused with purplish-red; inflorescence spike-like, but flowers attached by pedicels; at base of each pedicel, membranaceous scale; perianth 6-parted; calyx 2 upper lobes and 1 lower lobe, calyx-tube long and tubular, 3 cm. long, lobes about 2 cm. long, rose-orange veins deep orange on 2 upper lobes, yellow on lower lobe; corolla-tube adhering to calyx-tube, 2-3 cm. long, 1 lobe on top and 2 below, yellow, tips of lobes brownish, veins orange, glabrous; stamens 6, 3 mm. long, 3 wider; filaments 2 mm. wide in 1 set and 1 mm. wide in other set, yellowish; anthers dark red; stigma and style 1; ovary 6-

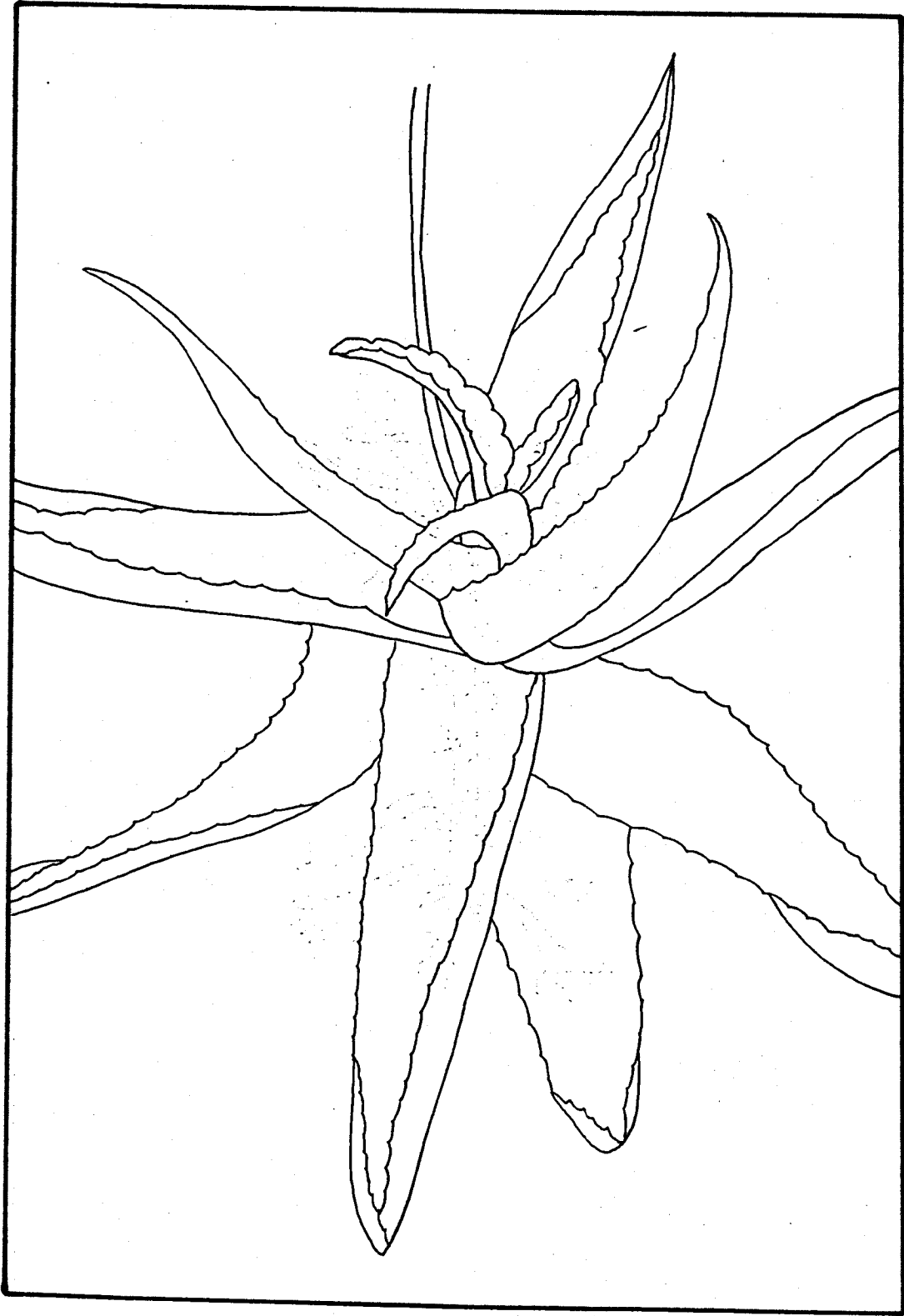


Plate 9. Aloe Schimperi.

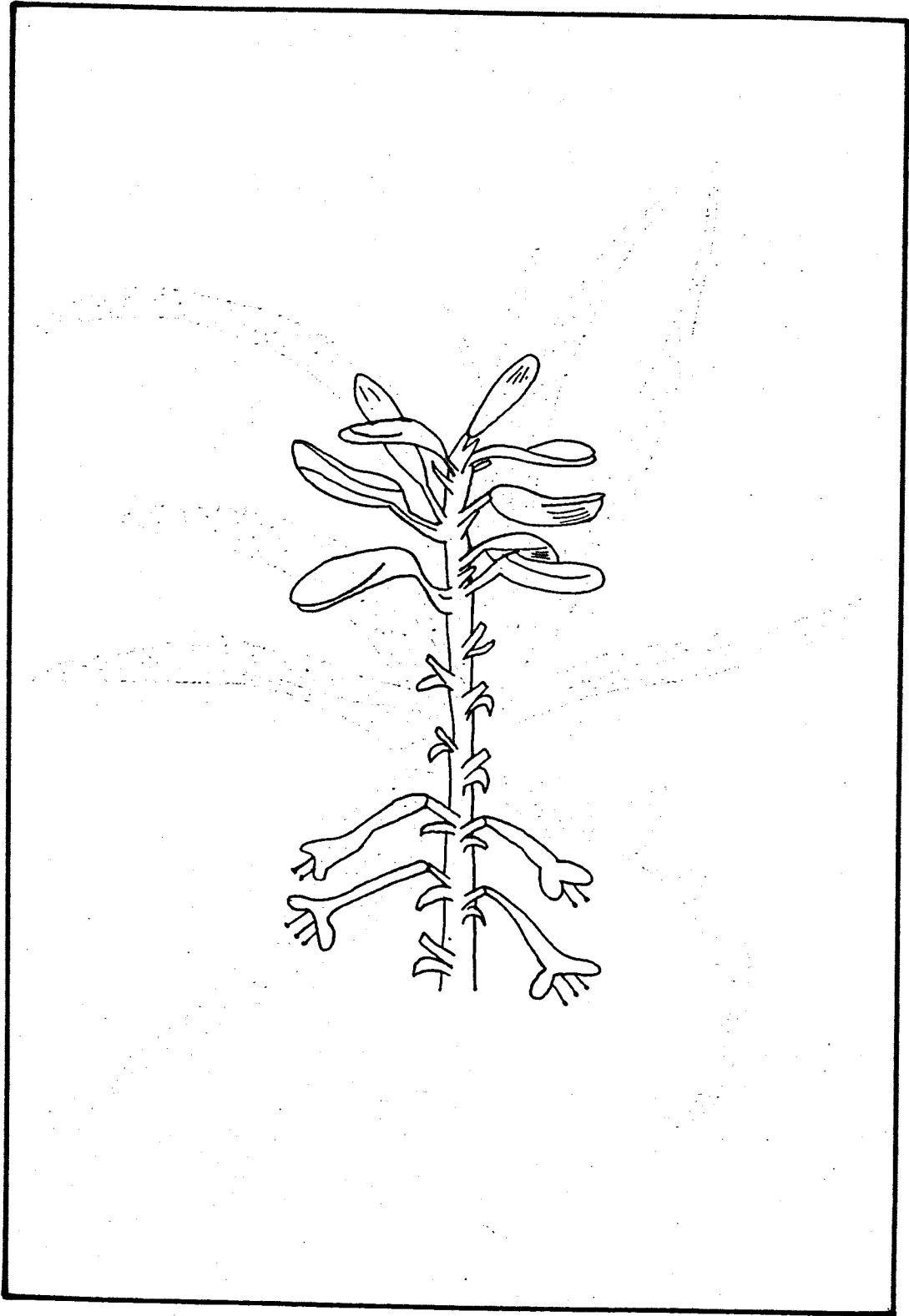


Plate 10. *Aloe serrulata*.



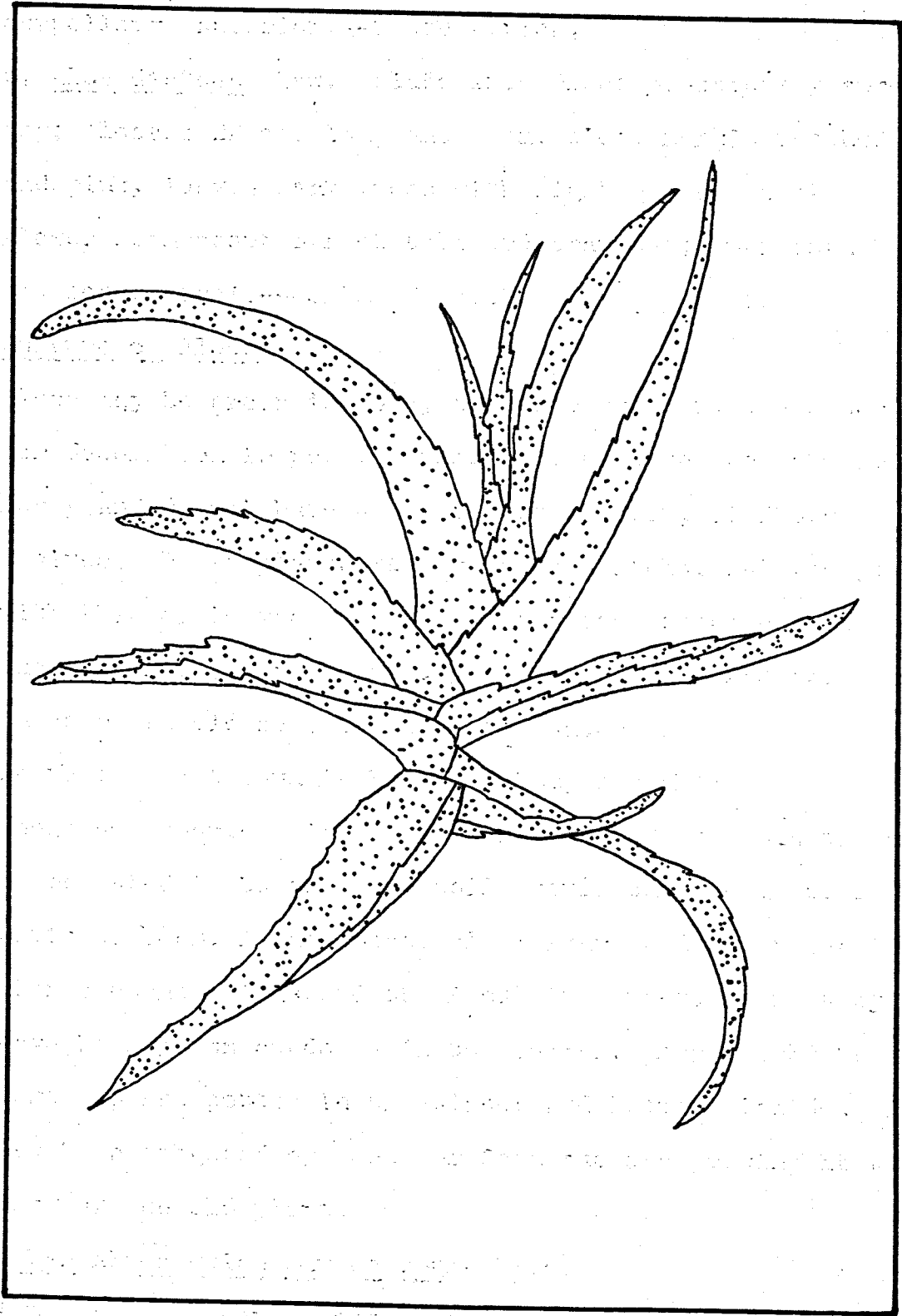


Plate 11. *Aloe serrulata*.

carpellary, superior.--South Africa.

6. Aloe distans Haw. Plate 12. Plant prostrately spreading; leaves 22 cm. long and 8 cm. wide, margin toothed and pink, leaves dark green with lighter green spots; flower stem about 3 feet tall and branched; perianth 3 cm. long, coral.--South Africa.

Culture of Aloes.

Aloes may be grown in pots, and they are very much used for decoration in public buildings, because they are so hardy and do not have to be repotted often, if flowers are not desired. These plants require a good light, but the plants with thinner leaves should be given some shade during the hotter part of the day. When the plants are being watered, care should be taken that the water does not touch the leaves, or get down in between them, for this will spoil their appearance. If flowers are desired, the plants should be repotted in March. The soil should be made up of 2 parts of loam, 1 part peat, old mortar, and river sand. These plants cannot withstand the frost in winter, so if they have been grown outdoors in the summer, they should be taken up and potted in the winter and brought inside. They may be propagated by seeds or from suckers growing at the base of the old plant.

Other Aloes which may be found here.

Aloe striata Haw. South Africa.

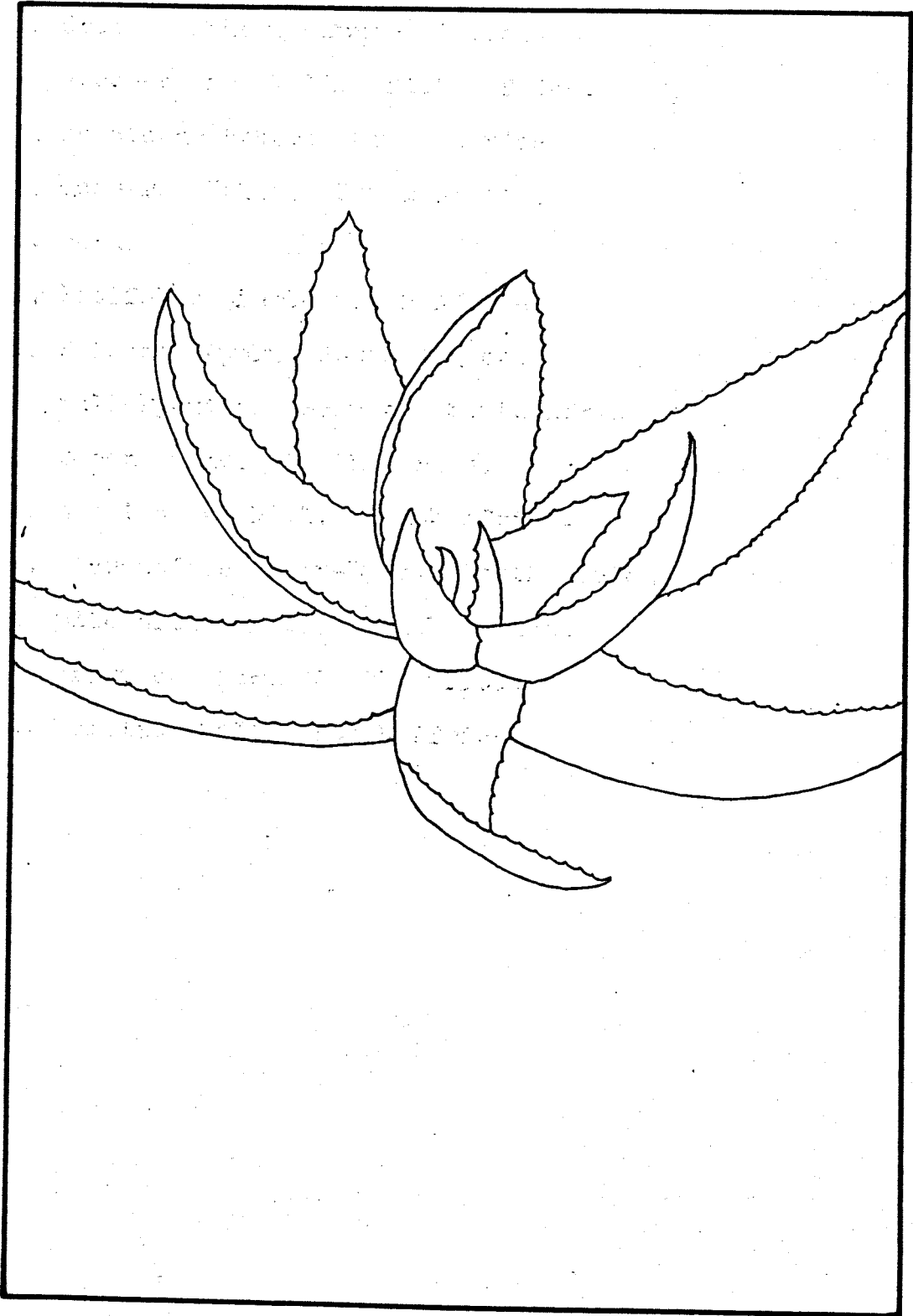


Plate 12. *Aloe distans*.

- A. *Greeni* Baker. South Africa.
- A. *arborescens* Mill. South Africa.
- A. *speciosa* Baker. South Africa
- A. *Cooperi* Baker. South Africa.
- A. *vera*.
- A. *latifolia* Haw. South Africa.
- A. *Bainesi* Dyer. South Africa.
- A. *Salm-Dyckiana* Schult. South Africa
- A. *ferox* Mild. South Africa.
- A. *brevifolia* Mill. South Africa.
- A. *microstigma* Salm-Dyck. South Africa.
- A. *plicatilis* Mill. South Africa.
- A. *aristata* Haw. South Africa.
- A. *humilis* Mill. South Africa.

5. Sansevieria. Bowstring Hemp.

Plants stiff-leaved; leaves barred, striped, or variegated; rhizome prominent, horizontal, bearing leaves with large bracts at their bases; scape about as long as leaves, slender, bracted; inflorescence racemose or spicate; pedicels whitish or yellowish; perianth tubular, with 6 narrow spreading and somewhat unequal lobes, tube usually swollen at base; stamens 6, attached on throat, usually curved and exerted; anthers versatile; ovary 3-carpellary; stigma usually exerted; fruit 1-3 seeded berry.

Leaves pale green and margined with yellow.....1. *S. thyrsoiflora*.

Leaves dark green spotted with grayish-green.....2. *S. cylindrica*.

1. *Sansevieria thyrsoiflora* Thunb. Plate 13. Leaves 30-100 cm. long, 4-9 cm. wide, succulent, broad, lanceolate, flat or nearly so, but tapering into a channelled petiole, peculiarly marked, lighter grayish green with much darker indefinite stripes crosswise, deep yellow margin; inflorescence a spike-like raceme, 2-3 pedicels growing from one place along flower stem; flowers viscid; perianth 6 lobed, 2.5 to 2.7 cm. long, lobes 5 mm. to 1.7 cm. long, whitish-green in color, veins green; stamens 6, exerted; anthers 2-celled; ovary 3-carpellary; stigma 1 and style 1; flowers fragrant. (*S. guineensis*).--South Africa.

2. *Sansevieria cylindrica* Boj. Leaves 120 cm. (4 feet) or more tall, cylindrical, dark green, banded with grayish-green, leaves 5-7 cm. wide; fruit 3-parted, 13 mm. long; inflorescence spike-like.--Tropical Africa.

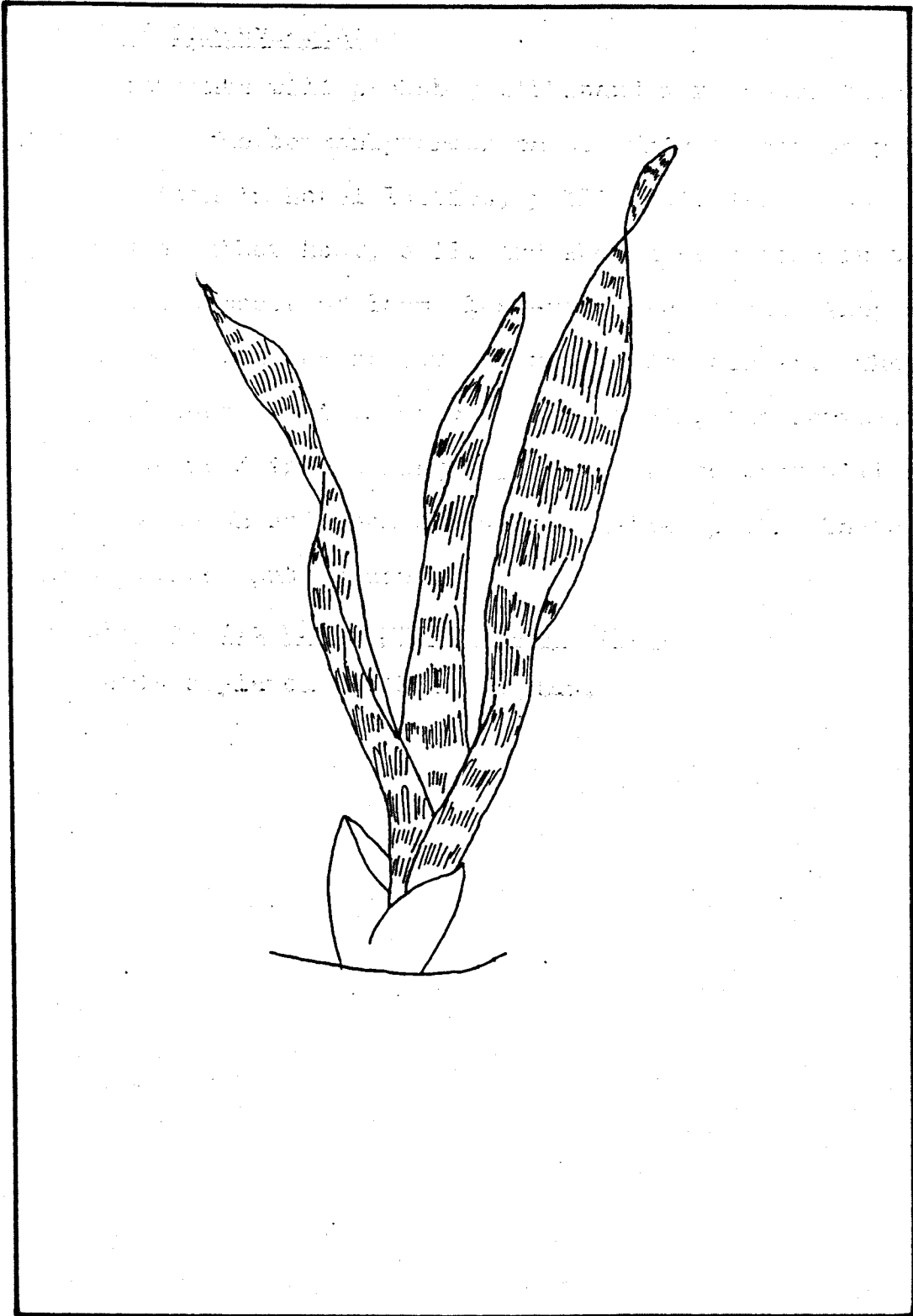


Plate 13. *Sansevieria thyrsiflora.*

Culture of Sansevierias.

