



LITHOPS

by

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Illustrations

With the exception of Fig. 1 all illustrations are by the author.

Cover picture: *Lithops verruculosa* in the collection of the author.

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LITHOPS

an introduction to a fascinating
group of plants

by
Brian Fearn

To the late Dr H. W. de Boer, whose
enthusiasm for the genus and
encouragement for me to continue
his work has brought this task to fruition,
this work is respectfully dedicated.

Preface

Advice was offered by the periodical *Punch* many years ago which is pertinent to those who wish to write a book. It was a 'letter of advice to those about to be married' and applicants received the single word—*don't*.

Fifteen years ago when I started research on aspects of the water relations of the **Lithopinae** I found that the taxonomy of the genus *Lithops* was in some confusion and decided to study that first. Professor G. C. Nel's superb monograph is now 30 years out of date. Much of the work by the late H. W. de Boer, who was the world's leading authority, is unpublished and the new English translation of *Das Sukkulentenlexikon* by Hermann Jacobsen, although it contains my analytical key, is rather more a recapitulation than a reappraisal of the genus *Lithops*. A book was published in 1970 by D. L. Sprechman *et al* on *Lithops* at a cost of over £25, but this is beyond the reach of most people. I therefore decided to produce a new booklet on *Lithops*.

I wish to express my sincere appreciation to all those who so generously have given invaluable help, assistance and encouragement in the preparation of this booklet. In particular I would like to thank the late Dr H. W. de Boer and his wife of Haren (Gn) Netherlands for freely given hospitality on the many occasions that I have had the pleasure of staying in their household, for the hours of enjoyment gained from just talking *Lithops*, but above all for access to the finest collection of *Lithops* in cultivation, enabling a detailed study and photographic record to be made. It was de Boer's enthusiasm for the genus and his encouragement for me to continue his work that has brought this task to fruition.

Acknowledgements are also due to the following people and institutions: Professor A. R. Clapham of Sheffield University, formerly head of the Department of Botany, for the use of facilities and for comments and suggestions; Professor A. J. Willis, head of the Department of Botany, Sheffield University for help and constructive criticism; the Director of the Royal Botanic Gardens, Kew, and members of staff, particularly S. W. Rawlings, for permission to use the library and for a detailed examination of the living collection of succulents; Professor D. T. Cole of the University of Witwatersrand, Johannesburg, for comments and habitat information; Dr T. T. Elkington of the Department of Botany, Sheffield University for help and constructive criticism; Professor D. J. Anderson of the University of Sydney, Australia, and formerly lecturer in the Department of Botany, Sheffield University for his interest in the project prior to his emigration; G. D. Rowley of the

Department of Agricultural Botany, Reading University for advice and interest in the project and help with the bibliography; also to Mr G. Woods for photographic assistance and to Miss Wells of Sheffield University Library, for her skill in tracking down and obtaining obscure journals.

Finally to R.F. and G.M.F. without whose help and encouragement in the last 15 years this work would never have come to fruition.

B. Fearn

Matlock 1980

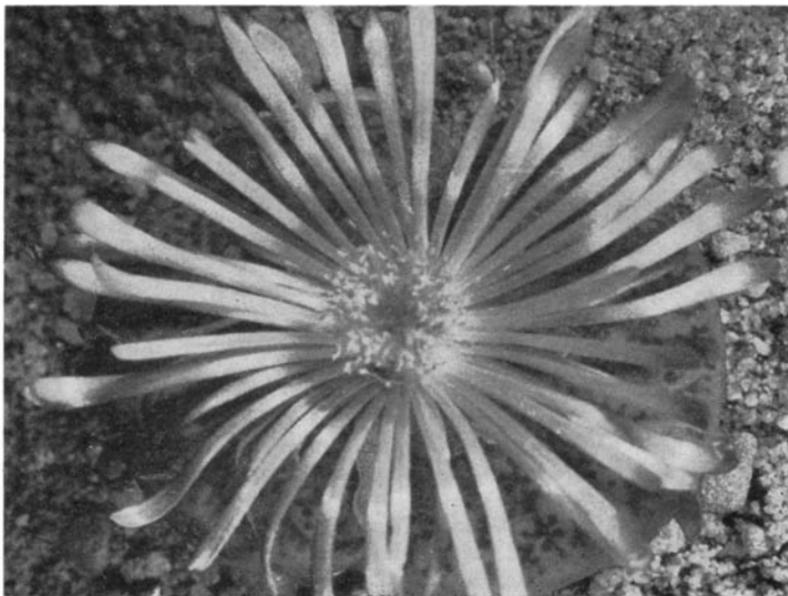


Fig. 1: A flowering plant of LITHOPS AUCAMPIAE. As can be seen, the diameter of the Lithops flower often exceeds that of the body.

Photo: C. van de Wouw

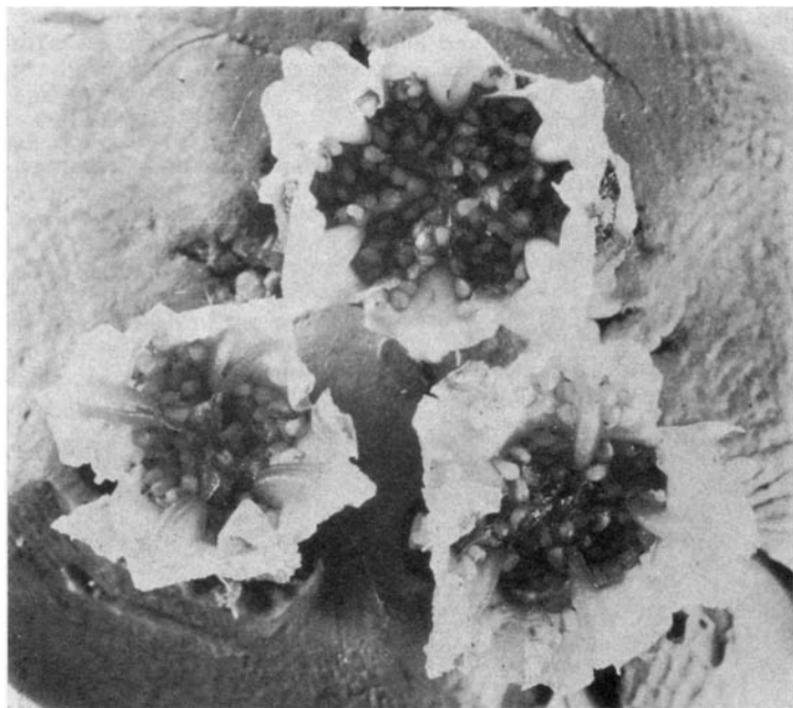


Fig. 2: Open seed capsules of LITHOPS SALICOLA. The capsules open when moistened and the seeds are scattered by a rain-splash mechanism.

Introduction

The fascinating genus *Lithops* belongs to the family of plants called the *Aizoaceae*, better known under the popular name of Mesembryanthema. The huge single genus *Mesembryanthemum* L., which in the widest sense could contain over 2500 species, has been split into a large number of separate genera (Herre, 1973). It was Dr N. E. Brown, working at Kew, who first discovered that the genus could be conveniently reclassified according to the structure of the seed capsule (see figs. 2 and 3). This work was later continued by Professor M. H. G. Schwantes and Dr H. M. L. Bolus working in Germany and South Africa respectively. The unbelievable variety in the shape and form of the leaves, the often strikingly beautiful flowers and the fascinating structure of the seed capsule makes the Mesembryanthema one of the most interesting groups of all succulent plants. They are of great horticultural interest and are widely cultivated.

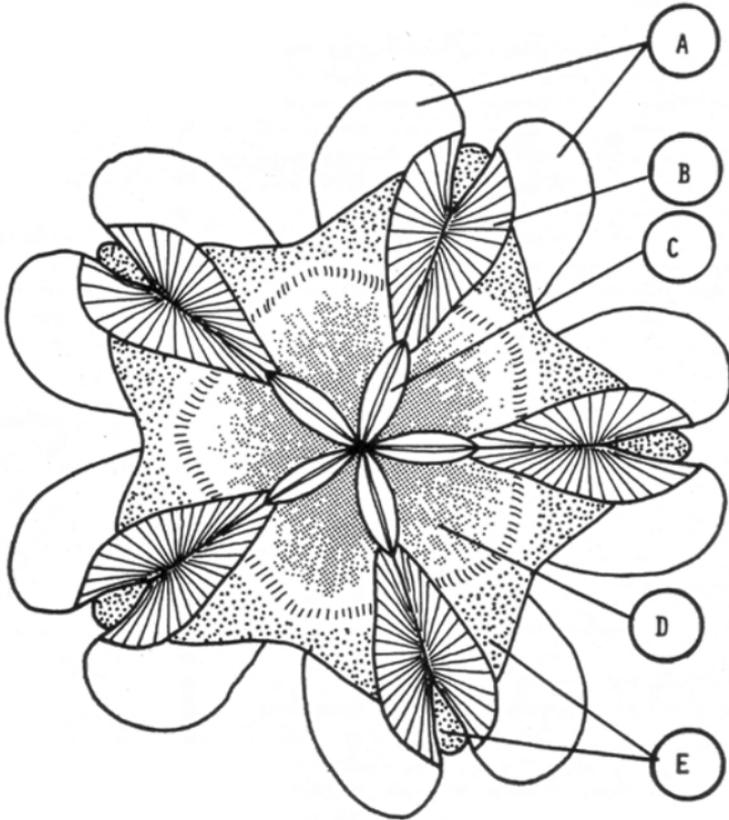


Fig. 3: Capsule structure of *LITHOPS VILLETII*.

- A Membraneous valve wings
- B Expanding keel
- C Rudimentary cell lid attached to the seed chamber dividing membrane
- D Seed chamber
- E Valve.

The genus *Lithops*

The name *Lithops* is derived from the Greek words *lithos*—a. stone, and *ops*—a face. The name was given to these plants in 1922 by Dr N. E. Brown on account of their resemblance in colour and appearance to the stones and pebbles among which they grew. William J. Burchell in his *Travels in the interior of Southern Africa* (1822-24) describes in the following words the discovery of the first *Lithops*, originally described by Haworth as *Mesembryanthemum turbiniforme*, which a century later became the first described member of Brown's genus *Lithops*.

'On picking up from the stony ground what was supposed a curiously shaped pebble, it proved to be a plant . . . but in colour and appearance bore the closest resemblance to the stones between which it was growing.'

The discovery was made in 1811 at Zand Vlei, in the Prieska district of South Africa. More than 100 years elapsed before *Lithops* was rediscovered in 1918 by Dr Pole Evans in the same area—after he had searched a whole week for it.

Cole (1971) raises many interesting problems concerning the identity of Burchell's *Lithops* and has made a field study of the area in which W. J. Burchell first discovered a *Lithops* species in 1811. Burchell did not introduce the plant into cultivation, but collected two herbarium specimens which unfortunately are no longer to be found.

Haworth's description was prepared from a drawing that Burchell made in South Africa (Haworth, 1821). Cole now raises serious doubts as to whether Burchell originally collected what we now call *L. turbiniformis*. In Cole's opinion Burchell's drawing definitely does not represent what we know as *L. turbiniformis* (Haw.) N.E. Br., neither is it *L. hallii* nor *L. verruculosa*. All these three plants grow in the general area where the original plant was discovered. Burchell's precise locality, 'Zand Valley', has still not been satisfactorily relocated. Dr I. B. Pole-Evans, as previously noted, found a *Lithops* in this area in 1918. As Cole has now pointed out, although he found *L. turbiniformis*, he might just as easily have found *L. hallii* or *L. verruculosa* when he made his search in 1918, in which case one of these could have been proclaimed to be Burchell's *Lithops*.

The next species to be discovered was found by Professor K. Dinter near Windhoek in Great Namaqualand and was named by Berger in 1908 as *Mesembryanthemum pseudotruncatellum*. Between 1920 and 1930 a great many species were discovered, largely on the

numerous and often arduous journeys made by Dinter. It is fitting that a distinctive and rare species was named by Schwantes in his honour. *L. dinteri* Schwant. was found in 1926 by Ernst Rusch at Wittsand, north of the Orange River in South West Africa. Rusch, himself commemorated by the name *L. ruschiorum* (Dint. & Schwant.) N.E. Br., was another active collector. Since 1950, and particularly since 1960, very many new species and varieties have been named by Dr H. W. de Boer working in the Netherlands. In addition many new localities have been discovered for existing species. This is due to the field work of Professor D. T. Cole, Dr Geyer and Messrs Hall, Littlewood, Gebser, Roux and others.

Species of *Lithops* are widely distributed in Southern Africa, some being quite rare, others relatively plentiful, and they are often found in remote areas to which access is difficult (Fearn, 1968 and 1969). Each species, with the exception of one or two, is very localised in distribution and is often widely separated from another species. One of the possible reasons for this is that we may have incomplete information about the distribution of the species concerned. In the literature very few of the geographical distributions for different species are reported as being overlapping. A few species are confined to a single locality, others occur in several places, often many kilometres apart. *Lithops lesliei*, named in 1912 by N. E. Brown after its discoverer who found it near Vereeniging, has so far been collected in at least 25 separate localities. Professor Cole suggests that there are many more localities although he has not yet been able to confirm all the reports which he has heard. The most northern locality for *L. lesliei* is at Pietersburg in the Transvaal and the most southern is near Fourteen Streams in the Orange Free State. The distance between these two localities is 640 km. A distribution map is shown in fig. 4.

