ENCEPHALARTOS

JOURNAL OF THE CYCAD SOCIETY OF SOUTHERN AFRICA

TYDSKRIF VAN DIE BROODBOOMVERENIGING VAN SUIDELIKE AFRIKA

NO. 16

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VOORBLAD/COVER

Encephalartos

lanatus

EDITORIAL

When the Cycad Society of Southern Africa originated five years ago, the need for a publication for the Society was soon realised. At the beginning of 1985 ENCEPHALARTOS took its first uncertain steps.

It has been a pleasure to see how the journal developed over the past four years from an unknown publication with a readership of just over 100 South African cycad lovers to an accepted journal read by well over 600 persons in 21 countries. As far as production is concerned, the original one-man operation has expanded into a team effort.

One reason for the success of ENCEPHALARTOS must surely be the fact that it provided in the need of cycad lovers to obtain interesting and enriching information in a language that everyone can understand. As far as this is concerned, it can rightly be said that ENCEPHALARTOS is the only cycad publication of its kind in the world.

REDAKSIONEEL

Toe die Broodboomvereniging van Suidelike Afrika vyf jaar gelede tot stand gekom het, is die behoefte aan 'n publikasie vir die Vereniging gou besef. Aan die begin van 1985 het ENCEPHALARTOS sy eerste wankelende treë gegee.

Dit was aangenaam om te kon sien hoe die tydskrif gedurende die afgelope vier jaar ontwikkel het van 'n onbekende publikasie met 'n lesertal van net meer as 100 Suid-Afrikaanse broodboomliefhebbers tot 'n aanvaarde tydskrif wat deur heelwat meer as 600 persone in 21 lande gelees word. Wat produksie betref het die aanvanklike een-man-operasie uitgebrei tot 'n spanpoging.

Een rede vir die sukses van ENCEPHALARTOS moet sekerlik die feit wees dat dit voorsien het in die behoefte van broodboomliefhebbers om interessante en leersame inligting te bekom in 'n taal wat almal kan verstaan. Wat dit betref, kan tereg gesê word dat ENCEPHALARTOS die enigste broodboompublikasie van sy soort in die wêreld is.

EDITORIAL
- CONTINUED -

Where I now retire as editor of ENCEPHALARTOS (see "From the President" elsewhere in this issue), I would like to thank all the loyal readers very much for their interest, support and encouragement during the past four years. Thanks very much also to all those who sent in contributions. Without that the journal could not have appeared. I owe a lot of gratitude to our President, Roy Osborne, for his loyal support as well as for the large number of interesting contributions for publication. Thanks very much also to the other two members of the ENCEPHALARTOS production team, Piet Vorster and Roy Shooter, to Dianna Fouché for the typing and to the other members of the Executive Committee for their support.

My best wishes to my successor(s) for many more sucessful editions of our journal. May you derive as much pleasure from it as I did.

MAANS KEMP

REDAKSIONEEL
- VERVOLG -

Waar ek nou uittree as redakteur van ENCEPHALARTOS (sien "Van die President" elders in hierdie uitgawe), wil ek graag vir al die lojale lesers baie dankie sê vir hulle belangstelling, ondersteuning en aanmoediging van die afgelope vier jaar. Baie dankie ook aan almal wat bydraes ingestuur het. Daarsonder sou die tydskrif nie kon verskyn nie. Ek is baie dank verskuldig aan ons President, Roy Osborne, vir sy getroue ondersteuning sowel as vir die groot aantal interessante bydraes vir publikasie. Baie dankie ook aan die ander twee lede van die ENCEPHALARTOS-produksiespan, Piet Vorster en Roy Shooter, aan Dianna Fouché vir die tikwerk en aan die ander lede van die Uitvoerende Komitee vir hulle ondersteuning.

Aan my opvolger(s) dra ek graag my beste wense oor vir nog baie suksesvolle uitgawes van ons tydskrif. Mag u net soveel genot daaruit put as ek.

MAANS KEMP

'n Wens van vreugde
en vrede
aan u met Kersfees
en deur die
Nuwe Jaar

VAN
DIE PRESIDENT,
REDAKTEUR,
NASIONALE
EN
STREEKKOMITEES

With best wishes
for a joyful
Christmas and
peace throughout
the New Year

FROM
THE PRESIDENT,
EDITOR,
NATIONAL
AND
REGIONAL COMMITTEES

FOCUS ON... FOKUS OP...

In each edition of ENCEPHALARTOS, we focus on one Southern African species, in the form of an in-depth article in layman's language. In this edition the spotlight falls on:

In elke uitgawe van ENCEPHALARTOS fokus ons op een Suider-Afrikaanse broodboomspesie, in die vorm van 'n in-diepte-artikel in leketaal. In hierdie uitgawe val die kollig op:

ENCEPHALARTOS LANATUS

by Roy Osborne

INTRODUCTION

In July 1988 I had the privilege to visit the Botshabelo Mission and nature reserve just north of Middelburg, an experience which I will recall with wonder for years to come. The tranquility of the mission settlement belies its turbulent past - a history in the latter half of the 19th Century of conflict between Christians and heathens, between the Ndebele and the Bapedi peoples, between the Boers and the British, and the complex power struggles within these groups. It is a place of refuge too (the original name was Toevlugt) and a site intimately linked with the Merensky family whose son, Hans Merensky, contributed so much to geological exploration of the Transvaal. The existence of a prolific cycad population seems like some incredible bonus to an area already so full of interest. Yes, Botshabelo is the home of the world's densest stand of *Encephalartos lanatus* splendidly set amongst some quite unique scenery.

DISCOVERY

Although he identified it as *Encephalartos friderici-guilielmi*, it was one O C Weeber of the Transvaal Department of Agriculture who first documented the Botshabelo cycad. His specimen, collected on 28th April 1911, is still filed in the Kew Herbarium as the type specimen of *E. lanatus*. Further samples were collected by Dr Pole Evans in 1915 and Dr Marloth in 1923. However, it was Joseph Burtt Davy, also of the Transvaal Department of Agriculture who seems to have made the first thorough comparative study of the Transvaal cycads. Burtt Davy was a prime mover in the formation of the National Herbarium and the Botanic Research Institute and after many years of field work in the Transvaal, went over to Kew where together with Dr O Stapf, he wrote "A Manual of the Flowering Plants and Ferns of the Transvaal, with Swaziland" in two volumes in 1926. Although the species notes would not nowdays qualify as adequate botanical descriptions, Stapf and Burtt Davy's text detailed and named the species *Encephalartos laevifolius*, *E. lanatus*, *E. paucidentatus* and *E. transvenosus* largely on the basis of their different leaf characters. All would have been well, but Hutchinson and Rattray in 1933 complicated matters by lumping *E. laevifolius* and *E. lanatus* back together again.

A general view of the habitat of E. lanatus at Botshabelo. The giant reddish-brown rocks are sedimentary sandstone of the Waterberg supergroup and are about 1750 million years old.

In his 1945 revision of the genus, Henderson re-examined this issue and once again separated these two species, largely after considering differences both in leaf and cone morphology. This decision was re-inforced by the work of Dr Inez Verdoorn which led to the description of another Transvaal species, *E. humilis*, in 1951.

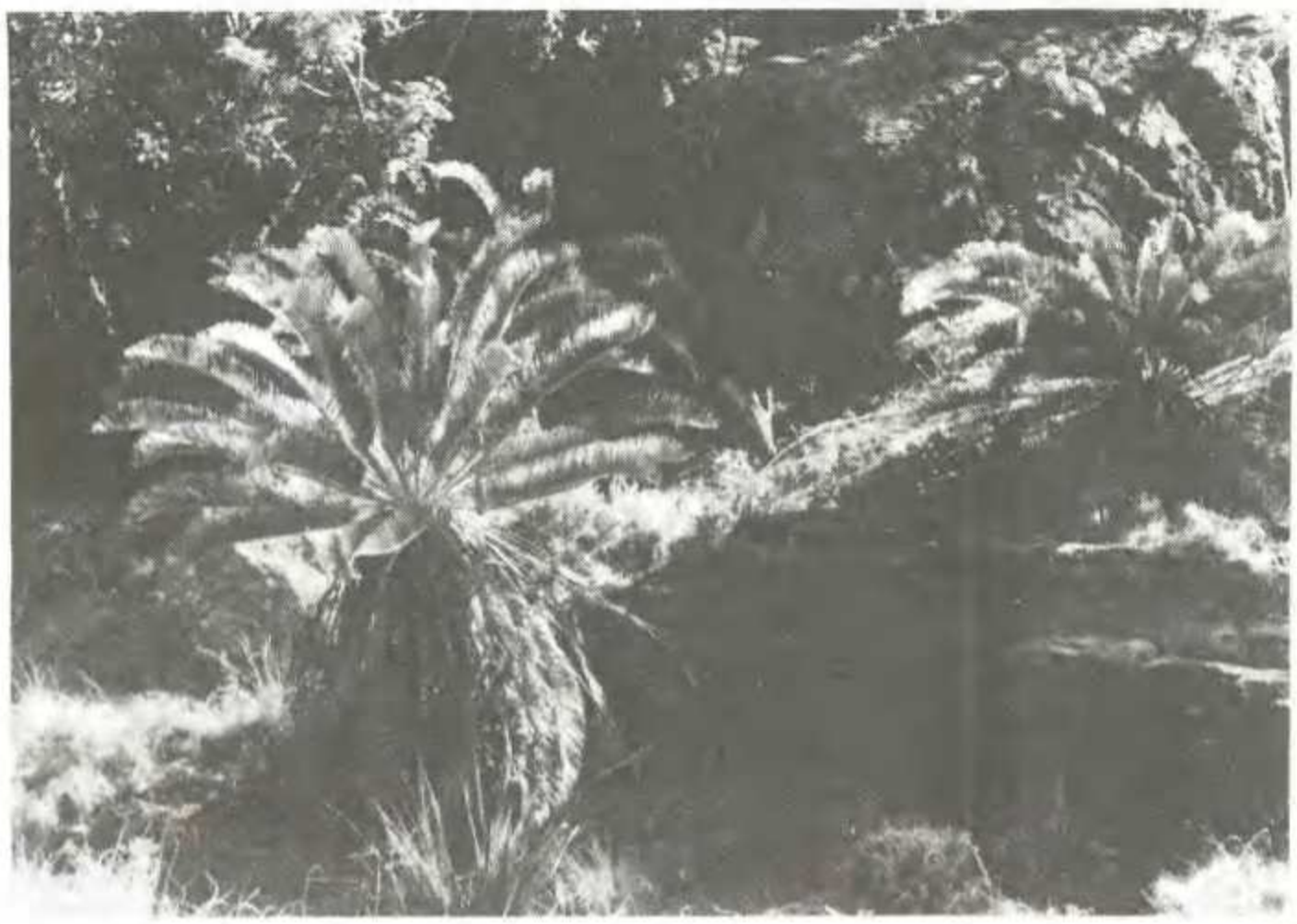
The Botshabelo cycad, also known as the Olifants River cycad, is thus correctly referred to as *Encephalartos lanatus* Stapf and Burtt Davy, and no further changes are anticipated at present.

DISTRIBUTION

E. lanatus is restricted in its distribution to a number of sheltered rocky valleys in the catchment areas of the Wilge, Olifants and Little Olifants Rivers, upstream from the Loskop Dam on the Transvaal Highveld. This distribution extends into the Bronkhorstspruit, Witbank and Middelburg Districts. The most prolific stands are found in the Botshabelo Mission Reserve and on several nearby farms; in some sites the plants occur together with *E. eugene-maraisii* subsp. *middelburgensis*. The average altitude is about 1500 m. The soil is fertile, deep but sandy and the rocks are geologically described as sandstone from the Waterberg supergroup. Rainfall is from 660 - 770 mm p.a. falling mainly as summer thunderstorms. Summer temperatures are high while severe frosts often occur in winter. In an apparently typical year, the temperature ranged from a winter low of -10^0C to a summer high of $+40^0$C. The general vegetation is described as sparsely-wooded sourveld and grass fires occur commonly in winter. These fires may indeed be essential for growth rejuvenation and to initiate the coning of the cycads, a subject of current research.

Herbarium records indicating collection of *E. lanatus* from various sites in the eastern Transvaal Lowveld (Pilgrim's Rest, Sabie, Nelspruit and Kaapsehoop) are undoubtedly incorrect and probably result in earlier confusion between *E. lanatus*, *E. laevifolius* and *E. humilis*.

Specimens of *E. lanatus* may be seen in Europe at the Les Cedres and Naples Botanical Gardens and in America at the Fairchild Tropical Garden, the Missouri Botanical Garden, the Huntington collection in California and the Foster Gardens in Honolulu, Hawaii. Locally, specimens are grown at the Ewanrigg Gardens near Harare, at Kirstenbosch and Durban Botanic Gardens. The best plants are found closer to their centre of distribution and fine examples are found at the Loskop Dam Nature Reserve, the Pretoria Botanic Gardens and the campus of the University of Pretoria, as also in numerous private gardens in the Pretoria area.



E. lanatus specimens in habitat at Botshabelo.

DESCRIPTION

1 STEM

The stems of mature plants of *E. lanatus* are up to 1,5 m tall but sometimes longer in old, reclining trunks. Diameters are typically in the 25-30 cm range. The stems are generally single but branching sometimes occurs at the base. The numerous small leafbase scars testify to the relatively slow growth rate of this species. Like most *Encephalartos* species, this plant produces coralloid roots which are usually infected with the cyanobacterium *Nostoc commune*.

2 LEAVES AND LEAFLETS

Young leaves are densely hairy and grow to about 60-100 cm in length, including the bare petiole of about 20-25 cm. The mature leaf recurves outwards near the apex and the rachis is sometimes slightly twisted. The leafbases are sunk into a matt of greyish hairs and bracts.

Leaflets have a silvery bloom in the young stage and mature to an attractive green to blue-green colour depending on local conditions. The mature leaflets are about 10-14 cm long by 6-8 mm wide. There are no teeth on the edges but the tip terminates in a single sharp spine. The leaflets have 10-14 parallel veins seen clearly on the undersurface. Leaflets are closely packed along the rachis in a tight V formation, with some degree of overlapping. They are twisted at their bases so that the flat surfaces of the leaflet are mostly at right angles to the long axis of the leaf.