These succulents will probably withstand more abuse than any other of the commonly grown ones. This is why they are found so often in hotel lobbies, public buildings, and homes. They need a rather heavy soil, and should be potted in the spring in a compost of loam, leaf-mold, and sand. They may be watered freely in the summer but not in the winter. They are propagated best by division of plants during the spring. Leaf cuttings about 3 inches long may be made, and they will root in about a month and form a new stolon-like part. These cuttings should be put in sand.

Other Sansevieria which may be found here.

*Sansevieria zeylanca* Willd. Zeylan.

Amaryllidaceae. (Amaryllis Family)

Perennial, stout, often fleshy plants, usually stemless and fibrous rooted, producing numerous young plants by offsets from base; perianth 6-parted; stamens 6, ovary inferior, 3-celled; style 1; fruit a capsule; seeds blackish.

1. Agave.

Acaulescent or short-stemmed perennials; growing from a thick fibrous-rooted crown; leaves evergreen, forming a rosette, fleshy, spine-tipped, and toothed; flower stem tall, arising from center of leaves; flowers numerous, paniculate or spicate; stamens exerted.

Inflorescence spicate.

Leaves soft and thin and without horny spines.

Stamens inserted near base of tube.....1. A. virginica  
var. tigrina.

Stamens inserted on upper part of lobe.2. A. maculosa.

Leaves thick and fleshy.

Marginal fibers delicate.....3. A. Schottii.

Marginal fibers short and stout.....4. A. parviflora.

Inflorescence paniculate.....5. A. Palmeri.

1. Agave virginica var tigrina Linn. Plate 14 and 15. Leaves 3-ranked and clasping stem, 17 to 19 cm. long, 4 to 5 cm. wide, medium green, glaucous, margins red and very finely toothed, upper and lower surface dotted with reddish purple blotches; flower stem 180 cm. tall (6 feet), and 1 cm. wide at base and





Plate 14. *Agave virginica* var. *tigrina*.

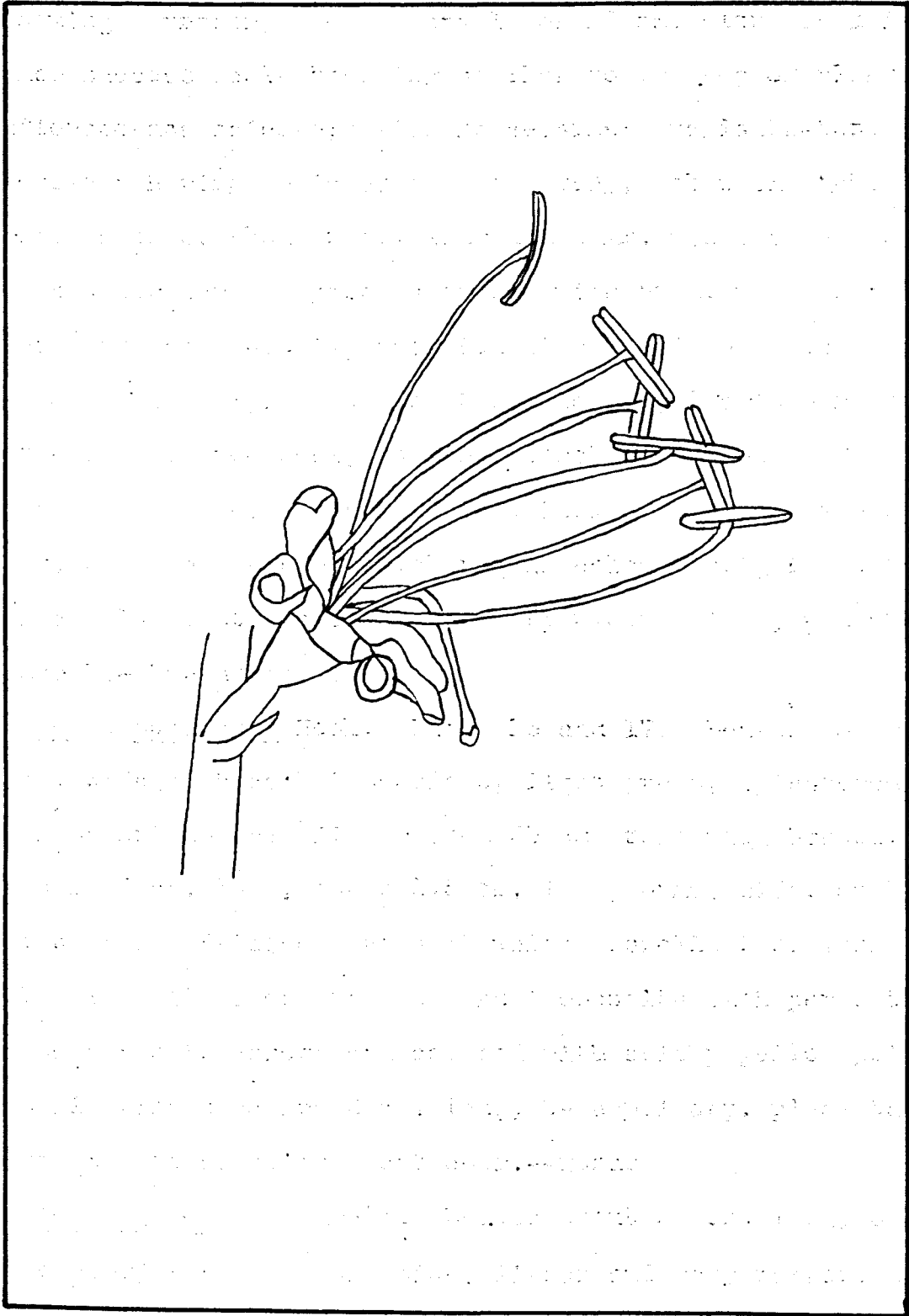


Plate 15. *Agave virginica* var. *tigrina*.

becoming narrower, about every 10 or 15 cm. along stem is membranaceous scale becoming smaller toward top of plant; inflorescence spicate; flowers sessile; perianth-tube closely adhering to lower part of ovary, lobes and tube 6 cm. long, lobes 6, about 2 cm. long and 8 mm. wide, tube green, lobes under surface green suffused with pink, upper surface green and quite heavily suffused with reddish-purple, especially toward the tips; stamens 6 cm. long, yellowish-green suffused with red dots, stamens attached to middle of each lobe at its base; anthers 18 mm. long, 2-celled, each cell 2 mm. wide and deep brownish-red in color; stigma and style 3.5 cm. long, stigma 3-lobed, ovary 3-carpellary, placenta central.--North America.

2. Agave maculosa Hook. Plate 16 and 17. Leaves 25 cm. long, 3 cm. wide at base; lanceolate, light green, splattered with transparent spots; flower stem 35 cm. tall with bracts; corolla 6 cm. long, lobes 2.5 cm. long, 6 mm. wide, much twisted; perianth 6 lobed, greenish white, corolla tube long, tubular with lines on it; stamens 1 opposite each perianth lobe; anthers reddish-brown and covered with sticky yellow pollen; pistil 3-lobed, ovary 6 cm. long, 3-carpellary, placenta central. Flowers have peculiar sweet odor.--Texas.

3. Agave Schottii Engelm. Leaves about 35 cm. long, 5 mm. wide, ascending, turned to one side, linear and very narrow, spine at tip horny, margins filiferous, white, remaining part of leaf olive-green; flower stem about 300 cm. tall (10 feet),



Plate 16. *Agave maculosa*.

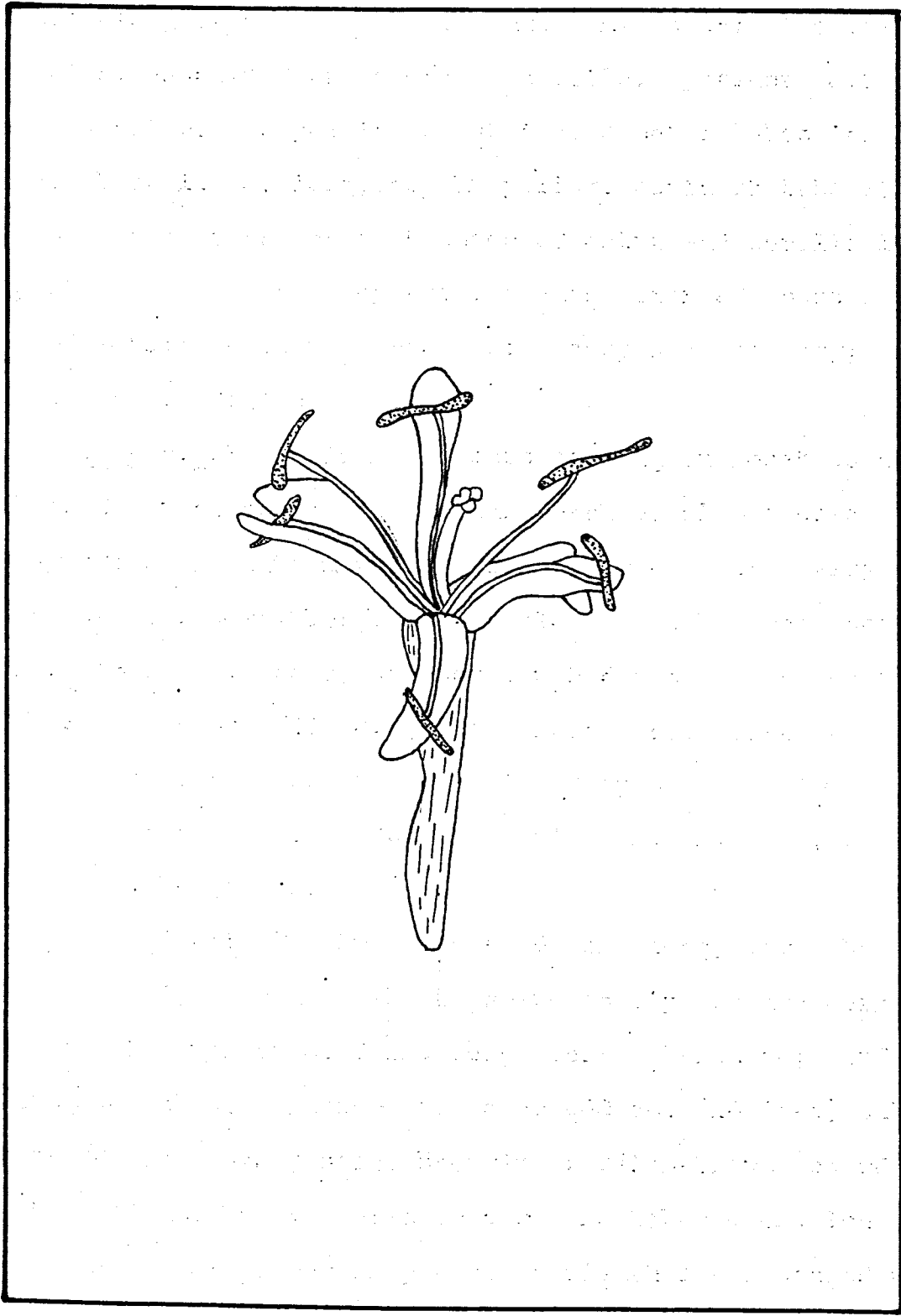


Plate 12 *Agave maculosa*.

scales along stem about 5 cm. long, 7 mm. wide; flowers borne in pairs, usually four together, sessile; perianth 3.5 cm. long, tubular, 3 sepal lobes outside, 3 petal lobes inside, lobes about 11 mm. long, bright yellow, perianth tube light green; stamens attached at union of calyx and corolla lobes, opposite the perianth segments, stamens exerted about 1 cm. beyond lobes; anthers versatile; ovary 3-carpellary; stigma 1, styles 3.--Mexico.

4. Agave parviflora Torr. Plants growing in rosettes about 7.5 to 8 inches tall; leaves many-ranked, almost erect, grayish-green with white markings, 9.5 to 10 cm. long, very sharp spine at tip, 5 mm. long, spines along edge but not sharp, about 1 cm. long, filiferous, threads tough and curve downward, white; flower stem about 150 cm. (4 to 5 feet) tall, orange-green; inflorescence spicate, flowers with very short pedicels, borne 2 to 3 in a cluster; capsule globular, 10 mm. long, 9 mm. wide; seeds black.--Mexico.

5. Agave Palmeri Engelm. Leaves 60 cm. long, more than 10 cm. wide, ascending, reddish-brown spine at tip, spines dark brown and somewhat recurved, 6 mm. long, leaves 3-ranked; inflorescence paniculate; flower stem over 300 cm. (10 feet) tall, grayish-green toward base, becoming reddish-brown toward apex; pedicel 12 mm. long; perianth tube and lobes 4 cm. long; the tube 3.5 cm. long, medium green; perianth lobes tinged with purple, not wide spreading; stamens exerted 4 cm. beyond perianth; attached at base of perianth lobes, 6; filaments suffused with purple; anthers versatile, 2-celled, 2 cm. long

yellow; ovary 3-carpellary, inferior.--Mexico.

Culture of Agaves.

Since many Agaves are native to the Southwest, they are well adapted to use in gardens here. They need a good soil of loam and sand. If they are to be planted in pots, thorough drainage must be provided or the plants will rot. They may be propagated by seeds, but hand-pollination is often necessary to obtain the seeds. The easiest way to reproduce the plants is to separate the suckers from the base of the old plant and replant these.

Other Agaves which may be grown here.

Agave Parryi Engelm. Arizona.

A. utahensis Engelm. Arizona.

A. Toumeyi

A. americana

A. Treleaseii

Aizoaceae. Carpet-weed Family

Widely distributed, prostrate or decumbent herbs, mostly succulent; flowers perfect, regular, solitary or clustered; calyx 4 or 5 lobed, free or more or less adnate to ovary; petals present or absent, many; stamens 4 to 5 or many; ovary 2 or more celled, superior or inferior; fruit a capsule.

1. Mesembryanthemum. Fig-Marigold.

Low succulent herbs, annual or perennial, prostrate or erect, sometimes subshrubs; leaves without stipules, thick, fleshy, usually opposite, 3-angled, terete or flat, with entire or more or less spiny margins; flowers axillary and terminal; calyx-tubes adnate to ovary, lobes 5 and unequal; petals many, linear, sometimes in several series, inserted together with numerous and indefinite stamens upon the tube of the calyx; ovary 5-12 celled; styles as many as cells of ovary, free or nearly so; fruit a fleshy capsule; seeds numerous and minute. Flowers pale pink.

Leaves small, triangular, and toothed...1. M. deltoides.

Leaves linear and 3-angled.....2. M. blandum.

Leaves covered with large glistening protuberances.....3. M. crystallium.

Flowers purple.

Leaves heart-shaped.....4. M. cordifolium.

Leaves linear.....5. M. edule.

Flowers white.....6. M. echinatum.



Flowers yellow.....7. M. multiceps.

Flowers cerise.....8. M. speciosum.

1. Mesembryanthemum deltoides Linn. Plate 18. Small shrub, long brownish stems; leaves short, triangular in form, on edges 3 to 4 reddish teeth with spike at end of leaf; flowers pale pink, about 7 cm. in diameter.--South Africa.

2. Mesembryanthemum blandum Haw. Plate 19. Plant procumbent; stem reddish-brown, woody; leaves 3-11 cm. long, triangular in cross-section, fleshy, medium green, glaucous, opposite; flowers terminal and solitary; sepals 5, 1-1.5 cm. long, more reduced ones partly scaly; petals distinct, linear, light pink, 2 cm. long, 2 mm. wide; stamens very many, of varying lengths up to 8 mm.; filaments white; anthers yellow; ovary 5-carpellary, inferior; stigmas 5, yellow; styles green, fleshy. (Lampranthus multiradiatus).--South Africa.

3. Mesembryanthemum crystallium. Linn. Ice Plant. Plate 20. Plant prostrate forming a thick mat on the ground; leaves on flowering shoot small, 1-2 cm. long, ovate; leaves, stems, and calyx covered with conspicuous white, glistening, watery protuberances; flower pale pink, calyx 13 mm. long, petals numerous. (Cryophytum crystallium).--California, Greece, Canary Islands, South Africa.

4. Mesembryanthemum cordifolium Linn. Dew Plant. Plate 21. Plant trailing, 2-3 feet or longer, all parts covered with tiny, glistening vesicles; stem yellowish green; leaves opposite, pairs alternate, ovate, 15 mm. long including petiole, 9 mm. wide,

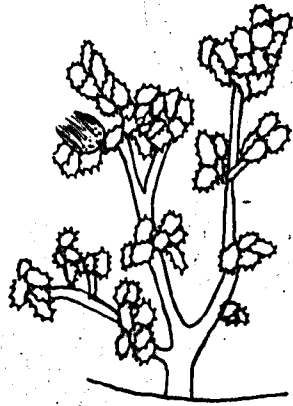


Plate 18. *Mesembryanthemum deltoides*.

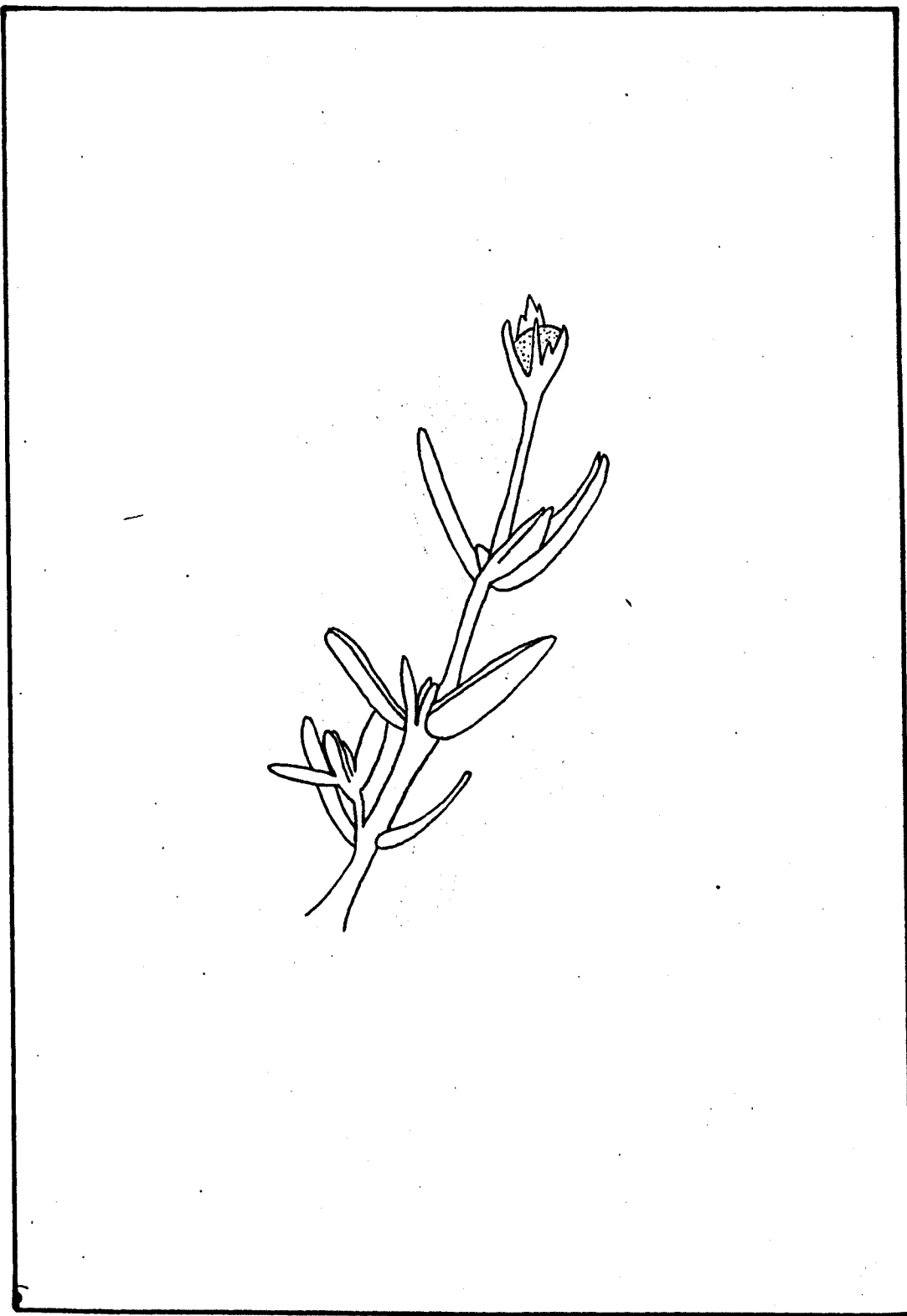


Plate 19. *Mesembryanthemum blandum*.