In the wild, the plants are often completely buried in sand and gravel with just the surface of the leaves visible. This is especially true of species which rarely occur as multiple heads, for example varieties of *L. pseudotruncatella* (Bgr.) N.E. Br. Clump-forming species, for example *L. marmorata* (N.E. Br.) N.E. Br., will obviously expose more leaf surface. In *Lithops*, the leaf colouring varies and 'mimics' the rock and soil in which they grow (Fearn, 1965).

It is often wondered just how long these plants can live. Dinter once counted 50-75 shrivelled leaf bases on each head of a 7-headed clump of *L. optica*, four heads of which were still living. It can be surmised that a single pair of leaves is produced each year, although in very dry years the plants probably do not grow at all. This plant would then be at least 50-75 years old. Dr R. Stopp (1954) also

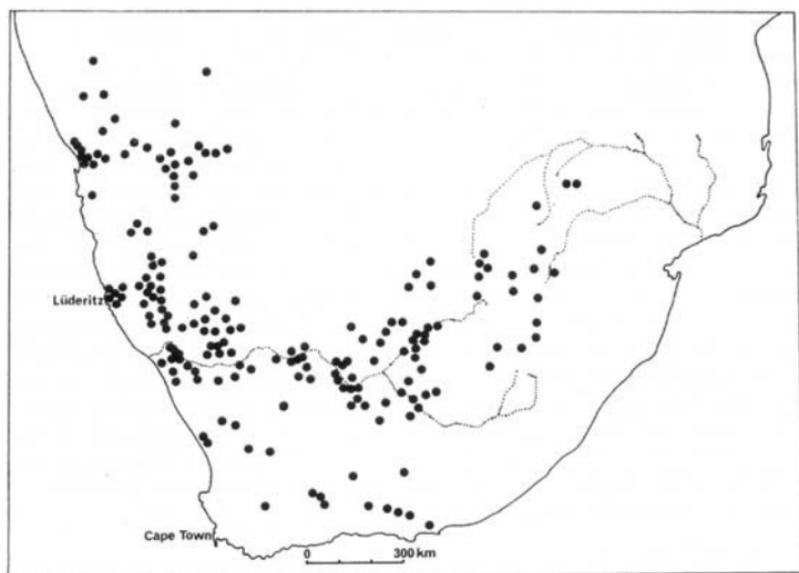


Fig. 4 The distribution of Lithops in Southern Africa.

examined plants of *L. optica* and counted pairs of shrivelled leaves and remains of flower stalks. He discovered that between 1929 and 1951 one plant had flowered on only nine occasions. It is surprising that the plants do not flower every year in the wild let alone in cultivation. One plant was calculated to be 95 years old. *L. ruschiorum* also appears to live to a great age. Clumps have been found in which 150 pairs of dried leaves remained. *Lithops* are thus far longer-living than had at first seemed possible.

It is difficult for a practised eye to find *L. pseudotruncatella* in the dry period, and is practically an impossibility for the novice. Professor Nel and several other botanists were taken by Ernst Rusch to a hill where there was a large number of these plants. Although they crept around on all fours they did not find a single specimen. Even when Ernst Rusch described a circle with his stick round one, they still could not see the plant (Schwantes, 1957). The situation changes during the short rainy season. The plant body swells and so is more easily seen. The plants also flower at this time and although the colour is either white or a shade of yellow, this does make them more conspicuous. The flowers open during the day and many specimens have been discovered because the plants happened to be in flower when the area was being searched. The rainy season is often very short and in some areas, notably S.W. Africa, there may be no rain at all for several years in succession.

A *Lithops* plant consists of a pair of leaves fused together and attached to a corky tap root. There is a meristematic region situated at the base of an enclosed fissure. A single pair of leaves is produced each year. During the resting period, i.e. dry season, this new pair of leaves, at right angles to the existing pair, is produced by the meristem. Sometimes, but not every year, the meristem produces a flower. When a flower is produced, adventitious buds are produced in the axil of the flower and the existing leaves. After flowering, two new pairs of leaves or heads can be produced, the plant eventually becoming a large clump. This is not always true, as one or other of the leaf buds may fail to develop. Many plants e.g. *L. pseudotruncatella* var. *gracilidelineata* rarely produce more than a single 'head'.

During the dry season, plants of *L. pseudotruncatella* are pulled down into the soil by means of contractile roots (Schmid, 1925). This ensures that only the top surface of the pair of leaves is exposed. Gaseous exchange, via the stomata, can still take place when the plants are buried in the soil, as many of these plants normally grow in very sandy, gravelly soils which contain a large number of air spaces. In many species the whole plant is encased in the dried papery remains of the previous season's pair of leaves. These are

shed at the beginning of the next growing season. This is an additional protection to cut down water loss by transpiration during the dry season.

The distribution of photosynthetic tissue in *Lithops* is very characteristic. When the plants are buried in soil, light cannot enter the leaves through that part of the epidermis which is below the surface. The plants have evolved a 'window' or translucent area, the cells beneath which are very large, water-filled and colourless. The light passes through the translucent area and diffuses through these water-filled cells to reach the light-receptive cells or chlorenchyma which line the inside of the epidermis. The amount of light reaching these cells is governed by the size and transparency of the window area. In some species there is a clear window e.g. *L. marmorata*, in others there is no window at all e.g. *L. turbiniformis*. In some species the window area is reduced in size by opaque islands and marginal ingrowths. There are in addition special cells, e.g. idioblasts and pellucid dots, which help or hinder the entry and internal diffusion of light (Fearn, 1977).

The cultivation of *Lithops*

In Europe it is essential for *Lithops* to remain dormant during the winter months. From the end of October until March no water should be given. During this period the old pair of leaves shrivels and a new pair is produced between them. In the spring the old pair is often reduced greatly in size: this is particularly so in *Lithops pseudotruncatella*. When water is given in the spring the new pair of leaves swells and bursts through the old leaves, which die away. As a general rule there should never be more than two pairs of leaves on a plant at any one time. If there are more than two, it suggests either that too much water is being given or that the plants are not receiving enough light. Watering once or twice a week should be sufficient in the growing season, which lasts from March to September. If during this time the epidermis shows signs of wrinkling, it indicates that not enough water is being given. Another indication as to water requirements is given by those species which should have a flat top surface to the leaves. If these appear to be concave, then too much water is being given.

Lithops species vary in their water requirement. Some species, particularly those which originate from the Transvaal and Orange Free State, grow in areas that have a relatively high annual rainfall—sometimes as much as 750 mm (30 inches) a year. This is particularly true of *L. lesliei* and *L. aucampiae*. Other species, particularly those from Little Namaqualand and S.W. Africa, grow in very arid areas which often receive less than 125 mm (5 inches) of

rain a year. Sometimes there may be no measurable quantity of rain for several years. Species from this area, e.g. *L. francisci*, *L. erniana*, *L. comptonii* var. *divergens* and *L. otzeniana*, are very sensitive to excess water.

It is interesting to note that some species, e.g. *L. localis* and *L. comptonii* var. *comptonii*, both grow, like the genus *Conophytum*, in winter rain areas of South Africa. Whereas it is impossible to grow *Conophytums* in the summer months, these two species of *Lithops* have a growing period which is the same as that of the rest of the species. It appears therefore that the growing period is not under the control of availability of water, but of day-length. Species of *Conophytum* are short-day plants and *Lithops* are long-day plants.

Lithops flower at the end of the growing period and *Conophytums* flower at the start of the growing period. In Europe most species of *Lithops* flower in the autumn, particularly in September, but *L. pseudotruncatella* and its relatives flower in July. The last species to flower is *L. optica* forma *rubra*, which can flower as late as December. It is advisable for this species to be watered and kept warm up to this time. It is also beneficial for it to be given artificial light so as to extend the day-length. This can be done by the use of warm white fluorescent tubes under the control of a time clock.

The finest European cultivator of *Lithops* was probably the late Dr H. W. de Boer. He grew his collection in square earthenware pans about 100 mm (4 inches) deep. A very sandy compost was used.

The minimum winter temperature should be 4–7°C (40–45°F). There is no maximum summer temperature but adequate ventilation must be given in hot sunny weather so that the plants do not scorch. Although it is possible to grow *Lithops* on the window-sill, a greater degree of success, particularly for flowering, will be achieved if they are grown in a greenhouse.

The propagation of *Lithops* from seed

Species of *Lithops*, like most stemless members of the *Aizoaceae*, are quite easy to grow from seed, provided that one or two simple instructions are followed. In Europe it is best to sow *Lithops* seed in September or October. Elsewhere in the world the seed should be sown at the end of the normal growing season. Shallow pans, about 60-80 mm (2½-3 inches) deep, in the bottom of which there must be a drainage hole, are used.

When making up a compost for *Lithops* it is most important to add coarse sand or grit so that the mixture is porous. Fine sand like silver sand is not suitable; builders' sand should be avoided because it contains lime. A suitable soil mixture for seed sowing and general *Lithops* cultivation can readily be made up as follows:

- (a) $\frac{1}{2}$ part coarse sand or grit,
- (b) $\frac{1}{4}$ part medium grade peat or well rotted leafmould.
- (c) $\frac{1}{4}$ part of garden soil.

Garden soil is an extremely variable material, but fortunately *Lithops* are fairly tolerant of soil conditions. As a general guide I recommend a friable and sandy loam which is slightly acidic in reaction. *Lithops* can also be grown successfully in a 'no soil' mixture consisting of equal parts of a nutrient-rich peat such as Fison's Levington potting compost and coarse sand. In the wild *Lithops* are found growing in alkaline soils, often on the tops of low limestone hills. Cole (1969) has published an extensive list of the soil types and the species found growing on them. Many species are also found growing in soils containing high concentrations of common salt (sodium chloride). In cultivation I have found that *Lithops* grow best in a neutral to slightly acid soil. Stemless members of the *Aizoaceae* have very low mineral requirements and it is not necessary to add fertilisers to the compost. In England one of the most successful growers of *Lithops* and *Conophytum* was the late J. T. Bates, who grew his plants in nothing but burnt clay, but I do not recommend this practice.

Fill the pans to within 5 mm ($\frac{1}{4}$ inch) of the rim with the compost and lightly level the soil. Then place a thin layer of sand on the surface. Scatter the seeds thinly and do not cover them with any material. Keep the pans moist but not soaking wet. Spraying overhead with a fine mist is beneficial before germination occurs, as there are soluble germination inhibitors in *Lithops* capsules which may also be on the seeds themselves. These have to be washed away before germination can proceed. *Lithops* seed needs light for germination, so place the pans in a light position at about 15-20°C. Germination is quite rapid, signs usually being visible after 7-10 days. *Lithops* seed remains viable for a considerable length of time which varies with the size of the seeds, the largest remaining viable for a longer period than the smallest. Fearn (1978).

Grow the seedlings for one complete year without withholding water. They should be the size of small peas by this time. They can be transplanted in the first spring or at about 6 months old. In the second winter the plants should be treated as mature plants and in Europe kept dormant from the end of October or beginning of November until the end of April.

A revised analytical key for the genus *Lithops*

Lithops plants are difficult to identify because there are few key characters (Fearn, 1966—Cole, 1969). There have been only two published keys for identification prior to the key by B. Fearn in the *Journal of the Cactus & Succulent Society of America*, **42**; pp. 90, 91, of which this is a revision. The key published by Nel (1947) is now unsuitable as many new plants have since been discovered. The key published by de Boer and Boom (1964) I consider to be unworkable as it attempts to identify not only the species, but all the varieties and forms as well, a list of over 90 names. The following key has also been published by H. Jacobsen (*Lexicon of Succulent Plants*: 511-513, 1975).

I attempted to make a species key using vegetative characters only. It is based on a critical examination of over 20,000 adult plants (over 3 or 4 years old) in the growing season. When the plants are resting the bodies shrivel and the colours are not characteristic. Size of the plants has not been used as this is a very variable feature, largely dependent upon environmental conditions. This is not to say that differences do not exist. For example single heads of *L. aucampiae* grow to more than 40 mm across whilst *L. wernerii* rarely achieves half this size and collected plants are nearly always less than 10 mm across (Schwantes 1957). My new key is not infallible but is believed to be a considerable advance on the two previous attempts.

In the following key:

- 1 A window is a transparent part of the top surface which is sometimes obscured by opaque islands and marginal ingrowths, e.g. *L. marmorata* (N.E. Br.) N.E. Br. (See Plate 20). It is sometimes difficult to decide whether a window is present or absent, e.g. *Lithops elisae* de Boer (Plate 9).
- 2 Pellucid dots are miniature windows up to 1 mm in diameter, usually greenish or bluish in colour and scattered over the top surface, e.g. *L. localis* var. *localis* (Plate 19).
- 3 The key uses the curvature of the top of the leaves as a character. This is based on plants grown under good conditions. Obviously plants which have been over-watered will present difficulties. In this case both options would be used and the descriptions of the alternatives checked.

Please consult the glossary for an explanation of the other terms used in the identification and description of *Lithops*.

To use the key

Starting at the beginning of the key, progressively select which of the pair of contradicting statements fits the plant being identified. Then proceed to the next pair of statements indicated by the number on the right. Continue to do this until you arrive at a name. Then check the plant being identified with the detailed description.

