

EAST AFRICAN SUCCULENTS.

Part I.

By P. R. O. BALLY.

Succulents have become more and more popular with the amateur gardener during the latter years; at home they are being increasingly grown in hothouses, or, on a small scale, they adorn many a sheltered window sill. In warmer climates, where they need less protection from the severity of rain and cold, Succulents do very well in rock-gardens.

East Africa has climatic conditions which especially favour the cultivation of Succulents—except in the higher altitudes above 6,000 feet or in those rare districts with regular, heavy, rainfalls.

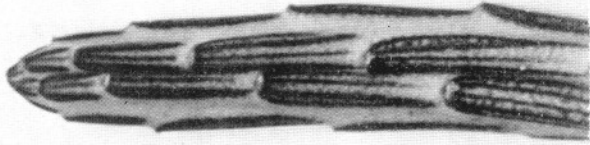
Many amateur gardeners take great pains to import Cacti and other Succulents from America and from South Africa; they seem to be quite unaware of the fact that East Africa possesses a wealth of beautiful indigenous Succulents which can well bear comparison with any of the imported plants.

With its modest requirements with regard to rainfall and to soil conditions, the Succulent garden is often the only patch of glorious abundance and of gay colours in the listless lull of the dry season, for Succulents will thrive where most other plants would die of starvation or of exposure.

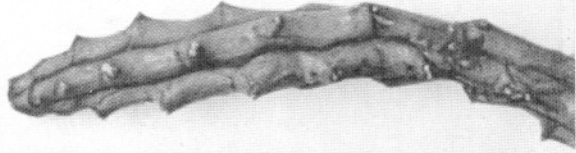
What, exactly, are Succulents? The term is used commonly without discrimination along with that of "Cacti" in order to designate all fleshy plants covered with spines. This is a mistake, for the term "Cactus" (plural "Cacti," a latinized word derived from the Greek noun "kaktos," the spiny cardoon) applies to members of one family of plants only, the CACTACEAE, most of which have indeed evolved into fleshy, leafless shapes, which are covered with clusters of spines. A few members of the Cactus family however, like the Genus *Peireskia*, do not look like true Cacti at all; they are woody, spiny, shrubs with fairly large, ordinary leaves; the expert only, who studies the anatomical character of their flower, knows that they belong to the Cactaceae.

The term "Succulents" has a much wider significance ("succulent" stands for "juicy," and it is derived from the Latin noun "succus," juice). It includes all plants which have developed a capacity for storing water in various parts of their frame, regardless of their place in the natural plant system. Thus it is correct to say that the fleshy Cacti are Succulents, but it is a mis-statement to call all Succulents: Cacti.

PLATE 6.



Notonia Gregorii
(Compositae).



Huernia aspera
(Asclepiadaceae).



Monadenium stapelioides
(Euphorbiaceae).

PLATE 7.



FIG. 1.

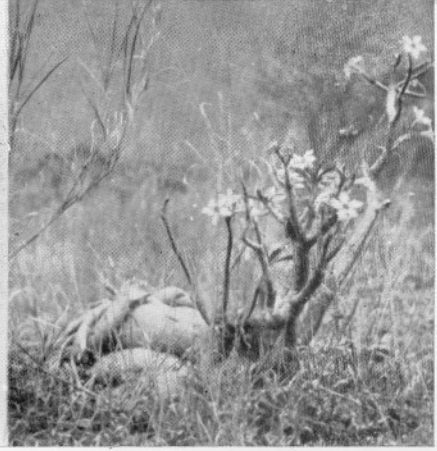


FIG. 2.



FIG. 3.

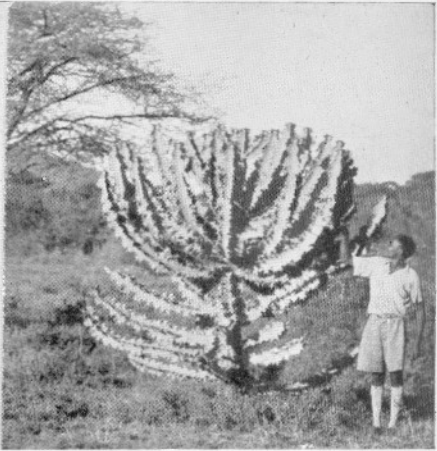


FIG. 4.