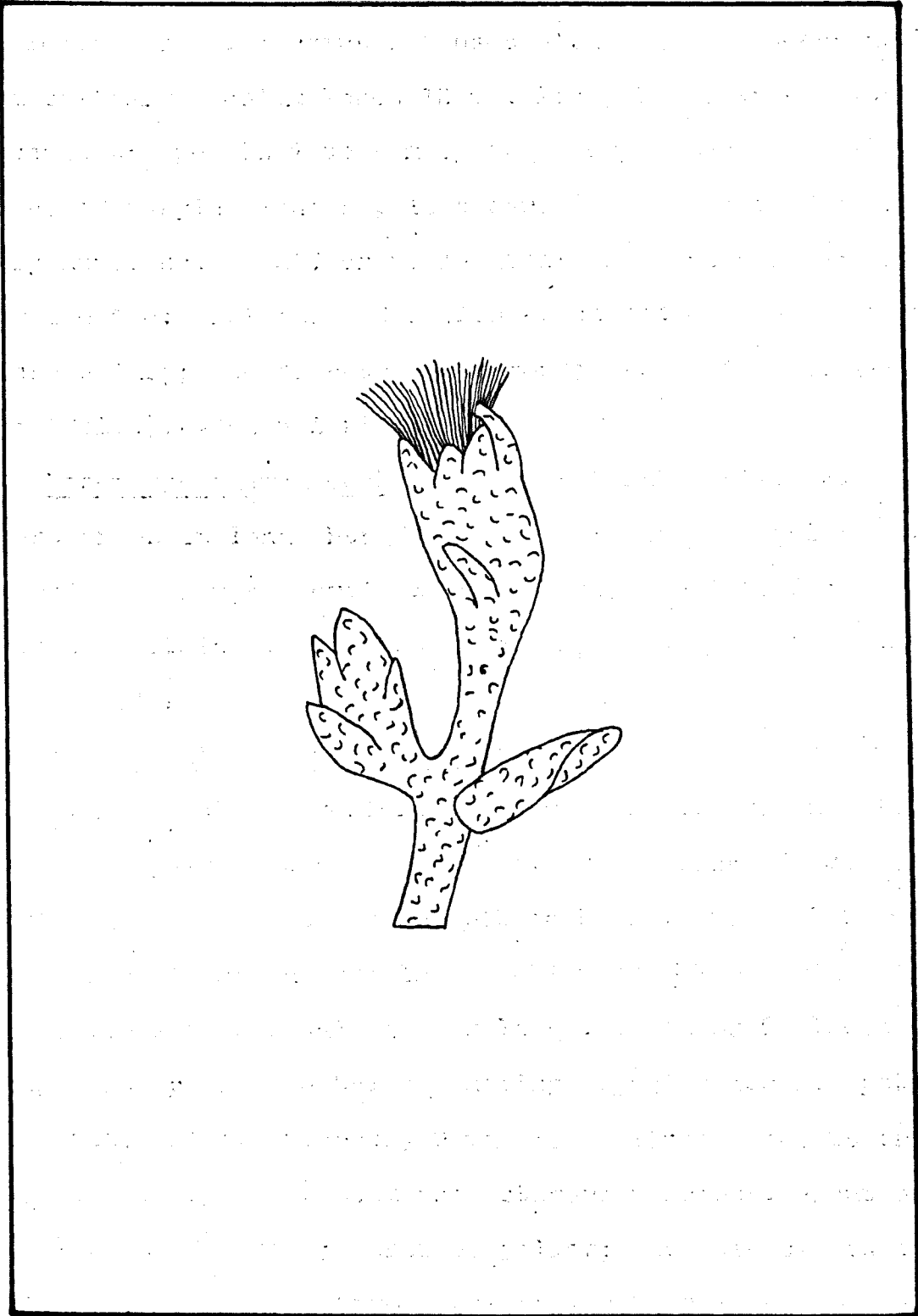


Plate 26. *Mesembryanthemum crystallinum.*

yellowish-green, margins suffused with pink; flowers axillary and solitary; calyx lobes 13 mm. long, 6 mm. wide, ovate, succulent; petals 7 to 9 mm. long, very numerous, united at base, of varying lengths, lavender; stamens united at base, very numerous, of different lengths; anthers yellow; filaments white; stigmas and styles 4, united at base; ovary 4-carpellary; seeds rather numerous; fruit fleshy. (*Aptenia cordifolia*).--South Africa.

5. Mesembryanthemum edule Linn. Hottentot-Fig. Plate 22.

Plant grows in long, hanging masses; stems angular; leaves opposite; flowers terminal and solitary, 3.5 to 6 cm. across, purple; petals linear; stamens many. (*Carpobrotus edulia*).--South Africa.

6. Mesembryanthemum echinatum Lam. Plate 23. Whole plant cover-

ed with crystalline vesicles; stem yellowish-green; leaves opposite, pairs alternate, terete, 12 mm. long, 5 mm. wide, medium green, with sparse papillose hairs, white, 1-2 mm. long; flowers solitary and axillary; calyx tube 7 mm. wide, 4 mm. long, lobes of unequal size, 2 large, 1 medium 2 almost vestigial, long white papillose hairs adhering to calyx lobes; petals distinct, white, numerous, 9 mm. long, linear, petals transitional, some almost like stamens; stamens numerous, about one-half the length of petals; anthers yellow; at base of stamens 5 dark green scales; stigmas and styles 5, yellow; ovary 5-carpellary, superior. (*Delosperma echinatum*).--South Africa.

7. Mesembryanthemum multiceps Salm. Dyck., Plate 24. Leaves

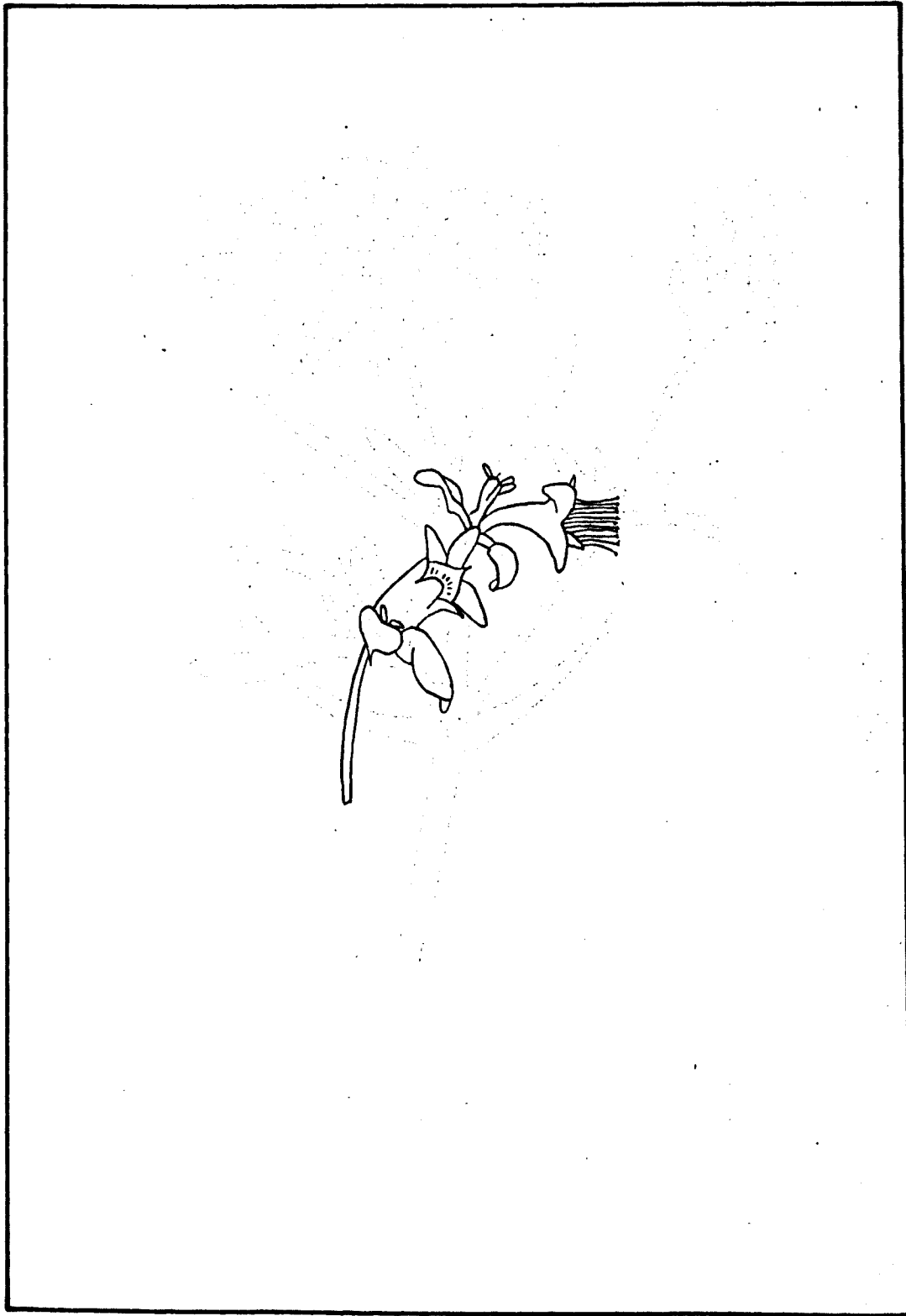


Plate 21. *Mesembryanthemum cordifolium*.



Plate 22. *Mesembryanthemum edule*.

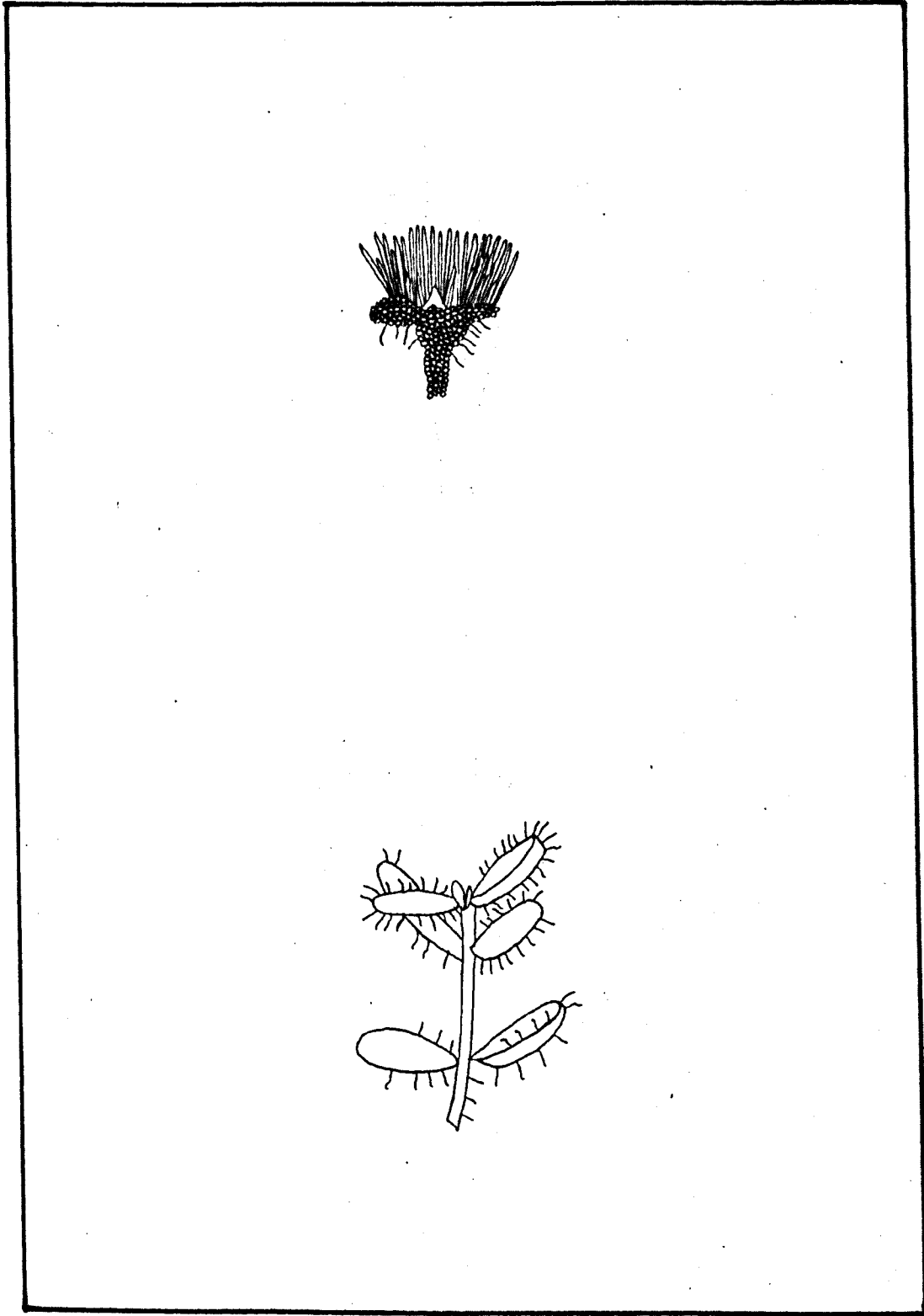


Plate 23. *Mesembryanthemum echinatum*.



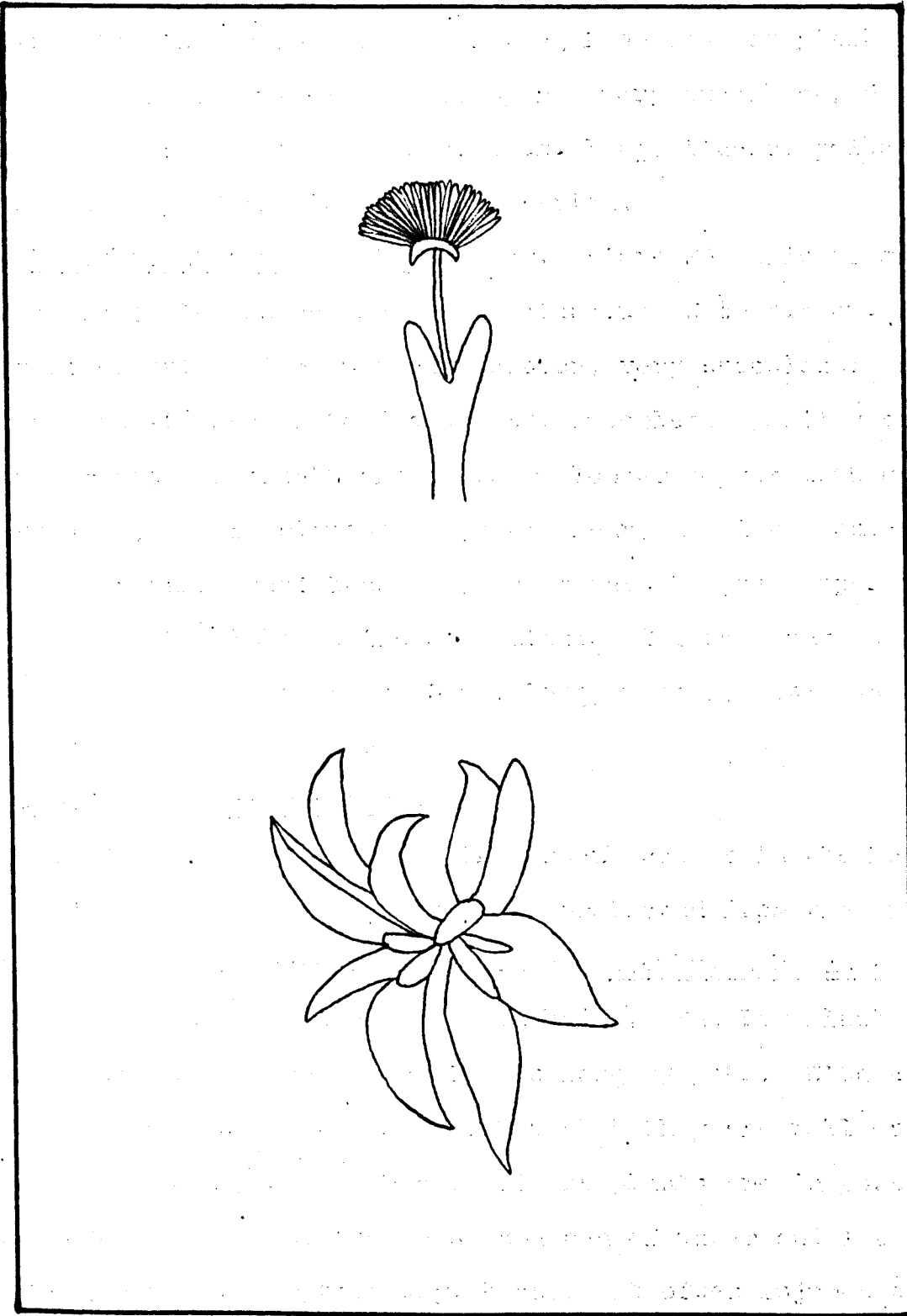


Plate 24. *Mesembryanthemum multiceps*.

triangular in cross-section, growing from base of plant, 3-6 cm. long, 12 mm. wide; sepals 5, not very succulent, 6 cm. long, green; petals numerous, 1 cm. long, linear, yellow; stamens many, 6 mm. long.--South Africa.

8. Mesembryanthemum speciosum Haw. Plate 25. Plants growing in clumps; leaves medium green, glaucous, 2 to 4.5 cm. long, opposite, triangular in cross-section, very succulent; sepals 5, united at base, 1 to 2 cm. long, succulent, smaller sepals with a membranaceous sheath around them, longer sepals much more succulent, green, glaucous; petals many, distinct, under surface of petals reddish-purple, upper part bronze, upper surface with reddish-purple stripe down middle, 2.5 cm. long, 3 mm. wide; stamens many, about 5 mm. long, yellow; stigmas 5, green; ovaries numerous.

#### Culture of Mesembryanthema.

These plants may be grown in the greenhouse or in the home. If care is taken to see that they are protected from the frost in winter, some of these forms, such as Mesembryanthemum speciosum, can be used to form dense mats on banks. The Dew Plant is found most often in the home, growing in hanging pots. With all of these plants, care should be taken that they are well drained, and given plenty of sunshine. If the plants are in pots, it is better to immerse the pots in a pan of water and let them take up their water this way, because it often injures the leaves when water is allowed to stand between them. During the winter resting season, water should be given only sparingly. A

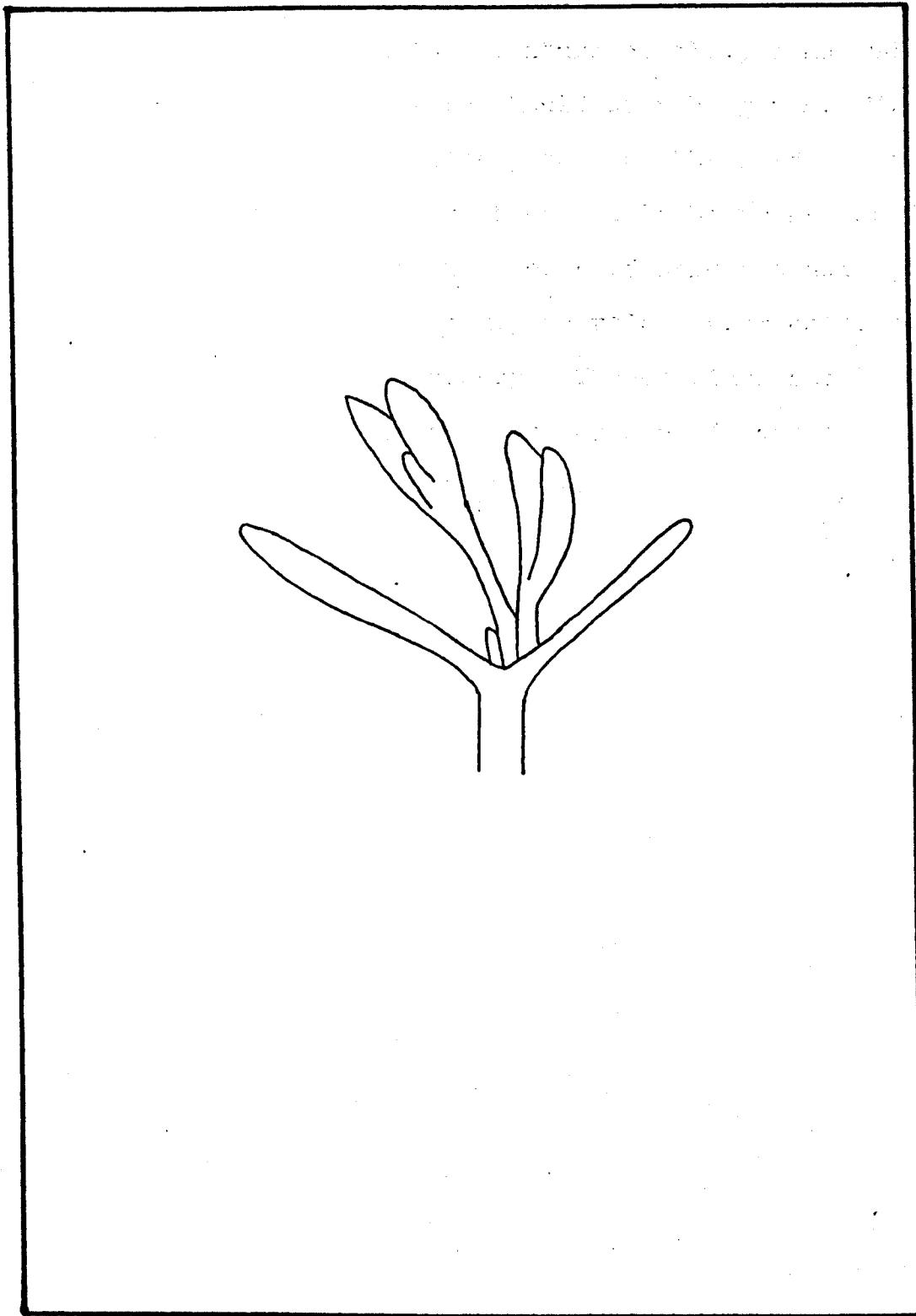


Plate 25. *Mesembryanthemum speciosum*.

good soil for the plants is a mixture of clay, sand and matured leaf mold. No fertilizers should ever be given. M. cordifolia is propagated by putting pieces of the stems in sand. As soon as these have rooted, they should be transferred to a small pot, containing a mixture of half sand and half good garden soil. M. crystallium may be raised from cuttings or from seed planted indoors in February. The cuttings should be four inches long, and dried in the sun for 2 or 3 days and then put into a sand bed until they have rooted.

Portulacaceae. Purslane Family.

Mostly more or less fleshy herbs and small shrublets; plants prostrate or erect, mostly glabrous; leaves alternate or opposite, sometimes connate, entire; flowers regular or irregular, sepals usually 2; petals 4-5 or seldom more, sometimes connate at base; stamens few or many; ovary single, 1-celled, with central or basal placenta; style 2 to 3 parted; fruits mostly dehiscent capsule; seeds usually many.