The Key

| | | |
|-----|--|--------------------------|
| 0 | Top of leaves green, greyish-green, whitish-green, olive-green or purplish-green | 1 |
| 0' | Top of leaves not so coloured | 17 |
| 1 | Pellucid dots present | 2 |
| 1' | Pellucid dots absent | 5 |
| 2 | Top of leaves strongly convex, leaves not tightly pressed together, fissure slightly gaping | 3 |
| 2' | Top of leaves not strongly convex, leaves tightly pressed together, fissure not gaping | 4 |
| 3 | Pellucid dots regularly scattered over the top surface | <i>localis</i> |
| 3' | Pellucid dots aggregated into indistinct lines | <i>francisci</i> |
| 4 | Red or brown lines present, often joined up to form dendritic markings | <i>pseudotruncatella</i> |
| 4' | Red or brown lines absent | <i>lesliei</i> |
| 5 | Top of leaves strongly convex | 6 |
| 5' | Top of leaves not strongly convex | 11 |
| 6 | Leaves tightly pressed together, fissure not gaping | <i>olivacea</i> |
| 6' | Leaves not tightly pressed together, fissure gaping | 7 |
| 7 | Fissure less than 8 mm deep | <i>optica</i> |
| 7' | Fissure greater than 8 mm deep | 8 |
| 8 | Flowers white, 6-merous. (number of stigma lobes, sepals, etc.) | 9 |
| 8' | Flowers yellow 5-merous | 10 |
| 9 | Window large, islands small, few or absent | <i>marmorata</i> |
| 9' | Window absent or obscured by islands and marginal ingrowths | <i>elisae</i> |
| 10 | Plants always greyish-green, window large, sometimes reduced by islands and marginal ingrowths | <i>helmutii</i> |
| 10' | Plants sometimes brownish or purplish-green, window large with a few small islands | <i>comptonii</i> |

| | | |
|-----|--|---------------------------|
| 11 | Red clots and /or brown lines present | 12 |
| 11' | Red dots and/or red or brown lines absent | 14 |
| 12 | Top with small raised red dots | <i>verruculosa</i> |
| 12' | Not as above | 13 |
| 13 | Window present, flowers white | <i>salicola</i> |
| 13' | Window absent, flowers yellow | <i>archerae</i> |
| 14 | Flowers white, 6-merous (number of stigma lobes, sepals, etc.) | <i>villetii</i> |
| 14' | Flowers yellow, 5-merous | 15 |
| 15 | Window large and distinct, with a few large islands | <i>otzeniana</i> |
| 15' | Window obscured by many small islands and marginal ingrowths | 16 |
| 16 | Window not distinct, with vague islands | <i>meyeri</i> |
| 16' | Window with distinct islands | <i>herrei</i> |
| 17 | Top of leaves white or pinkish-white | 18 |
| 17' | Top of leaves not so coloured | 24 |
| 18 | Top of leaves strongly convex | 19 |
| 18' | Top of leaves not strongly convex | 20 |
| 19 | Window absent. Flowers yellow | <i>ruschiorum</i> |
| 19' | Window obscured by islands and marginal ingrowths, flowers white | <i>elisae</i> |
| 20 | Pellucid dots present | <i>pseudotruncatella</i> |
| 20' | Pellucid dots absent | 21 |
| 21 | Top of leaves wrinkled with very fine chalky ridges | <i>vallis-mariae</i> |
| 21' | Not as above | 22 |
| 22 | Window present | <i>julii</i> |
| 22' | Window absent | 23 |
| 23 | Top of leaves flat | <i>karasmontana</i> |
| 23' | Top of leaves slightly convex | <i>erniana</i> |
| 24 | Leaves entirely purplish-red coloured | <i>optica f. rubra</i> |
| 24' | Top of leaves not so coloured | 25 |
| 25 | Top of leaves brownish | 26 |
| 25' | Top of leaves not so coloured | 47 |
| 26 | Pellucid dots present | 27 |
| 26' | Pellucid dots absent | 39 |
| 27 | Window present | 28 |
| 27' | Window absent | 31 |
| 28 | Top of leaves flat | 29 |
| 28' | Not as above | 30 |
| 29 | Red or brown lines present | <i>bromfieldii</i> |
| 29' | Red or brown lines absent | <i>lesliei, aucampiae</i> |
| 30 | Pellucid dots numerous, regularly scattered over the top surface. Window small | <i>localis</i> |
| 30' | Pellucid dots few, window often large | <i>francisci</i> |

| | | |
|-----|--|--------------------------|
| 31 | Red or brown lines absent | 32 |
| 31' | Red or brown lines present | 33 |
| 32 | Top of leaves flat | <i>aucampiae</i> |
| 32' | Top of leaves convex | <i>localis</i> |
| 33 | Lines joined up to form dendritic markings | 34 |
| 33' | Not as above | 36 |
| 34 | Top of leaves flat | 35 |
| 34' | Top of leaves convex | <i>weneri</i> |
| 35 | Flowering time July (in Europe) | <i>pseudotruncatella</i> |
| 35' | Flowering time September—October (in Europe) | <i>schwantesii</i> |
| 36 | Top of leaves strongly convex | <i>steineckeana</i> |
| 36' | Top of leaves not strongly convex | 37 |
| 37 | Lines and markings impressed so that the top of leaves appear bullate (puckered) | 38 |
| 37' | Not as above | <i>glaudinae</i> |
| 38 | Top with numerous large dark bluish-green pellucid dots up to 0.5 mm in diameter | <i>fulviceps</i> |
| 38' | Pellucid dots inconspicuous | 45 |
| 39 | Window present | 40 |
| 39' | Window absent | 45 |
| 40 | Red dots and lines present | 41 |
| 40' | Red dots and lines absent | <i>villetii</i> |
| 41 | Lines and markings impressed so that the top is bullate (puckered) | 42 |
| 41' | Lines and markings not impressed, top smooth | 44 |
| 42 | Top with small raised red dots | <i>verruculosa</i> |
| 42' | Not as above | 43 |
| 43 | Top of leaves flat | <i>julii</i> |
| 43' | Top of leaves slightly convex | <i>bella</i> |
| 44 | Window large, islands few if any | <i>salicola</i> |
| 44' | Window obscured by islands and marginal ingrowths | <i>dorotheae</i> |
| 45 | Flowers yellow, 6-merous | <i>turbiniformis</i> |
| 45' | Flowers white, 5-merous | 46 |
| 46 | Top of leaves flat | <i>karasmontana</i> |
| 46' | Top of leaves slightly convex | <i>erniana</i> |
| 47 | Pellucid dots absent, flowers white | <i>deboeri</i> |
| 47' | Pellucid dots present, flowers yellow | 48 |
| 48 | Red dots present | 49 |
| 48' | Red dots absent | <i>weneri</i> |
| 49 | Window present | <i>dinteri</i> |
| 49' | Window absent | <i>schwantesii</i> |

**Descriptions and photographs of
the Lithops species arranged in
alphabetical order**



LITHOPS ARCHERAE de Boer. Photograph of plants from which the type description was made, in the collection of Dr H. W. de Boer.

Plate 1 *Lithops archerae* de Boer *Succulenta* 1967b, 46: 122.

Size 29mm long and 22mm wide at the fissure.

Fissure Immature plants exhibit the typical narrow fissure of Series A, but mature plants have a slightly gaping fissure reminiscent of *L. vallis-mariae*. Fissure 2.5—3.5mm deep.

Colour Greenish-grey, tinged with yellow.

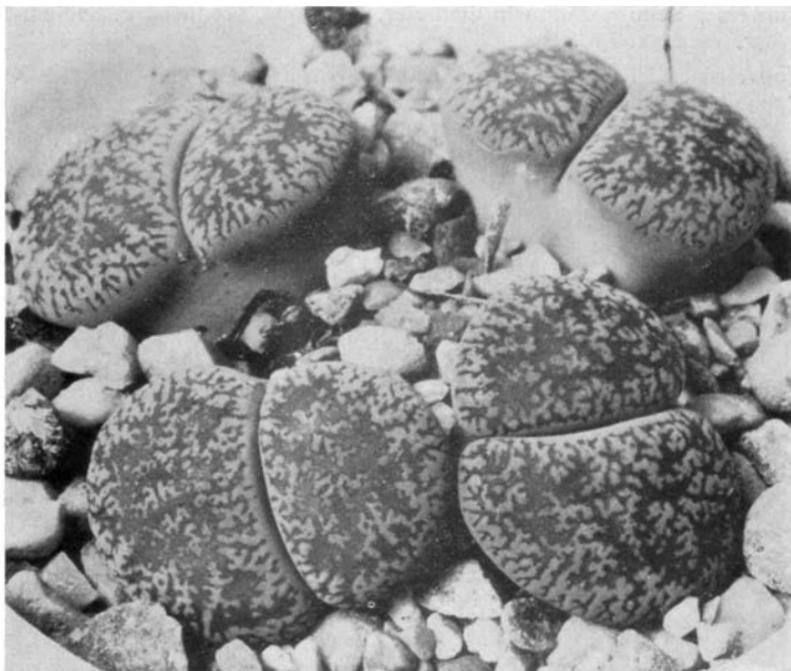
Top Windowless, flat, slightly concave with 4-5 indistinct, slightly impressed dendritic lines incompletely joined together.

Flowers Yellow, ?-merous, seed group 2 (see p.64).

Collected by Mrs A. Archer of Tsams West in 1966 and named in her honour.

Type locality Naukloofbergen, near Zaris, S.W. Africa.

Notes This is an extremely interesting species as it is an intermediate link between three complex species—*L. schwantesii*, *L. pseudotruncatella* and *L. vallis-mariae*. Cole (1973) has proposed the combination *L. pseudotruncatella* var. *archerae* (de Boer) Cole. At the present time I prefer to leave it as a separate species.



LITHOPS AUCAMPIAE L. Bol. Note the varying size of the window, which is either greenish or brownish.

Plate 2 *Lithops aucampiae* L. Bol. *S. Afr. Gard.* 1932 22: 276, 306.
Lithops aucampiae var. *aucampiae*.

Size Up to 40mm long and 20mm wide at the fissure. Forms large clumps up to 200mm in diameter.

Fissure Very narrow.

Colour Reddish-brown. The top surface is variable in both colour and markings; some plants have a distinct window, others have the window occluded by irregular, somewhat raised islands. These latter plants are very like *L. lesliei* var. *hornii*.

Window Dark olive-green to reddish brown with numerous antler-like branches in the outer margin. Top surface strikingly flat. Pellucid dots are occasionally present but certainly not in all specimens.

Flowers Yellow, 25mm in diameter, 6-merous, produced in September, seed group 1.

Collected by Miss Aucamp and D. McCormick in 1931.

Type locality North of Portmasburg, Griqualand West, Cape Province.

Notes The name *L. loganae* L. Bol. refers to a variant with bright markings, having a distinct window not occluded by islands. This variant is not true breeding and the name is excluded. This species and its varieties are widely distributed. De Boer has named two varieties and Cole another one. *L. lesliei* var. *hornii* appears to be related, so much so that it could well be a link between two otherwise distinct species. It is often difficult for amateurs to distinguish between them.

Varieties *Lithops aucampiae* var. *euniceae* de Boer

Lithops aucampiae var. *fluminalis* Cole

Lithops aucampiae var. *koelemanii* de Boer ex Cole

Plate 3 **Lithops bella** N.E. Br. *Gard. Chron.* 1922 Ser. 3 71; 80
Lithops bella var. *bella*.

Size Up to 35mm long and 25mm wide at the fissure.

Window Large, dark greenish or brownish, broken up by the raised light yellow, pinkish-yellow or light brownish-yellow islands which make the top surface very rugose.

Flowers Pure white, scented, 25mm in diameter, produced from September to October, (4-)5-6-merous. Seed group 3.

Collected by E. C. Phillips in 1922.

Type locality Near Aus-Gubub in granite mountains, S.W. Africa.

Notes Another locality, the first south of the Orange River, was found by Dr H. Andreae at Jakhalswater about 64km south of Vioolsdrift, Cape Province in May 1950.

L. marmorata has also been recorded from this area.

Varieties *Lithops bella* var. *eberlanzii* (Dint. & Schwant.)

de Boer & Boom

Lithops bella var. *lericheana* (Dint. & Schwant.)

de Boer & Boom

(See note on p39)



LITHOPS BELLA N.E. Br. The name, meaning beautiful, is very appropriate for such an attractive species.

Plate 4 *Lithops bromfieldii* L. Bol. *Notes on Mesemb. and allied genera* 1931, 2: 452.

Lithops bromfieldii var. *bromfieldii*

Size up to 3.0cm long and 1.8cm wide at the fissure, but usually much smaller than this. For example Harry Hall has collected a 24-headed plant which was only 5.0cm in diameter overall.

Colour characteristically yellowish-red-brown from a distance.

Top flat or slightly convex, usually strongly rugose being irregularly furrowed.

Window reduced to strips, dark green with deep rust-red lines.
Outer margin with 6-10 bifurcations of the window.

Islands present, strongly bullate, yellowish, sometimes reddish-brown.

Flowers yellow. 5-merous. Seed group 3.

Collected by H. Bromfield in September 1933.

Type locality 20 miles South West of Upington near the Orange River.

Varieties *Lithops bromfieldii* var. *insularis* (L. Bol.) Fearn
Lithops bromfieldii var. *mennellii* (L. Bol.) Fearn



LITHOPS BROMFIELDII L. Bol.

Plate 5 *Lithops comptonii* L. Bol. *S. Afr. Gard.* 1930 20: 214.
Lithops comptonii var. *comptonii*

Size Rather small, being up to 25mm long and 15mm wide at the fissure, rarely more than 2-headed but Nel (1947) records clumps of 15 heads.

Fissure Deep, the leaves often gaping.

Colour dark green, purplish-green or reddish, sometimes greyish-purple or brownish.

Window Large dark grey-green sometimes tinged purple, often with many islands but occasionally some specimens are without islands.

Flowers Yellow, 15-25mm in diameter, 5-merous. Seed group 4.