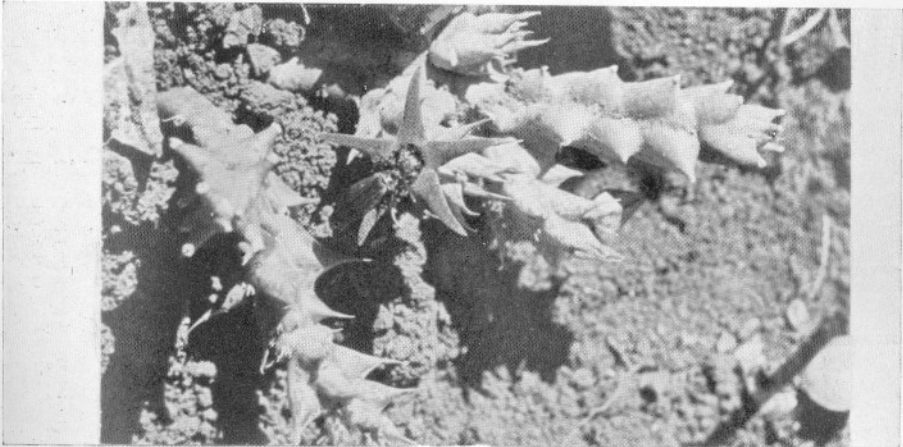


FIG. 5.

Typical representatives of succulent forms; for explanation *vide* text.

Strictly speaking, beets, potatoes, onions and all other plants with bulbous and tuberous roots should also be termed Succulents, but for practical purposes the meaning of the term has been limited to such plants as store their reserve of moisture in any part of their structure showing above ground, and which—by reason of this capacity—assume strange and bizarre shapes which set them definitely apart from the bulk of the so-called normal vegetation.

Storage of water becomes necessary where its supply is irregular or lacking for long periods, where the soil is porous or scarce, and where evaporation is high. As might be expected, Succulents are found mostly in arid districts, on rocks, in deserts, and in other localities presenting similar conditions, which are found sometimes even at high altitudes.

Most Succulents possess a comparatively weak and small root system and they are thus unable to penetrate deep down into the moisture-laden strata from which the surrounding desert vegetation may draw during the greater part of the year.

They must needs make up for this deficiency by some other quality in order to survive, and this quality is precisely the storage of water against the long periods when it is not available to them from extraneous sources. They have thus emancipated themselves to such an extent that they subsist where no subsoil water is present and where other types of vegetation will not live.

Some Succulents have developed the faculty of survival without external water supply to a point which is truly astounding. Most will live on for months, some for years. True, we are conversant with this phenomenon in the case of bulbs, tubers, even with our common potato; but these are well defined centres of growth, while with most Succulents the power to survive is inherent in all parts of the plant independently and in various degrees; a single leaf of Bryophyllum for instance will give rise to dozens of young plants.

At the beginning of last year I despatched a consignment of succulent Euphorbieae—mostly small cuttings and a few immature plants—all packed in a dry state, wrapped up in paper; although the consignment had been under way for well over two months, only four out of seventy-five died during that period.

Cuttings of a *Synadenium*—which I had left tied up in a bundle in a dry corner of the botanical room at the Museum, started to develop shoots and leaves after a period of apparent death of fully eight months, and without any visible provocation.

The most astounding example of the surviving power of a Succulent I have come across in the Berlin Museum: a seemingly dead plant of "bushman's candle" (*Sarcocaulon rigidum*,

GERANIACEAE) from South-West Africa had been kept there locked up in a drawer for an unknown period, but certainly for several years. It was then placed into a show case at the Museum, and, after having been an exhibit under glass for three further years, it started to emit young shoots. Transferred to the hot-house, the plant continued to develop normally, seemingly none the worse for its long period of apparent death. Incredible as this may seem, in the habitat of this plant periods of drought of seven years have been recorded. The "bushman's candle" with its poorly developed root system and with little facilities for absorption of the heavy dews which occur in the desert districts of South-West Africa, is thickly covered with a layer of resinous wax which is completely impermeable and which thus keeps its vital parts effectively protected against evaporation until conditions provide periods—rare and brief they are—which permit of the development of tiny leaves and of its propagatory organs.