E. lanatus in habitat at Botshabelo. Note the persistent leaf stalks and the appearance of the trunk, charred by grass-fires which occur in winter.

3 CONES

One to four cones are produced and are covered with a persistent hairy layer giving an overall creamy-grey appearance. The male cones are more or less cylindrical, 25-30 cm long by 5-6 cm in diameter. Their median scales have flattened faces or protrude only slightly. The female cones are barrel-shaped, 25-35 cm long by 12-15 cm in diameter, again with scale faces protruding only slightly.

The seeds have a yellow skin enclosing a thin fleshy layer over the kernel. They measure about 3 cm long by 2,5 cm broad. The kernels have a fairly smooth surface with about 20 small grooves running longitudinally from the deeply pitted point of attachment to the star-shaped micropyle. The kernels measure typically 3,0 cm by 2,3 cm and displace a volume of 6,6 cm^3.

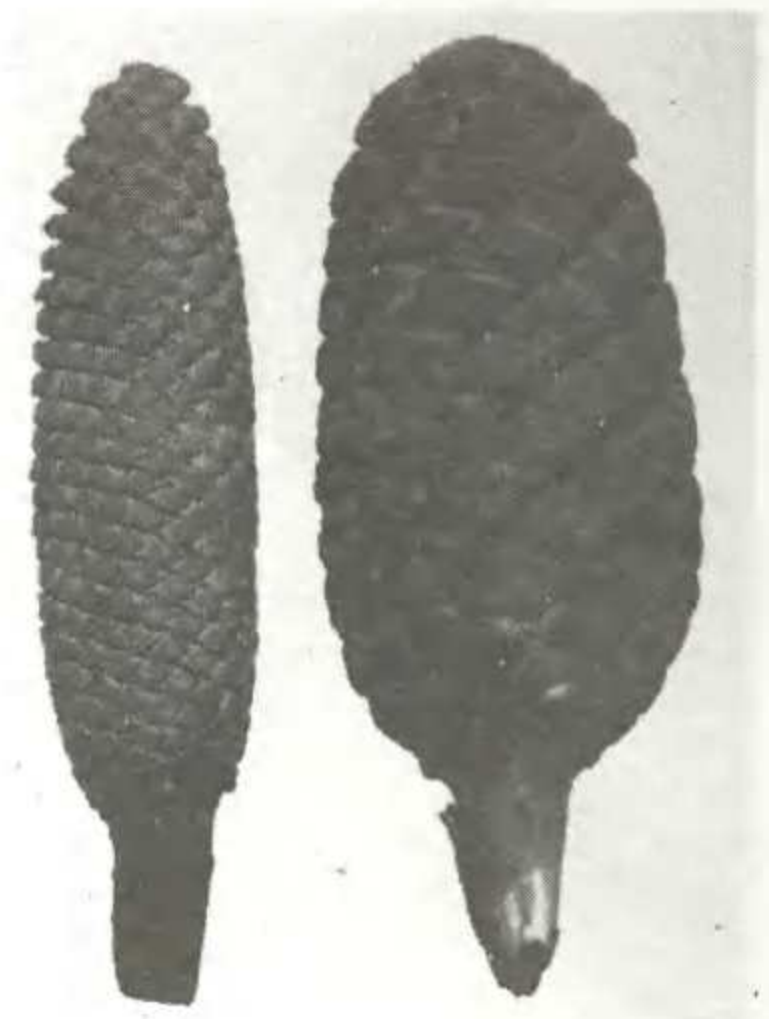
The name "lanatus" refers to the densely-woolly covering to the stem apex, leaf bases and cones.

Male cones of E. lanatus on a plant on the Middelburg Cycad Trail. (Photograph by Nat Grobbelaar)

AFFINITIES

The three narrow-leaved Transvaal species without leaflet teeth, *E. lanatus*, *E. laevifolius* and *E. humilis*, are clearly fairly-closely related to each other and probably also to *E. friderici-guilielmi* in the Eastern Cape. It is this degree of relationship which resulted in some of the earlier confusion between these taxa. It is not easy to tell the difference between seedlings or juvenile plants of these species as many of the distinguishing characters apply only to the adult plant. With experience the assessment of these species becomes easier.

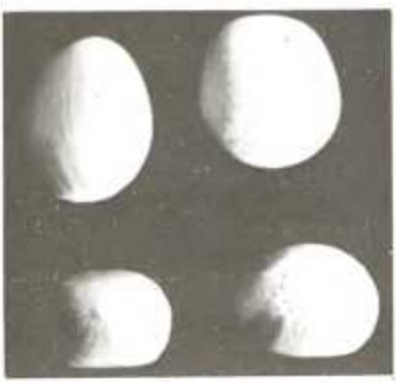
If the origin of the plant is known there is little doubt: *E. lanatus* comes from the catchment area of the Olifants River while *E. laevifolius* and *E. humilis* are much further to the east in the Crocodile River catchment zone. In terms of gross morphology, *E. lanatus* is intermediate between the smaller, branched *E. humilis* and the generally more robust *E. laevifolius*. The woolly leaf bases and cones of *E. lanatus* are clearly different to those of *E. laevifolius*. Cones of *E. humilis* are woolly, but more brown than grey.



Male (left) and female (right) cones of E. lanatus. (Photograph by Nat Grobbelaar)

The typically densely-woolly female cone of E. lanatus at maturity. (Photographed in Loran Whitelock's Los Angeles garden by the author.)

The leaflets of *E. lanatus*, in their tight V formation, differ from the more-or-less horizontal arrangement in *E. laevifolius*. Similarly the twisted leaflet base, which results in the leaflet blades lying at right angles to the long axis of the leaf, is a feature of *E. lanatus* which is useful in distinguishing it from *E. laevifolius*. *E. humilis* has more widely-spaced leaflets with fewer veins than *E. lanatus*. The leafstalk of *E. humilis* is more twisted than that of *E. lanatus*.



Cleaned seeds of E. lanatus. (Photograph by Nat Grobbelaar)

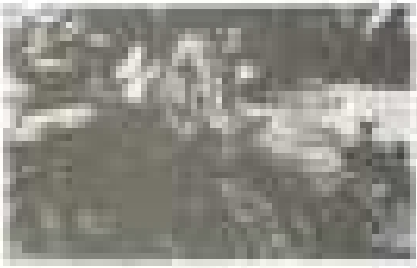
There are no reports of natural hybrids between *E. lanatus* and *E. eugene-maraisii* subsp. *middelburgensis*, the only possible combination in terms of distribution. This is possibly due to non-synchrony of coning times or the presence of specific insect vectors in pollination. There are no reports of any artificial hybrids between *E. lanatus* and other species, probably because no attempts have yet been made in this regard. If indeed *E. lanatus*, *E. laevifolius*, *E. humilis* and *E. friderici-guilielmi* are closely related it should be entirely possible to produce hybrids between these species.

CULTIVATION

E. lanatus is regarded as "difficult" in cultivation. Mature plants are rarely moved with success and attempts to re-establish specimens in gardens are usually unsuccessful. Seeds, however, germinate well and patience with this slow-growing species may be rewarding. Although the plants are frost-hardy, new leaves are sensitive to wind and heat-scorch effects. It is remarkable that this slow-growing plant has also been found to give the slowest response in attempts at tissue-culture: both Koeleman and Osborne have noted that material from this species takes significantly longer than other members of the genus to reach a callus stage in cultures.

CONSERVATION

E. lanatus is classified as "vulnerable" on the Threatened Plant List. Fortunately the largest stands of this species occur at Botshabelo falling under the jurisdiction of the Middelburg Town Council and proclaimed as a reserve. The owners of the surrounding farms are conscious of the valuable heritage which these cycads represent and exploitation of habitat specimens of this species appears to be minimal. Regrettably some petty pilfering does persist and it is these unfortunate incidents which have led to the closing of the well known "Cycad Trail" (see ENCEPHALARTOS No 2 page 17 and later ENCEPHALARTOS No 14 page 25). In a bid to reduce the demand on habitat specimens, the Transvaal Provincial Authority has raised many hundreds of *E. lanatus* seedlings for sale to the public.



A small sample view of some of the many hundreds of E. lanatus seedlings raised by the TPA Nursery at Pretoria.

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KING'S PARK - PERTH'S PRIDE

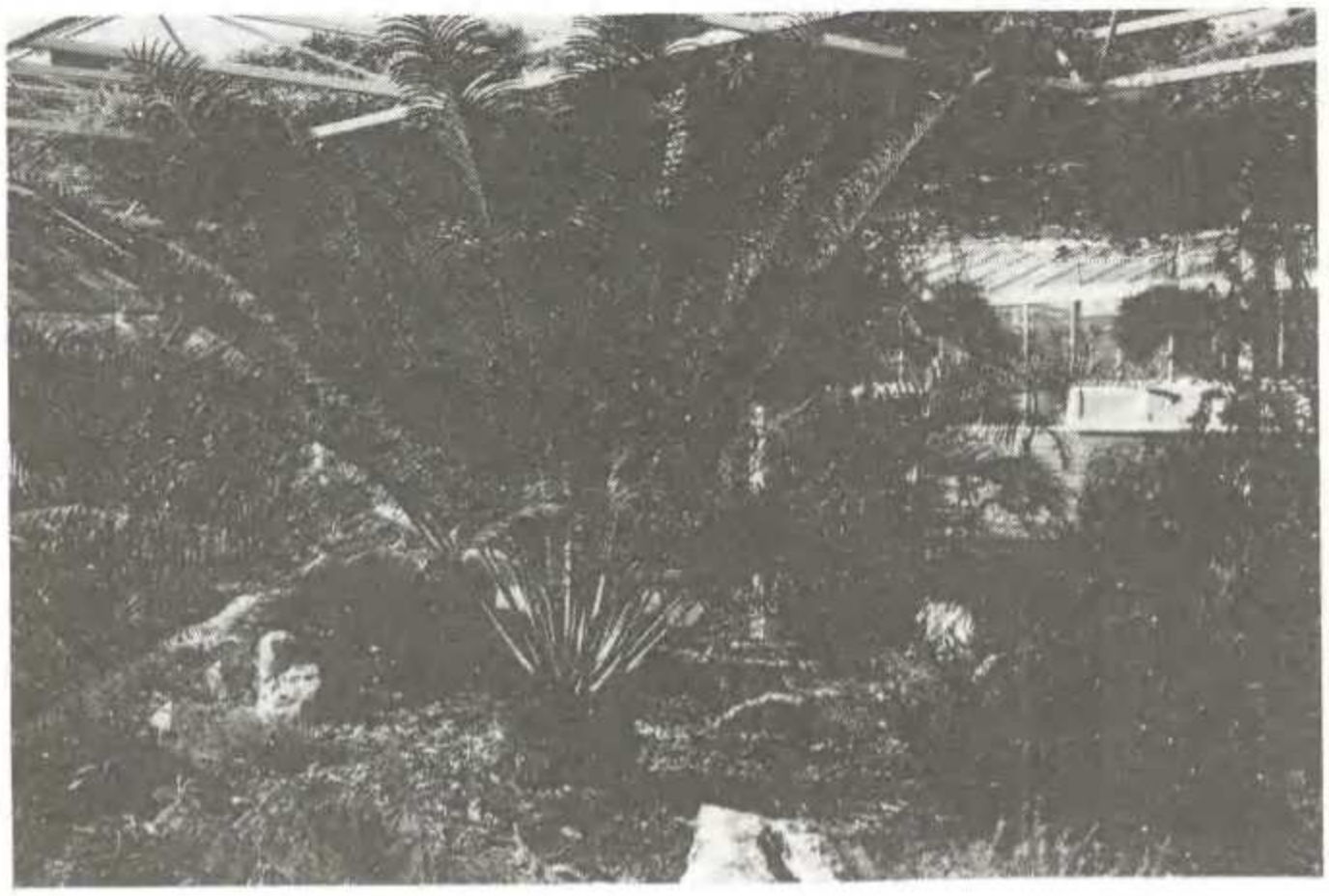
by Norm Patterson

According to Swan River aborigines, a mythological Rainbow Snake once made its way through the ground into King's Park and emerged to create a natural spring, later going on to Freemantle and into the Indian Ocean, thus forming the "Swan River". Perth, the capital of Western Australia, was established in 1829, King's Park then being known as "Mt. Eliza". The spring at the base of the mountain became very important to the European settlers at that time.

In 1831, Surveyor-General John Roe indicated that Mt. Eliza would be set aside for public useage. In 1872 it was gazetted as a 175 Ha public park (today it extends over 400 Ha). In July 1901, after a visit by the son of Kind Edward VII (himself later being King George V) it was named King's Park. At that time, a foundation stone for the South African War Memorial was laid : near the site of the present collection of S.A. cycads.

Stangeria eriopus in a King's Park greenhouse

Macrozamia moorei in the park



Lepidozamia peroffskyana

It was in 1959 that displays of various indigenous floras were initiated in the park. The site represents one of the world's largest city parks, second only to Stanley Park in Vancouver, B.C., Canada.

The cycad collection is housed in an open area between hothouses and presently includes *Macrozamia lucida*, *M. miquelii*, *M. communis*, *M. moorei*, *M. pauli-guilielmi*, *Cycas basaltica*, *C. pruinosa*, *Bowenia serrulata*, *Lepidozamia peroffskyana*, *Encephalartos ferox* and *E. gratus*. Of course, the local *Macrozamia reidlei* grows wild in the bush within the park. The *Lepidozamias* are about 25 years old while most other specimens are 10 - 15 years in age. Soil is sandy and the climate is of the winter-rainfall type.

King's Park, so large, so green, with its open and enclosed displays, its play areas and its memorials, is an invaluable asset to the city of Perth. It has preserved that particular area that the original settlers saw when they first arrived at Freemantle and travelled up by longboat to where Perth City now stands.

A healthy specimen of Macrozamia reidlei

BITS AND PIECES STUKKIES EN BROKKIES

NEWS FROM ITALY

Research workers from the Department of Botany at the University of Naples are well known internationally for their broad range of work on cycads. Indeed, the Orto Botanico, under the capable direction of Professor Paolo de Luca, has established itself as a centre of excellence in cycad research.

Professor Aldo Moretti, a key member of the Naples team, wrote to tell us of his recent work and experiences. "In January 1988 I spent three weeks in Mexico and Belize with Dennis Stevenson, Mario Vazquez Torres and geneticist Luciano Gaudio. In the Yucutan area we collected a number of Zamia plants from different localities. Although plants from different populations show a wide variability, we think all of them are to be attributed to a unique new species."