Collected by Professor R. H. Compton and named in his honour.



LITHOPS COMPTONII L. Bol. The new pairs of leaves may be seen emerging as the old leaves begin to dry off.

Type locality This is erroneously given in the type description and later in Nel's 'Lithops' (1947) as Matjesfontein and Karroo Poort. Professor R. H. Compton states that he originally made the collection midway between these two localities near the farm Sterkfontein to the north of the Bonteberg.

Notes This species with its widely divergent leaves is one of the most primitive of the genus and, as it grows in the south-west Cape region, is considered to be a species from which many others in the genus have evolved. It is rarely found in cultivation.

Varieties *Lithops complanata* var. *divergens* (L. Bol.) Fearn
Lithops complanata var. *divergens* forma *amethystina*
 (de Boer) Fearn
Lithops complanata var. *viridis* (Luckh.) Fearn



LITHOPS DEBOERI Schwant. Note the amount of variation in the window among this group of young plants. These plants have been grown from seed produced from Dr de Boer's original two plants.

Plate 6 *Lithops deboeri* Schwant. *Nat. Cact. & Succ. J.* 1952 : 7: 42.

Size Up to 40mm long and 25mm wide at the fissure, rarely forms more than 2 heads. Leaves equal in size.

Fissure Deep with a conspicuous pink blister at the base of the leaves.

Colour Sides bluish-grey, top bluish-grey or brownish.

Window Large, very dark bluish-grey or brownish-grey often reduced to reticulate lines by the many brown or reddish islands. Some plants have few or no islands in the centre of the window which is then large and prominent.

Flowers White, 6-merous, seed group 5.

Collector Unknown. Sent to Dr H. W. de Boer by Professor G. C. Nel.

Type locality Stafvlei, Cape Province.

Notes This species was named by Professor M. H. G. Schwantes in honour of Dr H. W. de Boer, one of the world authorities of the genus. De Boer writes of its origin as follows—

“Shortly after the war (1940-45) I received two plants from Professor G. C. Nel, with the name *L. verruculosa*. Neither by its description nor by the illustration in Nel (1947) does this name fit this plant. One might call it a white-flowering variety of *L. weberi*, but this likeness applies only to the form of the window and islands, the colouring being entirely different.”

The locality of this species has been found only very recently and all the thousands of plants in cultivation have been grown from seed produced by de Boer's original two plants and their progeny. Cole (1973) has proposed the combination *L. villetii* var. *deboeri* (Schwant.) Cole. At the present time I prefer to leave it as a separate species. See Cole (1972).

Plate 7 *Lithops dinteri* Schwant. *Zeitschr für Sukk.* 1927: 3: 97, *Lithops dinteri* var. *dinteri*.

Size Up to 22mm long and 15mm broad at the fissure. Lobes nearly always equal in size. Forms clumps of 8 or more heads.

Colour Light brownish-green, sometimes suffused with red.

Window Always present, surface flat or slightly convex, bordered irregularly with brownish-yellow. Red dots always present varying 3—15 in number and up to 0.5mm in diameter. Red lines sometimes present, up to 3mm long. Other dots present, sometimes indistinct, light bluish to very dark blue.

Islands Absent or many, light brownish-yellow, sometimes coloured.

Flowers Yellow, 6-merous, Seed group 5.

Collected by Ernst Rusch in 1926.

Type locality Wittsand, South of Warmbad, which lies north of the Orange River. Found growing in quartz.

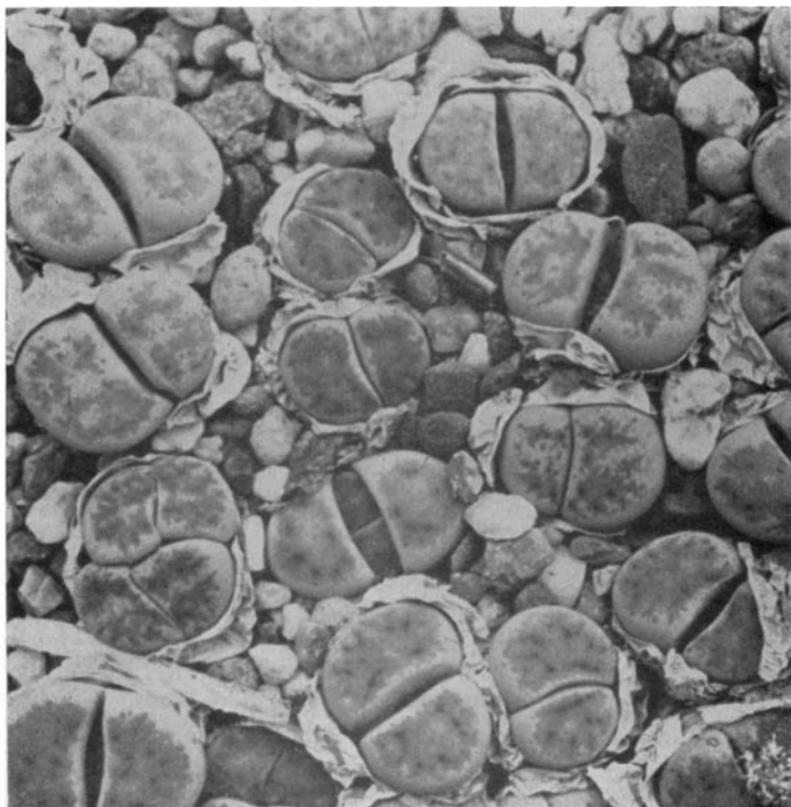
Notes This is a rare species not often cultivated. Many of the plants in cultivation as this species are *L. dinteri* var. *brevis*.

Varieties *Lithops dinteri* var. *brevis* (L. Bol.) Fearn

Lithops dinteri var. *frederici* Cole

Lithops dinteri var. *marthae* (Loesch. & Tisch.) Fearn

Lithops dinteri var. *multipunctata* de Boer



LITHOPS DINTERI Schwant. Compare this photograph with that of *L. comptonii* on page 22. Here the old leaves have dried completely to leave only a shell.

I consider var. *marthae* to be a link between *L. dinteri* and the *L. schwantesii* complex. Among the plants examined were specimens which were practically identical with *L. schwantesii*, *L. dinteri* var. *dinteri* and *L. dinteri* var. *brevis*. Plants with red dots are often like var. *dinteri* and others without dots often like var. *brevis*. Cole (1973) has published the combination *L. schwantesii* var. *marthae* (Loesch. & Tisch.) Cole. After examining large numbers of plants I believe that it is closer to *L. dinteri* than to *L. schwantesii*. In the future a union of both species may be preferred.



LITHOPS DOROTHEAE Nel. This is generally considered to be one of the most attractive species.

Plate 8 *Lithops dorotheae* Nel. *Succulenta*, 1939, 21: 1.

Size Up to 30mm long and 20mm wide at the fissure, very rarely forming clumps of more than 2 heads. A flowering clump at Kew had 5 heads.

Colour Light brownish-yellow, the window strongly contrasted against the islands and margins.

Window Slightly convex, smooth to the touch, dark grey with red dots and red, sometimes branched, lines. The window is nearly occluded in some plants by the light buff coloured islands.

Flowers Yellow, 5-merous, seed group 3.

Notes There has been much confusion concerning the type locality, the collector and the identity of the person after whom Nel named this plant. Professor D. T. Cole (1970), by an admirable piece of

detective work, has clarified the situation. He concluded that—

(1) The type locality of *L. dorotheae* Nel is near Pofadder, Bushmanland, C.P. not Pella as stated by Professor G. C. Nel and reiterated by other authors.

(2) The species was originally discovered and collected by Mrs Aletta Helena Ekstein, presumably in 1935.

(3) *L. dorotheae* Nel was named after Dr Dorothea van Hyssteen not van Huysteen as stated by G. C. Nel and not after Mrs Dorothea Ekstein as stated by Schwantes (1957).

L. dorotheae is probably closely related to *L. dinteri*. They appear to be completely interfertile. I have produced F₁ hybrids which look very like *L. dinteri* var. *multipunctata*.

Plate 9 *Lithops elisae* de Boer. *Succulenta*, 1961, 40: 107.

Size Up to 40mm long and 20mm wide at the fissure.

Fissure In large specimens up to 20mm deep.

Colour The plants have an overall bluish-yellow-grey colour often suffused with amethyst.

Window Occluded by the islands and reduced to narrow strips.

Islands Large and irregular in size.

Flower White, 6-merous, seed group 5.

Collected by Dr A. L. Geyer and others in May 1961.

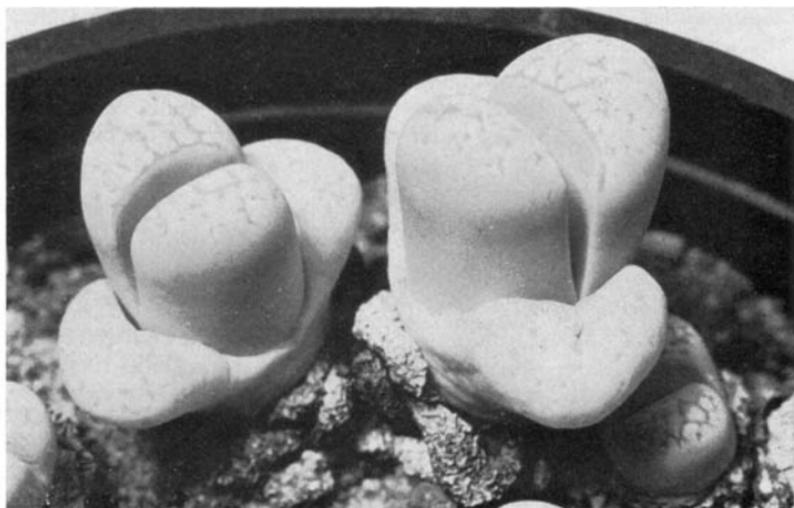
Type locality Between Steinkopf and Vioolsdrift in Little Namaqualand.

Notes This species is similar to *L. marmorata*, but differs in the occluded window, which is reduced to narrow strips. The plants also look very like *L. herrei* or perhaps *L. meyeri* but differ in the large islands and of course white flowers, both *L. herrei* and *L. meyeri* having yellow flowers. Cole (1973b) has proposed the combination *L. marmorata* v. *elisae* (de Boer) Cole. At the present time I prefer to leave it as a separate species.

Plate 10 *Lithops erniana* Tisch. ex Jacobsen *Die Sukkulanten* 1933: 145.

Lithops erniana var. *erniana*.

Size Up to 30mm long and 15mm wide at the fissure.



LITHOPS ELISAE de Boer, In this species the leaves stand apart, producing a deep and open fissure.

LITHOPS ERNIANA Tisch. ex Jacobsen.



Colour Sides bluish-grey, top light greyish-yellow, brownish-yellow occasionally suffused with pink.

Top Slightly rugose, markings are often distinctly contrasting with top, usually reddish-brown, occasionally greyish. Lines often star-shaped and ending in the outer margin with three branched lines.

Flowers White, 5-merous, seed group 3.

Collected by H. Erni.

Type locality near Pockenbank S.W. Africa.

Varieties *Lithops erniana* var. *aiaisensis* de Boer.

Lithops erniana var. *witputzensis* de Boer.

Notes The validity of this species and its varieties may be questioned. *L. erniana* might be a geographical variant of *L. karasmontana*. *L. erniana* var. *witputzensis* is very similar to *L. karasmontana*. Professor Cole believes that *L. erniana* var. *aiaisensis* may be related to *L. karasmontana* rather than *L. erniana*. I have found that some of the F₁ progeny of *L. bella* var. *bella* ♀ x *L. karasmontana* ♂ are similar to *L. erniana* var. *aiaisensis* and var. *witputzensis*. Further field work and crossing experiments are necessary before this question can be resolved.

Plate 11 *Lithops francisci* (Dint. & Schwant.) N.E. Br. *Zeitschr. für Sukk.* 1925: 2: 19.

Lithops francisci var. *francisci*.

Size Up to 40mm long and 20mm wide at the fissure. Fissure up to 15mm deep. Forms clumps of 6 or more heads.

Colour Variable, bluish-grey-green to greyish-yellow-brown.

Top Surface set with many pellucid dots, some of which occasionally coalesce to form larger transparent areas forming the beginnings of a window. Other dots and idioblasts are occasionally present, reddish, brownish or bluish.

Flower Yellow 15mm in diameter, 5-merous, seed group 3.

Collected by Professor Kurt Dinter.

Type locality Halenberg, 40 km east of Luderitz Bay, S.W. Africa.

Notes. This species has also been found by Messrs Eberlanz and Stober in the Kavisbergen on 9th August, 1924. I have found that this is one of the most difficult species of *Lithops* to grow successfully in cultivation. It grows naturally in an extremely arid region and a very well drained soil is essential.

Varieties *Lithops francisci* var. *annae* (de Boer) Fearn

Lithops francisci var. *gesinae* (de Boer) Fearn



LITHOPS FRANCISCI (Dint. & Schwant.) N.E. Br. Great care with watering is advisable when cultivating this species.

Plate 12 *Lithops fulviceps* (N.E. Br.) N.E. Br. *Kew Bull.* 1914: 167

Size Up to 25mm long and 15mm wide at the fissure. Forms clumps of up to 4 heads, but rarely forming more than two.

Colour Reddish-ochre-brown, pinkish, occasionally dull greenish.

Top Without a window, flat, slightly convex, fissure very narrow the leaves being closely adpressed. This species is characterised by the enormous circular dark green dots up to 0.5mm in diameter. These dots are slightly raised, making the surface rough to touch.