It is a curious fact that Succulents which belong to entirely different families and which are thus by no means related, often assume an outward resemblance which makes it difficult to tell them apart.

A botanist who had travelled extensively in Mexico as well as in Eastern Africa showed me photographs which were seemingly taken in one and the same locality; only a very close inspection revealed that some of the pictures represented Mexican Cacti and others East African Euphorbieae. If the two plants did not occur in two different continents, this resemblance would have made an ideal object for the supporters of the mimicry-theory.

Such outward resemblance is more probably due to analogous climatic and geographical conditions which tend to evolve certain features best adapted to endure.

An interesting example of similarity of appearance is recorded on Plate 6, which shows a comparison of the growths of *Monadenium stapelioides* (Euphorbiaceae), *Huernia aspera* (Asclepiadaceae), and of *Notonia petraea* (Compositae). All three plants occur in the vicinity of Nairobi on the same type of rocky ground. The resemblance is confined to their outward appearance, for they are not in the least related.

In spite of the frequent outward similarity of succulents of different origin, we find much diversity of appearance among them, though always on the lines of the one dominating principle: economy in water consumption. This aim is reached mainly by reducing the surface of evaporation to a minimum, while preserving at the same time the chlorophyll-covered surfaces which are essential for maintaining metabolism. Theoretically the ideal Succulent would thus present a spherical shape,

with its surface adapted for assimilation, and this extreme development has indeed been reached by certain globular Cacti from Mexico, by the South African *Euphorbia oesa* and by some South-West African *Mesembrianthemum* spp.

Nature has, however, a variety of ways for achieving a similar aim, and another trend of adaptation is represented in the abovementioned "bushman's candle": here, the plant is coated impermeably and has adapted itself in such a manner that the rare emission of leaves after exceedingly long periods of rest is sufficient to safeguard continuity of life.

Other Succulents have solved their problem in other ways, and we thus find that almost every part of the plant can be modified for the storage of water. It follows that Succulents may assume a very great variety of shapes: they may be classed into the following main categories, although it is pointed out here that this is by no means a scientific classification, its only purpose being to illustrate the various forms which may be met with in East Africa. On Plate 7 a typical representative of each of these forms is shown.

Modified parts.	Represented on Pl. 7 by
(1) Trunk only.	<i>Cissus</i> sp.
(2) Trunk and branches only.	<i>Adenium coetaneum</i>
(3) Branches and leaves (the latter well developed).	<i>Cotyledon barbeyi</i>
(4) Trunk and branches, while leaves are greatly reduced and deciduous. Spiny or spineless. Inflorescence fleshy. Turning woody with age.	<i>Euphorbia butuana</i> sf
(5) Whole plant including inflorescence fleshy, without woody structure.	<i>Caralluma subterranea</i> [in: <i>Stapelia semota</i>

Although it might be tempting to base a description of Succulents on the above external characters, it will be more satisfactory and more instructive to describe them according to the place which they hold in the natural system, i.e. in their phylogenetic order.

The families most prolific in succulent forms in East Africa are EUPHORBIACEAE and ASCLEPIADACEAE. Other families, like CRASSULACEAE and AIZOACEAE, though represented by numerous species in the South of the Continent, are known by a few species only from East Africa, while GERANIACEAE, to which the above-mentioned "bushman's candle" belongs, have not produced outstanding succulent forms in our part of the world.

On the other hand, some euphorbiaceous Genera, like *Stenadenium*, *Synadenium*, *Monadenium*, and *Dorstenia* are confined almost exclusively to Eastern Africa.

The following descriptions do not claim to include all Succulents to be found in East Africa; the flora of this country is far too imperfectly known for such an undertaking, nor has the author had access to all literature on the subject, and every year new species are discovered to increase an already great variety. This lack of completeness, however, adds rather than detracts from the charm of this interesting group, for every lover of nature has it within his reach to make discoveries of his own.