Leaves opposite.....1. Portulacaria.

Leaves alternate or nearly opposite.

Flowers showy.....2. Portulaca.

Flowers small and inconspicuous.....3. Talinum.

1. Portulacaria Afra. Stem woody; plant many-branched almost from base, branches up to 60 cm. long, outspreading; leaves opposite-alternate, very succulent, sessile, medium green, 2 cm. wide, 2.7 cm. long, broadly ovate.

2. Portulaca.

Fleshy mostly annual herbs, glabrous; leaves usually alternate or scattered, flat or terete, upper ones forming involucre to flowers; flowers open in sunshine; sepals 2, forming a tube at base and adnate to ovary; petals mostly 6, inserted on calyx, as also are the 7 or more stamens; style 3 to 9 parted; fruit small pod, 1-celled, many-seeded.

1. Portulaca grandiflora Hook. Rose Moss. Plate 26. Plants small upright or prostrate herb; leaves medium green, 2 cm.

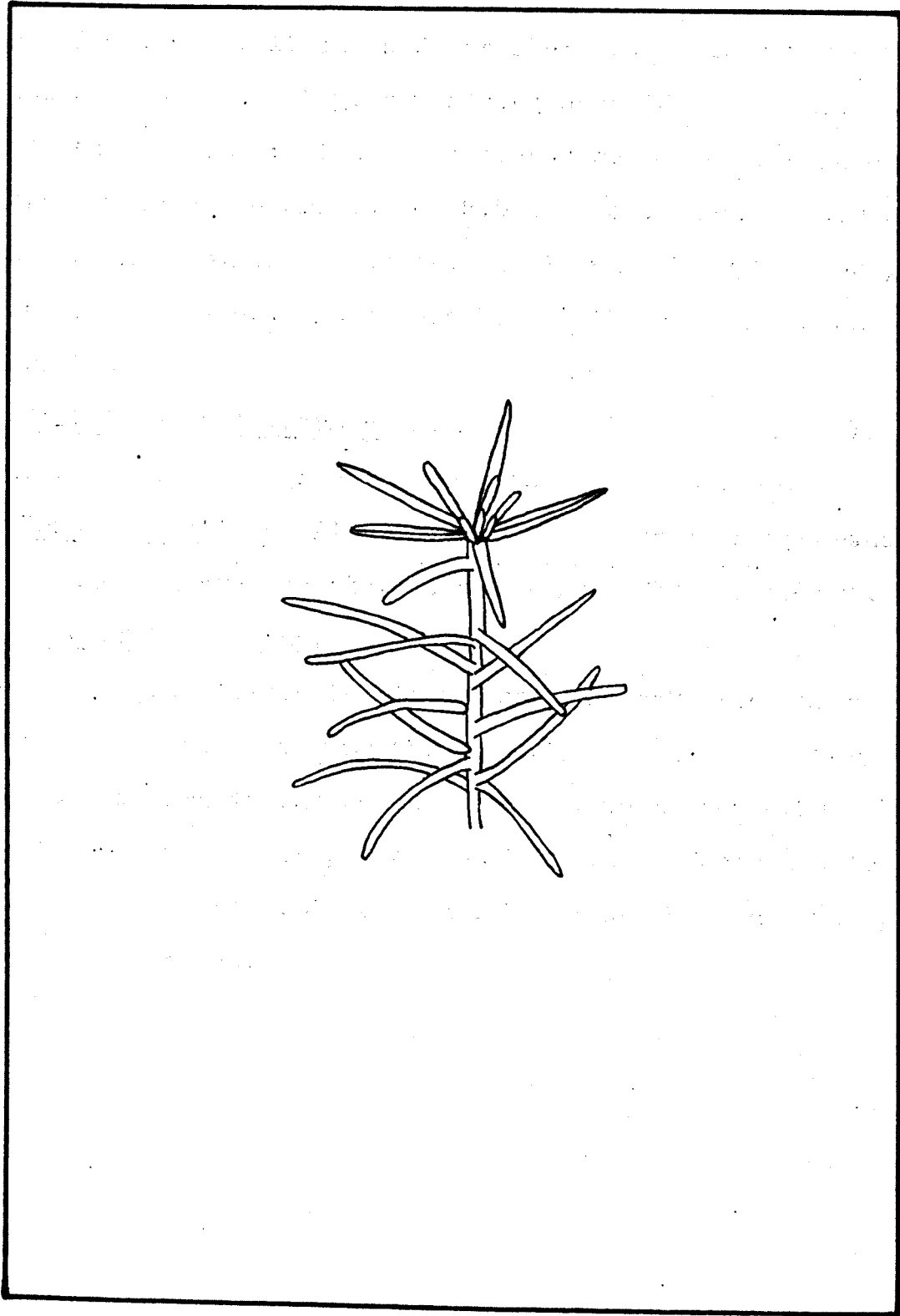


Plate 26. *Portulaca grandiflora*.

long, 2 mm. wide, linear and sessile; stem slender and terete, prostrate and ascending, not rising over 15 to 30 cm., hairy in tufts at joints; leaves scattered or somewhat clustered, short; terete flowers large, 2.5 to 5 cm. across, terminal and subtended by clustered leaves, in many bright colors, red, orange, and yellow. An old-fashioned flower still much grown. --Brazil.

2. Portulaca stelliformis F. Muell. Plant 18 cm. tall, leaves linear and terete, green, 2 cm. long, flowers rose.

3. Portulaca pilosa Linn. Plant 17 cm. tall, many-branched from base; leaves terete, 13 mm. long; flowers orange.

#### Culture of Portulacas.

*Portulaca grandiflora* is often found in rock gardens, as borders, or as solid mats covering the ground. The plant is very colorful, and blooms in the hot summertime, when few other plants are in flower. It is propagated by seeds. These should be sown in light sandy soil, in the full blaze of the sun. The plants bloom until frost.

Crassulaceae.

Herbs or shrubs, differing greatly in habit; leaves opposite or alternate, frequently in basal rosettes, often each pair connate at base, simple; stipules none; flowers often in cymes; bracts present or absent; calyx persistent, 3 to 5, rarely 6 to 30-parted; petals as many as sepals, free or more or less connate; stamens as many as, or twice as many as the petals; usually glands at base of each carpel; pistils as many in number as the petals; fruit free follicles, very rarely a 4-locular capsule, many seeded; seeds very minute.

Stamens as many as petals.....1. Crassula.

Stamens twice as many as corolla lobes.

Parts of flower in four's.

Stamens attached near base of corolla-tube.....2. Bryophyllum.

Stamens attached at middle of corolla-tube.....3. Kalanchoe.

Flowers usually 5-parted.

Inflorescence terminal.

Petals distinct.....4. Sedum.

Petals united at base.....5. Cotyledon.

Inflorescence axillary and terminal.

Leaves clasping stem at base.....6. Dudleya.

Leaves not clasping stem at base....7. Echeveria.

1. Crassula.

Herbs of shrubs, fleshy; leaves opposite, rarely petioloid,



often united at the base, fleshy, glabrous, pubescent, or scaly; flowers usually somewhat small, white, rosy, or rarely yellow, often in loose cymes, rarely in heads; calyx 3-5 parted, lobes erect or spreading; petals 3-5, free or united at base, erect or spreading; stamens 3-5, shorter than the petals; glands various; carpels 3-5, free; stigma small; style short; fruit 3-5, many seeded follicle.

Plants tall and shrubby.

Leaves awl-shaped and opposite leaves connate at base.....1. C. tetragona.

Leaves not awl-shaped.....2. C. arborescens

Plants of medium height.....3. C. perforata.

1. Crassula tetragona Linn. Plant 120 cm. tall, many-branched from base; lower leaves deciduous leaving branches scarred; leaves 1 to 3 cm. long, triangular in cross section, upper surface flat, yellowish green, linear, opposite-alternate, 2 opposite leaves joined at their bases and encircle stem of plant, leaves about 2.5 mm. apart of stem; inflorescence cymose; flower 4 mm. wide; sepals 5, united at base, light green, less than 1 mm. long; petals 5, opposite sepals, distinct, white, 3 mm. long, 1 mm. wide; stamens 5, attached to petals, not quite as long as petals; filaments white; anthers black; ovaries 4, distinct, white.--South Africa.

2. Crassula arborescens Willd. Plate 27 and 28. Plant 2-4 feet tall; stems woody; leaves opposite, pairs alternate, 3-7 cm. long, 1.5 to 2.5 cm. wide, yellowish-green, dotted with red,

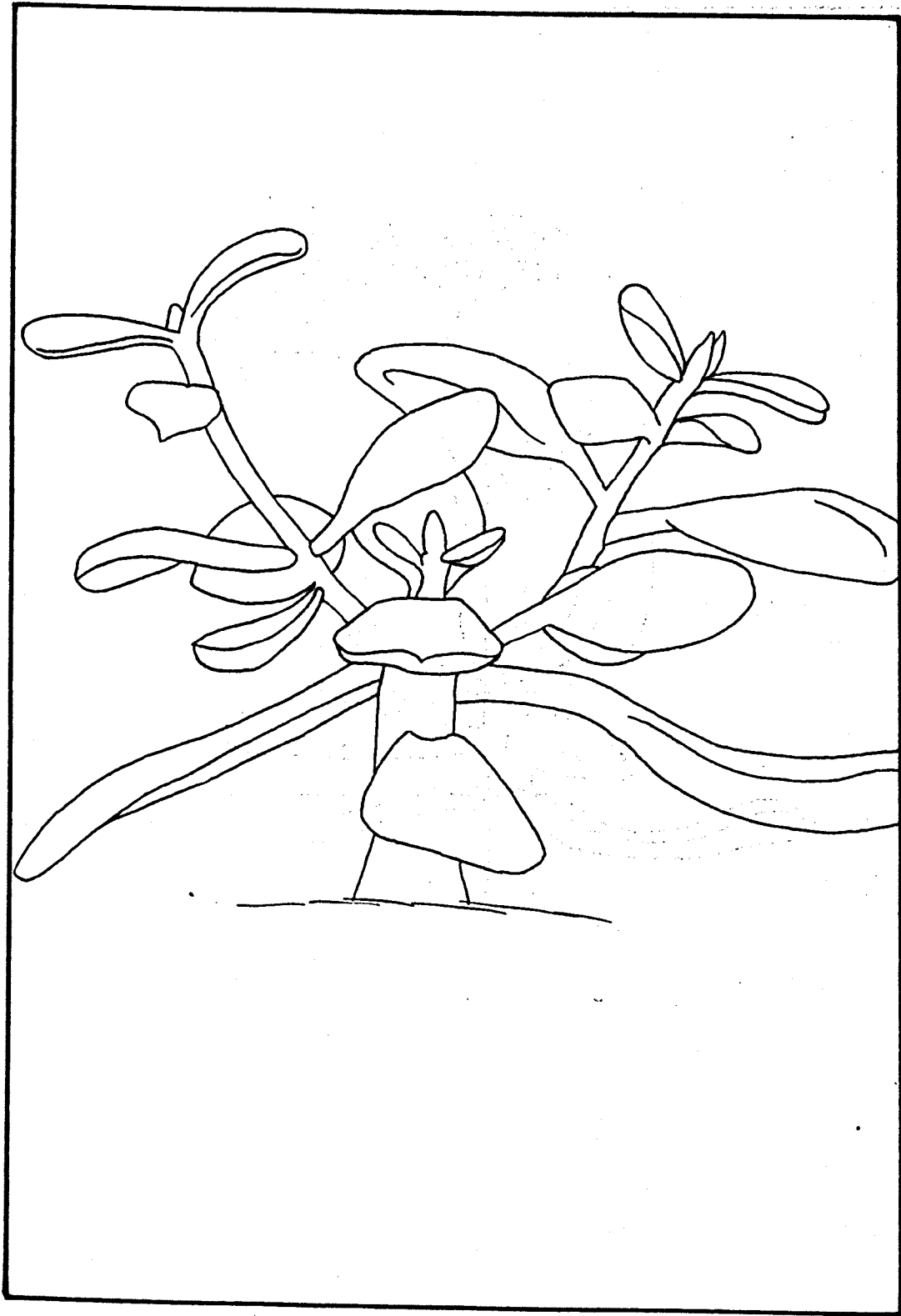


Plate 27. *Crassula arborescens*.

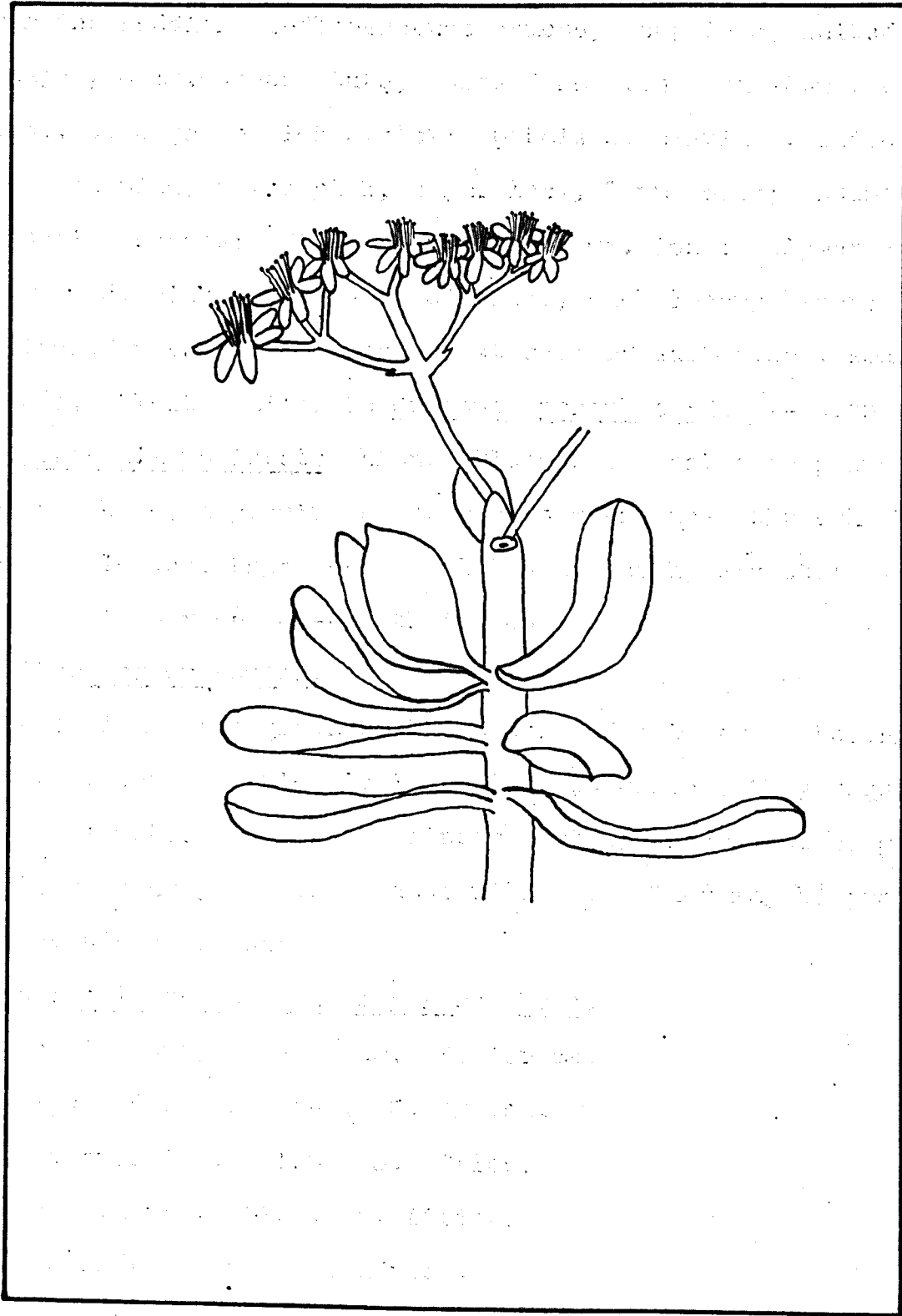


Plate 28. *Crassula arborescens*.

margins reddish; inflorescence cymose; sepals 5, united, cup-shaped, 3 mm. across tube, lobes 5 mm. long, and 5 mm. wide at base, tube green, lobes pink; petals 5, distinct, white suffused with pink, veins pink, 8 mm. long, 3 mm. wide; stamens 5, opposite sepals; filaments white, 5 mm. long; stigmas and styles 5, pink, ovaries 5, distinct, each 1-carpellary, white suffused with pink, superior, at base of each ovary, small red scale. Plant similar to Crassula portulacoides.--South Africa.

3. Crassula perforata Linn. Plate 29. Leaves in pairs, united at the base, appearing as though stem extended through the bases of the leaves, these green, glabrous, doubly cordate; inflorescence slender spike.--South Africa.

Culture of Crassulas.

These plants are grown both indoors and outdoors. During their growing period, which is in spring and summer, they require liberal watering. In the winter months, water must be given only sparingly, or the plants will rot. They may be propagated by cuttings in sand.

Other cultivated Crassulas found here.

*Crassula portulacea*. Lam. S. Africa.

*C. lycopodioides*. Lam. S. Africa.

*C. pyramidalis*. Linn. S. Africa.

*C. columnaris*. Linn. S. Africa.

*C. barbata*. Linn. S. Africa.

*C. falcata*. Wendl. S. Africa.

*C. multicava*. Lem. S. Africa.

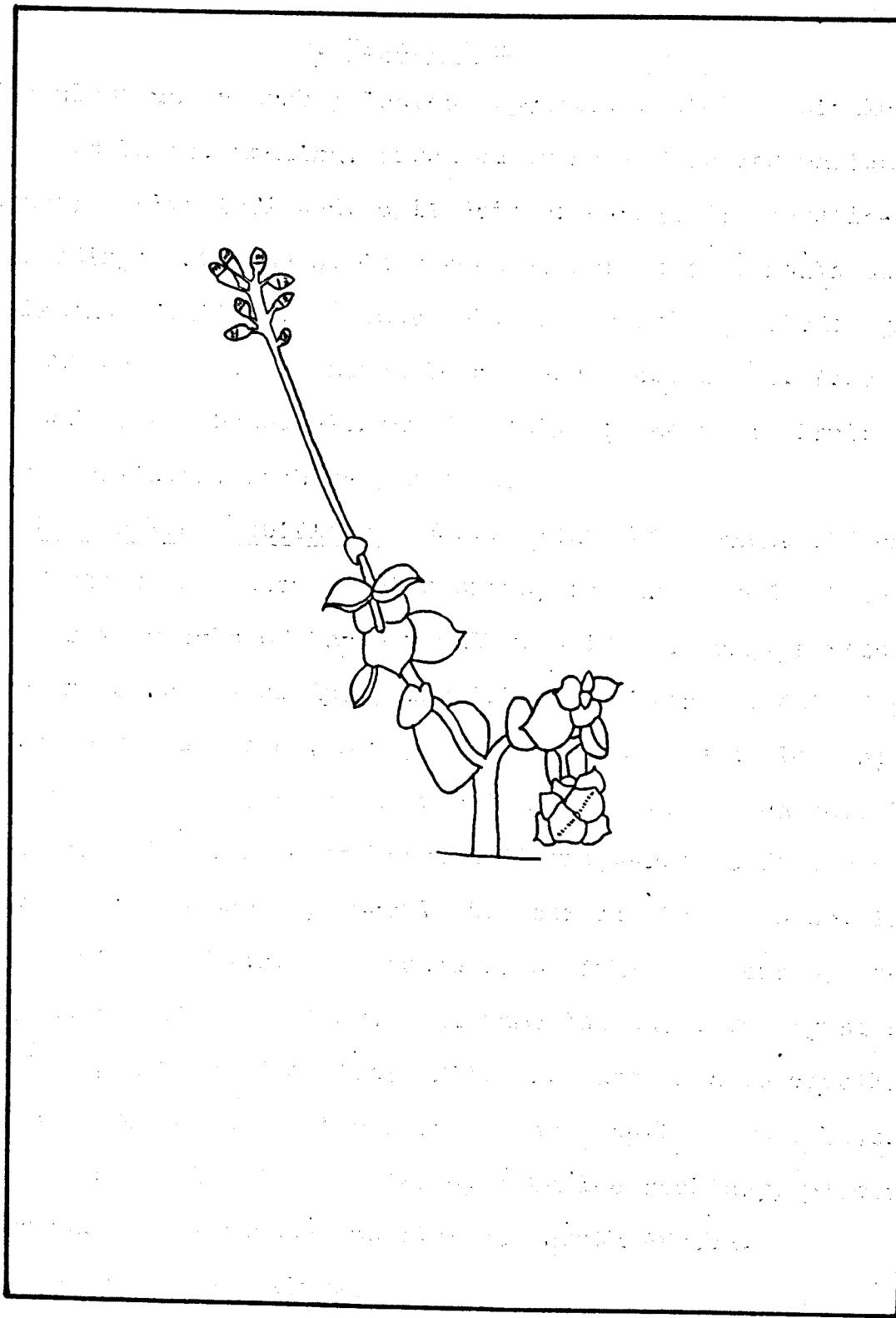


Plate 29. *Crassula perforata*.

2. Bryophyllum.

Succulent undershrubs; leaves opposite, petioled, simple; flowers large, nodding, arranged in many-flowered paniculate cymes; calyx inflated, cylindric or 4-angled; corolla-tube spreading; stamens 8, in 2 rows, inserted on corolla-tube; filaments filiform; anthers oblong, shortly exerted; glands 4, oblong, free, or united to carpels; carpels 4, free or united at the base, elongated; stigmas globose; fruit of 4 free follicles, each many-seeded.

1. Bryophyllum tubiflorum Harv. Plate 30. Plant 180 cm. (6 feet) tall; stem reddish brown, somewhat woody at base; leaves in whorls of three usually, 3-10 cm. long, terete, linear, 5 spines at apex, tannish grayish-green, dotted with large brown blotches, new plants grow at tips of leaves; inflorescence solitary and terminal; sepals 4, united, 14 mm. long, 6 mm. wide at base, dull gray-green suffused with light reddish-purple, succulent; corolla-tube 2.5 cm. long, 5 mm. wide, yellowish suffused with pink; stamens 8, exerted beyond corolla-tube 4 mm., all same length, 4 vestigial scales at base; anthers 2-celled; filaments attached to corolla-tube 17 mm. from base; stigmas 4, yellow, exerted 5 mm. beyond anthers; styles 4; ovaries 4, each 1-carpellary, placenta parietal. (*Kalanchoe tubiflora*).--South Africa.