In March, Prof. Moretti spent two weeks in Zaire with Jean Pierre Sclavo and Francois Malaisse. Prof. Malaisse has spent some 20 years in Zaire and is a leading expert on Central African cycads. Prof. Moretti writes: "It was my first trip to Africa and I found it interesting and exciting. We collected Encephalartos specimens in the Kolwezi area, presumably E. poggei or a closely-related taxon. Because of the rainy season it was not possible to reach the habitats of E. marunguensis or E. laurentianus." Unfortunately Prof. Moretti caught malaria as a result of this trip and required some time to recuperate at Naples.

The Italian team next plans a trip with Dennis Stevenson to the Rio Negro valley in the Amazonian forests, again on the hunt for novel Zamia species. After the trip, Prof. Moretti will spend some time studying the Zamia species at Fairchild Tropical Garden in Miami.

Dennis Stevenson, Aldo Moretti and Mario Vazquez Torres in frivolous mood in Belize, January 1988.

GALL MIDGE DAMAGE

The accompanying photograph of a distorted leaf of Encephalartos princeps is typical of a number of similar samples sent to the Society with the query: is this a virus, a fungus, a trace element deficiency or what? According to entomologist member Dr Stephen Compton of Rhodes University, it's none of those. Dr Compton states that this is the typical result of the activities of the cecidomyliid gall midge which attacks the soft cycad leaves at the time of their first emergence. The problem is particularly widespread on plants from the East London area.

Gall midge damage on E. princeps leaf. (Photograph: Roy Osborne)

CYCAD CONE LEAF OUTGROWTHS

The phenomenon of outgrowths of leaves from the top of cycad cones has aroused considerable interest following several reports on this occurrence in previous issues of ENCEPHALARTOS. The event has now been discussed in more scientific terms in a paper by Prof. P.J. Robbertse and Drs Isabella Claassen and Elzabe Schoonraad - all from the University of Pretoria - which is published in the August 1988 issue of the South African Journal of Botany (Vol. 54, no. 4, pp. 394-396).

The gist of their paper revolves around the question of whether a cycad cone borne at the top of a growing shoot can or cannot subsequently continue normal vegetative growth. Reference is made to the case of male and female cones of Cycas in comparison and the position of the inflorescence in Angiosperms by analogy. The possibility exists that the odd Encephalartos cones with vegetative outgrowths represent a throwback to a primitive ancestral "basitonic branching".

This is a technical paper of great interest to those concerned with developmental morphology. Reprints are available from Prof. Robbertse, Department of Botany, University of Pretoria, Pretoria 0002.

VOLUNTEER WANTED

The Director of the East London Museum, Miss R.M. Tietz (tel. no. 0431-22623 or 25644) has asked the Society if we could recruit a member in the East London area who would be willing to assist in the maintenance of the cycad collection in the Museum's grounds. The museum has several interesting and historically-important cycad specimens and works on a fairly limited budget. Any dedicated volunteer(s) who would like to ensure the well-being of these plants should contact Miss Tietz directly.

CYCAD TWINS

Following the note on "twin seeds" in Encephalartos natalensis (ENCEPHALARTOS no. 13, p.42), Signor Ottorino Stainer, a keen member from Treporti (Venice, Italy) has written to tell us of his experiences. With seeds of Cycas pruinosa and Lepidozamia peroffskyana he has observed that single seeds occasionally germinate to give two plants. This is an uncommon situation but probably explained by the fact that the female gametophyte generally develops two (sometimes more) egg cells (see ENCEPHALARTOS no. 8, p. 26-31). Usually only one is fertilised and one embryo results. However it is quite possible that both egg cells may be fertilised, probably by sperms from two different pollen grains, and that two embryos may develop and hence two plants can germinate from a single seed. The situation is not unlike that in non-identical human twins.

ENCEPHALARTOS EUGENE-MARAISII : PREVIEW.

Cycad enthusiasts familiar with the Transvaal species have long recognised considerable variation in the species known as Encephalartos eugene-maraisii and locality names such as "Waterberg", "Middelburg", "Wolkberg", "Downs", "Dolomitica" and "Mica" have been used. The work of Pretoria student Suzelle van der Westhuizen drew attention to this in rather more scientific terms in a thesis published in 1976. But this year has seen some unfortunate confusion : two teams of workers have independently published taxonomic papers arising from Mrs. van der Westhuizen's investigation. Douglas Goode and John Lavranos have recognised a subspecies in E. eugene-maraisii subsp. middelburgensis and also created two new species named E. dolomiticus and E. dyerianus. Hannes Robbertse, Piet Vorster, and Suzelle van der Westhuizen have named new species E. verrucosus and E. graniticolus.

We will attempt to clarify some of this confusion in a major article on "The Encephalartos eugene-maraisii complex" in the next issue of ENCEPHALARTOS.

Cycas pruinosa seed showing the "twin seedling" germination. (Photograph: Ottorino Stainer)

BOTSHABELO CYCAD POSTCARD

An attractive postcard, 15 x 10cm, featuring a colour print of *Encephalartos lanatus* in cone and printed on high quality linen board, is issued by the Botshabelo management authorities. These cards may be obtained through the Society. The price, including airmail postage, is R4.50 per 10 cards (local members) or R7.50 per 10 cards (overseas members). Orders may be placed with Robert Campbell, 95 Everton Road, 3610 Everton. (Tel. 031-742774).

COMMITTEE NOTICE

A recent notice of a cycad auction held in the Cape included the words "Member of the Cycad Society of Southern Africa" in the text. The Committee wishes to make it clear that we do not support commercial sales of habitat-collected cycad specimens and did not give approval for the use of the Society's name in this connection.

ANY MEMBER WISHING TO USE THE SOCIETY'S NAME IN A PUBLICATION IS REQUESTED TO OBTAIN CLEARANCE FROM THE EXECUTIVE COMMITTEE. YOUR CO-OPERATION IN THIS MATTER IS SINCERELY REQUESTED.

Roy Osborne,
President.

CYCADS OF AUSTRALIA

by Len Butt

Macrozamia macdonnellii

This beautiful glaucous-blue species is separated from other species by some 1 500 kilometres of arid desert and boulder country. Macrozamia macdonnellii is confined to the rugged mountainous strip known as the Macdonnell Range which is situated between the Gibson Desert in the west and the Simpson Desert in the east. Alice Springs is situated in this range area and the first specimens of this cycad collected were probably from around this area. Early across-Australia expeditionists must have marvelled at this impressive palm-like plant. In these ranges it could hardly be missed, growing in association with some few eucalypts and, of course, in its Palm Valley habitat, with the lovely Livistonia mariae, a fan palm with the peculiarity of having lovely bronze-red leaves while young. The Macrozamia occurs in bigger populations and is more widespread in Central Australia. The Macdonnell Range area is large and covers shallow rocky soils and also deep gorge country and the blue Macrozamia is found in these habitats, including the Stanley Chasm. The eye-catching blue fronds, the large and heavy female cones and the outstanding large seeds of M. macdonnellii are quite distinct from most other Macrozamia and may have been a factor in its survival.

Female cones are up to 40 cm long and 27 cm in diameter. Seeds can be 8 cm long by 4,5 cm wide. In large, mature plants the caudex can be three metres high and the fronds from fifty up to a hundred in number.

M. macdonellii in habitat

Many of these plants have their fronds low or prostrate to the ground, so I imagine that, like M. moorei and M. miquelii, the caudex is long in forming. Also, like the other typical Macrozamia, the cones are on a short stalk. The great curved arches of the large fronds have stiff V-shaped pinnae, again with slight similarities to M. moorei, but many other features are more suggestive of Macrozamia riedlei.

(Reprinted from "Australian Plants", Volume 13, no. 101, December 1984, with the kind permission of the author and the editor.)

FROM THE PRESIDENT

ENCEPHALARTOS no. 16 sees the end of the fourth year of the Society's activities. The year has been one of further consolidation and some degree of rationalisation. Membership has stabilised at about 600, comprising some 475 local enthusiasts and about 125 overseas supporters.

Your Committee has unanimously agreed to the election of Dr Knut Norstog and Professor D.D. Pant as honorary life members. A notice to this effect appears elsewhere in this issue of ENCEPHALARTOS.

Your Committee has further agreed that membership fees for 1989 will be as follows:

- Local ordinary membership: R25,00 p.a. (R20,00 if paid before 1 January 1989)

- Overseas airmail-rate membership: R60,00 p.a. (R50,00 if paid before 1 January 1989)

- Overseas seamail-rate membership: R30,00 p.a. (R25,00 if paid before 1 January 1989.

The 50% student and pensioner discount is regrettably not available to overseas members.

Members will have been invoiced for their fees in December and we trust the above will serve as a reminder to those who have not yet responded. We are obliged to remind members that the names of all members still in arrears at the end of March 1989 will be removed from the Society's mailing lists.

Members in Australia, New Zealand and the USA are reminded that their fees can be sent to their local representatives (see addresses on the inside back cover) for onward transmission.

VAN DIE PRESIDENT

ENCEPHALARTOS no. 16 dui die einde aan van die vierde jaar van die Vereniging se bedrywighede. Dit was 'n jaar van verdere konsolidasie en 'n mate van rasionalisasie. Die ledetal het op ongeveer 600 gestabiliseer, bestaande uit ongeveer 475 plaaslike entoesiaste en omtrent 125 oorsese ondersteuners.

U Komitee het eenparig ingestem tot die verkiesing van dr. Knut Norstog en professor D.D. Pant as ere-lewenslange lede. 'n Kennisgewing in hierdie verband verskyn elders in hierdie uitgawe van ENCEPHALARTOS.

U Komitee het verder besluit op die volgende ledegelde vir 1989:

- Plaaslike gewone lidmaatskap: R25,00 per jaar (R20,00 as voor 1 Januarie 1989 betaal word)

- Oorsese lugpostarief-lidmaatskap: R60,00 per jaar (R50,00 as voor 1 Januarie 1989 betaal word)

- Oorsese seepostarief-lidmaatskap: R30,00 per jaar (R25,00 as voor 1 Januarie 1989 betaal word)

Die 50% studente- en persioenaris-afslag is ongelukkig nie vir oorsese lede beskikbaar nie.

Lede sou in Desember 'n rekening vir hulle ledegeld ontvang het en ons hoop die bostaande sal as 'n herinnering dien vir diegene wat nog nie betaal het nie. Ons is verplig om lede daaraan te herinner dat die name van lede wat teen die einde van Maart 1989 nog nie betaal het nie, van die Vereniging se adreslyste verwyder sal word.

Lede in Australië, Nieu-Seeland en die V.S.A. word daaraan herinner dat hulle hul ledegeld aan hulle plaaslike verteenwoordigers (sien adresse op die agter-binneblad) kan stuur, wat dit verder sal versend.

A further facility being introduced is that of reciprocal memberships. Where a member belongs to our Society and one of the other Palm and/or Cycad Societies, we will attempt to "marry" local and overseas members with common interests so that each is responsible for two accounts in his/her own country. Arrangements in this respect are being made by Cynthia Giddy to whom any enquiries in this respect should be addressed. Her address is also found on the inside back cover.

It is with sadness that I have to announce the resignation, due to pressure of work, of Maans Kemp as editor of ENCEPHALARTOS. I'm sure that each and every member will join the Committee in thanking Maans for his wonderful work in producing 16 fine issues of our magazine and wishing him well in his "retirement" from the vital role he has played in our Society. At the time of writing your Committee was deliberating the difficult job of finding a suitable successor, but a final decision had not yet been made. In the interim period any editorial correspondence for ENCEPHALARTOS may be sent to the President.

In closing, may I express thanks on behalf of all members to the Executive and Regional Committees and our other helpers for their dedicated service during the past year.

Wishing all readers a joyful Christmas and a peaceful and successful New Year.

ROY OSBORNE

'n Verdere fasiliteit wat ingestel word, is die van wedersydse lidmaatskap. Waar 'n lid aan ons Vereniging sowel as een van die ander Palm- en/of Broodboomverenigings behoort, sal ons probeer om plaaslike en oorsese lede met gemeenskaplike belange te "paar" sodat elkeen verantwoordelik is vir twee rekeninge in sy/haar eie land. ReÎlings in hierdie verband word deur Cynthia Giddy getref en alle navrae hieromtrent moet aan Cynthia gerig word. Haar adres verskyn ook op die agter-binneblad.

Dit is met leedwese dat ek die bedanking, weens werkdruk, van Maans Kemp as redakteur van ENCEPHALARTOS moet aankondig. Ek is seker dat ek namens elke lid praat wanneer ek Maans bedank vir sy wonderlike werk in die produksie van 16 goeie uitgawes van ons tydskrif en hom alles van die beste toewens met sy "aftrede" uit die deurslaggewende rol wat hy in ons Vereniging gespeel het. Ten tye van hierdie skrywe was u Komitee nog besig om te beraadslaag oor die moeilike taak om 'n geskikte opvolger te vind, maar 'n finale besluit is nog nie geneem nie. Intussen kan enige redaksionele korrespondensie vir ENCEPHALARTOS aan die President gestuur word.

Ten slotte wil ek namens al ons lede baie dankie sê aan die Uitvoerende en Streekskomitees en ons ander helpers vir hulle toegewyde diens gedurende die afgelope jaar.

Met beste wense vir 'n gelukkige Kersfees en 'n vreedsame en suksesvolle Nuwejaar.

ROY OSBORNE

NURSERY NEWS

The "Cycad Nursery" of members Henkie and Ita van der Walt offers 17 South African Encephalartos species of varying sizes with prices ranging from R7,50 to R350,00. In addition, the following exotic cycads are available: Encephalartos manikensis, Cycas thouarsii, Cycas revoluta, Ceratozamia mexicana, Dioon spinulosum, Zamia furfuracea and Zamia pumila. The Pretoria outlet is a retail outlet for many of the plants which are grown from seed in a separate nursery in the Lowveld.

The "Cycad Nursery" is situated at Derdepoort on the northern outskirts of Pretoria and is adjacent to the magnificent private cycad garden of the Van der Walts. It is open 7 days a week. The telephone number is 012-576453 and the postal address is PO Box 15251, Lynne East 0039.