The aim of this paper is mainly to stimulate the interest in collecting and cultivating East African Succulents, and to disprove the often heard contention that they cannot bear comparison with those of other countries.

EAST AFRICAN SUCCULENTS ARRANGED IN THEIR NATURAL ORDER.

<i>Families.</i>	<i>Genera.</i>
CRASSULACEAE.	Cotyledon, Crassula, Kalanchoe, Sedum.
AIZOACEAE.	Mesembrianthemum.
PORTULACACEAE.	Portulaca, Talinum.
PASSIFLORACEAE.	Adenia.
CUCURBITACEAE.	Momordica.
CACTACEAE.	Rhipsalis.
EUPHORBIACEAE.	Euphorbia, Monadenium, Stenadenium, Synadenium.
MORACEAE.	Dorstenia.
ICACINACEAE.	Pyrenacantha.
AMPELIDACEAE.	Cissus.
APOCYNACEAE.	Adenium.
ASCLEPIADACEAE.	Caralluma, Ceropegia, Cynanchum, Duvalia, Echidnopsis, Edithcolea, Huernia, Sarcostemma, Stapelia.
COMPOSITAE.	Kleinia, Notonia, Senecio.
LABIATAE.	Aeolanthus.
LILIACEAE.	Aloe, Anthericum, Bowiea, Sansevieria.
ARACEAE.	Zamioculcas.

CRASSULACEAE. (Plate 8.)

This family is widely distributed over hot and temperate countries. The centre of its distribution is in Africa, but representatives are found also in Australia and Polynesia, a very few in South America.

In the Northern Hemisphere, including Europe, it is represented by the Genera *Sedum* and *Saxifraga*.

The Genera found in East Africa are: *Cotyledon*, *Crassula*, *Kalanchoe*, *Sedum*.

Cotyledon.

The genus is represented with over thirty species in South Africa, while only two are known from East Africa.

Cotyledon Barbeyii, Schweinf.

Has a wide distribution in East Africa, where it is endemic. It has been collected from south of Kenya Colony as far north as Erythrea. It is one of the most ornamental of East African Succulents, a vigorous shrub that may attain a height of seven feet. The erect branches bear large, fleshy, rounded leaves of a fresh green, powdered with a slight waxy bloom. The flowers rise on a slender stem in a graceful, somewhat drooping, cyme of bell-shaped flowers which range from a pale lemon-yellow to a glowing vermilion.

Plate 7 (3)—whole plant. Plate 8 (1)—flowering branch.

Cotyledon umbilicus, L.

The distribution of this species is very wide indeed; it is known to occur in Britain, in the Canary Islands, in North-Western Africa. In East Africa the plant has been found in the alpine zones above 10,000 feet of most of the higher mountains; it is a small, succulent herb, rarely over a foot in height. The small, bell-shaped, flowers are greenish-white, standing out almost horizontally from a single, sometimes branched, stem which rises from a rosette of fleshy, disc-shaped leaves with notched edges, attached to the stalks in the centre. The plant is not a truly xerophyte, but seems to prefer damp places; it is found mostly on mossy rocks near mountain streams.

Crassula.

More than two hundred species of the most varied appearance are known from Southern Africa, while the species known from East Africa are far less numerous and in most cases less showy. They are small herbs, with few exceptions more than a few inches high, with small, sometimes minute, star-shaped flowers, which grow either singly on slender stalks from the leaf-axils, or in dense clusters from a main stem.

Crassula abyssinica, A. Rich.

Is widely distributed over tropical Africa. It is one of the tallest and most robust member of the family, attaining a height of 2½ feet. The single stem, which is branched towards the top, carries a dense cluster of small, star-shaped, white or purple, flowers. The fleshy leaves are lancet-shaped and minutely saw-edged. They are arranged around the stem in such a way that the larger leaves form a kind of rosette at the base becoming less numerous and smaller as they ascend the stem. (Plate 8 (2a).)

Crassula alsinoides (Hook f. Engl.).

