ENCEPHALARTOS

JOURNAL OF THE
CYCAD SOCIETY OF
SOUTHERN AFRICA

TYDSKRIF VAN DIE
BROODBOOMVERENIGING
VAN SUIDELIKE AFRIKA

NO. 19

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EDITOR/REDAKTEUR

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VOORBLAD/COVER

A MAGNIFICENT E. laevifolius PLANT ON A ROCKY OUTCROP AT THE TOP OF KAAPSEHOOP. NOTE THE BLACK, CHARRED APPEARANCE OF THE LOWER TRUNK CAUSED BY ONE OF THE PERIODIC VELD FIRES IN THE AREA.

CONTENTS - INHOUD

INTRODUCTION

In Jackie de Klerk's commentary (ENCEPHALARTOS NO.15, p 31) on the Official opening of the Kaapsche Hoop Hiking Trail in June 1988, special mention is made of the spectacular scenery of valleys which have been deeply eroded by feeder tributaries of the Crocodile River. These have cut their way through black reef quartzite right down to a granite basement. Furthermore, the geology has a more applied history: since early times, gold has played an important role in the trade and development of the area, reaching something of a climax in the 1880's before being overshadowed by the Witwatersrand discoveries. But more valuable to us perhaps, this area is the home of Encephalartos laevifolius, in many ways the most impressive of the Eastern Transvaal cycads.

A fine twin-trunked specimen of *E. laevifolius* in habitat at Kaapsehoop.

DISCOVERY

In our report on Encephalartos lanatus (ENCEPHALARTOS No.16, pp 3-9), we describe the work of Joseph Burtt Davy in his study of the Transvaal flora which culminated in his publication in 1926 of "A Manual of the Flowering Plants and Ferns of the Transvaal". It is in this publication that the description of Encephalartos laevifolius Stapf & Burtt Davy is found. The epithet "laevifolius" is derived from the Latin "levus" (often incorrectly "laevus") and meaning smooth, i.e. "laevifolius" literally means "smooth-leaved" and emphasises the distinction from the wooliness of E. lanatus. In the ENCEPHALARTOS feature we also told how Hutchinson and Rattray in 1933 grouped E. lanatus and E.laevifolius together and how Henderson's major revision in 1945 re-established them as separate species.

The type specimen of E. laevifolius, collected by W.Todd some 70 years ago (the date was unfortunately not recorded), is filed in the Kew Herbarium with a duplicate in the Natal Herbarium. These specimens were said to have come from "Moodies, near Barberton" but Dr. Dyer pointed out later that they were most probably collected nearer to Nelspruit than Barberton. A search through the B.R.I. herbarium records in Pretoria showed that specimens were collected by J.J. van Nouhuys (1929), L. Leibenberg (1934) and subsequently by many other workers including Drs Dyer, Verdoorn and Henderson.

DISTRIBUTION

The main stands of E. laevifolius are found within the catchment zone of the Crocodile River at or near the tops of rocky krantzes of the Kaapsehoop Range west of Nelspruit. Isolated groups are present to the north of this main population on the Amajuba high points above Sudwala Caves. It is from this area (Spitzkop, near Sibthorpe) that Burtt Davy collected the material on

which he wrote the species description. About 130 km further to the north the Mariepskop mountains host a disjunct population of about four groups of the same species. Isolated smaller colonies are found to the west of this locality, in the Trichardtsdal area. The species has also been reported by Prof. Compton in 1965 and by Denis Heenan in 1969 as being present near Pigg's Peak in Swaziland, both reports being substantiated by herbarium specimens at the B.R.I.