Growing Encephalartos in a Miami-Type Climate

by Piet Vorster

General literature tells us that cycads are tropical plants, and occasionally that species like *Dioon edule* and *Encephalartos horridus* are desert plants. Botanic gardens react to this information by keeping their cycads in "steaming jungle" type greenhouses where they are more or less successful because of the incredible hardiness of these plants. However, are these results optimal?

Over a period of some 20 years I managed to bring together a collection of about 150 species or forms representing all of the genera of cycads. Most of these were grown from seed, but plants in various stages of maturity also were acquired as opportunities presented themselves. Successes and failures in growing these plants have led to much introspection about their requirements for optimal growth and survival. For the last eight years I have been living at Stellenbosch, some 40 miles (64 km) east of Cape Town, South Africa. This is well outside the tropics, 34 degrees south of the equator. We are 12 miles (19 km) from the ocean, 350 feet (105 m) above sea level. The annual rainfall of some 24 inches (60 cm) comes mainly during the winter months as soft drizzle.

Although I was able only two years ago to start transferring my plants to the open ground, most species have responded favorably. I like to think that my losses of plants over the years — which I don't like being reminded of — have been due to ignorance rather than bad luck. My wife, however, maintains that it would never be possible to grow all of the cycad species together in one collection because of the diversity of their natural habitats, and that our success rather testifies to the immense tenacity of these plants. Stubbornly I refused to acknowledge this, but two recent events made me reconsider the matter.

First, I visited one of America's foremost botanic gardens where there is a beautiful big tropical greenhouse with carefully controlled climate. "Just what is needed for cycads," thought I. And indeed, this greenhouse has some very nice *Dioon spinulosum, Ceratozamia robusta* and tropical African *Encephalartos*. However, the garden's *Cycas revoluta*, the hardiest and easiest of all cycads to grow, were the most depauperate I had ever seen: thin stems and only a few stunted fronds in spite of what felt like eminently suitable temperatures, humidity and light.

The second event was a letter from Dr. Knut Norstog of Fairchild Tropical Garden, inquiring why FTG cannot maintain *Encepharlartos horridus*. These happenings, plus an earlier visit to FTG, where I saw species with which I am familiar in the field and in my own garden growing under very different conditions, served to organize thoughts which had been in the back of my mind for some time.

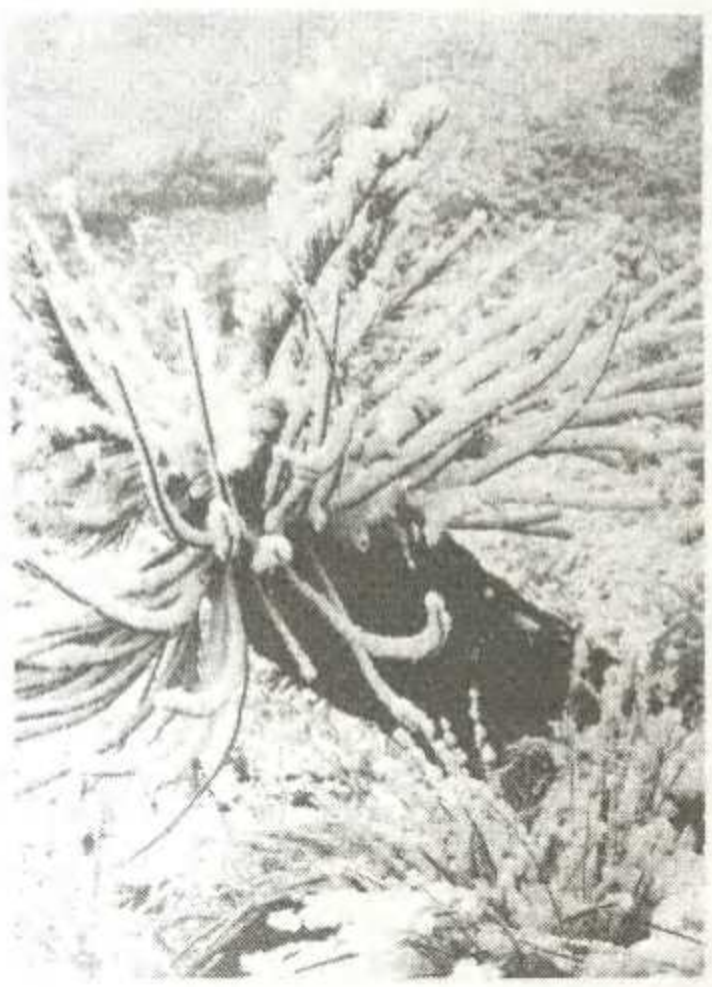


Figure 1. Encephalartos ghellinckii *festooned with snow in the Natal Drakensberg at an altitude of 7,000 feet (2,100 m). Photo by J.B. Vermeulen.*

Examination of a map showing the global distribution of cycads, such as the not quite perfect one in Giddy's *Cycads of South Africa,* reveals that cycads are by no means as tropical as popular literature makes out. Most species are concentrated in a northern and southern zone between 20 and 30 degrees latitude.

There is a slight variation among genera; for example, *Cycas* and *Zamia* tend to occur closer to the equator than other genera. It is rare indeed for cycads to occur closer than 10 degrees to the equator, and when they do, the plants always occur in locally cooler places such as mountain slopes, shady forests or seashores cooled by ocean winds.

In fact, most cycad species occur in surprisingly similar temperature ranges because of their choice of habitats irrespective of their location, though they differ widely in their water and light requirements.

Why then do certain species persistently fail under artificial conditions? I would say that the reason is that these are invariably such specialized species that their requirements do not fit in with the generalized formula. This poses a special problem for anyone attempting to grow these species without being familiar with them in the field, as all too often the literature is anything but explicit about their natural habitats.

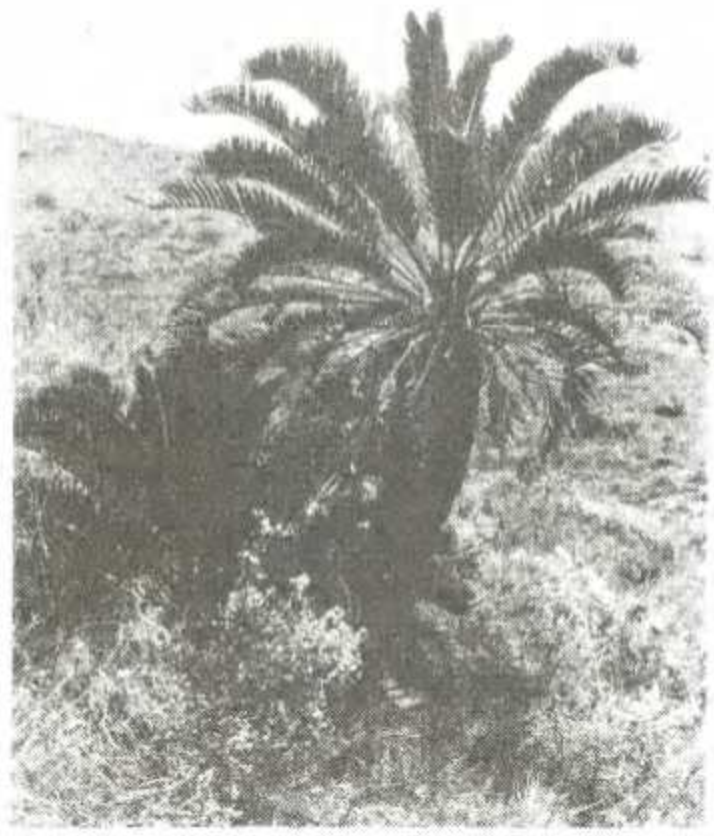


Figure 2. Encephalartos longifolius *in sclerophyllous mountain vegetation northwest of Port Elizabeth. The blackened trunk testifies to frequent fires. Photo by P. Vorster.*

Figure 3. Encephalartos horridus *in overgrazed succulent shrubveld between Port Elizabeth and Uitenhage. Such tall stems develop only with great age. Photo by P. Vorster.*

It is often stated that the external appearance of cycads provides a good clue to their environmental requirements. Thus more glaucous (blue) fronds with narrow, closely spaced leaflets indicate a preference for dry, sunny situations; whereas green fronds with wide, laxly spaced leaflets point to moist and shady conditions.

Spininess of the leaflets or petiole is thought to be an adaptation linked to desert habitats; for example, in species like *Encephalartos horridus* and *E. lehmannii,* the tips of the leaflets are ferociously spiny. There are, however, some notable exceptions such as *Encephalartos inopinus* with blue-green fronds which, true to its appearance, grows happily in direct sunlight but in nature occurs in shade.

The blue-green fronds of *Dioon mejiae* suggest tolerance of sunny conditions, yet in my garden it gets severely sunburnt when grown in the open, much more so than the morphologically very similar *D. spinulosum* with its green fronds, which is known to be a plant of dense forests.

Several other *Dioon* species have blue-green fronds, yet from literature accounts seem to grow in more or less shady places. The wide, green, laxly spaced leaflets of some forms of *Zamia furfuracea* suggest a shade plant, yet by all accounts they grow naturally in direct sunlight.

A syndrome still imperfectly understood involves leaflets oriented on the rachis in the shape of an inverted V. Some of the species showing this trait are *Encephalartos paucidentatus, E. heenanii, E. inopinus, E. ghellinckii,* to some extent *E. cycadifolius,* and *Microcycas calocoma.*

In other species the tips of the leaflets may droop when growing in shade, but in those listed above, the leaflets point downwards from their bases. In these *Encephalartos* species the fronds all bend upwards rather than down so that at least the young crown has a cup shape rather than an umbrella shape.

In species such as *Microcycas calocoma* and *Encephalartos pauciden-tatus* this arrangement of the leaflets may serve to direct rainwater towards the tips of the leaflets to be scattered rather than to channel it towards the rachis and ulti-mately the stem; but this explanation does not seem credible in the case of *E. ghel-linckii* and *E. cycadifolius* which often occur under rather dry conditions. In the case of the latter two species, the leaf arrangement may serve to handle snow loads: the upward curve of the fronds to channel snow towards the stout trunk rather than towards the tips of the fronds where its accumulating weight may snap the fronds, and the drooping leaflets to allow the snow to slide off towards the sides of the frond rather than accumulate at the rachis (Figure 1).

In spite of the exceptions mentioned previously, in general the outward ap-pearance of *Encephalartos* species does provide a clue to their individual environ-mental requirements, if not necessarily to their natural relationships.

With regard to light requirements and tolerances, all species can be grown in direct sunlight, especially if the atmos-pheric moisture is sufficiently high, but in nature not so many species occur in full sunlight. The most notable examples are indeed those species with heavily glaucous fronds, i.e., *Encephalartos hor-ridus, E. lehmannii, E. princeps,* and perhaps *E. eugene-maraisii.* These species will not thrive unless they get dry conditions and lots of sunshine. Others which occur naturally in full sunlight, but under cooler and moister conditions, are green-fronded *E. longifolius* (Figure 2) (which also occurs in a glaucous form), *E. transvenosus, E. heenanii, E. caffer, E. ngoyanus, E. septentrionalis, E. poggei, E. marunguensis* and *E. gratus.*

Only a few species of *Encephalartos* occur naturally almost exclusively in full shade, these being *E. villosus* and its sib-ling species *E. hildebrandtii.* In spite of its close morphological similarity to *E. vil-losus, E. umbeluziensis* is not so much a shade plant. Most of the other species are found in lightly shaded habitats, but it is not unusual to find individuals of a species in direct sunlight and others in dense shade.

One tends to think of a cycad habitat as stable, because the plants are reputed to grow and mature so slowly, but obser-vations on *E. ferox* in Mozambique and *E. altensteinii* in the eastern Cape Pro-vince of South Africa suggest that these cycads are an integral part of plant succes-sion with seedlings germinating in more or less sunny situations where the young plants reach maturity and cone. Eventually the surrounding vegetation grows taller, and once the cycads get covered under the forest canopy they still grow well, but no longer cone.

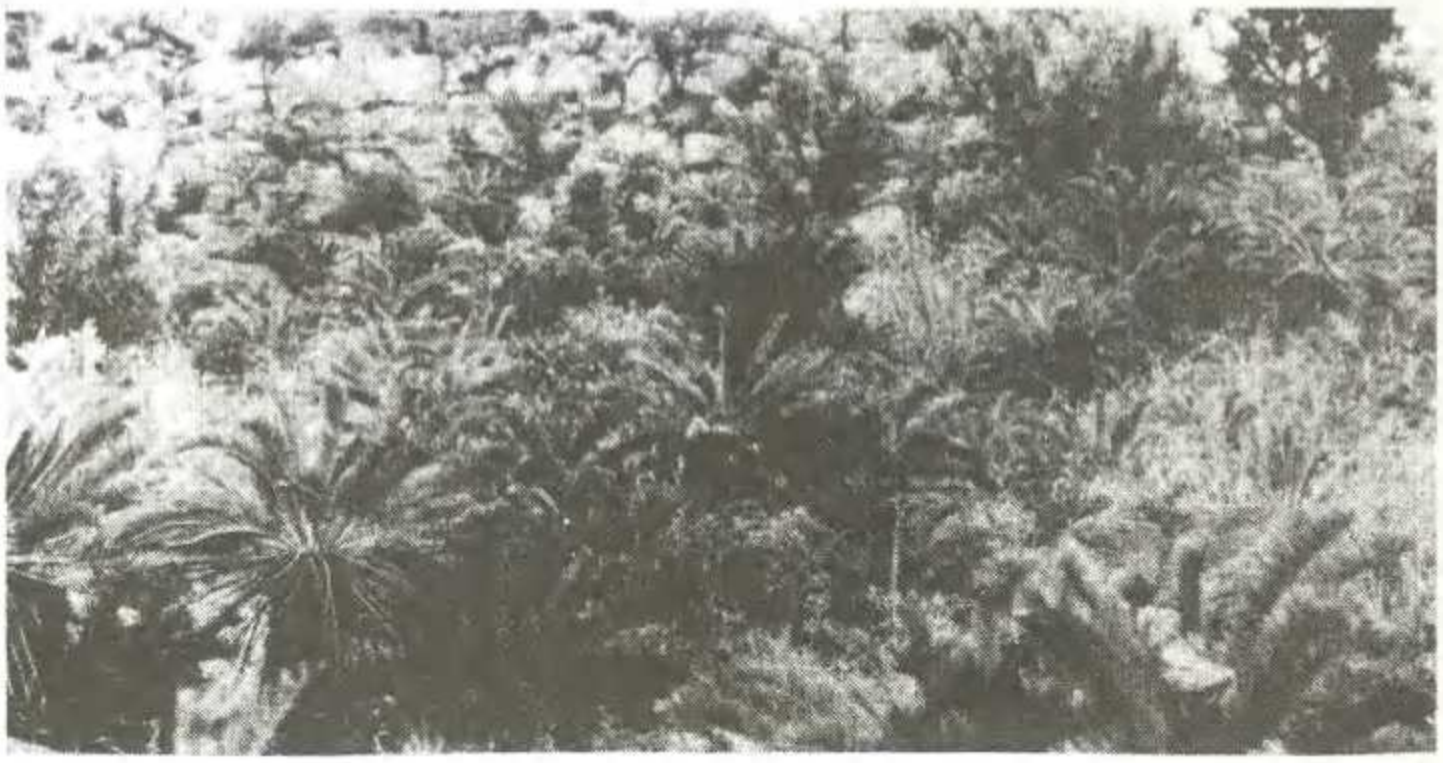


Figure 4. Encephalartos lanatus *in short, sour grassland on the escarpment north of Middelburg, Transvaal. These plants experience almost annual grass fires and winter frost. Photo by P. Vorster.*