Culture of Bryophyllums.

These plants do best in a fairly dry atmosphere and in a sunny

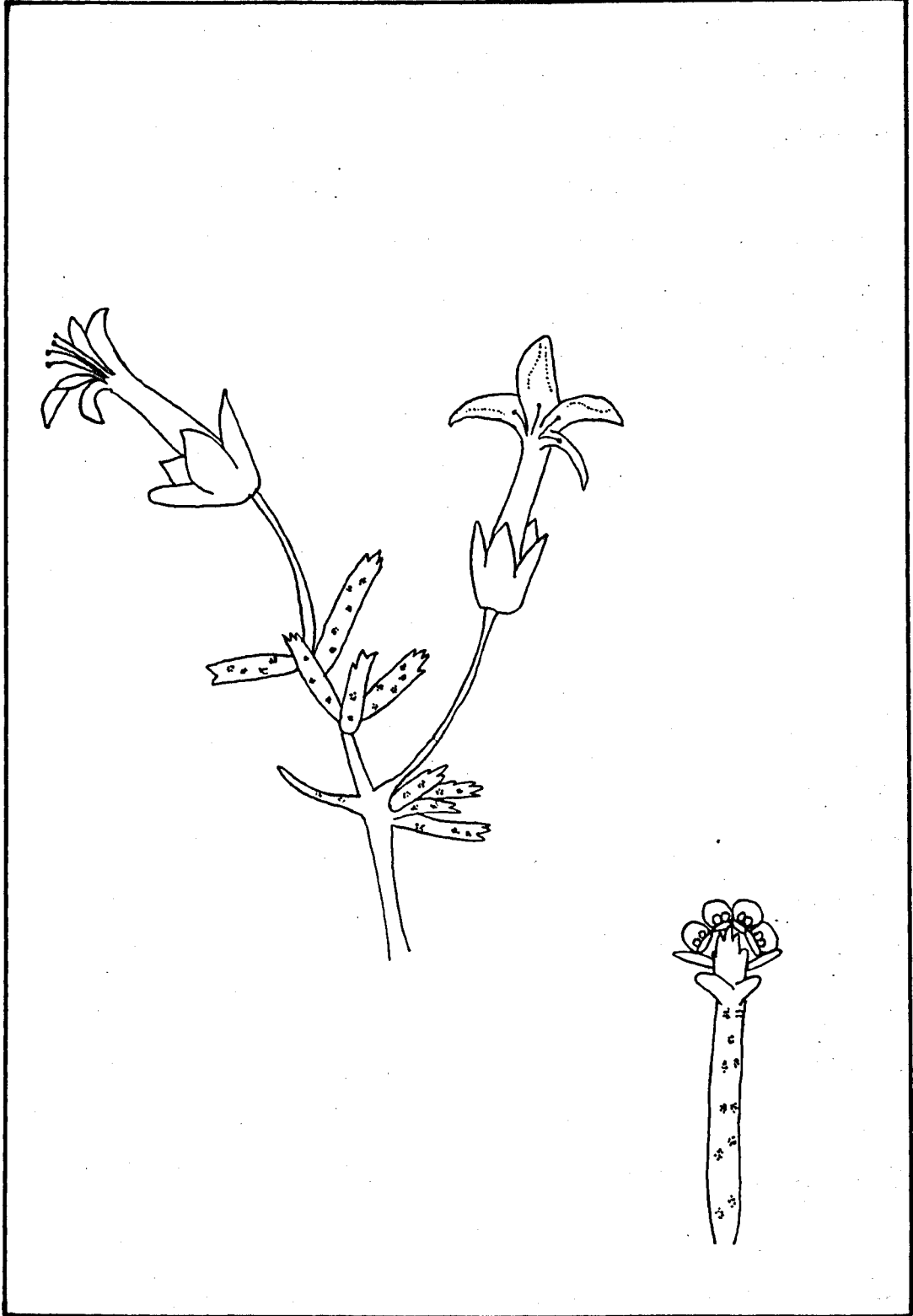


Plate 30. *Bryophyllum tubiflorum*.

position. They must be protected from the frost, or they will die. As with other succulents they should be repotted in the spring and good drainage should be assured. A compost of old brick and mortar, loam and sand should be used. Although they may be propagated in the usual way by seeds and stem-cuttings, the best way is to place a leaf on the surface of wet sand and allow the young plants to grow around the margins of the leaves.

Other Bryophyllums found here.

Bryophyllum crenatum. Baker. Madagascar.

B. calycinum. Salisb. Mexico.

B. pinnatum. Salisb. Mexico.

3. Kalanchoe

Herbs or robust shrublets; leaves opposite, fleshy, sessile or petioled, entire; flowers large, arranged in many-flowered paniculate cymes; calyx 4-parted almost to base, shorter than corolla-tube; lobes linear or ovate; corolla urn-shaped, 4-parted, spreading border; stamens 8, in 2 rows, adnate to corolla-tube; filaments short; anthers long; glands 4, linear, or oblong; carpels 4, adnate to base of corolla-tube; fruit 4 membranaceous follicles, many-seeded.

Flowers solitary and terminal.....1. K. marmorata.

Flowers in cymes.

Stamens unequal in length.....2. K. coccinea.

Stamens equal in length.....3. K. daigremontanum.

1. Kalanchoe marmorata Bak. Plate 32. Leaves and stems succu-



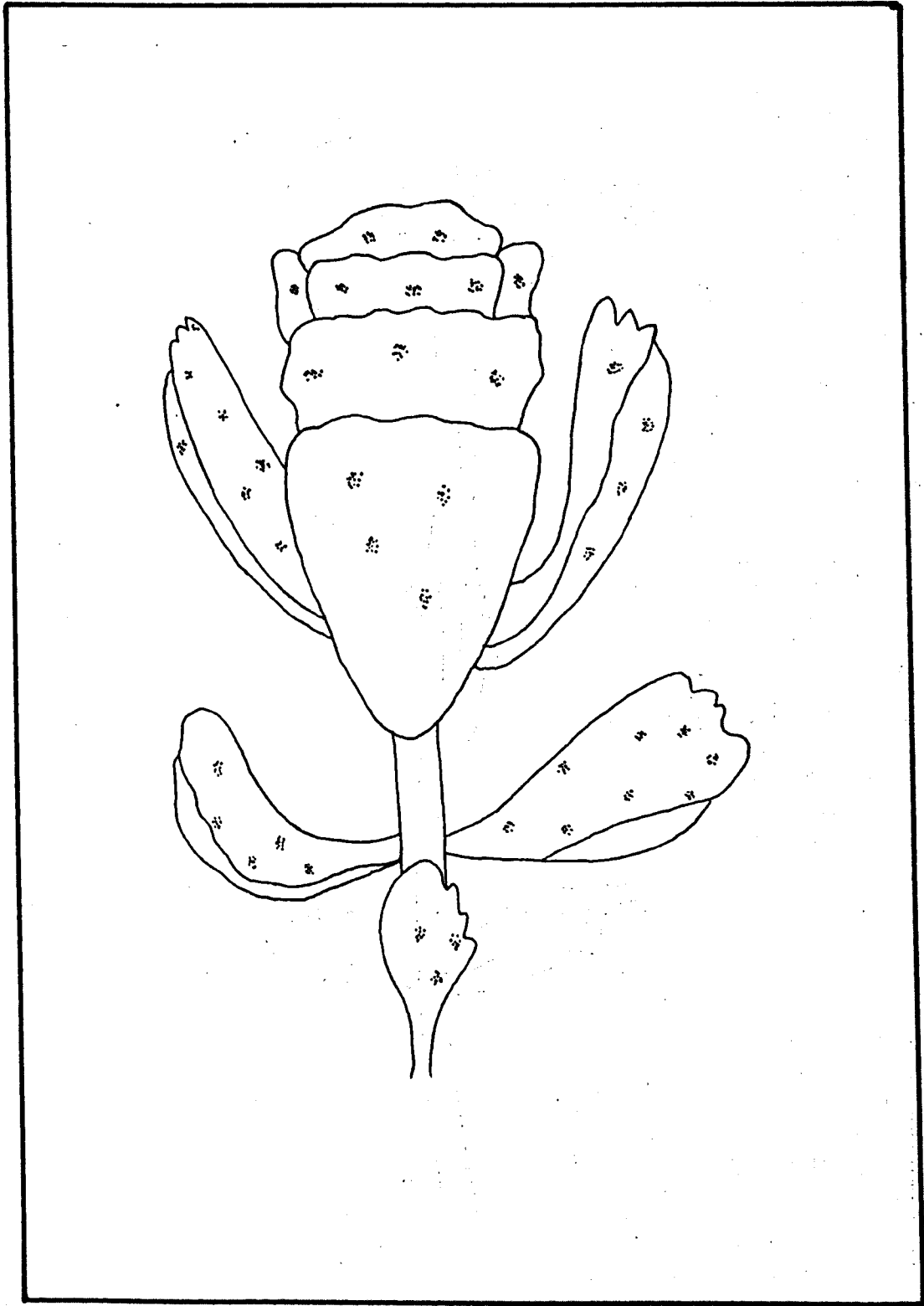


Plate 32a. *Kalanchoe marmorata*.

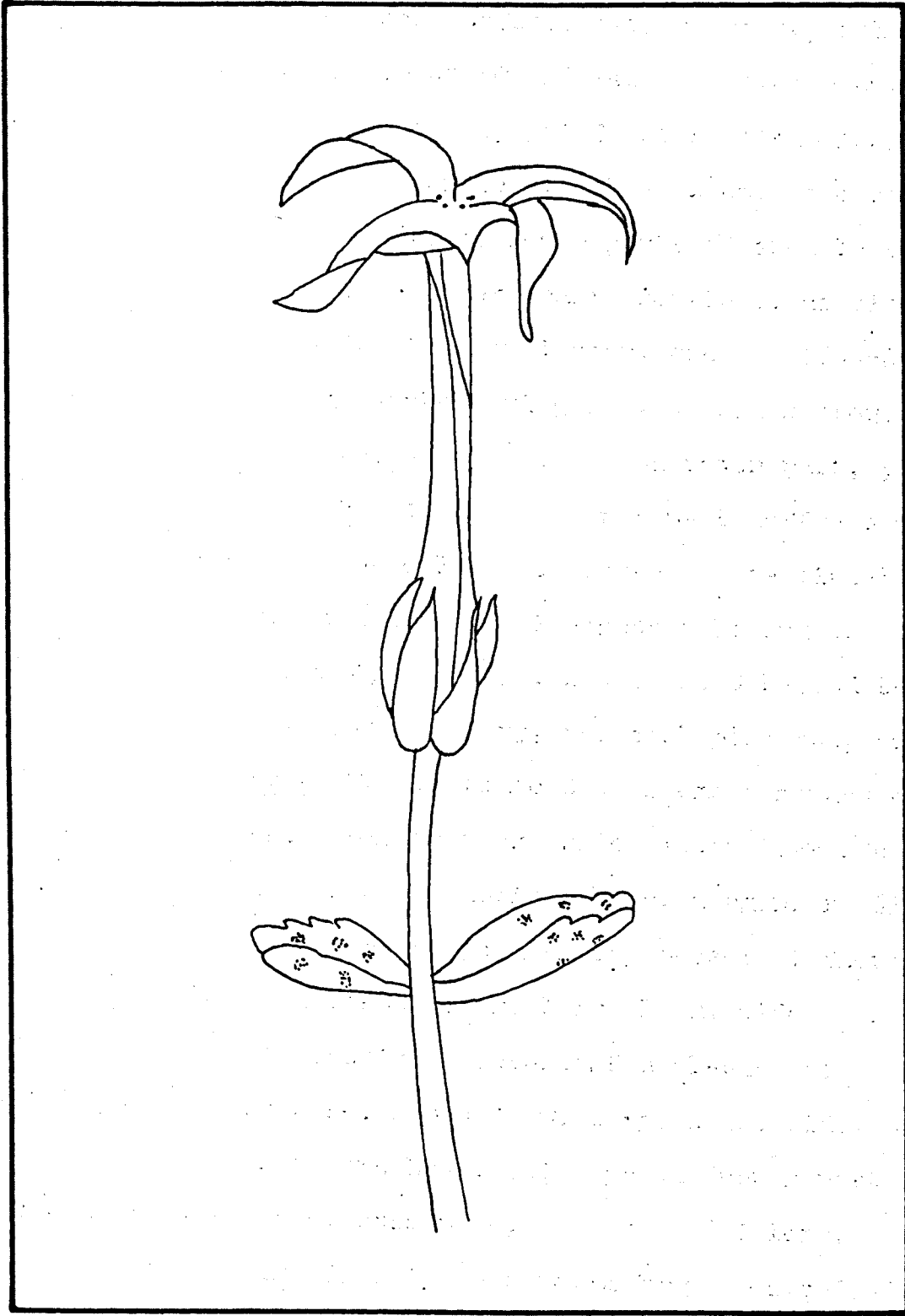


Plate 32b. *Kalauchoe marmorata*.

lent; stem yellowish-green suffused with reddish-purple, somewhat woody toward base, about 60 cm. long; leaves 3 cm. to 8.5 cm. long, sessile, opposite, pairs alternating, grayish-green dotted with reddish-purple blotches, 2 cm. to 5 cm. wide, obovate; leaves falling off of lower parts of stem leaving it definitely jointed; flowers terminal; sepals 4, distinct, 2.5 mm. long, 4 mm. wide at base, linear, green suffused with reddish-purple; corolla-tube 4-ridges, long and narrow, 11 cm. long, 9 mm. wide at base, 4 mm. wide at narrower part, yellowish-green; corolla lobes 4, white, inner part suffused with yellowish-green; stamens 4 long, 4 shorter, 4 vestigial, long stamens reach to corolla lobes; filaments adhering to walls of corolla-tube; stigmas 4, greenish, not exerted beyond tube; styles 4; ovaries 4, 1-carpellary, parietal placenta, superior.

2. Kalanchoe cocinnia Welw. Plate 33. Stems somewhat woody; leaves 1-3 cm. long, 5 mm. to 2 cm. wide, lower leaves petioled, upper leaves not petioled, yellowish-green, margins reddish-purple, glabrous, opposite-alternate, joints very close; inflorescence cymose; sepals 4, distinct, 3 mm. long, 1 mm. wide at base, yellowish-green, tip reddish; corolla funnel-shaped; tube 9 mm. long, 3 mm. wide at base, lobes 4 mm. long, 3 mm. wide, pink suffused with green toward base, veins green, upper part deep rose; corolla lobes 4; stamens 8, 4 short and 4 long, neither exerted, attached immediately to corolla tube; carpels 4, deep green.--Tropical Africa.

3. Kalanchoe daigremontanum Berg. Plate 31. Robust tender suc-

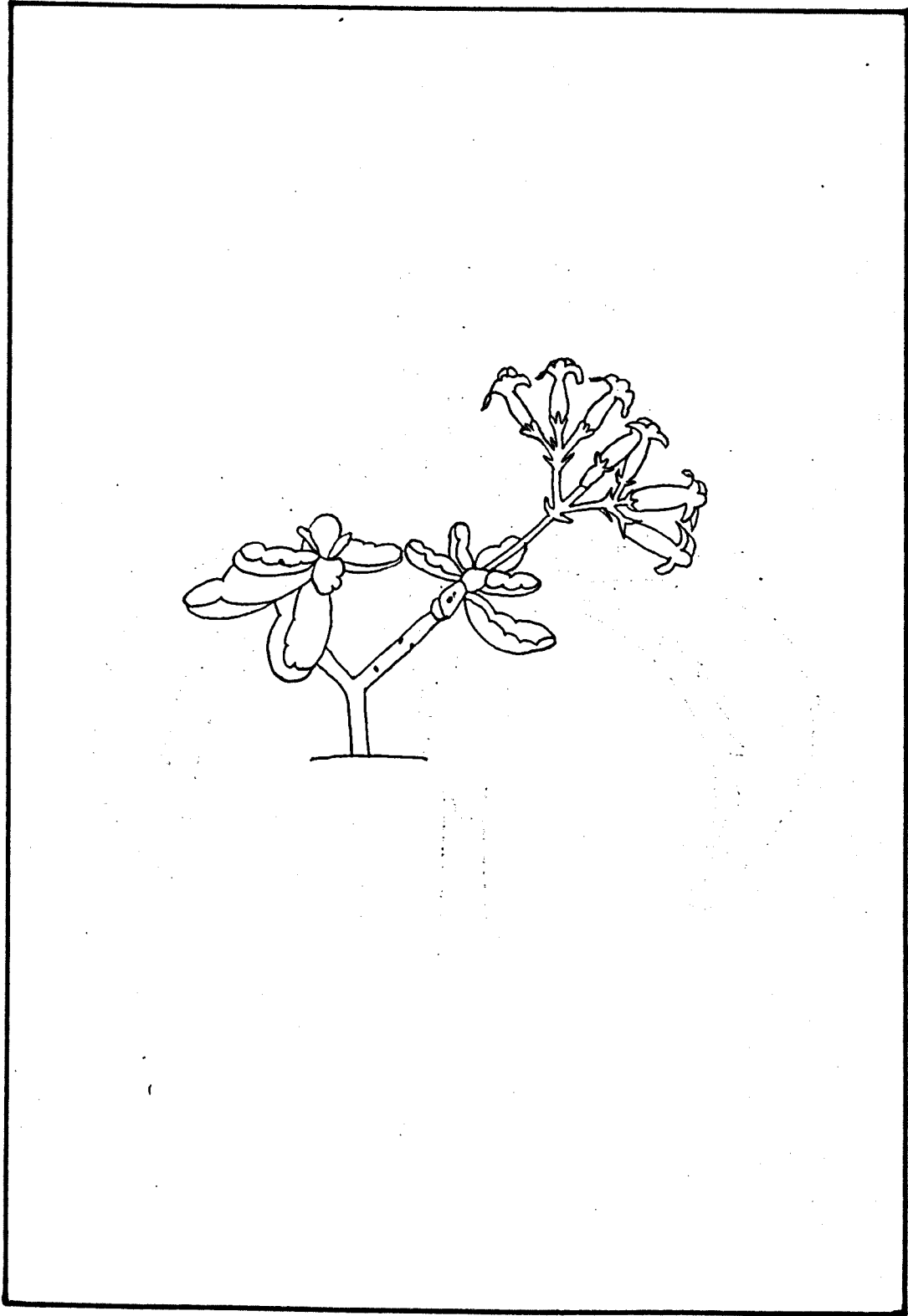


Plate 33. *Kalanchoe coccinea*.

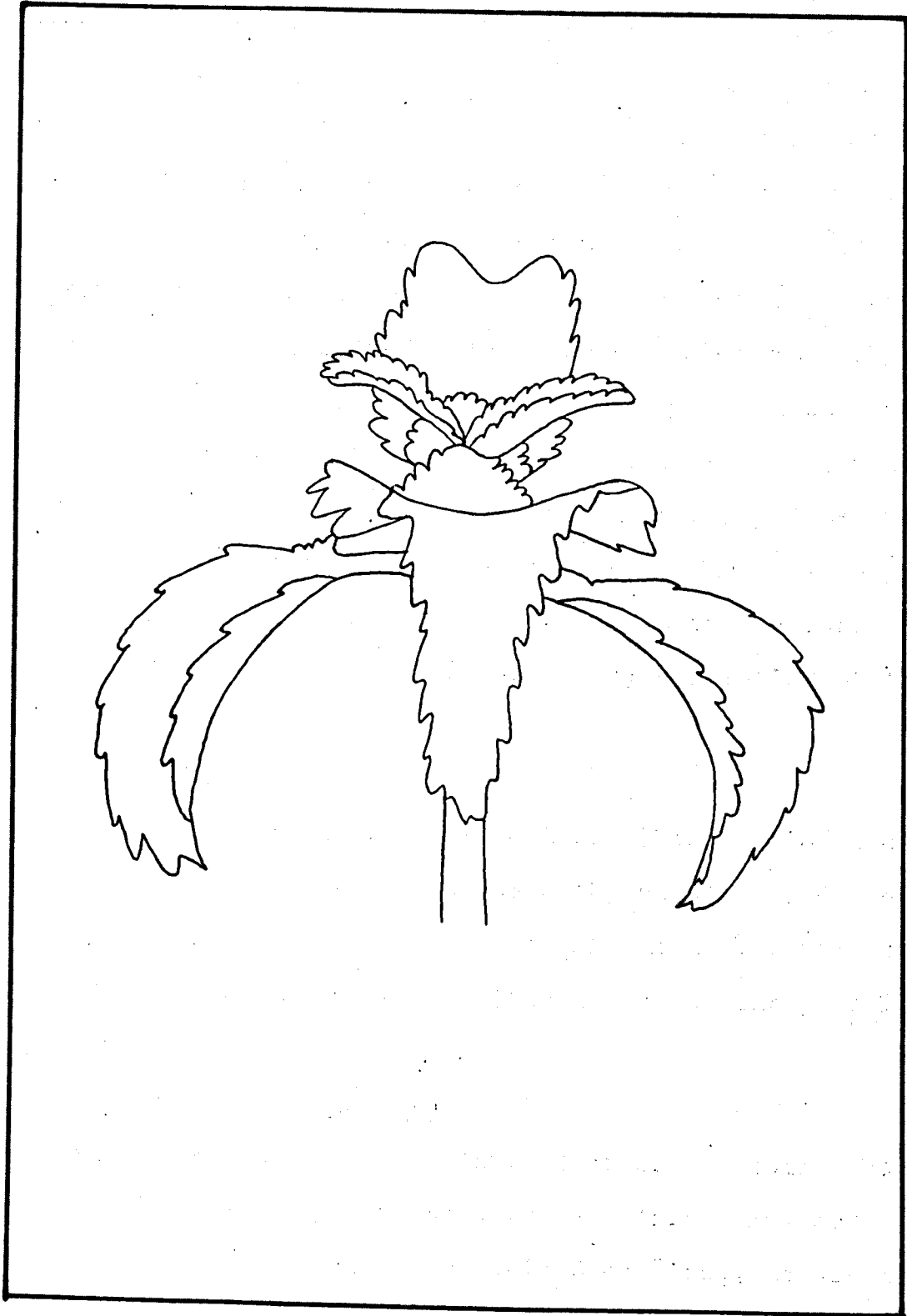


Plate 31. *Kalanchoe daigremontanum*.

culent, growing 60-240 cm. (2-8 feet) tall; leaves opposite, petioled, 8-25 cm. long, 2-7 cm. wide near base, petiole one-fourth of the length of the blade or less; upper surface of blade medium green, lower one grayish-green, blotched with red toward the outside; margins reddish, coarsely bluntly toothed; flower stems 1-2.4 m. long; inflorescence cymose, about 10 cm. across; sepals 4, united below, campanulate, grayish-green suffused with pink, 9 mm. long, including the lobes, the tube 5 mm. wide; corolla tubular-campanulate, petals 4, united below, 2.5 cm. long, tube 5 mm. wide near base, 3 mm. wide above, corolla rose suffused with green toward its base; stamens 8, equal in length, attached 5 mm. above the base; filaments deep rose above; ovary superior, consisting of 4 carpels united.