LITHOPS FULVICEPS (N.E. Br.) N.E. Br. The photograph clearly shows the characteristic raised dots which make this species instantly recognizable.

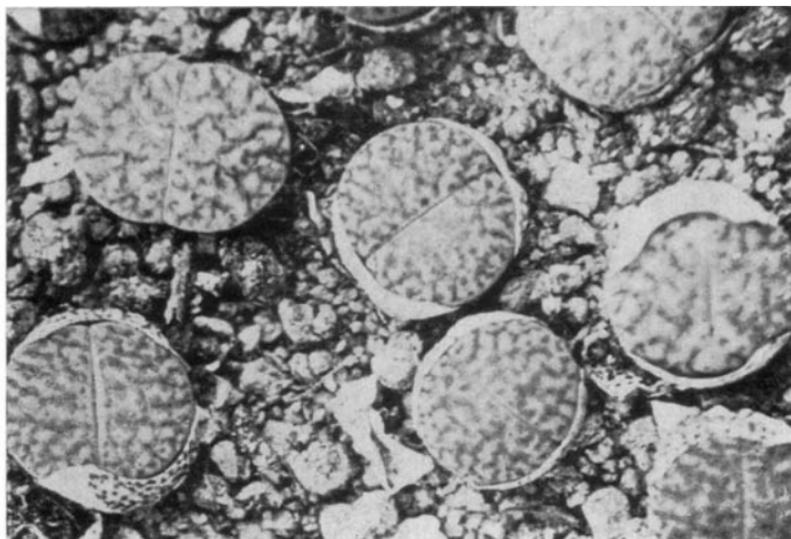
Amongst the green dots there are often several thin red lines and dots.

Flowers Yellow, 5-merous, occasionally 4 and 6-merous, seed group 3.

Collected by Professor Pearson.

Type locality Grunau Farm at South Narudas at 4,300 ft Great Karas mountains S.W. Africa.

Notes This is one of the easiest species of *Lithops* to identify correctly. The enormous circular dark green dots are very characteristic and occur in no other species. Cole (1973b) has published a new variety *L. fulviceps* var. *lactinea* Cole. The plants that I have seen appear to be only a little paler in colour than the type form, otherwise the markings were exactly the same. There is another very pinkish form of *L. fulviceps* in de Boer's collection but this has never been described.



LITHOPS GLAUDINAE de Boer

Plate 13 *Lithops glaudinae* de Boer. *Succulenta*, 1960d, 39: 129

Size Up to 30mm long and 20mm wide at the fissure. Forms clumps of 4 or more heads. Leaves often unequal in size and closely adpressed, the fissure being very narrow.

Colour Dark brown at a distance.

Window Greenish-grey, broken up with many raised reddish-brown islands. Red, sometimes greyish green lines between the islands. This species is characterised by the large number of large glossy pellucid dots which are especially distinct if they are seen against the light.

Flowers Yellow, 6-merous, seed group 2.

Type locality West of Griquatown, Haydistrict, Cape Province.

Notes Mrs Glaudina Venter was talking to Professor D. T. Cole and another man in Johannesburg and the subject of *Lithops* was raised. Mrs Venter said on her father's farm was a species of *Lithops*, This was later found and collected and proved to be a new species. The affinities of this species are interesting. If it

were not for the presence of the large glossy pellucid dots it might be linked with *L. bromfieldii* var. *bromfieldii* or var. *insularis*, or with one of the *L. turbiniformis* varieties. Cole (1973) has proposed the combination *L. bromfieldii* var. *glaudinae* (de Boer) Cole. At the present time I prefer to leave it as a separate species.

Plate 14 *Lithops helmutii* L. Bol. *S. Afr. Gard.* 1933 23: 218

Size Up to 25mm long and 15mm wide at the fissure. Forms large clumps with 17 or more heads.

Fissure Very deep with the leaves gaping.

Colour Sides greyish green. Top light olive green.

Window Large with many small islands.

Flowers Yellow, 5-merous, seed group 5.

Collected by G. Meyer in June 1933.

Type locality Between Steinkopf and Arrabies, Namaqualand.

Notes Some specimens are without islands and these resemble *L. comptonii* or var. *divergens* which both have yellow flowers. It may also resemble *L. marmorata* which has white flowers. It is also similar in many ways to *L. herrei* and to *L. naureeniae* (see Postscript).

Plate 15 *Lithops herrei* L. Bol. *Notes Mesemb.* 1932 2: 346

Size Up to 30mm long and 20mm wide at the fissure, forms large clumps with up to 15 heads.

Colour Light grey, sometimes greenish, sometimes suffused with amethyst.

Window Greyish-green, nearly absent in many specimens being occluded by the many islands which are sometimes joined together leaving the window as dots or small lines.

Flowers Yellow, 5-merous, seed group 3-4.

Collected by H. Herre in October 1930.

Type locality Swartwater 20 km south-east of Hohenfels, Little Namaqualand, Cape Province.



LITHOPS HELMUTII L. Bol. The flowers of this species are said to have a scent reminiscent of orchids.

LITHOPS HERREI L. Bol. A group of young plants showing considerable variation.



Notes I am unsure of the taxonomic status of this species. In spite of the considered opinion of the late Dr H. W. de Boer that var. *hillii* and var. *geyeri* are good varieties I believe that we are dealing with a single variable species with geographical forms. I have found great difficulty in distinguishing de Boer's varieties from *L. herrei*. Of the two, var. *geyeri* with islands which never completely occlude the window is perhaps the more distinctive. After examining the seed capsules I have found similarities with *L. optica* and *L. marmorata*, both these species having white flowers. On one occasion only, I have produced viable seed from a cross between *L. herrei* and *L. marmorata*. The F₁ hybrids looked like *L. optica*.

Plate 16A *L. julii* (Dint. & Schwant.) N.E. Br. *Zeitschr. für Sukkul. ent.* 1925 2: 2.

Synonyms

L. julii forma *pallida* Tisch.

L. julii var. *pallida* Tisch.

L. julii var. *lactea* Schick & Tisch.

L. julii var. *typica* Tisch.

L. julii forma *reticulata* (Dint. & Schwant.) Tisch.

L. julii var. *reticulata* (Dint. & Schwant.) N.E. Br.

L. julii var. *littlewoodii* de Boer

L. lactea Schick & Tisch.

Lithops julii var. *julii*.

Size Up to 25mm long and 18mm wide at the fissure.

Colour Variable, pinkish-grey to yellowish-brown-grey.

Top With a characteristic brown line or smudge on the margins of the fissure. This is very distinct in some plants, but indistinct in others, occurring only as a few dots. Top sometimes distinctly reticulate, but the window is nearly as light as the islands. Some plants are slightly rugose.

Flowers White, 20-30mm in diameter, 5-merous. seed group 5.

Collected by Professor K. Dinter and named after Dr Julius Derenberg of Hamburg.

Type locality Halfway between Vahldorn and Warmbad.

Varieties *Lithops julii* var. *rouxii*

Notes For a comprehensive review of this species see Fearn (1976b).



LITHOPS JULII (Dint. & Schwant.) N.E. Br. The plant in the centre of the photograph displays the characteristic smudge, while the others show only a broken line.

Plate 16B *Lithops julii* subspecies *fulleri* (N.E. Br.) Fearn.

Nat. Cact. & Succ. J., 1976: 31: 59.

Size Up to 40mm long and 25mm wide at the fissure.

Colour Variable, sides light grey, sometimes tinged yellow. Plants at a distance look greyish.

Window Large, bluish-grey-purple to yellowish-brown. Lines always present in the window, predominantly red, but in some plants they are brown and are sometimes joined together to become reticulate. Outer margin characterised by distinct radiating lines, red, rarely brown, with a thin line of yellowish-grey-brown between the lines and the sides of the lobes. Top distinctly rugose.

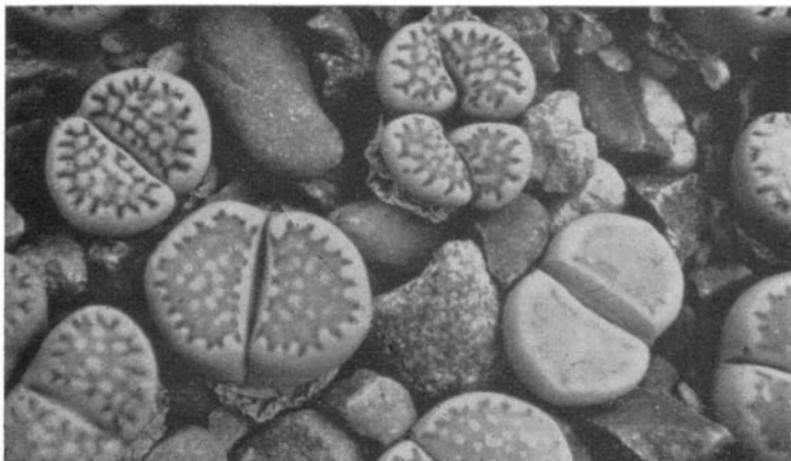
Islands Few, only a little darker than the sides.

Flowers White, 30mm in diameter, 5-6-merous, seed group 5.

Collected by R. E. Fuller.

Type locality 20 km west-south-west of Kenhardt, between Kenhardt and Groot Riet, West of the Hartebeest River C.P.

Notes The relationship between *L. julii* subsp. *fulleri* and *L. salicola* L. Bol. is very interesting. In 1960 de Boer published a



LITHOPS JULII ssp. FULLERI (N.E. Br.) Fearn. Note the variation in the window in these plants.

new variety which he called *L. salicola* var. *reticulata* which was found by Dr A. L. Geyer in June 1959. It was discovered 45 km to the south of Hopetown in the neighbourhood of Kraankuil, Cape Province. In the thesis by Fearn (1968) p. 286 it was suggested that this plant was rather similar to *L. fulleri* var. *ochracea*. In his review of *L. hallii* Professor D. T. Cole (1969) drew attention to several problems in the taxonomy of *Lithops*. He combined *L. salicola* var. *reticulata* de Boer with *L. hallii* de Boer and noted an affinity of this plant with *L. fulleri* var. *ochracea*. Cole (1973b) has since published the combination *L. hallii* var. *ochracea* (de Boer) Cole.

I have now synthesised *L. hallii* by crossing *L. salicola* with *L. julii* subsp. *fulleri*. I have found these species to be completely interfertile. Some of the F_1 hybrids are identical with de Boer's *L. salicola* var. *reticulata*, now regarded as *L. hallii*. All these plants are fertile and do not produce segregated offspring in the F_2 generation.

It now appears that the varieties of *L. fulleri*, var. *brunnea* de Boer, var. *ochracea* de Boer, and *L. hallii* de Boer, are very closely related. It seems that they are geographically isolated populations produced from hybridisation between *L. fulleri* and/or *L. julii* and *L. salicola*. Although I have not synthesised var. *brunnea* and var. *ochracea* I do not believe that these are any different from *L. hallii* in this characteristic.



LITHOPS KARASMONTANA (Dint. & Schwant.) N.E. Br. A beautiful species which is very variable.

Plate 17 *Lithops karasmontana* (Dint. & Schwant.) N.E. Br.

Monatschr. der Deutsch. Kakt. Ges. 1920, 30: 26

Size Up to 35mm long and 20mm wide at the fissure.

Colour Extremely variable. The top is light grey, pinkish, yellowish, grey, brownish-grey, light yellowish-brown or reddish-brown. Sides grey sometimes tinged brown.

Markings Very variable. The markings, often reticulate, may be nearly the same colour as the rest of the top surface and hence hardly visible. In other plants there are distinct short lines which are sometimes joined together and star-like. These may branch and become reticulate. The markings are usually light ochre-brown to dark reddish-brown. The markings may be surrounded by a bluish-grey area.

Flowers White, 5-merous, seed group 5.

Collected by Professor K. Dinter.

Type locality Karas mountains, S.W. Africa.

Notes

Lithops karasmontana is a very variable species and a number of varieties have been described (Fearn, 1975b). Cole (1973b) confirmed Nel's and my own suspicions that for the most part the varieties described, var. *opalina*, var. *mickbergensis* and var. *sum-*

mitatum, are not geographically isolated but occur growing together at a single locality.

I have found this species to be completely interfertile with *Lithops bella*. Cole (1973b) has published a new variety *L. karasmontana* var. *tischeri* (Cole and a new combination *L. karasmontana* var. *lericheana* (Dint. & Schwant.) Cole. I have synthesised both of these plants. Two separate crosses between *L. bella* var. *bella* ♀ and *L. karasmontana* var. *summitatum* ♂ produced two different F₁ populations. One is the same as *L. bella* var. *lericheana* and the other is the same as *L. karasmontana* var. *tischeri*. There are no segregants in the F₂ generation.

It may be that *L. erniana*, particularly *L. erniana* var. *witputzensis* and var. *aiaisensis* are either varieties or hybrids of *L. karasmontana* as well. In addition, the *L. karasmontana* complex may be related to the *L. julii* complex, as pure grey forms occur in both species. Further field work and crossing experiments are needed to elucidate the problems concerning the taxonomy of many of the *Lithops* from S.W. Africa.

Plate 18 *Lithops lesliei* (N.E. Br.) N.E. Br. *Trans. Roy. Soc. S. Afr.* 1912, 2: 369.

Lithops lesliei var. *lesliei*.

Size Up to 30mm long and 18mm wide at the fissure. Usually 1 or 2 heads, occasionally with 4 heads.

Window Large, dark brownish-green in colour. Islands many, light yellowish or reddish-brown. Pellucid dots are numerous, covering the top surface and are present within the islands. The sides of the lobes are grey, tinged greenish or brownish.