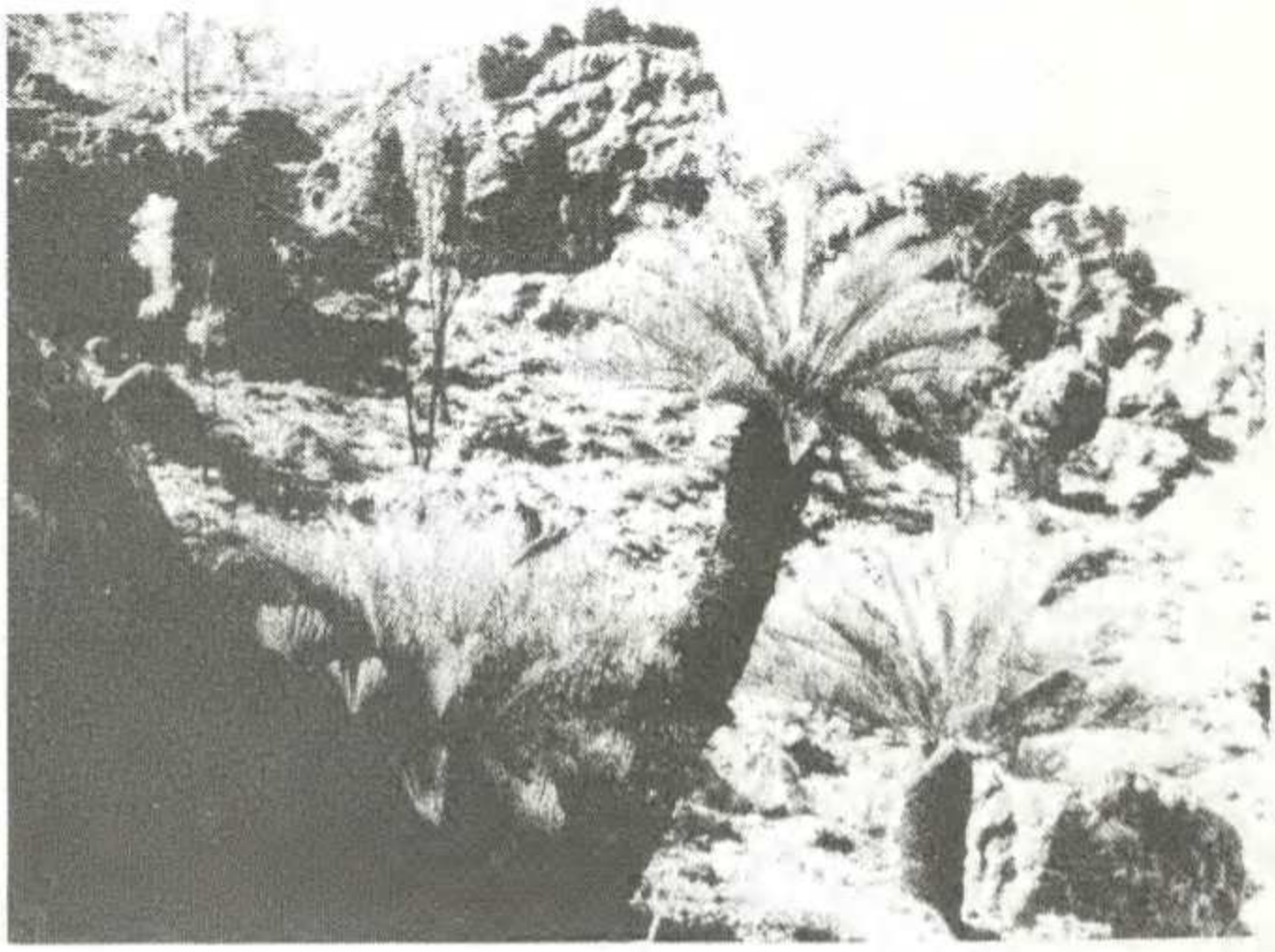


Figure 5. Cycas pruinosa *in northwestern Australia. Note similarity of plants and surroundings to those in Figure 4. Photo by J.M. Huff.*

My visit to FTG took place during summer, and my impression was that the temperature was much higher than in the normal habitat of most South African species, my experience of tropical African species being limited. However, I found that most plants here grew impressively well, which makes one wonder why these species occur in such mesic habitats if they so obviously react favorably to conditions of higher temperature, humidity and rainfall. Could it be that under more tropical conditions these slow-growing cycads would become overshadowed by surrounding vegetation before reaching sexual maturity?

Visitors to South Africa coming from parts of the world where cycads occur naturally are usually surprised at how rare and localized the plants are. Africa has had a long history of climatic fluctuations, and the relic cycad populations seen today are held captive in tiny pockets where local conditions allow them to survive and reproduce but not to escape to distant areas, which at the present time may be much more favorable for cycads.

Rather than attempt to describe the habitat requirements of species which have proved to be successful in Miami, I shall instead concentrate on those species which do not grow well at FTG, or which I would not expect to, and endeavor to explain the reasons for these expected failures against the background of my experience of these species in their native habitats.

I was fortunate to have had the opportunity to visit a number of species in their natural habitats. Personally I think that it is of inestimable value to a plantsman to get the "feel" of a habitat — that subtle interplay of temperature, humidity and light which is so difficult to define in words — because it enables one to place individual plants in spots in the garden which most closely resemble their native homes.

First let us consider *E. horridus* (Figure 3), *E. lehmannii* and *E. princeps*. These species occur under extremely dry conditions, in blazing sunlight, usually on heavy soils derived from shale or dolerite. Experience indicates that they do not react favorably to more water and higher humidity, even when planted in a lighter soil. One may surmise that in their natural environment they have diminished resistance to root pathogens since they do not need such immunity under dry conditions. This theory is supported by the fact that when plants perish in cultivation they usually die from rot spreading from the roots upwards through the stem. It should nevertheless be possible to grow these species in a Miami-type climate if they are treated like desert succulents: they should be planted in coarse, well-drained, gritty sand to prevent root rot, fed on liquid fertilizer to prevent burning of the roots (and especially the coralloid roots under these well-drained conditions) and given

the maximum amount of direct sunlight. Adequate ventilation also may be beneficial.

Encephalartos trispinosus is morphologically similar to *E. horridus* but it occurs over a much wider range of environmental conditions, and not surprisingly proves to be less demanding in cultivation. At some inland localities it occurs in xeric succulent shrub vegetation under conditions even more severe than those under which *E. horridus* grows. At the other end of the scale it occurs right at the mouths of river valleys in much moister conditions in association with riverine forests in which species like *Euphorbia triangularis, Strelitzia nicolai* and *Encephalartos altensteinii* are conspicuous. Here it often grows right amongst *E. altensteinii* and even hybridizes with it. Such coastal forms should grow well in Miami, though inland forms may be more exacting in cultivation.

Encephalartos longifolius (Figure 2) is a component of sclerophyllous, shrubby vegetation commonly associated with a temperate Mediterranean-type climate with winter rainfall. It should be noted, though, that this species occurs on nutrient-poor, sandstone-derived, often highly acid soils at the eastern end of the sclerophyllous zone where the rainfall is evenly spread through the year. This is a hardy species which adapts well to cultivation under a wide range of conditions in temperate areas, but tends to be less conspicuous in more tropical gardens. Temperatures throughout its range are moderate.

Encephalartos ghellinckii (Figure 1) and *E. cycadifolius* are morphologically very similar. It should be understood that there are two very distinct forms of *E. ghellinckii*: a montane form occurring in alpine grassland or sclerophyllous shrubbery in ravines at an altitude of about 7,000 feet (2,100 m) in the Natal Drakensberg, and a coastal form found in short, dry grassland near sea level.

These two forms differ morphologically: the leaflets of the coastal form are markedly longer and narrower than those of the montane form, and seem to retain their juvenile hairiness longer.

The montane form usually occurs in ravines or on slopes on more or less perpetually moist soil. Rainfall may be as high as 40 inches (100 cm) annually, and mist frequently occurs. Temperatures are always moderate to cool, and in winter snow is common.

In contrast, the coastal forms of *E. ghellinckii* and *E. cycadifolius* both occur under rather similar conditions in short, dry grassland, in much hotter and drier climates with a rainfall of 20 to 25 inches (50-62.5 cm). Both the coastal forms of *E. ghellinckii* and *E. cycadifolius* grow very well in Kirstenbosch Botanic Garden in Cape Town under local conditions reminiscent of those experienced by the montane form of *E. ghellinckii*, which indicates that these two do not object to moister conditions. Local experience suggests that high temperatures are the limiting factor in their distribution, especially when coupled with high humidity,

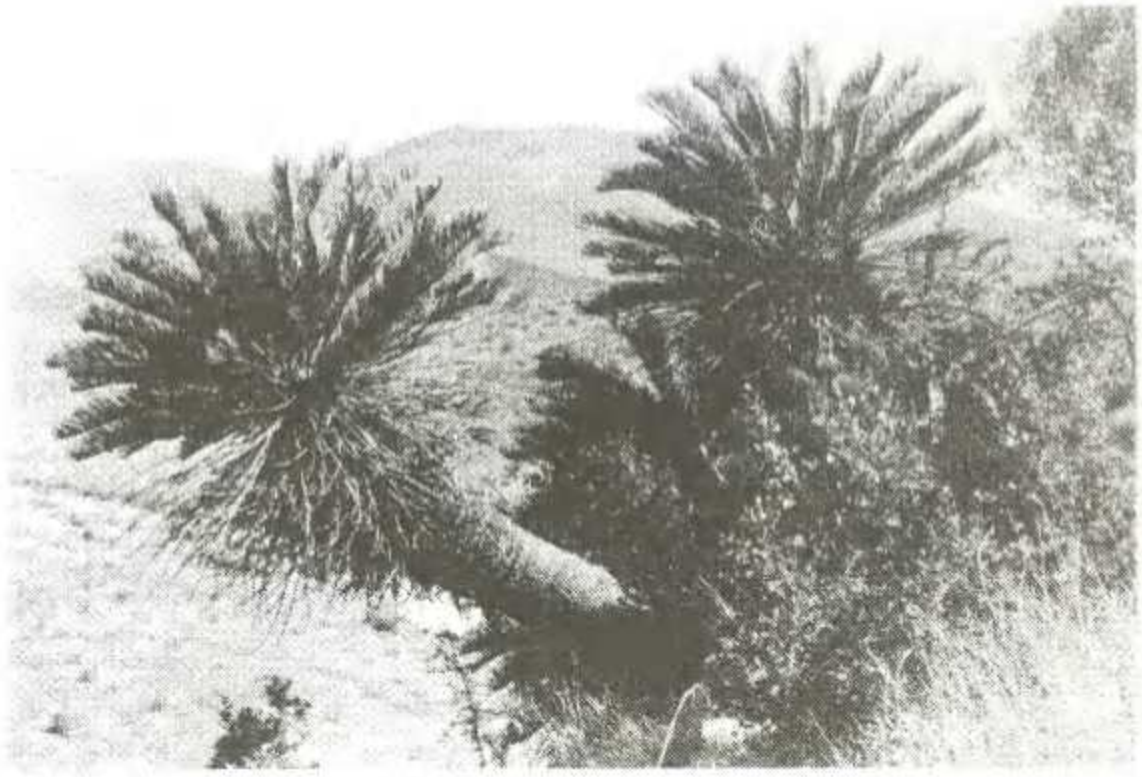


Figure 6. Encephalartos friderici-guilielmii *in mountains near Cathcart. Frost, grass fires and drought are part of their lives. Photo by P. Vorster.*

Figure 7. Encephalartos woodii *in the Durban Botanic Garden being admired by the author in 1972. Photo by Elsa Vorster.*

and I would be surprised indeed if they can be grown successfully in Miami.

In the same way, the morphologically similar group of species comprising *E. lanatus* (Figure 4), *E. laevifolius*, *E. humilis* and *E. friderici-guilielmii* (Figure 6) does not react well to hot and humid conditions. They occur under moderately dry conditions (summer rainfall of about 24 inches or 60 cm) at altitudes of 5,500 to 6,000 feet (1,650 to 1,800 m) which, at a latitude of 25 degrees, translates to cool conditions.

Just how deceptive outward appearance may be as a clue to environmental requirements is shown by the photograph of the blue form of *Cycas pruinosa* (Figure 5) taken in the dry monsoon area of northwestern Australia. Not only the plants, but the habitat as well, look exactly like those in the photograph of *E. lanatus* (Figure 4); but I have the greatest difficulty in keeping *Cycas pruinosa* alive in our more temperate climate, unlike *E. lanatus*.