Culture of Kalanchoes.

Kalanchoes will stand a colder climate than many of the other succulents. They may be propagated by cuttings and seeds. Many of them will start new plants if the leaves fall to the ground and find favorable conditions such as sandy soil and moisture.

Other Kalanchoes found here.

- ✓ Kalanchoe flammea. Stapf. Plant about 30 cm. tall, whole plant covered with pubescence, white hairs, 1 mm. long; leaves opposite-alternate, petiole 6 cm. long, leaves 1-10 cm. long, 4-7 cm. wide, ovate, edge crenate, medium green, reddish around nodes of stems.

K. crenata. Haw. Tropical Africa.

4. Sedum.

Perennial herbs; leaves alternate, glabrous; flowers in terminal cymes usually consisting of a few racemose branches, rarely solitary, white, yellow, and rose, rarely red or blue; calyx 5-lobed; petals 5, distinct, nearly to base; stamens 8-10, perigynous; carpels 5, quite distinct; ovules numerous; follicles several-seeded.

Small creeping, mat-forming plant.....1. S. lydium.

Small much-branched bushy plant.....2. S. multiceps.

1. Sedum lydium Boiss. Plate 34. Plant trailing; stems 40 cm. long; leaves succulent, terete, grayish-green, glaucous, whorled, sessile, 7 mm. long; flowers solitary and axillary, 13 mm. across; pedicel 2 mm. long; sepals 5, distinct, 3 to 5 mm. long, 1 mm. wide, succulent, grayish-green, glaucous; petals 2 mm. wide, white on upper surface, lower surface with brownish midrib, petals star-like; stamens 10, 5 opposite sepals, 5 opposite petals, 4 mm. long; anthers green; filaments white; stigmas and styles 5; ovaries 5, distinct, 3 mm. long.--Asia Minor.

2. Sedum multiceps Coss. and Dur. Small much-branched, bushy plant, 8 to 10 cm. tall; leaves crowded very close together, usually at tip of branches, succulent, linear, 6 mm. long; sepals 5; petals 5, distinct, yellow, about 5 mm. long; stamens 10, 5 opposite sepals, 5 opposite petals, almost as long as petals; ovaries 5, distinct.--Algeria.

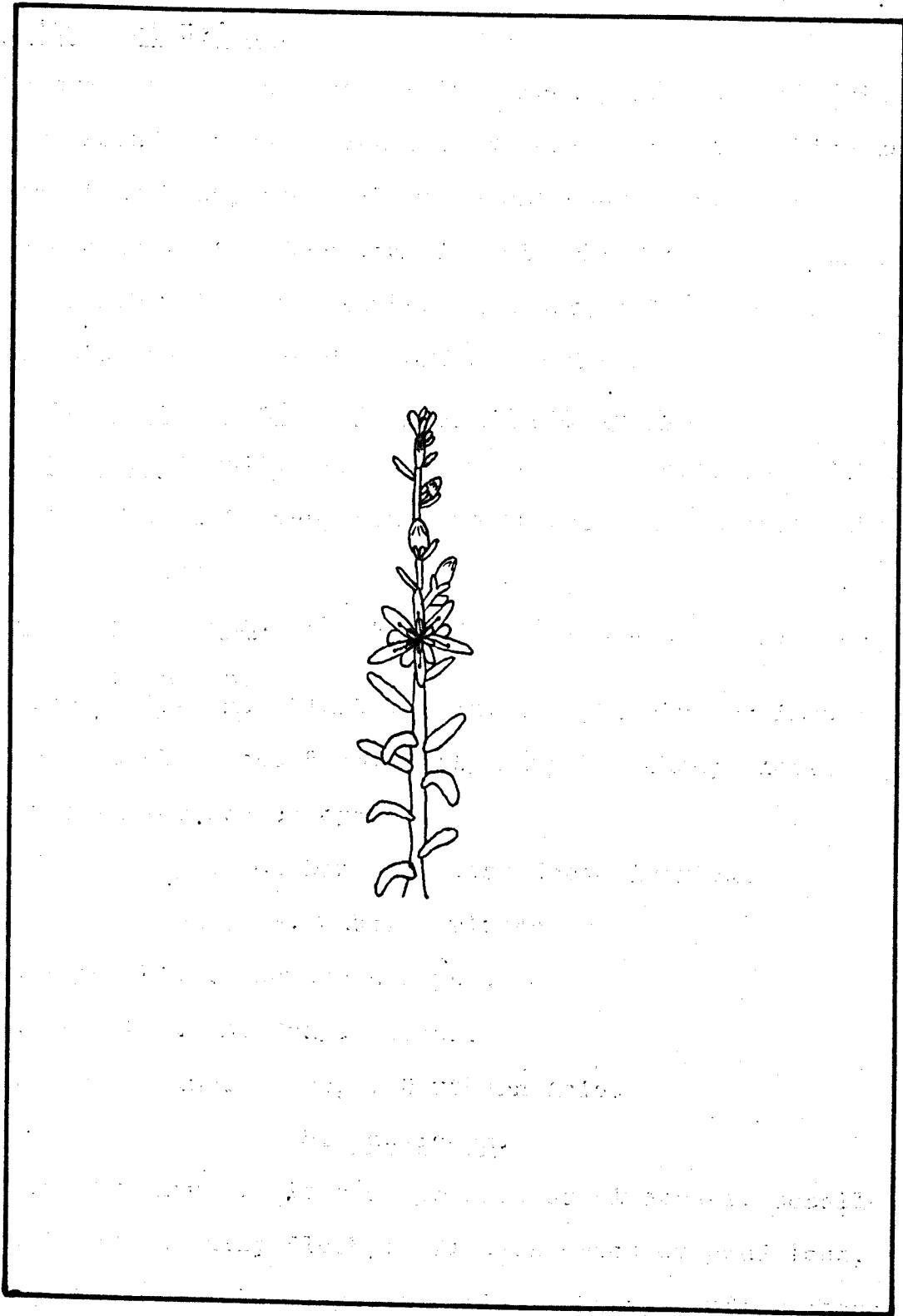


Plate 34. Sedum lydium.



Culture of Sedums.

Sedums are used a great deal in rock-gardens, for edgings, and for ground covers, because they form mats. They like sunny locations best, and will get along even in poor soils. Ordinary garden soil with some lime is suitable for most species. Pieces of branch will, if inserted in sandy soil, take root. They may also be increased by offsets and seeds.

Other Sedums found here or which may be found.

Sedum Griffithsii. Plant 8 cm. tall; flower stem 6.5 cm. tall; leaves form into many small rosettes; leaves spatulate, 6 mm. long.

Sedum rhodanthum. Plant 7 cm. tall, leaves many, 4-10 mm. long, spatulate.

Sedum stellatum. Plant 7-9 cm. tall, including flower stalk, plant itself about 5 mm. tall, many branched; leaves spatulate; inflorescence cymose.

Sedum Torreyi. G. Don. Eastern North America.

S. stelliforme. S. Wats. Arizona

S. spectabile. Northern Japan.

S. Wrightii. A. Gray. Texas.

S. acre. Linn. Europe, Northern Asia.

5. Cotyledon.

Herbs or shrubs; leaves opposite or alternate, sessile or petioled, usually fleshy; flowers erect or pendulous, varying from small to large, sometimes showy; inflorescence spikes, racemes, or cymes; calyx 5-parted, equalling or

shorter than corolla-tube; corolla-tube narrow, or wide, terete or 5-angled; stamens 10, very rarely 5, inserted on tube of corolla near base; filaments filiform, frequently broadened at base; 5 free carpels, each narrowed into filiform style; fruits of separate follicles, many seeded.

1. Cotyledon sp. Plate 35. Leaves thick and fleshy, almost round in cross-section, 2.5 to 4 cm. long, 5 to 8 mm. wide, lanceolate, light green, covered with white glaucous, lower leaves dehiscent; flower stem 18 cm. long; inflorescence racemose; sepals 5, fleshy, 3 mm. long; petals 5, 17 mm. long, united in corolla, tubular, petals distinct half their length, pink suffused with yellow; stamens 10, exerted beyond corolla-tube; ovaries 5, distinct.

2. Cotyledon sp. Leaves 4 to 12 cm. long, 2.5 to 11.5 wide, in rosette, leaves opposite alternate looking down on plant, pointed at tip, yellowish-green toward edge of leaf, medium green in middle; flower stalk 11.5 cm. long, covered with grayish bloom and suffused with red; inflorescence cymose; sepals 5, united, 1 cm. long, 1 cm. wide, triangular in shape, white bloom on them, medium green in color; corolla 22 mm. long, 14 mm. wide, yellowish-green suffused with orange-red; corolla-lobes 2 cm. long, 16 mm. wide, orange-red suffused with yellowish-green; stamens 10, 5 long, 5 short, 24 to 35 mm. long; anthers yellow; ovaries 5, distinct; small glands at base of each ovary.

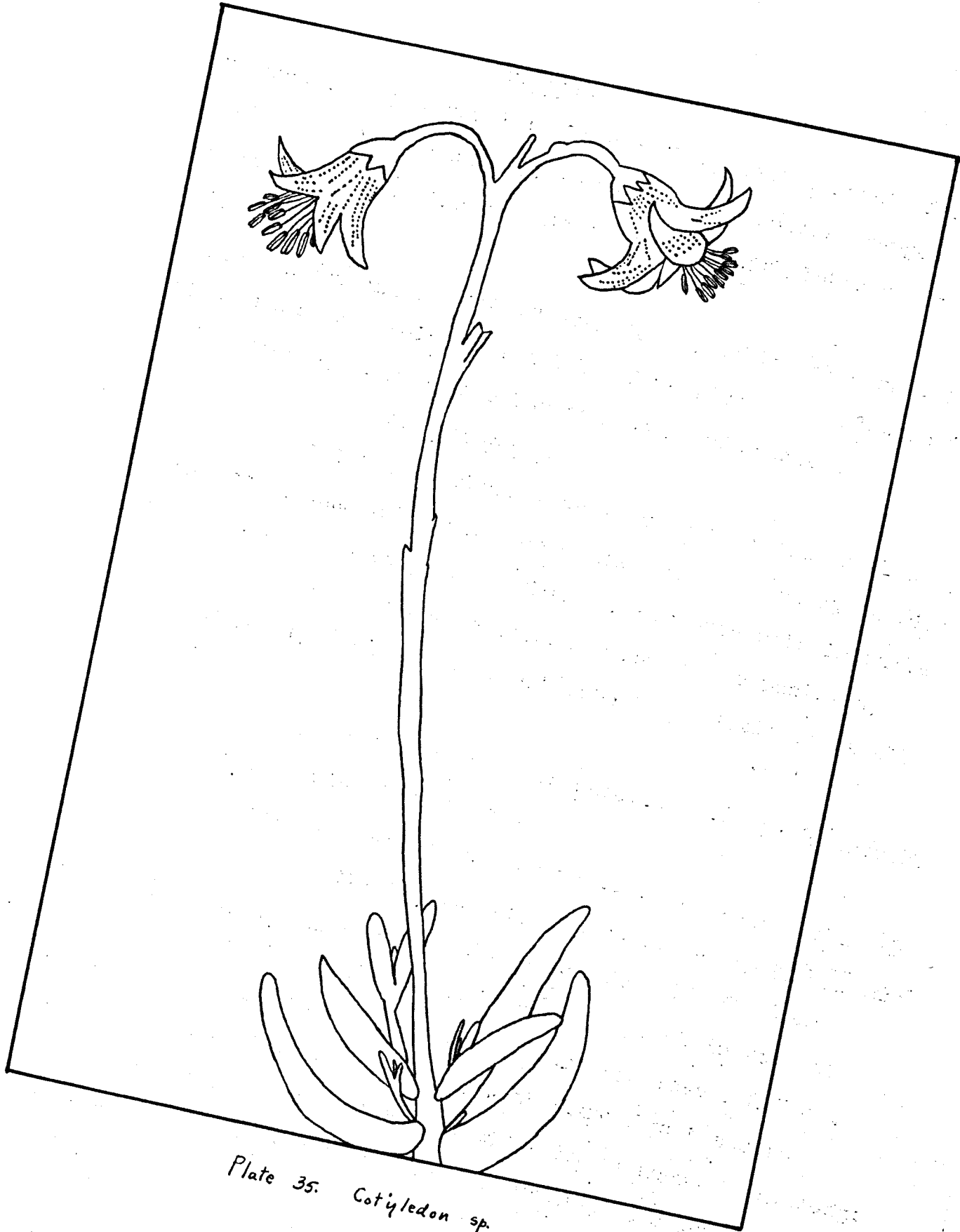


Plate 35. *Cotyledon* sp.

6. Dudleya.

Low succulent perennials; leaves flat, acute, basal, form rosettes; flowers usually in panicles; flowers orange, yellow, red, greenish to white; corolla with lobes united below middle.

1. Dudleya collomae. Flower stem 40 cm. tall; flowers yellow; sepals red; red vein down middle of petals; many flowers in inflorescence. One of our handsome Arizona species.

7. Echeveria.

Plants perennial herbs, shrubby or in rosettes; leaves fleshy, but usually broad and flat, never dentate, but usually terminating in a very short point; flower stems originate in axils of basal leaves; flowers in spikes, racemes, or panicles; corolla strongly angled with short tube that little if at all exceeds the calyx.

Whole plant covered with heavy pubescence.....1. E. pubescens.

Plant not covered with pubescence.

Leaves have crystalline appearance.....2. E. mucronata.

Leaves without crystalline appearance.....3. E. metallica.

1. Echeveria pubescens. Schlecht. Plate 36. Plant 22 cm. tall, including flower stalk; main part of plant in form of elongated rosette, 9 cm. tall, 11 cm. across; leaves 3-7 cm. long, an elongated wedge in shape, with some almost square, yellowish-green, covered with long white hairs about 1 mm. long; flower stem with leaves at regular intervals; inflorescence a raceme; sepals 5, 10-15 cm. long, linear, covered with pubes-

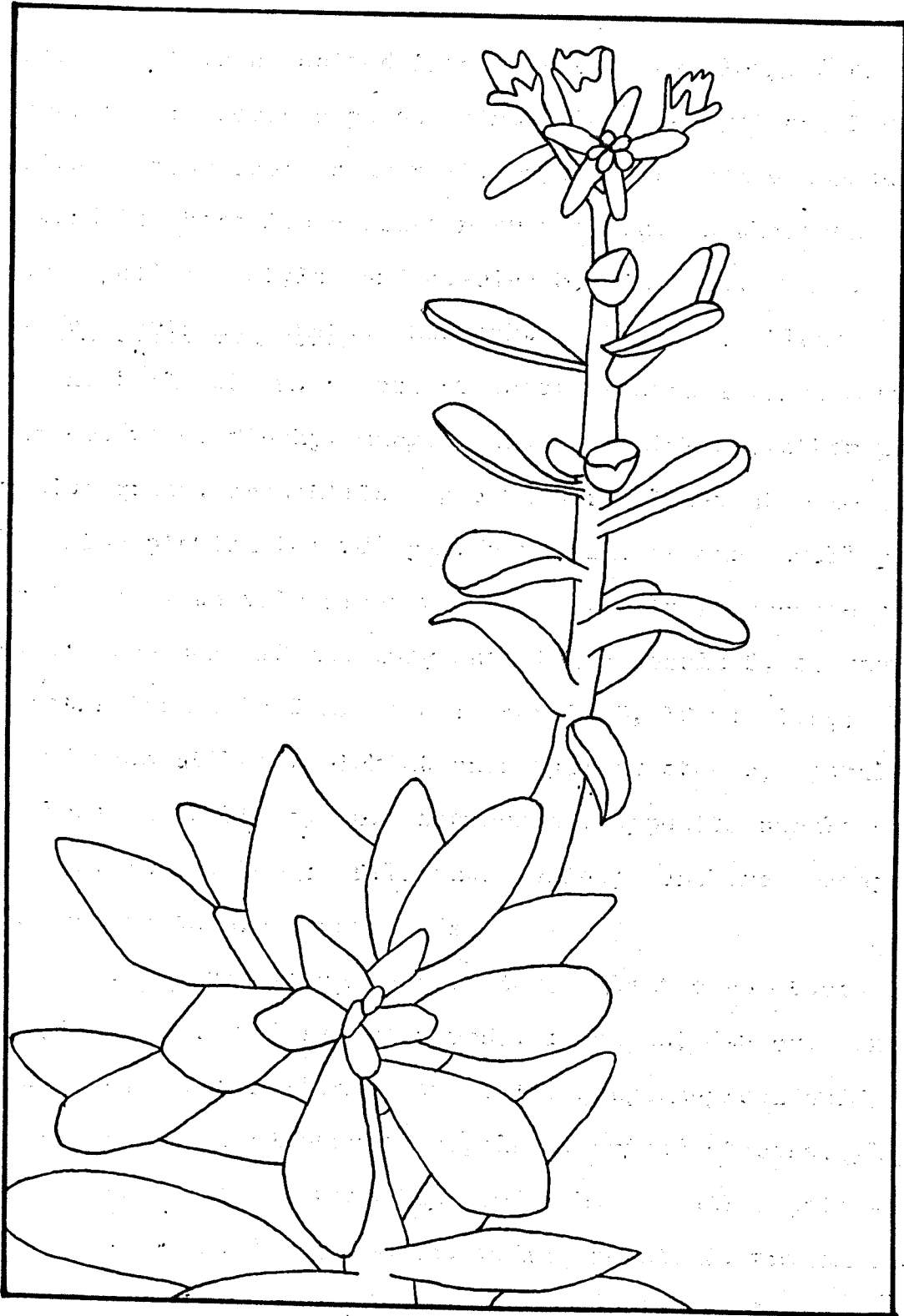


Plate 36. *Echeveria pubescens*.

cence; petals 5, united into a tube 13 cm. long, 8 cm. wide, cup-shaped; lobes separate almost to base, yellow, lower part suffused with red; stamen 10, opposite sepals and petals, extend to where lobes start narrowing in; anthers and filaments yellow; styles and ovaries 5, distinct.

2. Echeveria mucronata. Schlecht. Plate 37. Plant a rosette, 12 cm. tall, 15 cm. across at base; leaves largest 8 cm. long, 2.5 cm. wide, fleshy, margins and tips pinkish, other part medium green, crystalline appearance; flower stem 40 cm. long, becoming pinkish toward apex, very pink at end, small pink scales at intervals along flower stem; inflorescence scorpoid cyme; pedicels 12 mm. long and pink; sepals 5, of varying lengths from 6 to 9 mm. long; petals 5, 16 mm. long; corolla 9 mm. wide at base, pink at base, yellow at tip; petals united at base and half way up; stamens 10, opposite sepals and petals, 10 mm. long; filaments yellow; anthers green; ovaries 5, each containing many seeds.

3. Echeveria metallica Hart. Kew. Plant a rosette; leaves grayish-green suffused with rose, glaucous, 4-8 cm. long, 3-5 cm. wide; flower stem 50 cm. tall, grayish-green suffused with reddish-purple, glaucous; sepals 4, united at base, glaucous, light grayish-green with tips reddish, not all sepals same length, 5-9 mm. long, 2-3 mm. wide; petals 5, united into cup-shaped tube, rose, deeper along margins of lobes and veins; tube 13 mm. long, 9 mm. wide; lobes 8 mm. long, 5 mm. wide at base; stamens 10, attached at base of corolla-tube; stigmas

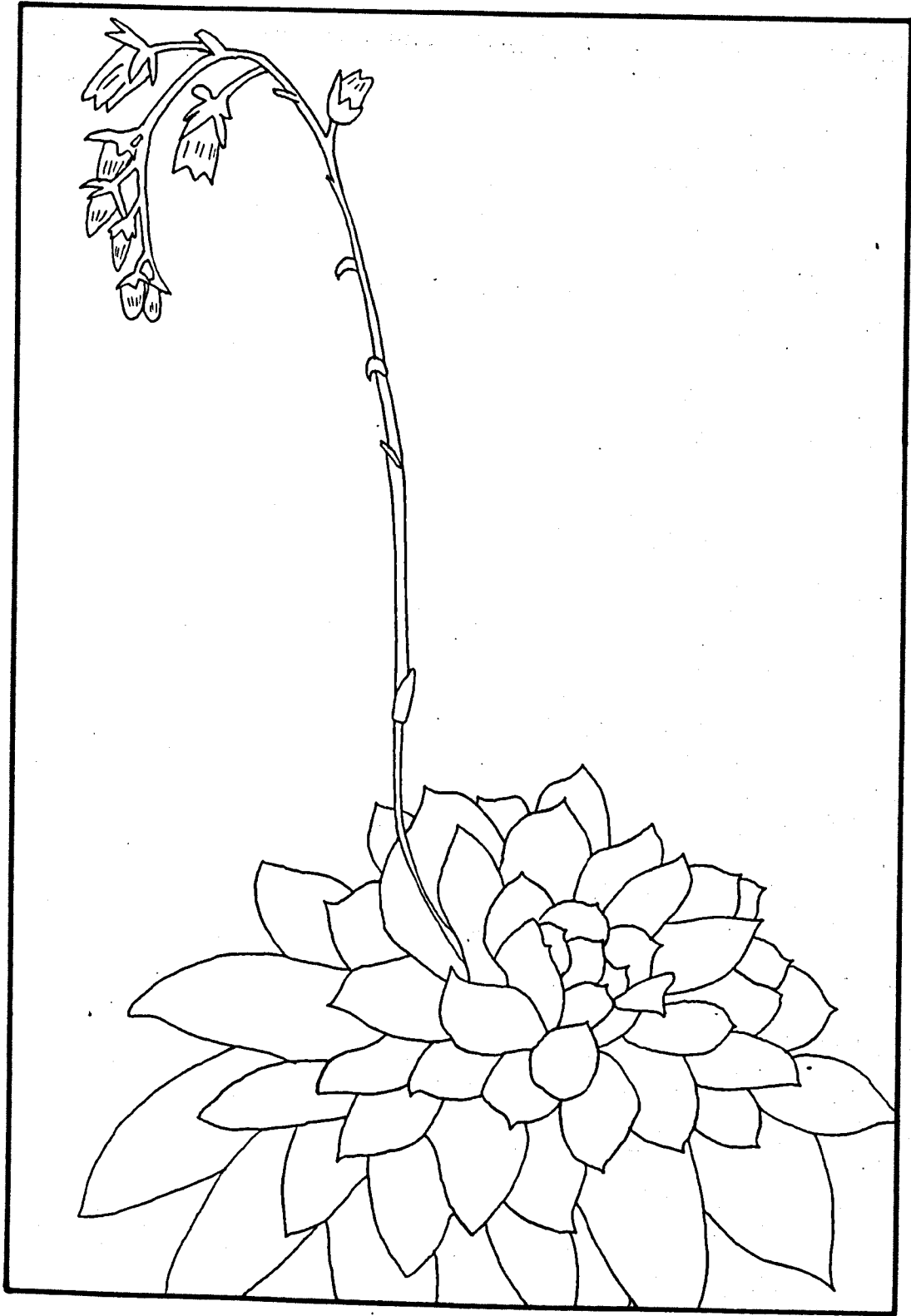


Plate 37. *Echeveria mucronata*.

and styles 5, tips red and dark red; ovaries 5. (*E. gibbiflora* var.)