Flowers Yellow, 5-merous, Seed group 1.

Collected by the youngest son of T. N. Leslie on August 9th, 1908.

Type locality Dwyka Conglomerate outcrop on the banks of the Vaal River at Vereeniging, Transvaal.

Notes Burt Davy received the plant from Leslie and the following day, at the 4th meeting of the Transvaal Biological Society held in Pretoria, exhibited and described the plant but in the absence of flowers the description was never published until N. E. Brown did so in 1912.

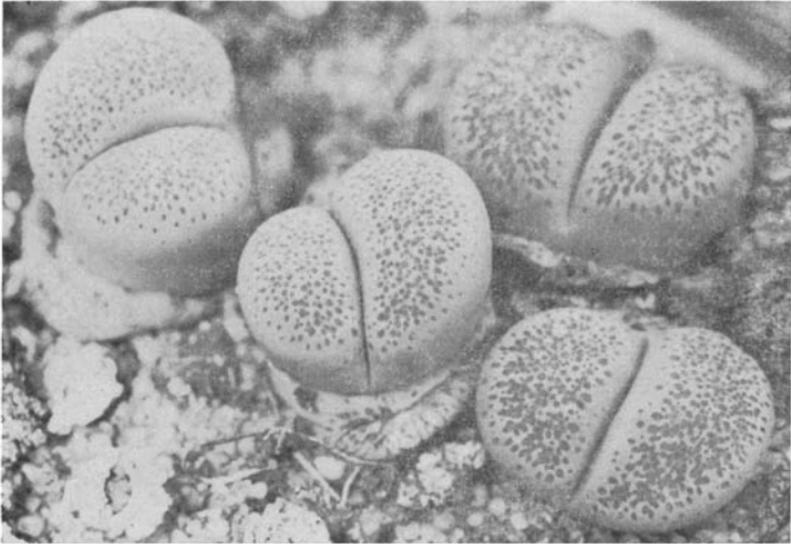
Professor D. T. Cole probably knows more about the habitats and geographical distribution of this species than any other person. He has discovered many new localities and has found many new forms which he says intergrade with each other. Dr de Boer has



LITHOPS LESLIEI (N.E. Br.) N.E. Br. A light-coloured form of this variable species. One of the most interesting introductions of recent years is the white-flowered, green-bodied forma *albinica*.

named a number of these forms as varieties, against the better judgement of Professor Cole. These varieties are maintained at the present time until a decision has been made on their relative merits. I have found that in the main they are true breeding. If as Cole states, intermediates exist between them, it is of interest to speculate why these intermediates do not appear in seedling generations. This species has a wide distribution having so far been collected at 25 separate localities.

- Varieties** *Lithops lesliei* var. *lesliei* forma *albiflora* Cole
Lithops lesliei var. *lesliei* forma *albinica* Cole
Lithops lesliei forma *minor* (de Boer) Fearn stat. nov.
(*Lithops lesliei* var. *minor* de Boer, Succulenta, 1961 :40: 53).
Lithops lesliei var. *hornii* de Boer
Lithops lesliei var. *rubrobrunnea* de Boer
Lithops lesliei var. *venteri* (Nel) de Boer & Boom
Lithops lesliei var. *mariae* Cole



LITHOPS LOCALIS (N.E. Br.) Schwant. A distinctive species which is easily recognised.

Plate 19 *Lithops localis* (N.E. Br.) Schwant. *Journ. Linn. Soc. Bot.* 1920 45: 68.

Lithops localis var. *localis*

Size Up to 25mm long and 15mm wide at the fissure.

Colour Pinkish brown to fawn.

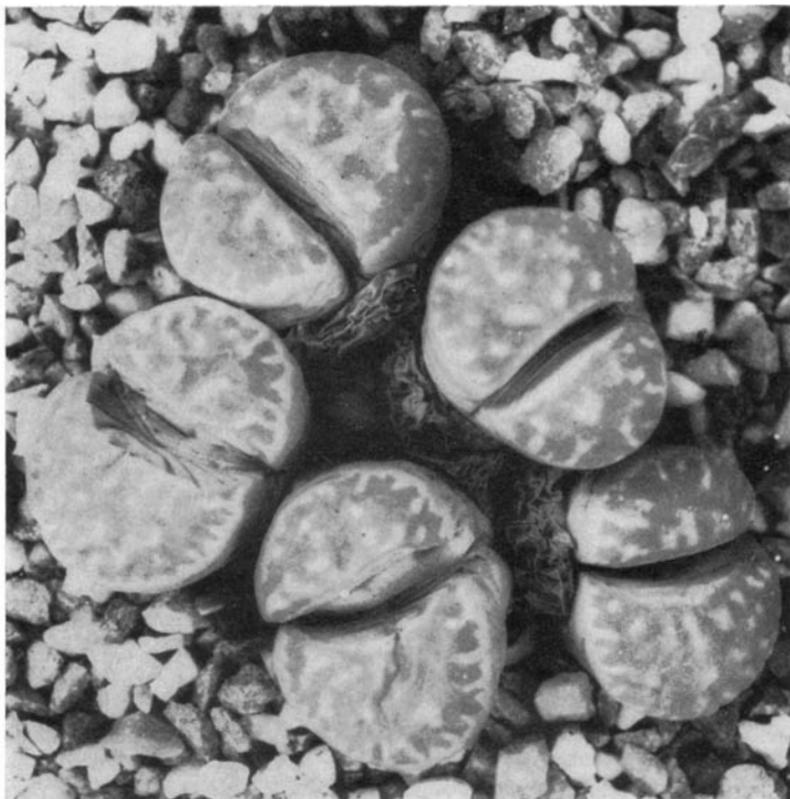
Window Nearly always absent, top surface marked with numerous, isolated pellucid dots. The var. *localis* is true breeding and the population in cultivation shows little variation.

Flowers Yellow, 5-merous. Seed group 3.

Collected by Mr Burke (in 1918?), recollected by Mr D. A. Cole in 1960.

Type locality Near the Gamka River in Beaufort West Division, Cape Province.

Notes De Boer maintained var. *peersii* and var. *terricolor* as varieties but in my experience, after examining many plants from these populations, the two varieties of de Boer can be distinguished from each other only by selecting a green or a purple plant and



LITHOPS MARMORATA (N.E. Br.) N.E. Br. A green species with white flowers from the coastal area just south of the Orange River.

ignoring the variation. Single plants cannot be selected at random and with certainty be assigned to one or other taxon.

The variety *terricolor* is the most widely distributed—Prince Albert, Beaufort West, 40 km from Aberdeen near the road, Miller Station, Steytlerville, Springbok Vlakte and near Uitenhage. Within the variation of var. *terricolor* there are plants which are purplish; the variation therefore overlaps into de Boer's var. *peersii*. It is thus believed that they are one and the same variety and reduction of var. *peersii* into synonymy with the oldest of the varietal names, var. *terricolor*, is proposed. Cole (1973b) suggests that the Prince Albert population may be distinct but the plants I have seen do not justify separate status.

Plate 20 *Lithops marmorata* (N.E. Br.) N.E. Br. *J. Linn. Soc. Bot.* 1920 45: 68.

Size Up to 25mm long and 20mm wide at the fissure.

Fissure In adult plants generally deeper than 10mm.

Colour This species is characterised by the overall grey-green appearance and the few grey islands on the large window surface. Some specimens have no islands, but in others there are many.

Flower White, up to 30mm in diameter and slightly scented. 6-merous, seed group 5.

Collector Unknown.

Type locality In the hills to the north of Port Nolloth in little Namaqualand, C.P.

Notes In cultivation the colour of this species varies considerably. When plants are grown with little water and full sun they become more greyish or brownish, sometimes amethyst suffused or even a little greyish-yellow; these latter plants are like *L. elisae* (compare with Plate 9). Plants with brownish windows have been described as *L. framesii* L. Bol.

Plate 21 *Lithops meyeri* L. Bol. *S. Afr. Gard.* 1932a 22: 102

Size Up to 35mm long and 25mm wide at the fissure. This species has one of the deepest fissures in the genus, being up to 25mm deep. Forms clumps of 10 or more heads.

Colour Bluish-grey-green, sometimes a little yellowish.

Window Sometimes distinct, but mostly occluded by indistinct islands, the window being reduced to a few patches. Window area a little more bluish-green than the sides which are predominantly grey-green. Sometimes there is a pale yellowish-brown edge to the window area which may include a few greenish-blue dots.

Lobes In old plants sickle-shaped, caused by the curved inner margin; lobes distinctly divergent.

Flowers Yellow, 5-merous, seed group 5.

Collected by the missionary Mr G. Meyer in October 1931 and subsequently named in his honour by Louisa Bolus.

Type locality The neighbourhood of Brakfontein in the Richtersveld, Little Namaqualand, Cape Province.



LITHOPS MEYERI L. Bol. In this species the lobes are normally unequal in size and gape widely.

LITHOPS OLIVACEA L. Bol. Note the degree of variation in this group of young plants.



Plate 22 *Lithops olivacea* L. Bol. *Notes Mesembr.* 1929, 2: 84
Descr. ampl. *S. Afr. Gard.* 1930, 20: 182.

Size Up to 25mm long and 18mm wide at the fissure. This species forms very large clumps, often with 30 or more heads.

Colour The window is olive-green or greyish green; sides are grey sometimes tinged greenish-yellow, sometimes distinctly purplish.

Window Characteristically smaller than the largest circumference of the heads. In collected plants the window is often flattened and dull brownish-green, but in cultivation the windows are invariably green and convex. In some plants islands are absent (var. *maculata* n.n.) but in others there may be up to 16 islands. The edge of the window is only a little denticulate in some plants, whilst in others the margin is distinctly denticulate.

Flowers Yellow up to 30mm in diameter, 5-merous, seed group 5.

Collected by Mr E. R. Fuller in 1928.

Type locality Near Kakamas in the Kenhardt district.

Notes Another locality for this species is a few km south west of Pofadder growing in close association with *L. julii* ssp. *fulleri* var. *brunnea* together with many other species of succulents, notably *Dinteranthus vanzijlii* and *D. puberulus*.

Dr N. E. Brown (*Mesembryanthema*, p. 251. 1931) suggested that this species was allied to *L. fulleri*. I believe that this species is not closely related to *L. fulleri*. It is not clear on what grounds this statement was made.

There is a plant of *L. olivacea* which has been growing at Kew since 1929 and in 1966 measured 125mm in diameter with 30 heads. This plant is growing in the S. African succulent house which was built at Kew from subscriptions raised in South Africa. It is probably one of the original plants sent with the bequest from S. Africa.

Plate 23A *Lithops optica* (Marl.) N.E. Br., *Trans. Roy. Soc. S. Afr.*, 1910, 1: 405.

Size Up to 35mm long and 20mm wide at the fissure. The fissure is often deeper than 10mm. In cultivation it forms very large clumps 80mm in diameter with 16 or more heads. Nel (1946) records plants with up to 30 heads. In habitat it is much smaller—a plant calculated to be 95 years old was only 45mm high, the individual heads being 3.5mm in diameter.



LITHOPS OPTICA (Marl.) N.E. Br. The 'poor relation' of its forma rubra, this is nevertheless an attractive plant in its own right.

Colour Overall greyish-green, sometimes a little pinkish.

Window Large mostly without islands, only a little greener than the sides.

Flowers 15-20mm diameter, white, 5-merous, seed group 4. I have found a single seed capsule of this species which was 4-merous.

Collected by Professor Marloth.

Type locality Coastal desert between Luderitz Bay and Buntfeldschuk near Prince of Wales Bay, S.W. Africa. It was growing in sand-filled fissures of gneiss rocks.

Notes This species looks somewhat like *L. meyeri* but has white flowers. According to Oztig (1940), white leucoplasts occur instead of chromoplasts, and cause the dull glassy colour in the centre of the window. See also Cole (1978).

W. Triebner has found this species growing in quartz hills and flat quartz screes up to 16km north and 80 km south of Luderitz

Bay. It grows no further inland than 3-4 km and close to the sea shore in one locality. Further to the southern limits of its distribution, Triebner suggests that *L. optica* is merged into *L. herrei*. This is supported by my studies of the capsule structure of *L. optica* and *L. herrei*, species which also have affinity with *L. marmorata* and *L. helmutii*. I succeeded in hybridizing on one occasion *L. herrei* x *L. marmorata* and the F₁ hybrids resembled *L. optica*.

L. optica var. *minor* Jacobs is only a habitat variant which grows to normal size in cultivation.

Plate 23B *Lithops optica* forma *rubra* (Tisch.) Jacobs.

This form is perhaps the most easily named of all *Lithops*. The colour is unmistakably reddish-purple from a distance. Sides greyish-purple, window deep reddish-purple. Otherwise the same as *Lithops optica*. Originally collected by W. Triebner and his son, 24 km south of Luderitz in quartz scree, S.W. Africa.

Notes This is perhaps the finest and most desirable of all the *Lithops*: certainly no collection of these plants should be without this form. In the wild it occurs always with *L. optica*, not in pure stands, at the edge of, and protected by, bushes of *Zygophyllum* and only in a belt 8-48 km south of Luderitz Bay in the Prohibited area No. 1 of the Consolidated Diamond Mine Company. De Boer first obtained seed of this distinctive form in 1946 from Wilhelm Triebner, 10 seeds of which cost him ten shillings (1946 prices). Triebner also sold plants at £5 each. De Boer managed to raise 8 plants from this seed and grew and flowered the seedlings. He obtained further quantities of seed by cross-pollination. He grew thousands of plants and it is due to de Boer's skill as a cultivator that this most desirable of *Lithops* is widely distributed today. De Boer has published two authoritative papers about this plant (de Boer, 1955 and de Boer, 1959).