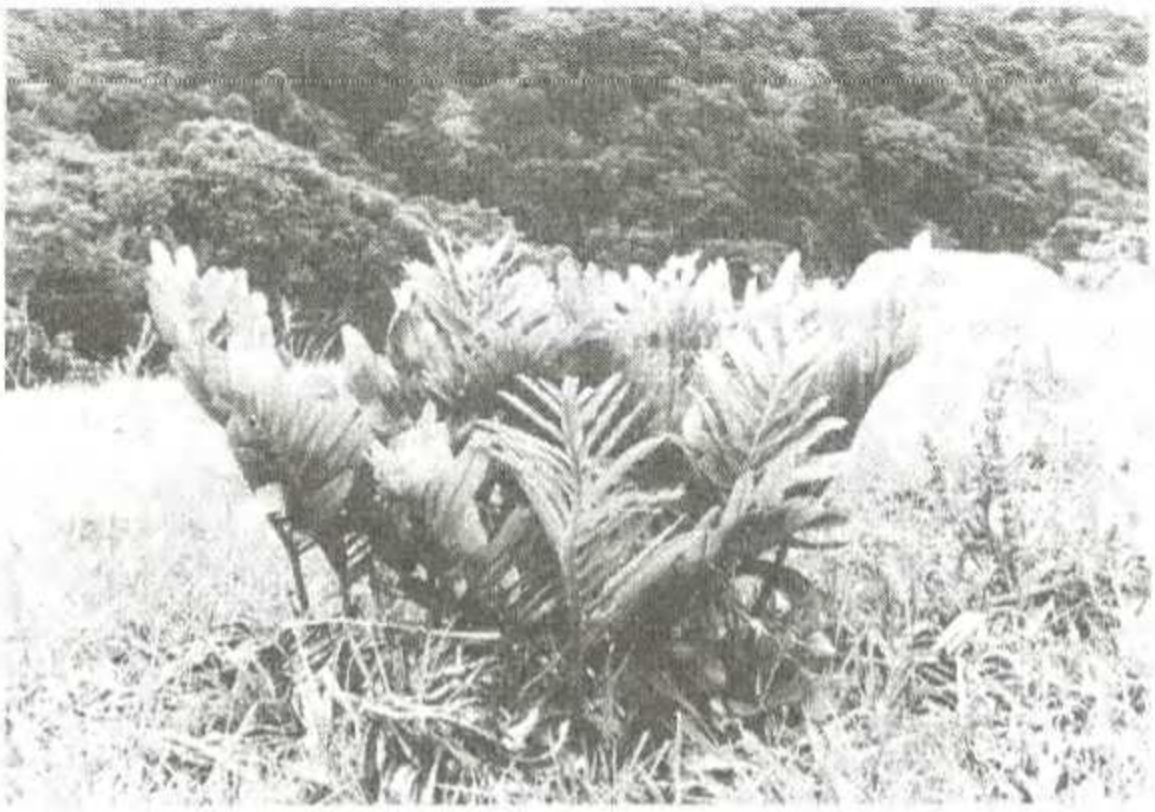
Encephalartos caffer and *E. ngoyanus* are probably not very closely related to each other, but both are dwarf species with somewhat similar environmental requirements. Both occur in temperate, short grassland under moderate temperatures and in direct sunlight. Unlike so many other species growing under similar conditions, they escape the almost annual grass fires not by confining themselves to rock outcrops, but by burying their short trunks underground. When planted in soft sand, *E. ngoyanus* buries itself deeper and deeper so that one has to remove sand continually from the crown, and I have seen plants eventually growing in foot-deep depressions.

Neither of them reacts well to hot, humid conditions. In the case of *E. ngoyanus* this may come as a surprise, as it occurs within a stone's throw of where *E. woodii* was supposed to have grown, and the latter is astonishingly lush in the hot and humid Durban Botanic Garden. The answer lies in their respective habitats: *E. ngoyanus* grows on a cool, breezy, seaward slope in the open, whereas *E. woodii* grew in a forest glade where air movement was limited, with consequently much higher temperatures and humidity.

When at FTG, I was proudly shown the *E. woodii*. To the amazement of my hosts I did not at first recognize it. To me it looked like a particularly fine *E. longifolius*. Perhaps the nutrient-poor soil at FTG is to blame for its lack of vigor. While the plant is in truth growing very nicely, it still pales beside the magnificent specimens in the Durban Botanic Garden, one of which is shown in Figure 7.

Some of the species discussed above vary in their morphology according to their geographical origin, and almost certainly also vary in their climatic responses. Thus the montane and lowland forms of *E. gbellinckii* experience vastly different environmental conditions, but both are likely to be difficult to grow in Miami. *Encephalartos trispinosus* from inland localities occurs under conditions very different from those at the river mouths and, if there is any variation in environmental response, one would expect plants from the river mouths to grow better in Miami, especially as they occur together with *E. altensteinii*, which grows well enough in FTG.

Figure 8. Stangeria eriopus *in short grassland outside Ngoya Forest, northern Natal. This is also the habitat of* Encephalartos ngoyanus, *and the sole plant of* E. woodii *was found in a glade within the forest. Photo by P. Vorster.*



Finally, *Stangeria eriopus* occurs in a strip along the east coast of South Africa over a distance of more than 500 miles (800 km) from north to south, which means a considerable climatic gradient. At the cooler southern end of the range the plants occur close to the sea, while at the more tropical northern end of the range the plants tend to occur further inland on cooler, higher slopes.

Nevertheless, a climatic gradient does exist and, not surprisingly, there is a considerable genetic morphological variation between plants from different parts of the distribution area. Thus in the south, close to the sea, but also in the north, on cooler slopes some distance inland, the plants grow in short grassland. Their fronds are perhaps 18 inches (45 cm) long (Figure 8) and the leaflets are leathery with inrolled margins.

The other morphological extreme occurs in coastal moist evergreen forest. These plants are giants with fronds 8 or 10 feet (2.4 to 3 m) long and leaflets 2 inches (5 cm) wide and more than 2 feet (.6 m) long (Figure 9). Their leaflets are soft and membranous with flat margins. Near the northern end of the range, close to the sea, plants are found in light shade cast by encroaching shrubs under hotter and more humid conditions than elsewhere. In morphology and size these plants are intermediate between the other two forms, and the margins of the leaflets are flat and often serrated. *Stangeria* is adaptable in cultivation, but I would expect the northern lowland form to be the most successful in Miami, especially as it grows so luxuriantly in the climatically similar Durban Botanic Garden.

People often raise eyebrows at my attempts to grow cycads 34 degrees south of the equator. However, whereas we have to contend with certain adverse climatic factors, such as frequent gales and dry unsatisfactorily short summers, the fact that we don't have extremes of temperature and humidity counts in our favor. Frost is completely absent and hail rarely occurs. In spite of somber forebodings, our wet winters, during which our annual rainfall of 24 inches (600 mm) is precipitated, are not detrimental to most species, though all are on raised rockeries to improve drainage.

Species which we grow successfully outdoors, though perhaps not as luxuriantly as at FTG, include almost all of the South African *Encephalartos* species as well as tropical species such as *E. hildebrandtii, E. ferox, E. gratus* and *E. barteri;* several species of *Macrozamia*, including *M. macdonnellii*; both *Bowenia* species; *Lepidozamia peroffskyana; Zamia furfuracea* and *Z. pumila (sensu lato).* Tropical species such as *Z. lindenii, Z. muricata* and *Z. pseudomonticola* grow happily under shadecloth. Also grown successfully are *Ceratozamia hildae* and *C. mexicana; Dioon edule, D. spinulosum, D. purpusii* and *D. mejiae; Cycas revoluta,* and several unnamed species of the *C. circinalis.* complex from the Comores, India, Sri Lanka, Thailand, Solomon Islands, New Caledonia and Vanuatu. The last named *Cycas* species are particularly successful, in spite of their tropical origin, and often produce more than one set of fronds each summer. We are not successful with northwestern Australian *Cycas* species.

When all is said, the fact of the matter is that I don't know for sure why some species fail under certain conditions, as climatic and experimental data are nonexistent. It is very difficult and professionally risky to put one's intuition into words. Nevertheless, this article will have served its purpose if it is of some use to prospective growers of cycads under tropical conditions.

Piet Vorster holds a Doctor of Science degree from the University of Pretoria in South Africa. From 1967 to 1979 he was employed by the Botanical Research Institute in Pretoria, where he was a colleague of Dr. R.A. Dyer of cycad fame. His research there involved aspects of nomenclature, and the subject of his doctoral thesis was the taxonomy of the South African species of Mariscus *(Cyperaceae). Since 1979 Dr. Vorster has been affiliated with the University of Stellenbosch in a research capacity, focusing primarily on the genus* Pelargonium *(Geraniaceae). He has been responsible for the compilation of an identification handbook for the 200 South African species of Amaryllidaceae. His interest in cycads also is reflected in his personal collection of living plants.*

Figure 9. Stangeria eriopus *in dense, moist, evergreen coastal forest in northern Transkei. The fronds are 8 feet (2.4 m) long. Photo by P. Vorster.*

Reprinted from the Fairchild Tropical Garden Bulletin, April 1988, with the kind permission of the author, the editor and the FTG Director.

THE PRETORIA NEWS Wednesday October 12 1988

Cycad auction called off

PHILLIP VOSLOO
Staff Reporter

AN auction of 80 cycads was called off when the Directorate of Nature Conservation intervened.

Nature Conservation officials informed the auctioneers for the private collection, Bernardi Auctioneers, late last Friday afternoon that the auction which was planned for Saturday would not be allowed.

Permission was granted, however, for the cycads to be sold on a tender basis.

The private collection — which included rarities like the E Woodii, Altensteinii, Natalensis and Thoarsii — was to be auctioned on behalf of the owner, Mr George Fraser, who has been transferred from Pretoria.

Auctioneer Mr Tullio Bernardi said it annoyed him that he was prohibited from auctioning the cycads only hours before the well-publicised event was to take place.

"I informed the directorate two weeks ago about the auction, and I fail to see why officials could not have informed us earlier," Mr Bernardi said.

"The result of the tender sale was that my client was the biggest sufferer because lower prices were reached."

Transvaal Provincial Administration Director of Nature Conservation, Dr Piet Mulder, said the auction clashed with the directorate's policy to suppress the commercialisation of cycads.

He said auctions connecting cycads with high prices could possibly evolve in two negative consequences. People interested in owning a cycad could decide it is too expensive to buy cycads, and would thus be encouraged to dig up plants in the veld.

Another consequence is that if cycads reach unjustifiably high prices on auctions, it could motivate anybody to steal cycads in their natural habitat and sell them at auctions. This would in turn lead to the eradication of cycads.

According to Dr Mulder, the Nature Conservation directives allow the selling of cycads from a private collection mainly when a cycad collector/owner is unable to attend to the welfare of the plants any longer. To protect their well-being, the person is then only permitted, or encouraged, to sell the plants.

Should an owner decide to sell his house, he is encouraged to sell the plants to the buyer of the house.

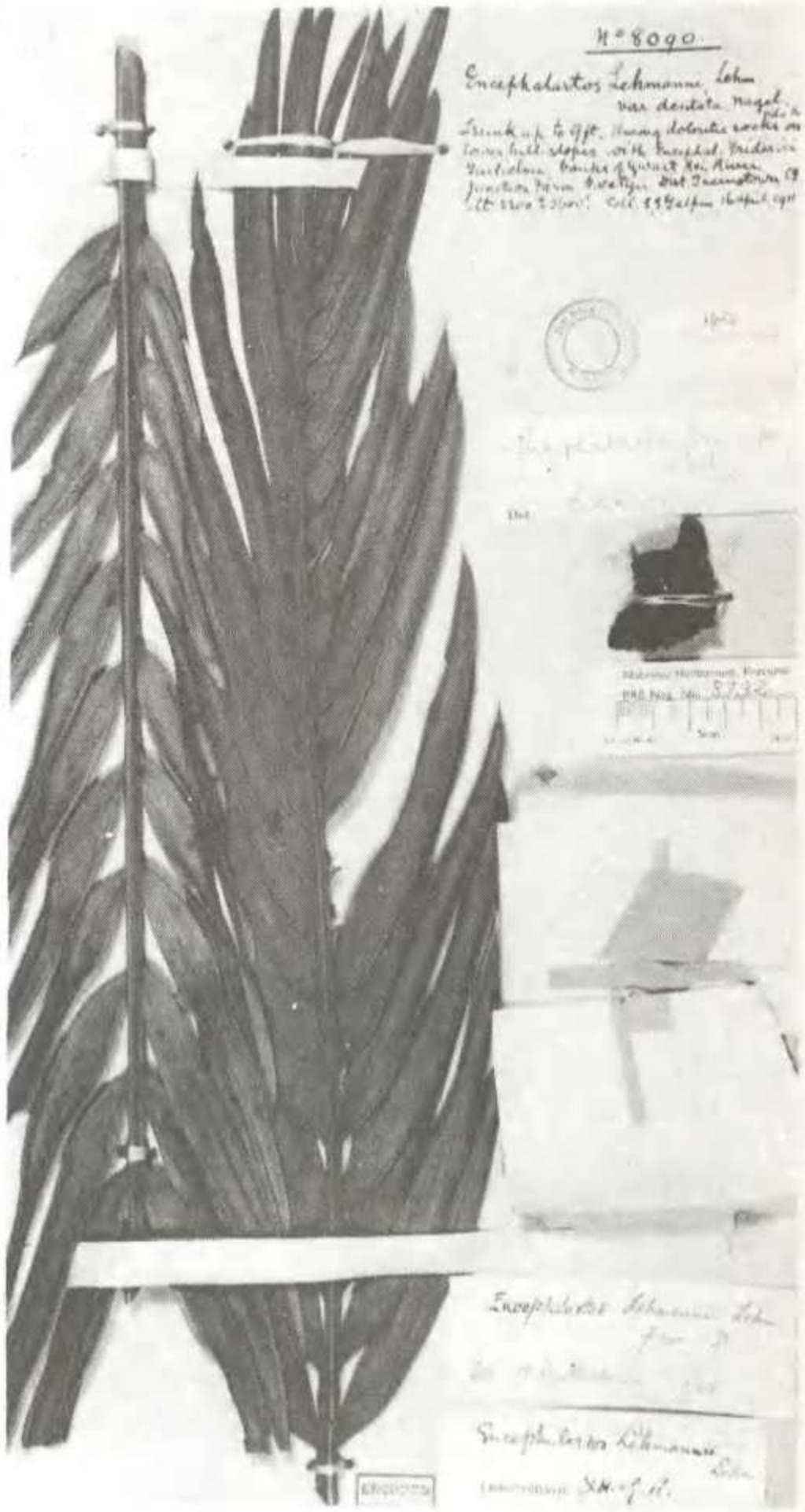
The main attraction of the collection, the large E Woodii which has a trunk height of 1,1 m, was sold for R9 000.