Was first discovered in Cameroon but was found later to extend all over tropical Africa, including East Africa. It is a herb with fleshy, oblong leaves which are dotted with small maroon spots. The flowers are star-shaped, white, and somewhat fleshy, and grow singly on slender stalks, from the leaf-axils. The plant grows seldom higher than about eight inches. Very nearly related to this species are:—

Crassula coleae, Bak., which is common on rocks in Kenya Colony (Plate 8 (2b).);

Crassula galunkensis, Engl., with slightly narrower leaves;

Crassula volkensis, Engl., from Lake Dschalla in Tanganyika, a more robust species, growing to nearly a foot in height; and

Crassula nakurensis, Engl., which is found on rocks around Lake Nakuru.

Crassula crassipes, C. A. Smith.

Crassula pharnaceoides (Hochst.), Fisch. et Mey.

Crassula parvifolia, E. A. Bruce,

and related species show yet another type of appearance: the small, narrow, fleshy, leaves are arranged very closely in opposite alternating pairs, which give the branches an outward resemblance to club-mosses. None of them grow very tall; they have sometimes the appearance to miniature trees of less than a foot high and are quite ornamental in a rock-garden. The flowers are minute and not showy. On Plate 8 (2c) a *Crassula* sp. belonging to this type is shown.

Crassula erubescens, Bullock, from Mt. Elgon, growing on rocks, is a very small herb, barely two inches high, with bright scarlet foliage; it has small, single, cream-coloured flowers.

Crassula aquatica, L.

Crassula pentandra, Boyle.

Crassula Wrightiana, Bullock.

All occur in E. Africa, they are also succulent herbs, but as their habitat is mostly in swamps and bogs and in other damp places, they are outside the scope of this paper, which deals with Succulents suitable for rock gardens.

KALANCHOE.

This genus which is very rich in forms is distributed over the tropical and sub-tropical parts of Asia and Africa. It is represented by a number of very ornamental species in East Africa. They are sturdy, very succulent, herbs, sometimes attaining a height of six feet and over, growing often in clumps.

PLATE 8.



FIG. 1.

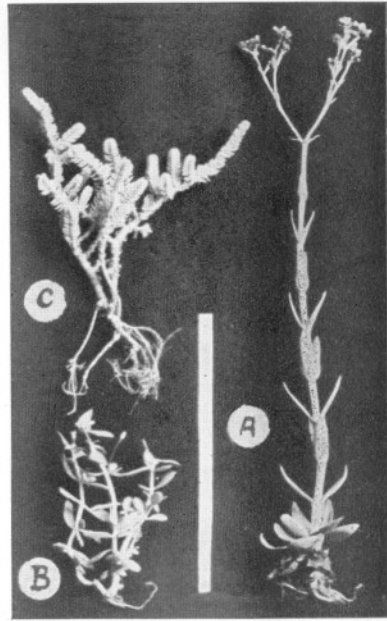


FIG. 2.



FIG. 3.

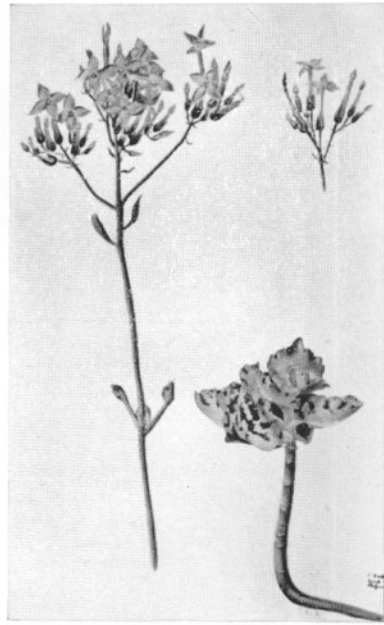


FIG. 4.

CRASSULACEAE.

The fairly large four-petalled flowers grow in dense cymes on a tall stem. Their range of colour is wide. White, cream, yellow in many shades, salmon-pink, brick-red, and scarlet-flowering species make *Kalanchoe* a desirable plant in rock gardens. Even when not in flower, the fleshy, often showily marked leaves, are very attractive.

Kalanchoe crenata, Haw.