Euphorbiaceae. The Spurge Family.

Monoecious or dioecious herbs, shrubs, or trees, with acrid often milky sap; leafy or leafless, sometimes succulent and cactus-like; leaves alternate or opposite, entire, toothed, or rarely lobed; stipules present or absent; flowers nearly always apetalous, often also without calyx, and sometimes enclosed in calyx-like involucre; stamens few or many; filaments united or distinct; ovary superior, usually 3-celled; styles as many as the cells of the ovary, simple, divided, or many-cleft; capsule separating at maturity into three 2-valved carpels.

1. Euphorbia.

Involucre a cup, with an outer series of 2 to 8 glands; staminate flowers each consisting of a single stamen jointed to a pedicel and soon falling away from it; mingled with membranaceous or wooly scales or bracteoles; ovary really a female flower, with or without a minute 3-lobed, or very rarely cup-like, or tubular calyx at base of ovary, but without a tubular involucre surrounding the pedicel; glands distinct and equally spaced, or very rarely united, entire, petal-like or divided into teeth.

Plant body or stem globose, and small.

Stem covered with light green bands.....1. E. meloformis.

Stem covered with dull purple bands.....2. E. obesa.

Plants of medium height, and not globose.

Plant tuberculate.

Plant slender, solitary form.....3. E. mammilaris.

Plant much-branched.....4. E. pseudo-medusae inermis.

Plants not tuberculate.

Plants leafless in ordinary form...5. E. canariensis.

Plants nearly always leafy.....6. E. splendens.

1. Euphorbia meloformis Ait. Melon Spurge. Plate 38. Plant 6.5 cm. in diameter and 5.5 cm. tall, 8-ribbed, spineless, and spherical; inflorescence of 3-flowers, appears on branched stems which persist as dry sticks on plant after flowers have faded; number of growths produced on ribs, which are regularly marked from the top to the bottom of the middle of the ribs; growing point is lower than the rest of plant.

2. Euphorbia obesa Hook. Plate 39. Plant 4.5 cm. in diameter and 3 cm. high; globose stem reddish or greenish-brown, and slightly striped with dull purple; flower green, stamens yellow; pistillate flower, peduncle simple, but often once or twice branched; staminate flowers simple, peduncle also branched, in both staminate and pistillate flowers, peduncle deciduous.

3. Euphorbia memmilaris Linn. Plate 40. Plant 48 cm. tall and 2.5 to 3.5 cm. wide; tuberculate ribbed with long needle-like spines; branch like growths also from the tubercles; stigmas 3, 2-lobed; styles 3; ovary superior, 3 carpellary, surrounded by reddish scale-like cup; 5 tiny red glands at

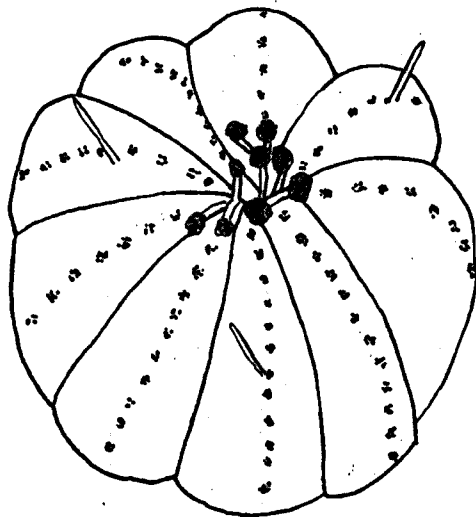


Plate 38. *Euphorbia meloformis*.

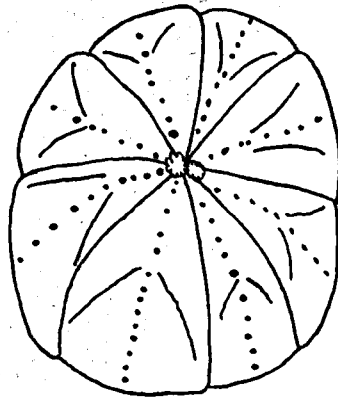


Plate 39. *Euphorbia obesa*.

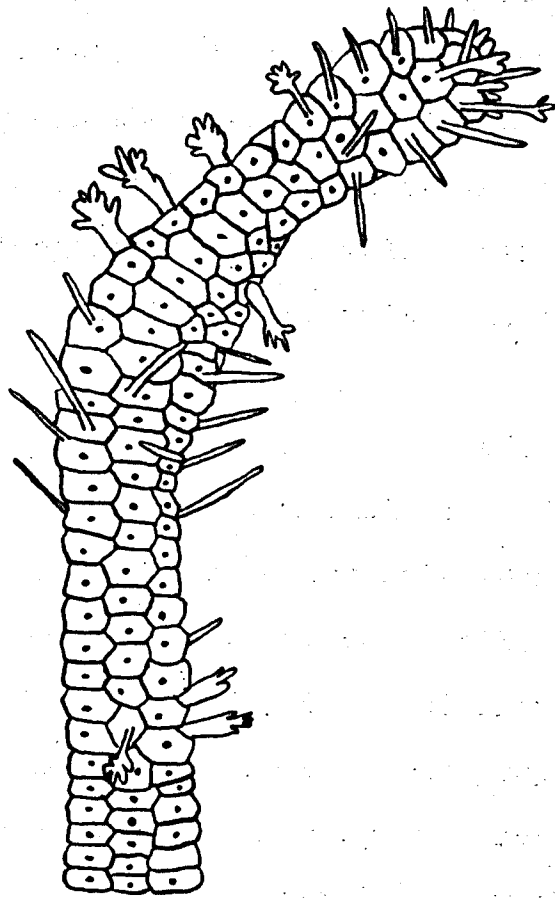


Plate 40. *Euphorbia mammilaris*.

base of ovary; sepals 3; bract yellowish with red margin; flowers here all pistillate; plant dioecious.--South Africa.

4. Euphorbia pseudo-medusae var. inermis Plate 41. Plant many-branched and tuberculate; medium green; tubercles 10 mm. long and 9 mm. wide; leaf from ridge on each tubercle, early deciduous leaves scar, 5-9 mm. long and 1 mm. wide; sepals 4, 3 mm. long, lanceolate, red suffused with yellow in color; bracts 5, outer half of lobes yellowish white, inner part yellowish-greenish-brown; covering stamens and attached to bract lobes, 5 reddish-brown bract-like parts; stamens many and of varying lengths; anthers yellow tinged with red; stigmas 3 and 2-lobed; styles 3 and united at the base; ovary 3-carpellary.

5. Euphorbia canariensis Forsk. Plate 42. Plant 6.5 feet tall, 4 cm. wide; 4-ridged, lengthwise; ridges somewhat twisting; spines in group of two, every half inch along top of ridge; flowers yellowish-green, and small.--Arabia.

6. Euphorbia splendens. Boj. Crown of Thorns. Plate 43. plant somewhat drooping and needs to be propped; 4 or more feet tall; older part of stem woody and greyish-brown in color; spines 1-2 cm. long, gray tipped with brown; leaves develop between 2 spines, leaves 1.5 to 8.5 cm. long and 1-3 cm. wide, yellowish-green in color, and margins red; inflorescence an umbel, 8-flowered; pedicels long and sticky, ending in a cyathium, which is surrounded by 2 bright red involucrel bracts.--Madagascar.

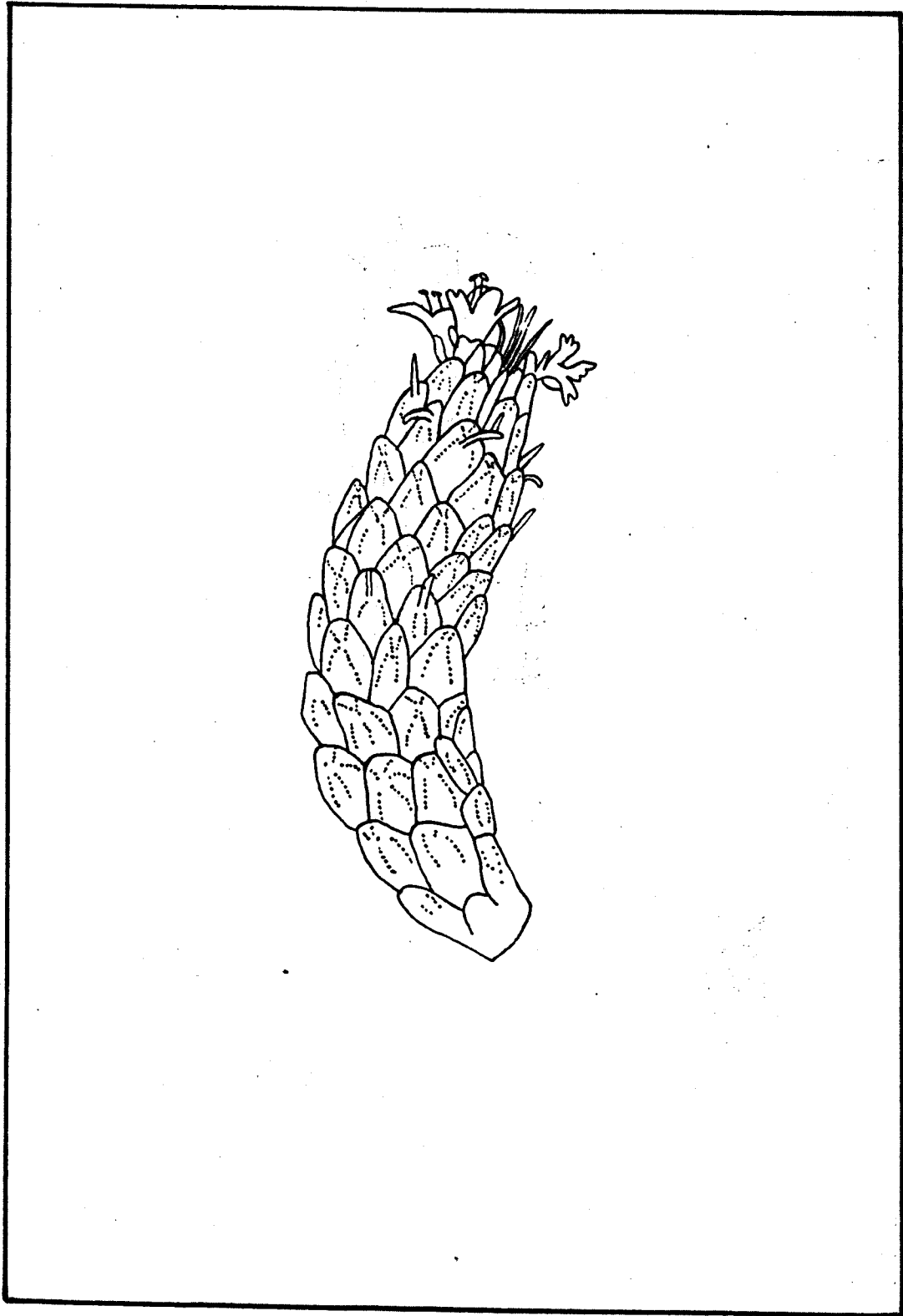


Plate 41. *Euphorbia pseudo-Medusae* var. *inermis*.

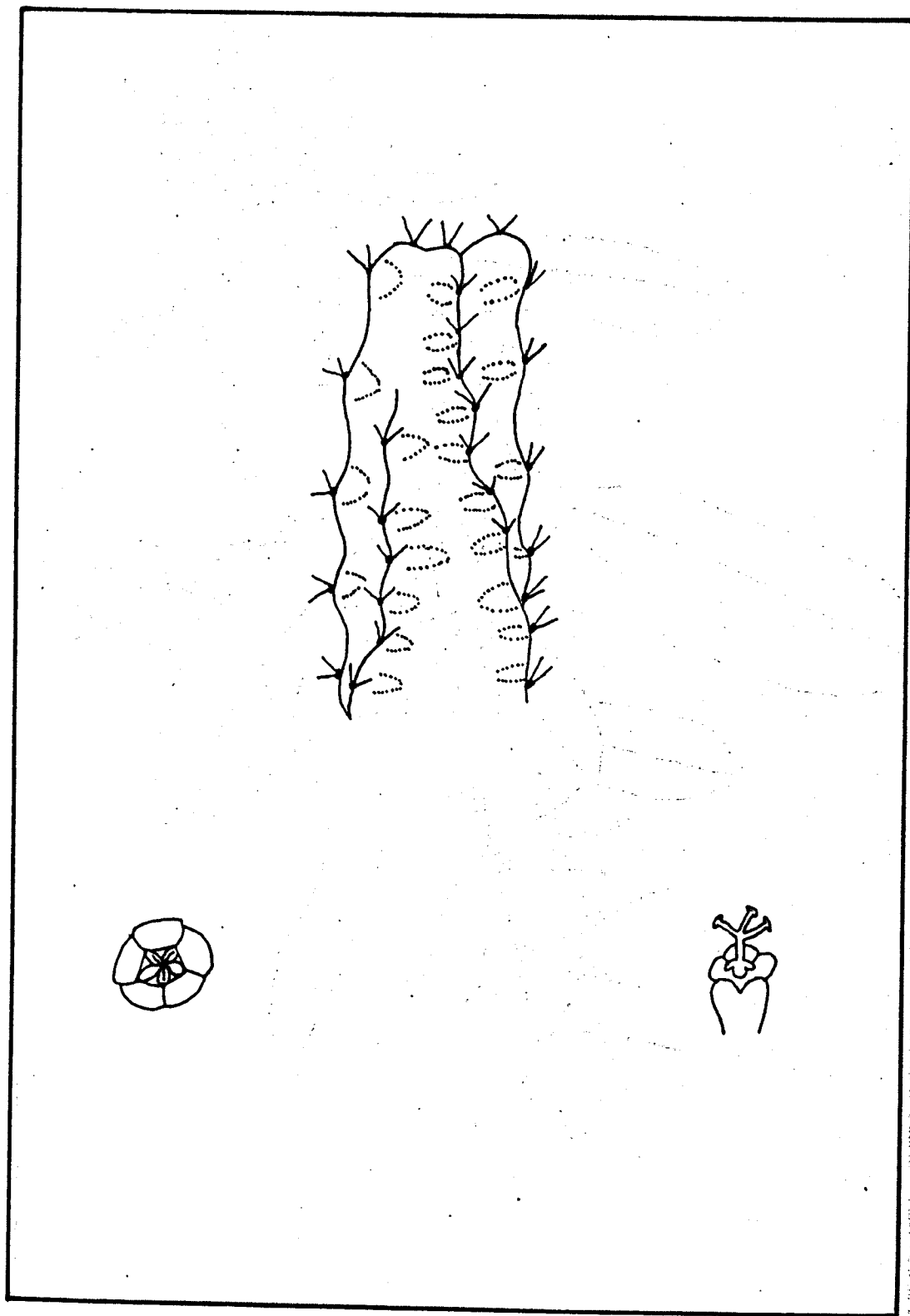


Plate 42. *Euphorbia canariensis*.



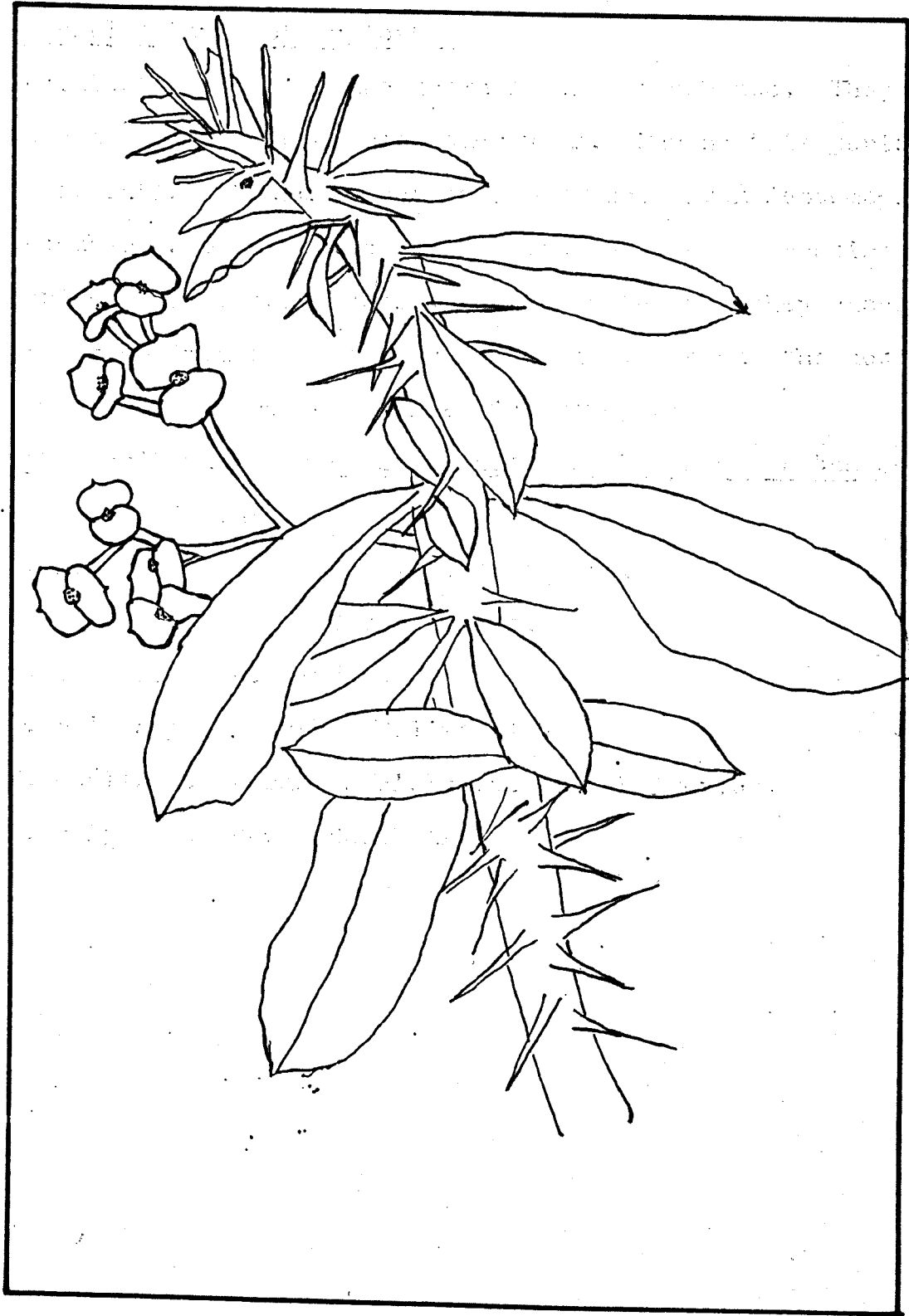


Plate 43. *Euphorbia splendens*.

General culture of Euphorbias.

Succulent Euphorbias are grown in the greenhouse. They must have a long period of rest each year. During this period, the water ration should be cut to a minimum. From September to December, and from March to May are the general resting periods. If these plants are grown outdoors, they should be protected from the frost and wind in winter and the hot sun in summer. They grow best in a rich sandy soil.

Other cultivated Euphorbias which may be found in the Southwest.

Euphorbia Sapini.

E. caput-medusae. Linn. South Africa.

E. globosa. Sims. South Africa.

E. lactea. Haw. India.

E. polycarpa. Benth. California.

E. ocellata. Durand & Hillgard. North America.

E. polygona. Haw. South Africa.

Asclepidaceae.

Herbs or shrubs, sometimes fleshy, generally with milky juice; leaves opposite, whorled, rarely alternate, without stipules; flowers perfect, regular, mostly umbellate, often hairy, ill-smelling, often dull-colored; calyx deeply 5-lobed; corolla 5-lobed; 5-lobed crown usually present between corolla and stamens, adnate to either or both; stamens 5, adnate to base of corolla; pollen grains united into wax-like or granular pollinia; carpels 2, with distinct superior ovaries and styles, but united above by stigmas; fruit 2 follicles; seeds many.

Short, mostly toothed, fleshy stems.....1. Stapelia.

Stems not fleshy.....2. Ceropegia.

1. Stapelia.

Cactus-like herbs, fleshy, leafless; stems coarsely 4-angled, angles often toothed or rarely bearing small leaves; flowers often large, 1 to several along stem, barred or mottled with dark or dull colors; outer part of crown usually of 5 entire or divided free lobes, inner part 5 lobes adnate to base of anthers; stamens with filaments united into very short tube.

Flower greenish-yellow with dark brownish purple spots...  
.....1. S. variegata.