THE NATIONAL HERBARIUM

by Dr D.J.B. Killick and Roy Osborne

The National Herbarium in Pretoria forms part of the Botanical Research Institute, which falls under the Department of Agriculture and Water Supply. The herbarium can trace its beginnings to 1903 when it was housed in the Old Volkstem Building on the corner of Pretorius Street and Fountain Lane. In 1915 the herbarium was transferred to Vredehuis in Vermeulen Street below the Union Buildings, where it occupied a room of 12 x 5 meters. In 1923 a new building was erected and this housed the national collection for 50 years until 1973, when the BRI moved to new and more spacious premises in the Pretoria National Botanic Garden at Brummeria, opposite the CSIR. Today the National Herbarium contains some 850 000 plant specimens and is fully computerized.

As far as cycads are concerned, the National Herbarium possesses what is probably one of the largest cycad collections in the world. We have summarized some interesting statistics below. It houses over 900 specimens (833 Encephalartos and 75 Stangeria specimens), each with its scientific name, collector's name, date, locality, habitat and other important details. The cycads best represented in the herbarium collection are Stangeria eriopus (75 specimens), E. villosus (63 specimens), E. natalensis (65 specimens, E. altensteinii (51 specimens), E. transvenosus (49 specimens), E. lebomboensis (49 specimens) and E. longifolius (42 specimens). The earliest cycad specimens were deposited in the herbarium by H.G. Flanagan of Prospect Farm in the Komga District who, in 1892, collected specimens of S. eriopus, E. altensteinii, E. princeps and E. villosus from the Eastern Cape. The largest single contributor to the cycad



Holotype of Encephalartos princeps R.A. Dyer, Galpin 8090 collected in 1911, in the National Herbarium, Pretoria.

section of the herbarium has been Dr Inez Verdoorn (an honorary member of the Society). Other extensive contributors have been J.P.H. Acocks, H. Christiaan, L.E.W. Codd, R.A. Dyer, E.E. Galpin, R. Marloth, G.G. Smith, R. Story and M.J. Wells.

Associated with the herbarium is the well-known Mary Gunn Library with its nearly 9 000 books and 890 journals (now including ENCEPHALARTOS) on its shelves. In the Pretoria National Botanical Garden is the nursery complex under Dave Hardy's expert management, where numerous "special" cycads are kept, including plants from the original collection of Harry Butcher in Durban, perhaps one of the first serious cycad collectors in this country. Finally, and indeed often the main focus for cycad-orientated visitors to the BRI, is the magnificent cycad garden, with numerous plants carefully set against the rocky hillside backdrop.

Apart from the National Herbarium in Pretoria, the BRI has three regional herbaria: the Natal Herbarium in Durban, the Albany Museum Herbarium in Grahamstown and the Government Herbarium in Stellenbosch.

The BRI has served as a focal point for many cycad research workers in the past and will undoubtedly continue to play this vital role in future.

NEW COMMITTEE MEMBER

The new Eugene Marais regional branch of the Society has elected their chairman, Stef Schoeman, to represent the region on the Executive Committee of the Society. It is a pleasure to introduce him.

- Gebore te Lydenburg, waar hy sy skoolopleiding voltooi
- Werk as bosbouer by Transvaal Gold Mining Estates, Oos-Transvaal en boer 'n ruk saam met ouers
- Tree in 1931 in diens van die Landbank tot sy aftrede in 1975 as Assistent-Hoofbestuurder
- Voltooi B.A.-graad in Ekonomie en Staatsleer d.m.v. buitemuurse studie aan die Universiteit van Pretoria
- Na aftrede word hy 'n eiendomsagent en voltooi die nodige professionele eksamens
- Dien tans op verskeie direksies wat hoofsaaklik te doen het met finansies en eiendomme
- Getroud met 'n ou skoolmaat, Bonnie Schulze, en het drie getroude dogters en vyf kleinkinders
- Het in 1983 begin belangstel in broodboomversameling en beskik oor 'n redelike hoeveelheid jong plante. Het nou ook saad begin kweek vir verskeidenheid. Lees heelwat in die verband.
- Ander belangstelling is gemeenskapsdiens

NUWE KOMITEELID

Die nuwe Eugene Marais-streektak van die Vereniging het hulle voorsitter, Stef Schoeman, verkies om die streek op die Uitvoerende Komitee van die Vereniging te verteenwoordig. Ons stel hom graag voor.

STEF SCHOEMAN

ON THE EVOLUTION OF CYCADS

by Roy Osborne

What really did happen "in the beginning" of life on earth is a puzzle which is likely to remain unsolved, at least in our lifetimes. Careful examination and re-examination of all the evidence by a great many trained minds has resulted in a story of what might have happened. Over the last century this story has been progressively modified and becomes steadily more convincing.

The first plants abundant on this planet were undoubtedly fairly simple algae which grew in the oceans up to three billion years ago. Their photosynthetic ability resulted in the production of oxygen which slowly built up to 1%, 5% and 10% in the earth's atmosphere. This increase in oxygen had two far-reaching consequences: the potential for life outside the marine environment and the establishment of the protective ozone layer high up in the atmosphere which could screen out lethal ultra-violet radiation and allow organisms on land to survive. The stage was thus set for the first of the land plants, the liverworts, mosses and primitive ferns, to make their appearance. But these early plants all retained one trait from their marine ancestors - an actively swimming male sperm cell and the constraint that water is essential in the reproductive process. Later, with the advent of the seed-bearing plants, the motile spermatozoid became redundant and (except for a few strange anachronisms such as Ginkgo biloba) water was no longer essential in reproduction.

Somewhere in the complex evolutionary pattern between the great groups of 'ferns' and 'seed-plants' came the cycads, which do have motile sperm cells like their primitive ancestors but which bear seeds smimilar to those of the most advanced flowering plants.

Dr Knut Norstog of the Fairchild Tropical Garden draws an analogy between the evolutionary sequence in plants and animals - in his comparison the cycads are the 'reptiles' of the plant world since it is the reptiles that span the great gap between the amphibian restricted to its watery habitat and the birds and mammals with internal fertilisation. Norstog and his colleagues are presently carrying out detailed electron microscope studies on the sperm cells of mosses, ferns and cycads, and believe that the fundamental differences and similarities could shed new light on plant evolution.

Within the cycads, characters range from the primitive to the advanced. Take for instance the way in which the leaflets of Cycas uncoil - very much like the circinate characters of the fern fronds. In Cycas too, the very loosely-organised collection of modified seed-bearing leaves (see Fig. 1) is clearly earlier in evolutionary time than the compact cone we know in Encephalartos Yet the prominent midrib in the Cycas leaflet is considered advanced. Wind-pollination is considered primitive and insect or bird-pollination advanced; obviously animal-pollinated plants cannot pre-date the animals themselves! But the experts cannot seem to agree just how cycads are pollinated, so that does not help much. Consideration of features like the anatomy of the stem and the structure of leaf stomata all add more evidence. The overall conclusion is that cycads usually have a mixture of some relatively advanced and some relatively primitive characteristics - the situation is not as simple as was first thought.

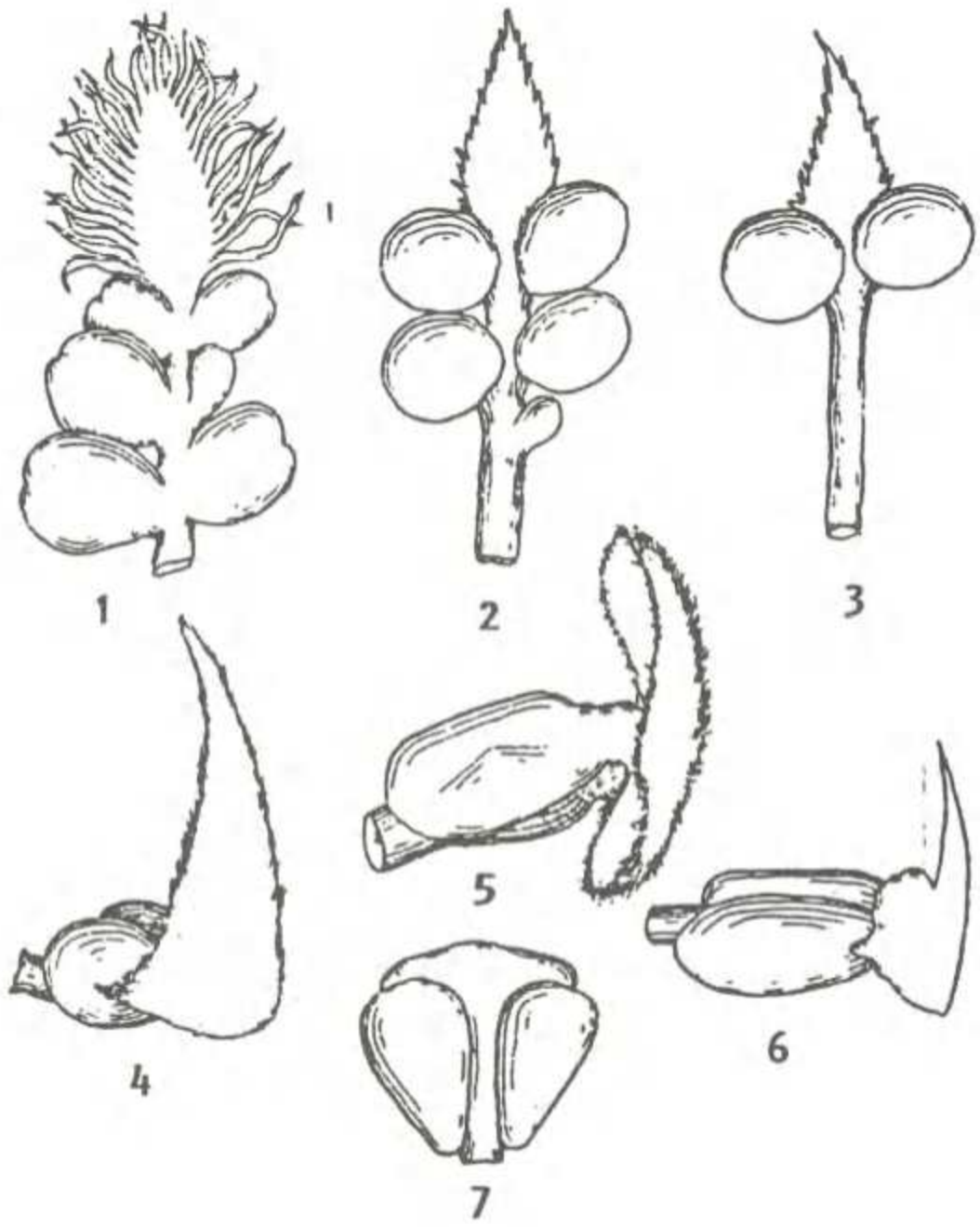


FIG. 1:
Series of female sporophylls, showing reduction from its leafy condition to the reduced sporophyll of the most compact one:

1. *Cycas revoluta*
2. *Cycas circinalis*
3. *Cycas media*
4. *Dioon edule*
5. *Dioon spinulosum*
6. *Macrozamia miguelii*
7. *Zamia floridana*

(Chamberlain, 1919).

In explaining this apparent paradox, some of the most useful evidence comes from the fossil records. Figure 2 shows a 160-million year old cycad leaf called Zamites, a name implying a probable relationship with the present Zamia genus. Since the age of rock strata is fairly accurately assessed, the age of any fossil specimen trapped within may be estimated. But not all fossils are perfect specimens; often they are poorly preserved and consist of incomplete fragments rather than whole plants. The latter difficulty has frequently resulted in fossil leaves, stems and other parts of the same plant being given different names at first. But painstaking work by many dedicated palaeobotanists has allowed the theoretical reconstruction of the plants and forests of many millions of years ago. Figure 3 shows some examples of these reconstructed species.

Well-preserved cycad fossils have been found, often abundantly, in Mesozoic rocks from Siberia, Manchuria, Oregon, Alaska, Greenland, Sweden, England and central Europe, India, Australia, Antartica and South Africa. The fossil record from this part of the world shares the same problems of incompleteness and fragmentation as do most other areas. The seed-fern (pteridosperm) foliage, which preceded the cycads, is quite well represented by the so-called Dicroidium flora, examples of which have been found in the upper Umkomaas valley and 'Little Switzerland' in Natal, Rouxville in the O.F.S. and Dordrecht in the Eastern Cape. More recent and more typical cycad foliage called Zamites and Dictyozamites comes from the geological 'Uitenhage' series, and good examples are displayed in the Port Elizabeth and King William's Town museums and the Bernard Price Institute for Palaeontological Research at Witwatersrand University. The tireless efforts of workers like Professor Alex du Toit, Dr Edna Plumstead and Dr Heidi Anderson have done much to sort out the complexities of the early cycad flora of Southern Africa.

Another factor which may shed some light on cycad evolution is the earth's climate. For instance, it is now known that the lycopod type vegetation described as the Devonian Flora was almost entirely destroyed by a major glaciation in the Southern Hemisphere at the end of the Palaeozoic era, about 250 million years ago. But the cold was

FIG. 2:
A 160-million year old fossilized frond named *Zamites fenconis* found in France.
(Case, 1982).

followed by a long period of warm and balmy years, the Mesozoic era. Mean temperatures were about 10 degrees C higher than at present and the climate was more or less the same worldwide. It was at this time that the cycads rose to abundance in the world's vegetation; just as in the animal world the dinosaurs were then at their zenith. But the Mesozoic cycads were not the same as our present cycads, an important and often-overlooked point. Indeed there were two broad types, the cycadaleans (ancestors of our present-day cycads) and the cycadeoidaleans (sometimes called the Bennettitales) which later became extinct. These two groups differed so much in their reproductive habits, and in other ways, that it is thought that both groups evolved independently from a much earlier ancestor in die seed-ferns.