A tall, succulent herb up to 5 feet, which is widely distributed over tropical Africa. The fleshy foliage is of a rich glossy, green, sometimes with a narrow maroon edge, the flowers primrose yellow. It is common around Nairobi and seems to prefer the light shade of forest edges and of high grass.

Kalanchoe glandulosa, Hochst.

Common in the Ngong Hills on poor rocky soil, this plant rarely attains a height of more than 16 inches. The radical leaves at the base are no more than two inches long and $\frac{3}{4}$ inch wide, and they diminish in size along the stem of the plant, which bears a cluster of primrose-coloured flowers, rising from fleshy, globular, calices which are, like the rest of the plant, covered with fine, rather sticky, hairs. (Plate 8 (3).)

Kalanchoe glaucescens, Britt.

One of the most attractive of indigenous *Kalanchoes*. It is mostly found in clusters which present a most pleasing aspect when in full bloom. The medium-sized leaves have notched edges of a deep maroon, while their green surface is covered with a bluish-green bloom. The flowering stalks rise to a height of over two feet where they form a mass of coral-red flowers. Though small in size individually, their number and bright colour, contrasting with the blue-green of the leaves, produce a very good effect. The plant is common in the Ngong Hills and on Lukenya, near Nairobi.

Kalanchoe lateritia, Engl.

Not unlike in appearance from *Kalanchoe glaucescens*, this species has smaller flowers with narrower petals, nor are the flowering heads so dense. The flowers are, however, more brilliantly coloured, a bright vermilion. It prefers low and hot districts and is found in the country extending from Kilimanjaro to the Teita Hills.

Kalanchoe Lugardii, Bullock.

A tall, apparently widely spread, *Kalanchoe*, which attains a height of over 5 feet. The flowers measure about one inch in

diameter and seem to vary much in colour, but pure white and yellow seem to be predominant. The leaves are large up to nine inches long and five inches wide, the notched margins marked with maroon. The plant has been found from Mount Elgon at 7,500 feet to Lake Rukwa in Tanganyika at various altitudes down to 4,900 feet. (Plate 8 (4).)

Kalanchoe petitiana, A. Rich.

Is very similar to *Kalanchoe crenata*, except that leaves and all green parts are quite smooth. The distribution is approximately the same.

Kalanchoe somaliensis, Baker.

The giant of East African Kalanchoes occurs quite commonly in Nairobi district on old cultivated land. It was probably introduced in Kenya by Somali cattle and horse dealers, and it is now firmly established here.

The large, pale-green leaves are mottled with maroon and they cling to the thick, sturdy stalk at its base, rather in the fashion of cabbage leaves, while higher up they are set more loosely in opposite pairs.

The flower heads are large, and so are the individual flowers, which are waxy-white and attain a diameter of $1\frac{1}{2}$ inches, their tube being two inches long.

Kalanchoe sp.

In the half-shade of shrubs and trees on the Ngong Escarpment and on Lukenya behind Athi River station occurs a *Kalanchoe* which differs from all others by its finely divided, though fleshy, leaf, which makes it an attractive plant in the rock-garden. The flowers are small and ivory-white, and they are set off very well by the brilliant emerald-green of the fleshy leaves and stalks.

SEDUM.

The Genus is but poorly represented in East Africa, and apparently confined to the higher regions.

Sedum ruwenzoriense, Baker.

A small succulent herb of decumbent habit which grows mostly epiphytically in trees or on mossy rocks. The leaves are distributed loosely all along the stem; they have the size and rounded shape of hulled rice. The flowers grow at the end of the branches in rather dense cymes. They are five-petalled stars of a brilliant golden yellow, and a plant in full bloom is a very attractive sight.

Sedum Meyeri Johannis, Engl.

from Mt. Kilimanjaro is a plant of appearance and habits very similar to the above.

This concludes the descriptive list of the Crassulaceae which are represented in the Herbarium of the Coryndon Memorial Museum, and although it is by no means a complete record of all East African species, it is hoped that it will convey to the reader a fair idea of the appearance, the habits and the distribution of this family without bothering him unduly with highly technical terms or descriptions.

(To be continued)