Flowers purple.....2. S. pillansii.

1. Stapelia variegata Linn. Plate 44. Stem succulent, glabrous, 15-20 cm. long, about 2 cm. wide, including spines, medium green and some stems suffused with red, many ridges, each ridge ending in spine which is quite sharp, 4 rows of ridges, 2 spines opposite each other and the opposite spines alternate, each ridge 1.5 cm. long, 5 mm. wide; flower stem emerges from end of ridge; pedicel green suffused with red stripes, 4 cm. long; flower 7 to 7.5 cm. across; sepals 5, 1.2 cm. long, 5 mm. wide, united at base, reddish-green; petals 5, united at base, each petal 3 cm. long, 2 cm. wide at base, yellow with reddish-brown blotches, more numerous and smaller toward inner part of flower, inner part of corolla wrinkled, under surface of petals yellow suffused with red; corona 2.5 cm. in diameter, also yellow suffused with reddish-brown blotches; stamens 5; ovary 2-carpellary, united at stigmas.--South Africa.

2. Stapelia pillansii N.E. Brown. Plate 45. Sepals 5, united at base, 6 mm. long, 2 mm. wide, linear, yellowish-green suffused with red towards tip; petals 5, united, 11 mm. of petal united, 2.5 cm. of petal distinct, purple, edges have sharp hairs 6 mm. long, white and tinged with purple, all over petal fine purple hairs, less toward center.

#### Culture of Stapelias.

Stapelias will stand a small degree of frost, but they must have good drainage. They will do very well if they are planted in brick rubbish and good sandy loam, and fed a little weak

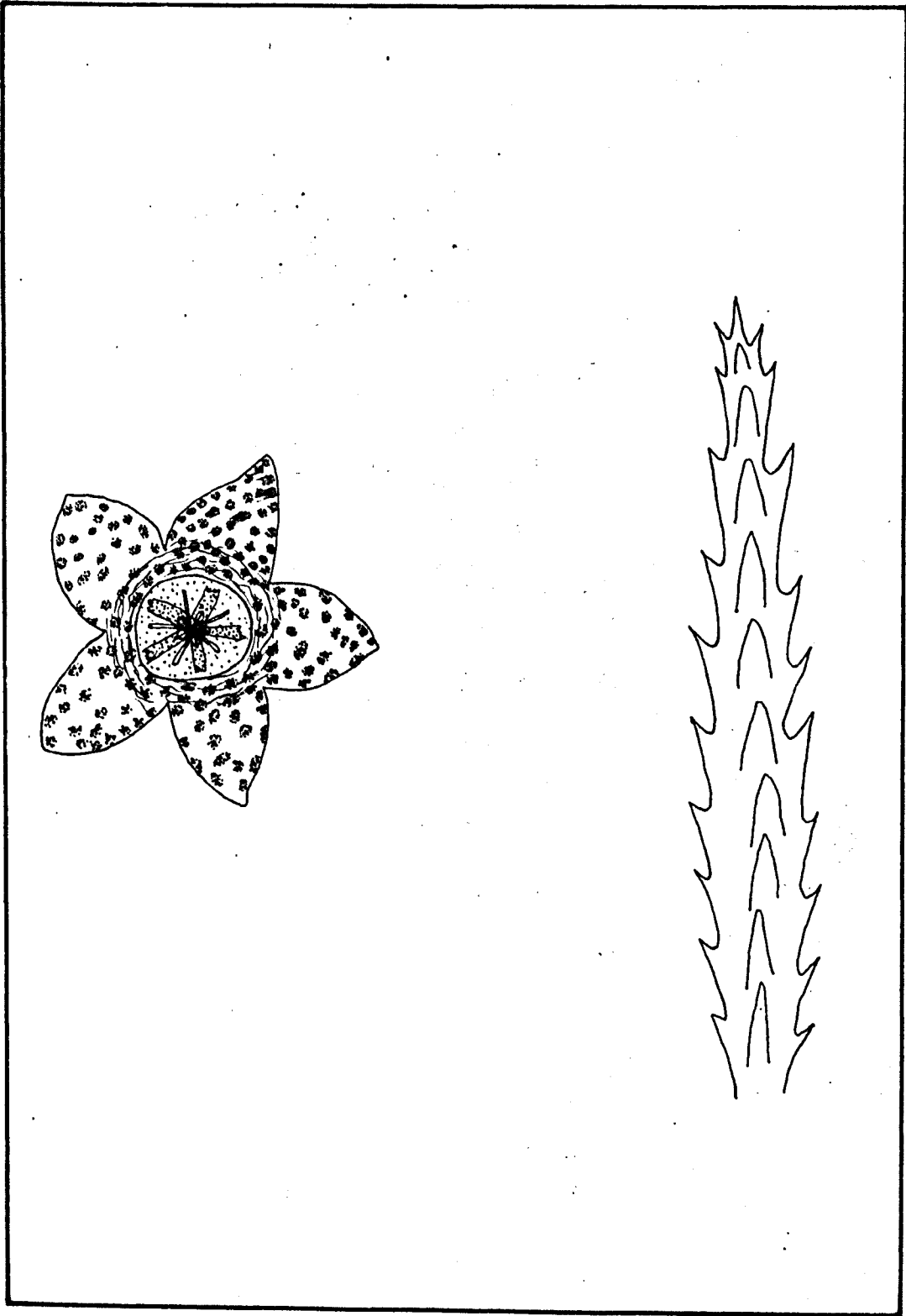


Plate 44. *Stapelia variegata*.

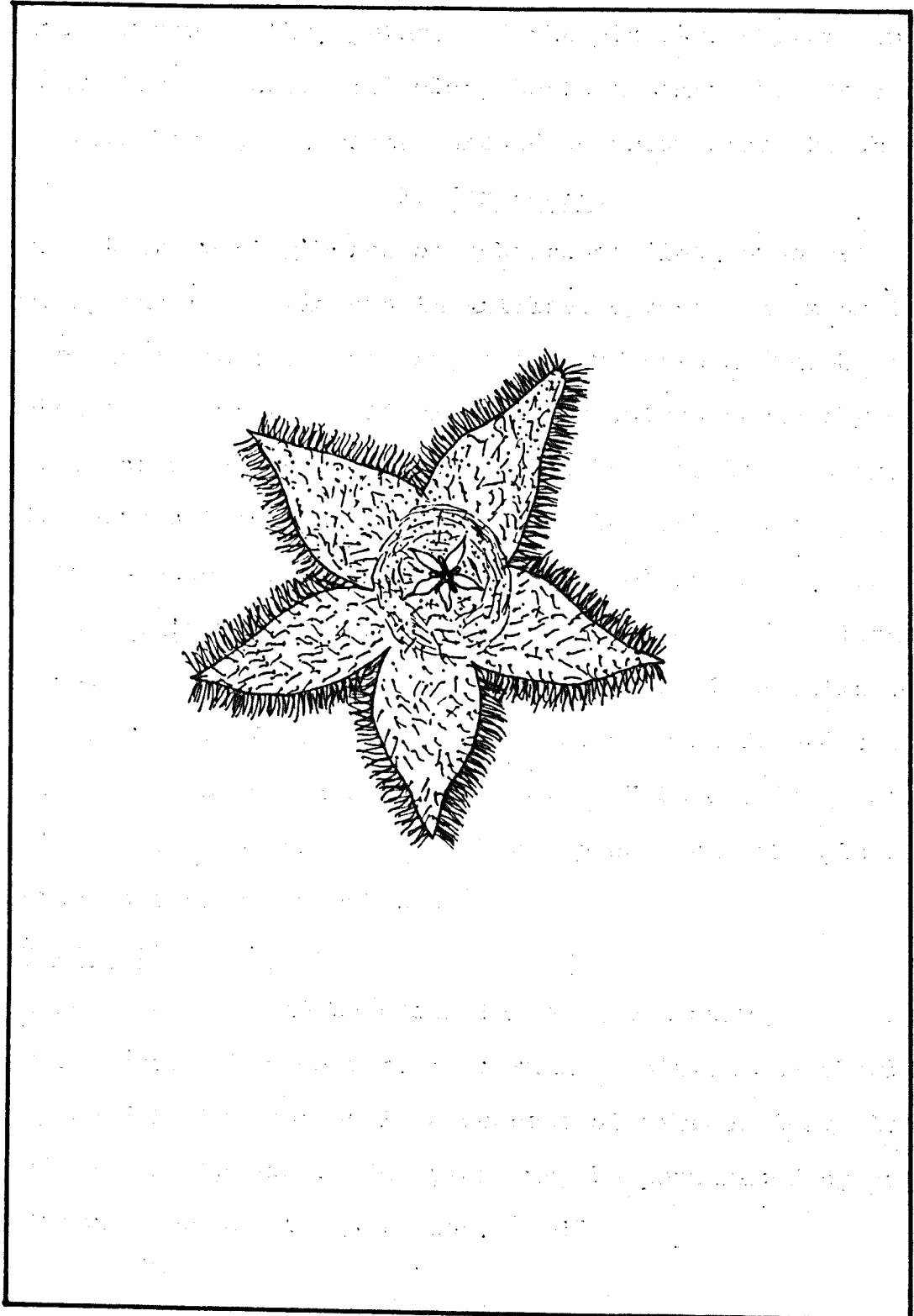


Plate 45. *Stapelia pillansii*.

manure water in the spring. If the plants are grown in the shade, the branches will elongate to a remarkable degree. In the greenhouse, the plants should be grown close to the glass.

## 2. Ceropegia.

Upright or twining herbs or subshrubs; leaves opposite or rarely lacking; flowers in axillary cymes; calyx small and glandular; corolla tubular, often inflated at the base, the lobes free, erect or reflexed, or sometimes variously united at tips; crown attached at staminal tube, double, stamens with filaments united into short column, the anthers unappendaged; stigma truncate or shortly conical; follicles lanceolate.

1. Ceropegia woodii Plate 46. Stems fine and trailing; leaves opposite and heart-shaped, deep green, little bulbils form at each node, if stem is creeping along ground, 3-4 cm. long; flowers in pairs, axillary on stalks, 7-23 cm. long, corolla slightly curved, about 2 cm. long, pink with dark lines below, upper part almost purplish.

### Culture of Ceropegias.

These plants should be grown in pots or hanging baskets in the greenhouse. They do best in a sunny position and should be repotted in the spring in a compost of fibrous loam, leaf-mold and sharp sand. The plant may be propagated by cuttings of young shoots placed in sandy soil.

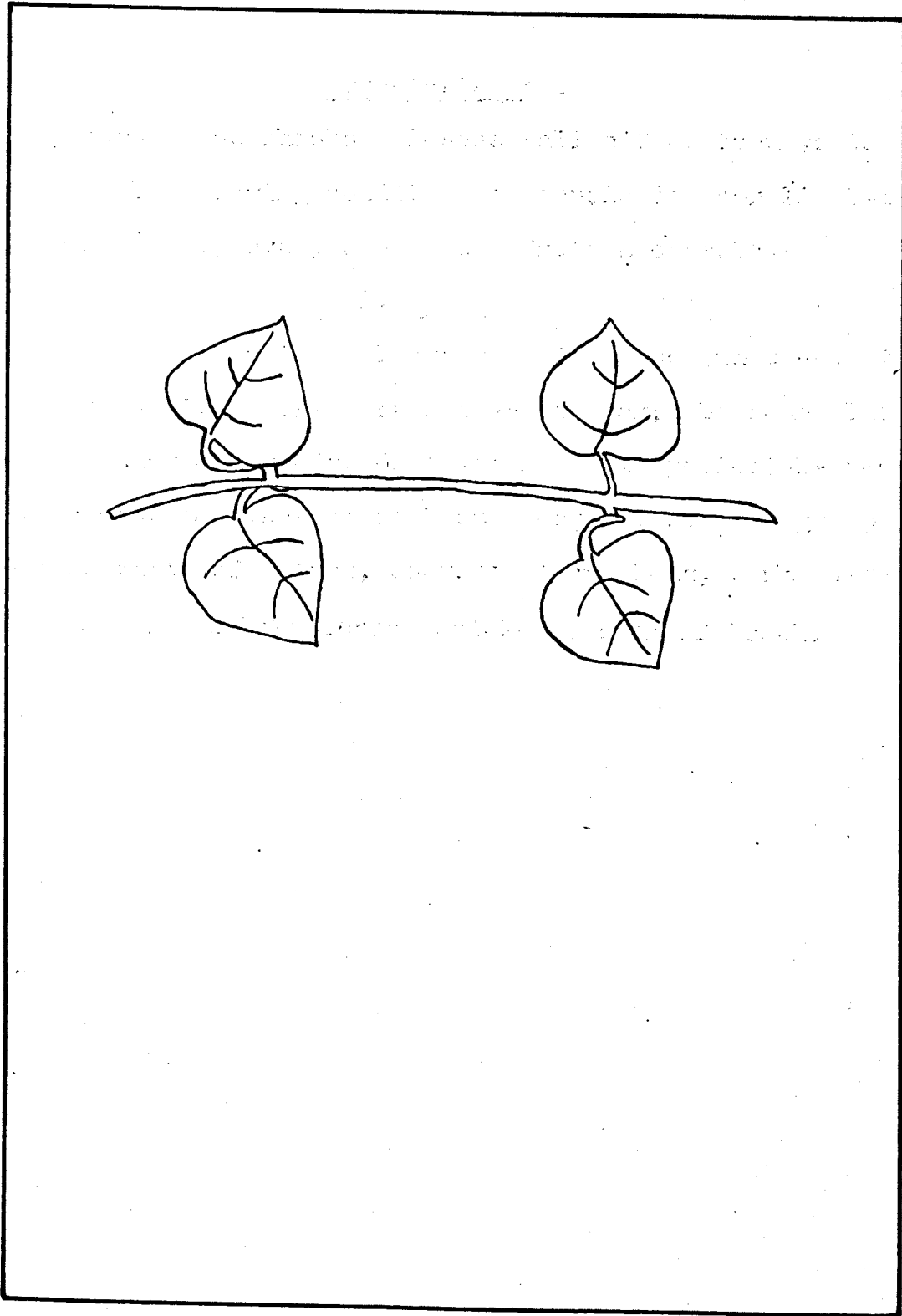


Plate 46. *Cerropegia woodii*.



Fouquieriaceae.

Spiny trees and shrubs; leaves fall off or turn yellow during unfavorable growing conditions; sepala 5; corolla 5-lobed; stamens 10-17, ovary 3-celled; fruit a capsule.

1. Idria.

1. *Idria columnaris* Kellogg. Cirio or boojum tree. Trunk  $7\frac{1}{2}$  feet tall, tapering from base to apex; branches lateral and slender and woody, 60 cm. long, pale yellowish-green, covered with spines up to 3 cm. long; leaves in groups of 3-5 in axils of spines, obovate, 1 cm. long, 5 mm. wide, grayish green; inflorescence panicle at apex of trunk.

Compositae.

Flowers from heads, which are surrounded by an involucre of bracts; single flowers, inferior ovary, calyx modified into often threadlike pappus, corolla tubular, usually 5-parted, fruit indehiscent and an achene; outer flowers often unequally enlarged into showy rays; stamens usually 5, anthers united into ring around style; style mostly 2-branched.

1. Kleinia.

Fleshy shrubs or herbs, branches rounded or angular; leaves alternate; flowers white or pale yellow; heads discoid; all flowers are alike and rayless; outer flowers pistillate only; disk flowers perfect.

1. Kleinia articulata Haw. Candle Plant. Plate 47. Plant including inflorescence 2 feet tall, lower part of stem often decumbent; stem greyish-green with green lines about 2.5 cm. long running lengthwise irregularly over the plant; branches jointed and swollen; leaves deeply pinnatifid; flower stalks few headed; flowers white and ill-scented.--South Africa.

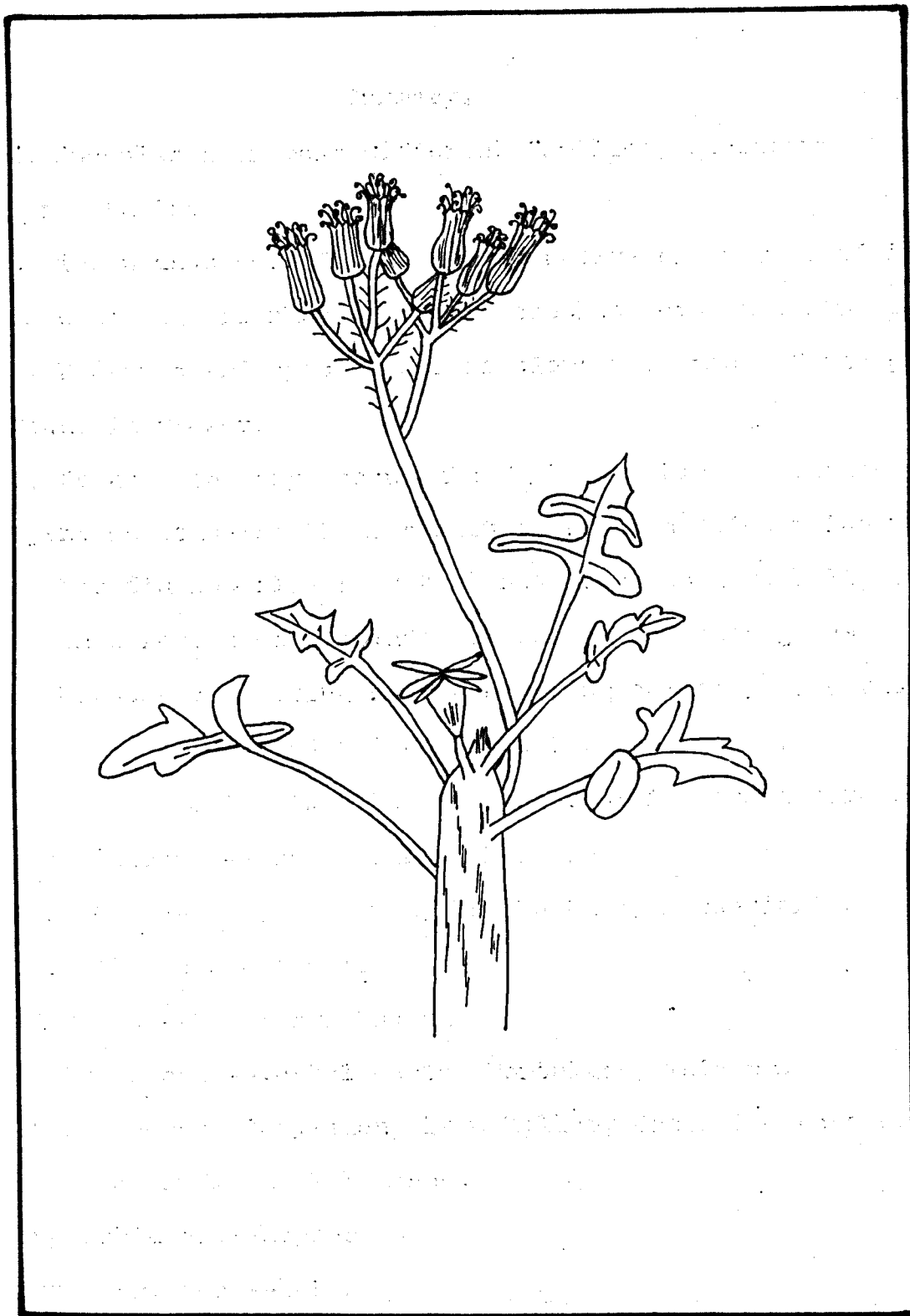


Plate 47. *Kleinia articulata*.

Summary.

1. Succulents in many different families, exclusive of cacti, were studied.
2. The plants were found growing native or cultivated in gardens and greenhouses of the southwestern United States.
3. Drawings and species descriptions were made of the plants found in flower.
4. Because so many succulents failed to blossom during the time spent in studying them, a list of these species which were studied but did not flower or that have been authentically reported in this region was included at the end of each genus.
5. Methods of growing and propagating commonly cultivated genera were studied and reported for each genus.
6. The following is a list of the families and genera studied:  
Commelinaceae--Tradescantia, Rhoeo.  
Liliaceae--Aloe, Gasteria, Hawthorthia, Sansevieria.  
Amaryllidaceae--Agave.  
Aizoaceae--Mesembryanthemum.  
Portulacaceae--Portulacaria, Portulaca, Talinum.  
Crassulaceae--Cotyledon, Bryophyllum, Crassula, Echeveria, Sedum, Dudleya, Kalanchoe.  
Euphorbiaceae--Euphorbia.  
Fouquieriaceae--Idria.  
Asclepiadaceae--Ceropegia, Stapelia.  
Compositae--Kleinia.

7. Acknowledgment is due Professor J. J. Thornber for his assistance in making this study.

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Tradescantia fluminensis Vell. Fl. Flum. 140 iii t. 152 Bras.



Common Families and Genera in  
which Succulence Occurs.

Commelinaceae: Tradescantia. L.

Liliaceae: Aloe L., Gasteria Duv., Haworthia Duv., Yucca,  
Hesperaloe. Nolina: Dasylirion, Dracaena, Sanseveria.

Amaryllidaceae: Agave L.

Aizoaceae: Mesembryanthemum L. (with many smaller genera.)

Portulacaceae: Anacampseros L., Portulacaria Dacq. (Portulaca,  
Talinum.)

Crassulaceae: Sempervivum L., Monanthes Haw., Cotyledon L.,  
Bryophyllum Salisb., Kalanchoe Adans., Crassula L., Rochea  
D. C., Adromischus Lem., Aenium. Webb. and Bertrn., Echever-  
ia D. C., Greenovia W. B., Pachyphytum Link., K., K and  
O., Rosularia Staph., Umbilicus D. C., Byrnesia, Dudleya,  
Graptopetalum, Oliveranthus.

Geraniaceae: Sarcocaulon Schiz., Pelargonium L'Her.

Euphorbiaceae: Euphorbia L., Jatropha L.

Vitaceae: Cissus DC.

Passifloraceae: Passiflora.

Cactaceae: Many genera.

Asclepiadaceae: Ceropogia L., Hoodia Sweet., Caralluma R.Br.,  
Stapelia L., Heurnia R.Br., Sarcostemma R.Br.

Compositae: Senecio L., Kleinia L.

Also Moringaceae, Cucurbitaceae, Convolvulaceae, and Oxalidaceae  
and maybe orchid.

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