A final factor in the cycad equation is that of the geography of the world of the late Palaeozoic and Mesozoic eras. This was the time when the southern part of Africa, South America, India, Antarctica and Australia were all joined to form the massive supercontinent of Gondwanaland (see Figure 4). At the time when the cycads had reached their zenith, great cracks appeared in the land and thousands of tons of basalts welled up and spread over the surface. The South Atlantic ocean gradually widened, starting by a separation of the Falkland tip from the Agulhas escarpment fairly late in the Mesozoic era. On the eastern side, the Mascarene Plateau reached across Tanzania-Kenya through Madagascar to India - a giant dinosaur trail which later became disrupted. Only 65 million years ago India separated and rafted up to collide with the Asian land mass. To the south, Antartica formed a bridge between South America and Australia until about 50 million years ago. As recently as 25 million years ago the African continent had assumed its present position, but major uplifts were still to follow. These raised the interior plateau by more than 1800 m and increased the gradient to the coast. The great escarpment took its present form and the central Karoo became the arid basin we know now.

Throughout this time the cycads were changing - the present world distribution provides an excellent example of how a group of plants evolved from presumably one common ancestor and, as a result of geographical isolation and consequent climatic and other differences, underwent a whole series of very marginal changes which collectively gave rise to different genera: Encephalartos and Stangeria in Africa, Cycas in the Indian Ocean lands, Macrozamia, Bowenia and Lepidozamia in Australia, and Zamia, Ceratozamia, Dioon, Chiqua and Microcycas in the New World. Furthermore, within each of these genera, there was the possibility of further speciation under the influence of local environmental conditions. In Encephalartos for example, we can postulate a fairly close relationship between E. altensteinii, E. natalensis, E. woodii (?), E. lebomboensis, E. manikensis and E. gratus. E. princeps is thought by Dr Dyer to be the first (hence the name) in a group including E. lehmannii, E. trinspinosus and E. horridus. Clearly related are E. villosus and E. umbeluziensis; E. ghellinckii and E. cycadifolius; E. arenarius and E. ferox; E. caffer and E. ngoyanus.

It is to be considered something of a miracle that the cycads survived through so many and such extreme climatic and geographic changes. Those that survived did so by virtue of their adaptability - the ability to change through genetic processes, the elimination of weaker plants in competition with the stronger, the 'survival of the fittest'. Thus the cycads are not really some sort of hangers-on from the coal ages, but as Dr James Eckenwalder of the University of Toronto puts it: ... 'a vigorous and successful modern group of plants, still evolving and capable of responding to changing environmental conditions'.

The author is indebted to Professor Esmé Hennessy (University of Durban-Westville) and Dr R.J. Rayner (Bernard Price Institute for Palaeontological Research, University of the Witwatersrand) for their kind assistance in the preparation of this feature.

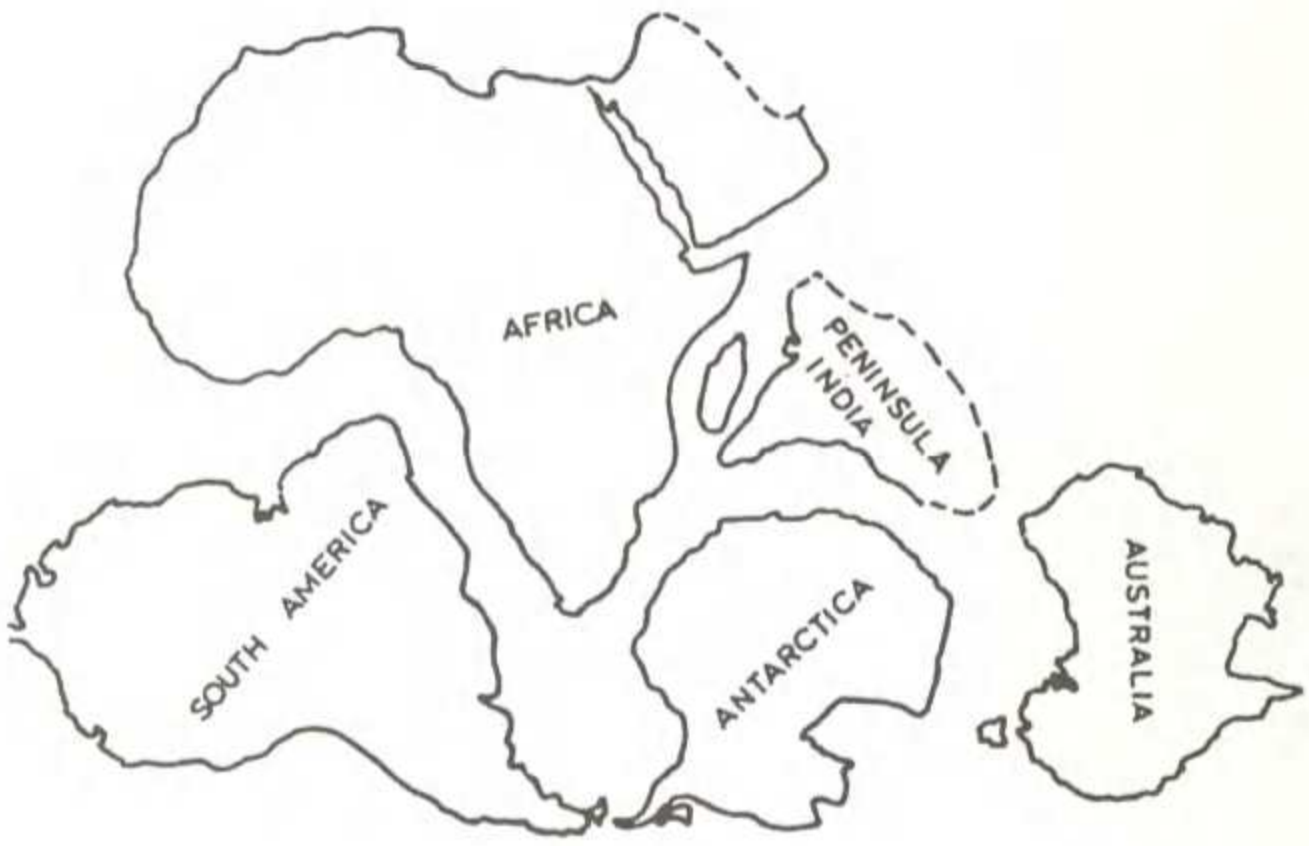


FIG. 4:
Proposed continental re-grouping for Gondwanaland.
(Truswell, 1970).

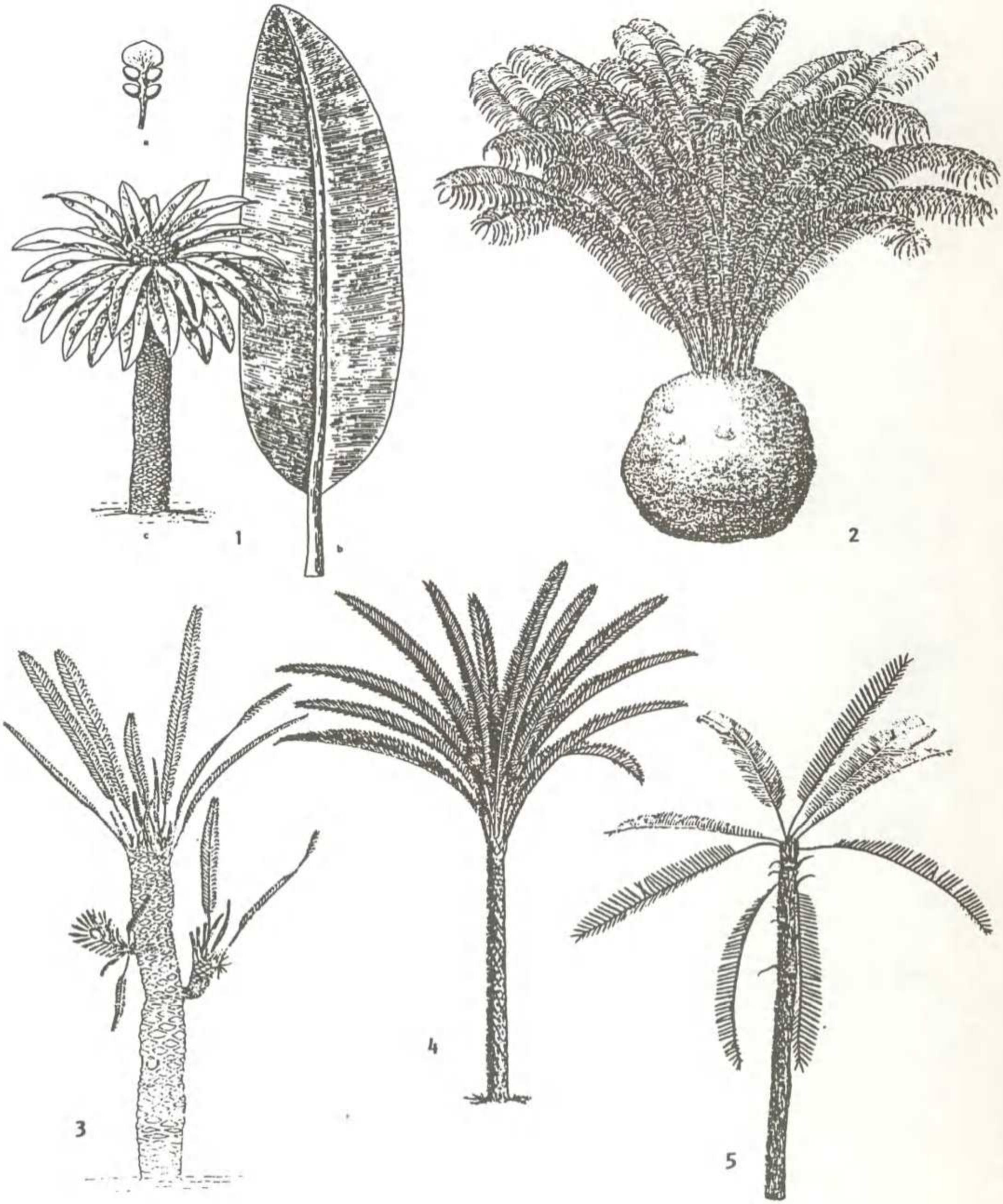


FIG. 3: Hypothetical reconstructions of early cycads from fossil records. 1. *Bjuvia simplex* (Florin, 1933); 2. *Cycadeoidea* (Delevoryas, 1971); 3. *Williamsonia sewardiana* (Sahni, 1932); 4. *Williamsonia gigas* (Williamson, 1870); 5. *Leptocycas gracilis* (Delevoryas & Hope, 1971).

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HONORARY LIFE MEMBERS

The Executive Committee of the Society is pleased to announce that two friends of the Society have been unaminously elected to honorary life membership. They are Professor Divya Darshan Pant, Emeritus Professor of Botany of the University of Allahabad, India, and Dr Knut Jonson Norstog, Research Associate of the Fairchild Tropical Garden in Florida, U.S.A. These gentlemen are both highly-respected botanists with extensive records of distinguished service. Both have contributed a wealth of information and real advances to cycad biology at an international level and our honour is but a small token of respect to their consistent excellence. They join Dr Inez Verdoorn, our only other present honorary life member.

Dr Knut Norstog (left) and Prof. D.D. Pant (right). (Photographed in France, April 1987, by Roy Osborne.)

LETTERS BRIEWE LETTERS BRIEWE

Readers are invited to write to the editor (See address elsewhere.) Where applicable, experts will be asked to deal with specific questions.

Lesers word genooi om aan die redakteur te skryf (sien adres elders). Waar van toepassing sal kenners gevra word om spesifieke vrae te beantwoord.

Dear Sir

Our institute, the Bundesgärten Schönbrunn in Vienna, Austria, has been growing Encephalartos specimens since the 18th century and some of our plants are actually about 200 years old. We are interested in enlarging our collection and I would like to ask members of the Cycad Society of Southern Africa for seed of any species of Encephalartos or Cycas, regardless of whether we already have them, as we need partners for propagation.

I look forward to hearing from your members soon. Any information (e.g. names and addresses of cycad enthusiasts offering seeds) would also be welcome.

JULIUS BRUNNER
c/o Burdesgarten Schönbrunn
A-1131 Vienna
AUSTRIA

Dear Sir

I have been a member of the Cycad Society of Southern Africa for about two years. I have been interested in cycads for the past 15 years, but my knowledge of these plants has increased greatly since reading ENCEPHALARTOS. I have also made some new friends in South Africa along the way. I am very happy about this.

DOUGLAS ATWATER
SAN LUIS OBISPO
CALIFORNIA, U.S.A.

Geagte Heer

Ek rig hierdie skrywe aan u om die lede van die Vereniging in kennis te stel van die skielike afsterwe van Willie Pretorius van Tzaneen. Ek sal dit waardeer as u hierdie kort huldeblyk aan hom sal plaas.

HULDEBLYK AAN WYLE WILLIE PRETORIUS VAN TZANEEN

Dit is met leedwese dat ons en ander broodboomversamelaars verneem het van die skielike heengaan van Willie Pretorius van Tzaneen op Sondag 9 Oktober 1988. In die kort tydjie wat ons vir Willie geken het (3 jaar en 9 maande), was hy altyd baie gasvry, vriendelik en hulpvaardig. Vir hom as broodboomliefhebber was geen moeite te groot om 'n ander versamelaar te help waar hy kon en hom van goeie raad te bedien nie. Hy was 'n baie moedige mens en vir dié wat hom geken het, is sy lewe 'n voorbeeld want, ten spyte van 'n vroeëre motorongeluk waarin sy liggaam geknak is en latere chroniese leukemia, is sy gees nooit geknak nie en as diep-gelowige Christen het hy steeds sy bekende "Mini-Broodboomkwekery" tot onlangs hanteer.

Aan die einde van September 1988 het Willie en sy gade, Lenie, 'n welwillendheidsbesoek gebring aan al sy broodboomvriende in Pretoria - sy laaste. Wetend?

In ENCEPHALARTOS no. 13 (Maart 1988, bladsy 18), het daar 'n artikel deur hom, "Keëlblare in Transvenosus" verskyn, waarin hy vertel van sy poging om 'n volwaardige plant te kweek van hierdie rare verskynsel. Tydens sy laaste besoek aan ons het hy ons meegedeel dat sy eksperiment onsuksesvol was en dat die plante dood is.

Aan sy vrou Lenie en hulle kinders wil ons namens lede van die Vereniging ons innige medelye oordra. Aan lede van die Vereniging wil ek vra: wees 'n oomblik stil - daar het 'n broodboomman verbygegaan.

DR. N.G.C. EN MEV. LISE HENNING
VERWOERDBURG

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