In Europe it is the last of the *Lithops* to flower, usually in December, and additional artificial light is beneficial at this time. I have found that *L. optica* is the only *Lithops* species which increases the number of heads by means of adventitious buds formed at the junction of the leaf and the hypocotyl.



LITHOPS OPTICA f. RUBRA (Tisch.) Jacobs. This is the most sought-after of all Lithops. It continues growing a little later into the winter than other species.

Plate 24 *Lithops otzeniana* Nel. *Kaktk.* 1937 23: 123.

Lithops otzeniana var. *otzeniana*.

Size Up to 30mm long and 15mm wide at the fissure. It forms large clumps 100mm in diameter with 15 or more heads.

Colour Top surface nearly always dark green, sometimes a little greyish, brownish or purplish. Sides light grey-green.

Window Large, only rarely with islands. The characteristic feature of this species is the outgrowth of the area surrounding the window to form distinctly denticulate markings. These are usually the same colour as the sides of the lobes but are sometimes yellowish or reddish. There may occasionally be plants without these markings. Professor G. C. Nel described one of these (*Lithops*, 1947, p. 128) but I have not seen such a plant in cultivation.

Flowers Yellow, 5-merous. Seed group 3.

Collected by Professor G. C. Nel on 30th April, 1937.



LITHOPS OTZENIANA Nel. The teeth-like markings of this species make it instantly recognisable. It is very popular with collectors.

LITHOPS PSEUDOTRUNCATELLA (Berger) N.E. Br. This is possibly the most frequently encountered species in cultivation.



Type locality Bushmanland, at Brakfontein 50 km from Loeriesfontein. It was found in weathered granite under bushes and in open spaces between stones.

Varieties *Lithops otzeniana* var. *weberi* (Nel) Fearn.

Plate 25 *Lithops pseudotruncatella* (Berger) N.E. Br. *Mesemb. und Portulac.* 1908: 289.

This is an extremely variable species with a large number of geographical forms. The taxonomic status of these many forms has long been in dispute. A reappraisal of all these suggests that some are sufficiently distinct to maintain as varieties, but others have been 'sunk' into synonymy. For example de Boer and Boom (1961) proposed the new combinations : var. *pulmonuncula*, var. *edithae*, var. *elisabethae* and var. *mundtii*. I find it impossible to identify the first three plants with certainty. Var. *mundtii* is a brown form which I have noticed occurs within the variation of var. *pseudotruncatella*. *Lithops alpina* is a brownish-grey form with pronounced markings. It is a smaller growing form of var. *pseudotruncatella* found on the summit of the Ruschberg at 2400 metres by E. and O. Rusch in 1925.

Lithops pseudotruncatella var. *pseudotruncatella*

Size Up to 40mm long and 25mm wide at the fissure. The size is very variable. The lobes are often unequal in size.

Colour Extremely variable, top brownish-grey, bluish-grey, greenish-grey or yellowish-brown, sometimes a little reddish-brown. Sides grey, tinged green or brown.

Top of leaves Flat or slightly convex. Markings extremely variable, but there are always some short brownish lines which are often dendritically arranged. These lines are usually bluish or greyish at the edges. Occasionally the lines are indistinct. Pellucid dots sometimes numerous and distinct, occasionally indistinct, and often border the dendritic lines.

Flowers Yellow, usually in July, 6-7-merous, seed group 1.

Collected by Professor Kurt Dinter in 1897.

Type locality Auas mountains near Windhoek, S.W. Africa.

Varieties *Lithops pseudotruncatella* var. *brandbergensis* de Boer
Lithops pseudotruncatella var. *dendritica* (Nel) de Boer
Lithops pseudotruncatella var. *gracilidelineata* (Dint.) Fearn
Lithops pseudotruncatella var. *gracilidelineata* forma
waldronae (de Boer) Fearn
Lithops pseudotruncatella var. *volkii* (Schwant. ex Jacobs.)
de Boer

Plate 26 *Lithops ruschiorum* (Dint. & Schwant.) N.E. Br. *Zeitschr. für Sukkulent.* 1925 2: 21.

Size Up to 40mm long and 20mm wide at the fissure. According to W. Triebner it forms clumps of up to 60 heads.

Colour Bluish-grey-white, sometimes yellowish or brownish. New growths are distinctly brownish.

Top distinctly convex and the lobes are sometimes divergent. Some plants have a distinct ridge on the top of the lobes which probably represent affinity with the genus *Dinteranthus*. A few red lines and dots are usually present, often very faint, sometimes distinct but occasionally absent. A few faint bluish dots may also be present.

Flower Yellow, 5-6-merous, seed group 5.

Collected by Ernst Rusch in 1923.

Type locality In the neighbourhood of Khan Cooper Mine, 10 km to the west of Rossing.

Notes Plants with distinct markings have been named *L. lineata*, others without markings and smaller in size have been called *L. nelii*. There is little difference between these two populations when compared with *L. ruschiorum*. De Boer and Boom regarded them as varieties but I believe they are synonymous. Cole (1973b) likewise believes *lineata* to be a variety.

I have produced hybrids by crossing this species with *L. pseudotruncatella* var. *dendritica*. Several plants from these crosses are like *L. wernerii*, others are like *L. pseudotruncatella* var. *gracilidelineata* f. *waldronae*. As already noted earlier, isolated geographical populations produced by hybridization may again be involved here.

Plate 27 *Lithops salicola* L. Bol. *Notes Mesembr.* 1936 3: 33.

Size Up to 30mm long and 15mm wide at the fissure. It forms large clumps of 20 or more heads.

Window Large, dark olive green, sometimes brownish and often with a distinct pinkish border to the window. Islands absent to many, pinkish-brown to greyish-green. There are often dark green flecks in the window which are sometimes reticulate in arrangement. Short reddish-brown lines are sometimes present around the edge of the window.



LITHOPS RUSCHIORUM (Dint. & Schwant.) N.E. Br. A species with a very deep cleft between the leaves, the tops of which are distinctly convex.

LITHOPS SALICOLA L. Bol. In habitat the plants grow in salt 'pans' where they are often partly submerged during the rainy season.



Flowers White, 5-6-merous, seed group 3.

Collected by Mr I. C. Verdoom in October 1935.

Type locality Near Fauresmith, on the farm Rose Marie, growing in salt pans, Orange Free State.

Notes This species is interfertile with *L. julii* subsp. *fulleri* and some of the F₁ hybrids are the same as de Boer's *L. salicola* var. *reticulata*. This is regarded by Cole (1969) as *L. hallii*. I believe it to be a natural hybrid.

Plate 28 *Lithops schwantesii* Dint. *Sudwestafr. Lithopsart.* 1928: 14.

Lithops schwantesii var. *schwantesii*.

Size Up to 40mm long and 25mm wide at the fissure; forms large clumps.

Colour Very variable, usually reddish-brown, sides amethyst or greenish-grey.

Top Often with the beginnings of a window. There is often a distinct amethyst or pinkish-brown line bordering the top surface. The top has many green dots and also red dots and lines which are sometimes branched.

Flower Yellow, 5-merous, seed group 2.

Collected by Ernst Rusch in August 1926.

Type locality Barby and Krugersputz in S.W. Africa.

Notes Seven varieties have been named of this species, many of which I have great difficulty in identifying. The taxonomic status of many of them is uncertain.

Cole (1973b) reports that plants identical with var. *triebneri* also occur in populations of var. *schwantesii*. On this evidence it is reduced to synonymy. Cole also suggests that var. *nutups-driftensis* is identical with var. *christinae* but I am leaving these as good varieties for the time being, pending further research. He confirms my comments (Fearn, 1968) that these are closely related to var. *urikosensis*. Cole has also published the new combination *L. schwantesii* var. *marthae* (Loesch & Tisch.) Cole, but I still prefer my original combination with *L. dinteri*. (See note on p.25.



LITHOPS SCHWANTESII Dint. The old leaves on the four-headed clump have finished drying, but those on the other plants are still plump.

- Varieties** *Lithops schwantesii* var. *christinae* (de Boer) Fearn
Lithops schwantesii var. *gebseri* de Boer
Lithops schwantesii var. *kunjasensis* (Dint.) de Boer & Boom
Lithops schwantesii var. *nutupsdriftensis* de Boer
Lithops schwantesii var. *rugosa* (Dint.) de Boer & Boom
Lithops schwantesii var. *urikosensis* (Dint.) de Boer & Boom



LITHOPS STEINECKEANA Tisch. The photograph shows mature plants in Dr de Boer's collection.

Plate 29 *Lithops steineckeana* Tisch. *Succulenta*, 1951 30: 37.

Size Up to 20mm long and 15mm wide at the fissure, slowly forming clumps of two or three heads.

Colour Brownish-yellow, suffused with amethyst.

Top As strongly convex as *L. ruschiorum*. Some plants are without markings, but others have indistinct brownish lines and bluish-green dots.

Flowers Yellow-orange, 6- or 7-merous. One capsule from Dr de Boer's plants had 12 segments. Seed group unknown.

Locality Unknown.

Notes This plant was originally raised in Steinecke's nursery in Ludwigsburg near Stuttgart, from seed sent from S.W. Africa. The name should be spelt steineckeana as it was named by Dr Tischer after Steinecke. This taxon is closely related to *L. ruschiorum* which grows in the area around Walvis Bay in Damaraland, S.W. Africa. It is thought by de Boer and myself to be a hybrid. It produces large quantities of seed which germinates satisfactorily,

but the seedlings nearly always die after 2 or 3 months. It is thus rarely met with in collections.

Both de Boer and myself have tried to reproduce this plant by crossing *L. ruschiorum* x *L. pseudotruncatella* using both species as pollen donors. We have produced an interesting crop of hybrids but nothing as yet resembling *L. steineckeana*.

Plate 30 *Lithops turbiniformis* (Haw.) N.E. Br. *Haw. Rev. Pl. Succ.* 1821: 84.

Lithops turbiniformis var. *turbiniformis*.

Size Up to 35mm long and 25mm wide at the fissure. Forms clumps usually 2-headed, occasionally with 4.

Colour Generally is reddish-brown, sometimes a little yellowish or purplish. Top surface is the same colour as the sides.

Top Strongly rugose with a distinct reticulation. There is no window. The reticulation is a darker brown. Top distinctly flattened with the lobes closely adpressed together, making the fissure very narrow.

Flowers Yellow, 6-merous, seed group 2.

Collected by William John Burchell on the 14th September 1811.

Type locality Zand Vlei near Soutput, which lies 21 km S.E. of Prieska.

Notes This plant was first described by Haworth as *Mesembryanthemum turbiniforme* in 1821 and figured by J. D. Hooker in 1874 as *M. truncatellum*, believing it to be Haworth's plant of this name. (*Bot. Mag.* tab. 6077). In 1908 Alwin Berger showed that this illustration did not fit the description of the real *M. truncatellum* and named the plant *M. hookeri*. Then N. E. Brown discovered that Hooker's figure really represented Burchell's plant and restored its original name. Over a century later, from the time it was first described, it became the type species of N. E. Brown's new genus *Lithops*.

Sir W. T. Thiselton-Dyer (1906) described W. J. Burchell's find and published a photograph of plants raised from seed at Kew and plants which had been sent by N. S. Pillans in 1902. It was stated that these plants had been collected from the Laingsburg District in the same region as Burchell's Zand Vlei. Burchell originally collected his *Lithops* species in the Prieska district which is many kilometres further north than Laingsburg. The problem



LITHOPS TURBINIFORMIS (Haw.) N.E. Br. A healthy crop of young plants jostle for position. Under these conditions the weaker and more sickly plants are liable to succumb.

is that the plants figured are of *L. pseudotruncatella* which had been found a few years earlier in 1897 by Professor K. Dinter near Windhoek in S.W. Africa. *L. pseudotruncatella* is only found in S.W. Africa and so there must be a mistake in the locational data supplied by Pillans. The true Burchell's *Lithops*, i.e. *L. turbiniformis*, was not collected again until Dr I. B. Pole-Evans re-discovered it in 1918.

Jacobsen attributed *L. hookeri* to *L. localis* v. *peersii*, believing it to have been collected near the Hex river. De Boer (private communication) indicated that there appear to be two such rivers in Southern Africa, one near the Orange River and the other in the Karroo. *L. turbiniformis* has been collected near the Hex river in northern Cape Province and this may be one of the reasons for the confusion. Cole (1970) has published a very interesting

account of this species and put forward the suggestion that Burchell's original collection could have been *L. hallii* rather than *L. turbiniformis*.

L. turbiniformis is a very variable species and de Boer has named three of the more distinct forms as separate taxa; in addition Cole has named another two forms. Cole (1970) has collected this species at thirty different localities.

The only difference between *L. turbiniformis* and *L. marginata* is the presence or absence of pellucid dots. These are absent in *L. turbiniformis* and its varieties but inconspicuously present in *L. marginata*. Whether this is a sufficiently good character to distinguish between two species is open to question. Both species have yellow flowers, are 6-merous and are in seed group 2. The geographical distribution is overlapping. Cole (1973b) has now reduced *L. marginata* to a variety of *L. turbiniformis*. This I accept. *L. dabneri* L. Bol., *turbiniformis* var. *dabneri* (L. Bol.) Cole, is, in the opinion of Dr de Boer and myself, merely a more distinctly marked form of *L. marginata*.

- Varieties** *Lithops turbiniformis* var. *brunneo-violacea* de Boer
Lithops turbiniformis var. *elephina* Cole
Lithops turbiniformis var. *lutea* de Boer
Lithops turbiniformis var. *subfenestrata* de Boer
Lithops turbiniformis var. *marginata* (Nel) Cole
Lithops turbiniformis var. *susannae* Cole

Plate 31 *Lithops vallis-mariae* (Dint. & Schwant.) N.E. Br. *Zeitschr. für Sukkulent.*, 1925: 2: 22.

Lithops vallis-mariae var. *vallis-mariae*.

Size Up to 28mm long and 18mm wide at the fissure.

Colour Variable, usually whitish, greyish or pinkish, sometimes yellowish or brownish.

Markings Usually indistinct, pinkish or deep amethyst, sometimes pale reddish-brown. Markings consist of short unjoined lines or dots which are sometimes reticulate.

This species is characterised by the very fine vermiform wrinkles on the top surface.

Flowers Yellow, 6-merous, seed group 2.

Collected by Dr Beetz in July 1923.

Type locality Near Mariental.

Notes This species is easily recognised.

Varieties *Lithops vallis-mariae* var. *groendraaiensis* (Jacobs.) de Boer



LITHOPS VALLIS-MARIAE (Dint. & Schwant.) N.E. Br. Note the characteristic wrinkles on the top surface.

Plate 32 *Lithops verruculosa* Nel. *Ann. Univ. Stellenb.* 1943 Sect A.I. 21: 9; cf. Nel, *Lithops*, 1947: 161 and 178
Lithops verruculosa var. *verruculosa*.

Size Up to 28mm long and 20mm wide at the fissure. The lobes are often unequal in size.

Fissure This is often of a different depth on each side of the same plant, e.g. 3mm and 8mm.

Colour Very variable, sides bluish-grey, pinkish-grey or brownish. Top reddish-brown, greenish or greyish-brown. Some plants have a distinct bluish-grey border to the window.

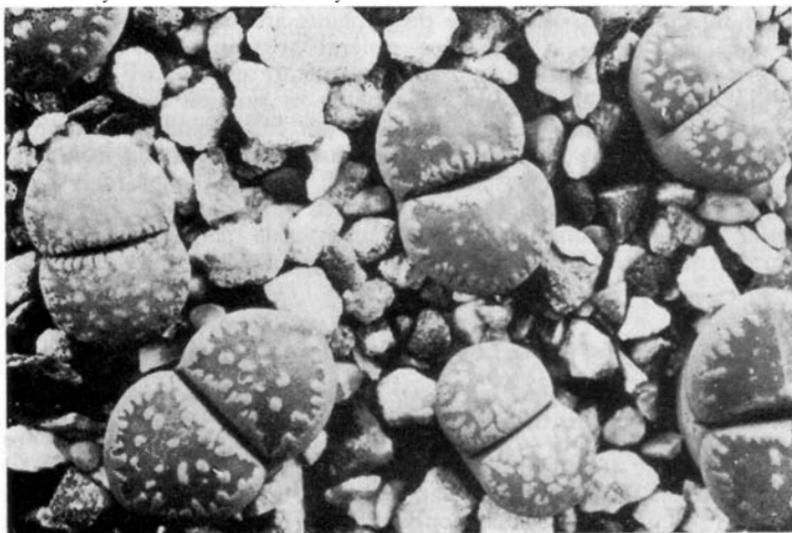
Window Sometimes reduced to very tiny areas between the numerous islands, but in other plants there are fewer islands, the window appearing larger. The top is often distinctly grooved. This species is characterised by the large raised dark red dots which do not occur in any other species of *Lithops*. They may be seen with the naked eye or with a x10 hand lens.

Flowers Yellow to brownish-orange, 5-merous, seed group 5.



LITHOPS VERRUCULOSA Nel. The raised spots within the area of the window can be seen in this photograph.

LITHOPS VILETII L. Bol. This species is distinguished from the superficially similar *L. otzeniana* by the colour of its flowers.



Collected by Dr van der Westhuizen in September 1939.

Type locality Near Kenhardt in Bushmanland, C.P.

Notes According to Harry Hall this is an extremely rare plant at the type locality, an isolated farm near Kenhardt.

Varieties *Lithops verruculosa* var. *glabra* de Boer

Plate 33 *Lithops villetii* L. Bol. *Notes Mesembr.* 1950 3: 234.

Size Up to 30mm long and 18mm wide at the fissure.

Colour Sides greyish-yellow, top distinctly dark grey-green to brownish.

Window Large with a carinate margin. Islands are always present but the number is very variable; the edges of the islands are not always sharply defined and are usually yellowish-brown in colour.

Flowers White, 6-merous, seed group 3.

Collected by Mr C. T. Villet in 1939.

Type locality Near Loeriesfontein in the Calvinia district, C.P.

Notes The flowers of *L. otzeniana* var. *otzeniana* and *L. otzeniana* var. *weberi* are yellow and 5-merous, whilst those of *L. villetii* are white and 6-merous. These three plants are otherwise nearly the same and grow in the same general area in south-west Cape Province. In addition the capsule structure of the two species is also comparable. It seems reasonable to suppose that *L. villetii* was closely related in the past, the flower colour and leaf structure having arisen by mutation/hybridisation and subsequent isolation.

Plate 34 *Lithops wernerii* Schwant. ex Jacobs. *Cactus Succ. J. Gt. Bt.* 1951 13: 69.

Size Up to 20mm long and 15mm wide at the fissure, but the majority of plants are smaller than this. Collected plants are usually only 10mm in diameter with one or rarely two heads. In cultivation the plants form large clumps with up to 25 heads. A plant in de Boer's collection and sent to him by an unknown



LITHOPS WERNERI Schwant. ex Jacobs. In the habitat, during the resting period, the bodies of this species range in size from pinhead to that of a pea.

person in England now resembles a tight ball measuring 40mm high.

Colour Bluish-grey often tinged yellow, brown or red. The top surface is usually the same colour as the sides.

Top Surface windowless, with very fine grooves, reticulate markings at right angles to the fissure. These markings are reddish to yellowish-brown. Blue pellucid dots are present in all specimens and are sometimes obscure and sometimes prominent. These latter plants are very similar to *L. francisci*, to which this plant is probably closely related.

Flowers Yellow, 6-merous, seed group 2.

Collected by Mr Werner Triebner and named in his honour.

Type locality 40 km S.E. of Usakos, growing in broken granite at the foot of the Erongo mountains, S.W. Africa.

Notes In addition to affinities with *L. francisci*, this species may well have arisen by hybridisation between *L. pseudotruncatella* v. *dendritica* and *L. ruschiorum*. Several plants that I have produced from this cross are like *L. wernerii*.

Glossary

In the description of *Lithops* certain terms are used, the meaning of which may, at first sight, not be obvious. Some of the terms have a special meaning when used in connection with *Lithops*. It is because of this specific use that a list of these terms and their meaning has been included.

- anther*—the part of the stamen which contains pollen grains.
- bifurcation*—a division or forking into two.
- bullate*—a surface which is not smooth; puckered or blistered (rugose).
- capsule*—dehiscent fruit, having more than one carpel, with a dry pericarp. In the **Mesembryanthema** the fruit is divided into several compartments or 'cells' containing many seeds which are dispersed by a rain-splash mechanism (see figs. 2 and 3).
- carinate*—keeled or ridged, e.g. *L. otzeniana* (Plate 24) in which there are ingrowths into the window from the margin.
- carpel*—one of the compartments which composes the female part of the flower. It contains the ovules which after fertilisation develop into seeds.
- chlorenchyma*—cells containing chlorophyll; green tissue of the leaf or stem.
- chloroplast*—a chlorophyll-containing structure usually packed into palisade cells or chlorenchyma.
- chromoplast*—a cell structure which is pigmented with a substance other than chlorophyll (cf. idioblasts).
- concave*—a rounding inwards.
- convex*—a rounding outwards (see Plate 26).
- cross-pollination*—transfer of pollen from anthers of one flower to the stigma of another.
- dendritic*—having a structure joined together in such a way as to form a tree-like network.
- dichotomy*—equal branching by simple forking.
- divergent*—separating widely; applied to leaves which have separated leaving the fissure gaping.
- ecology*—the study of plants in relation to their habitat.
- endemic*—a plant restricted to one place or region and occurring nowhere else.
- et al., et alii*—and others.
- ex*—as in, for example, *Lithops erniana* Tisch. ex Jacobsen, indicates that a name proposed but not validly published by one author has been properly published by another author. In the example given the name was originally proposed by Tischer and later validly published by Jacobsen.

- filament*—stalk of the stamen.
- fissure*—gap between the two leaves. At the bottom of the fissure there is a meristem which produces new leaves or flowers.
- forma*—a category of plants differing from the species or variety usually by only a single conspicuous but minor character such as colour or size.
- gaping*—a widening of the fissure by lateral movement of the leaves.
- grooved*—a structure which is more or less impressed and contained in ‘channels’ (cf. bullate).
- head*—this refers to the plant body which consists of a pair of leaves.
- hypocotyl*—stem axis of the seedling just below the cotyledons or seed leaves.
- idioblasts*—these are specialised cells which show as pellucid dots, but they are opaque as they contain substances such as tannin and calcium oxalate. In incident light they appear dark because the light has been absorbed and not reflected.
- island*—an opaque area surrounded by a transparent area such as the window or a network of channels. (See Plate 20).
- leucoplast*—a colourless structure within a cell.
- merous*—referring to the number of flower parts, e.g. stigmas, carpels or compartments within the fruit.
- mutant*—an organism which exhibits a sharp change in one or more characters from the parental characters and which can transmit such a changed character to its offspring.
- nomen nudum*—a name that has not been validly published according to the International Code of Botanical Nomenclature.
- occluded*—closed up; clouded, rendered opaque, referring to the window area.
- pellucid dots*—miniature ‘windows’ up to 1mm in diameter, usually greenish or bluish and scattered over the top surface. In incident light they appear dark because the light has been absorbed not reflected (cf. idioblasts) (See Plate 19).
- phytogeography*—the study of plant distribution, especially in relation to past and present climate and topography.
- rugose*—a surface that is not smooth; wrinkled (cf. bullate).
- Seed group*—*Lithops* seed varies in size. De Boer has made measurements and published a scale of seed size from 1–5 based on the number of seeds filling a standard volume.
- Scale of seed size*
- | | | |
|--------------|-------------|---------------------|
| Seed group 1 | 1,500–2,000 | seeds per cubic cm. |
| Seed group 2 | 4,000–5,000 | seeds per cubic cm. |
| Seed group 3 | 7,000 | seeds per cubic cm. |
| Seed group 4 | 10,000 | seeds per cubic cm. |
| Seed group 5 | 15,000 | seeds per cubic cm. |
- size*—the measurements are taken along the line of fissure and across both lobes at right angles to the fissure.

- species*—a group of plants belonging to the same genus which have similar genetical and morphological constitution. Crosses between different species are usually but not always infertile.
- stamen*—the male part of the flower—a stalked structure producing pollen grains in the anther.
- stigma*—the part of the flower that is a receptor for pollen.
- subspecies*—a group of plants which is not sufficiently distinct from another species to warrant separate taxonomic status at the species level, but is too distinct to be merely a variety.
- trifid*—three-forked.
- variety*—a category of plants which show a minor variation within a species.
- vegetative reproduction*—multiplication by vegetative means; propagation by splitting a clump into pieces and their subsequent development as separate plants.
- vermiform wrinkles*—very small worm-like folds or ridges in the top surface. A distinctive character of *L. vallis-mariae* (See Plate 31).
- window*—a transparent area of the top surface. It usually appears darker as the light falling on it is absorbed, not reflected. (Contrast Plate 20 with Plate 26).
- xerophyte*—a plant which can flourish under conditions of poor water supply.

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Postscript

Lithops naureeniae Cole

This a new species described by Professor D. T. Cole in 1980 (Nat. Cact. & Succ. J. **35**: 74). It is a yellow flowered 'green' species related to the *L. comptonii*—*L. helmutii*—*L. otzeniana* complex. To the author this is a very interesting find of great significance. It supports the author's view that the same factors which have acted on the Cape endemics have also had an influence on *Lithops* species.

The type locality for *L. naureeniae* is given as 60 km (37 miles) south-east of Sprinkbok in the Kamiesburg mountains. In 1969 the author predicted this find as follows (Fearn 1969):

"This north-western interval lies in an area between the Cedarburg and the Kamiesburg sub-centres, a distance north to south of about one hundred and sixty miles. *Although there are at present no known Lithops growing in the Kamies mountains it is suggested that it would be a good locality in which to look for species of Lithops, as many of the Cape endemics grow here.* This is feasible since *Lithops comptonii* var. *divergens* and forma *amenthystina* occur adjacent to a direct line between the Kamiesburg sub-centre and the north-western centre. These are able to survive in the very arid region known as the Knersvlakte and probably represent a relic of a previously wider distribution. *L. comptonii* var. *comptonii* grows to the south, to the south-east lie *L. comptonii* var. *viridis*, *L. otzeniana* and var. *weberi*. North of the Kamies mountains grow *L. meyeri*, *L. helmutii*, *L. herrei* and its two varieties var. *geyeri* and var. *hillii*. All these species are 'green' with yellow flowers. *Lithops villetii* and *L. marmorata* also grow in the vicinity, these are again 'green' species but are the only two in the area with white flowers."

Having now had one prediction come true it would be interesting to see if a further prediction should also prove positive. "It should prove rewarding to look for *Lithops* in the Sneeuwbergen area around Middleburg and also in the northern part of Basutoland bordering on the Orange Free State." (Fearn 1969). I wonder what the future will bring.

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