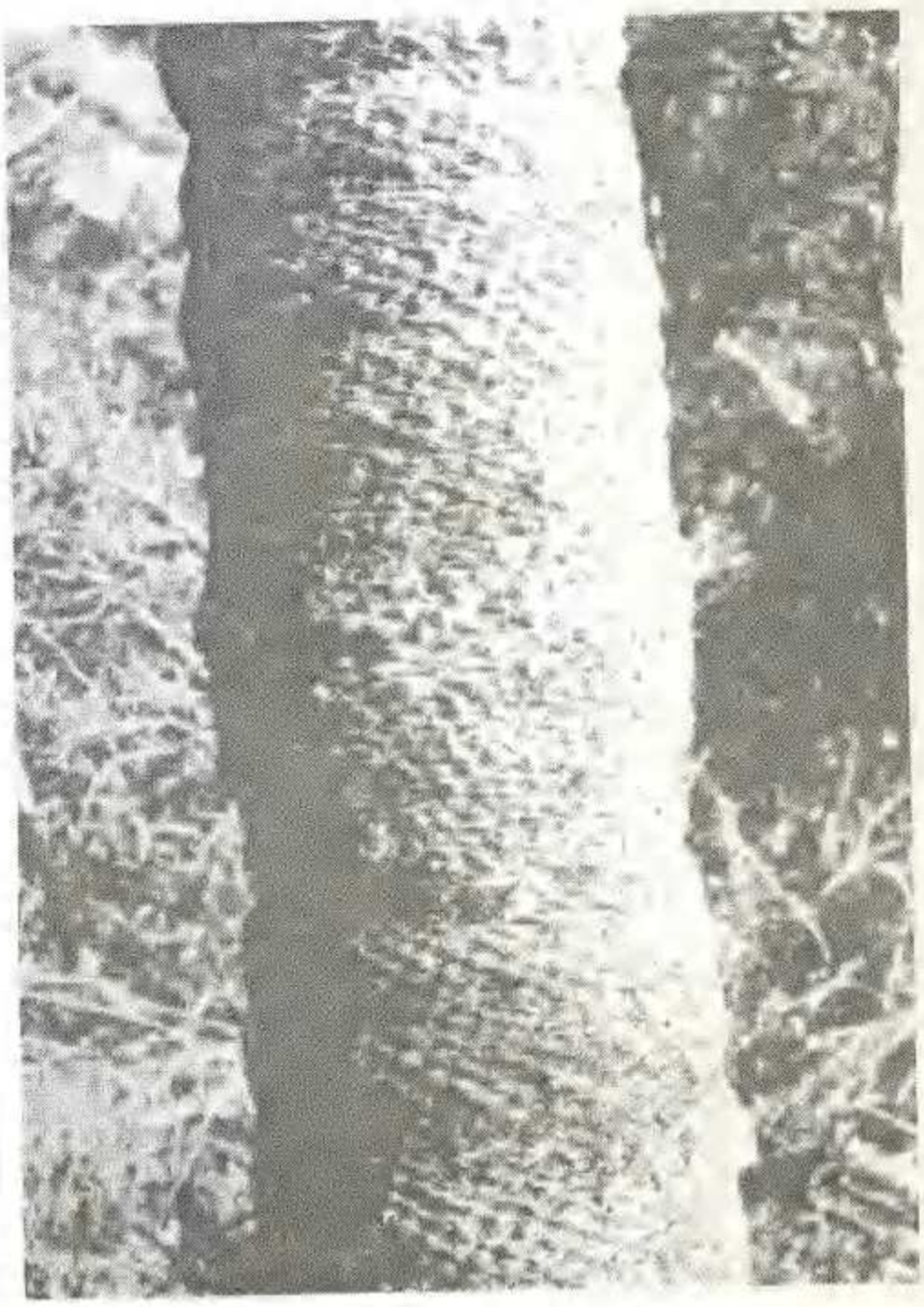
All the localities are high altitude sites (1300 to 1500 m) which receive a high rainfall (over 1000 mm p.a.) falling mainly as summer thunderstorms and with frequent mists. Temperatures vary between the extreme of 40 deg C. in mid-summer and severe frosts in winter. Like many other Encephalartos species, E. laevifolius appears to be adapted to a 3-5 year burning cycle.

The species is not widely-distributed in botanic gardens. To my knowledge the only plants outside South Africa are those at the Naples Botanic Garden and at Ewanrigg, near Harare. In this country, specimens can be seen at Kirstenbosch, Durban Botanic Gardens, the BRI gardens at Pretoria and in the grounds of the University of Pretoria. Nearer to its habitat, specimens have been established at the Lowveld Botanic Garden, in the grounds of the Citrus and Sub-Tropical Fruit Research Institute at Nelspruit, and outside the Town Hall in Barberton. A unknown number of plants is in the possession of private collectors, mainly in the Transvaal.

DESCRIPTION

1.STEM

E. laevifolius is a tall-stemmed plant, often reaching 3-4 meters in height. The

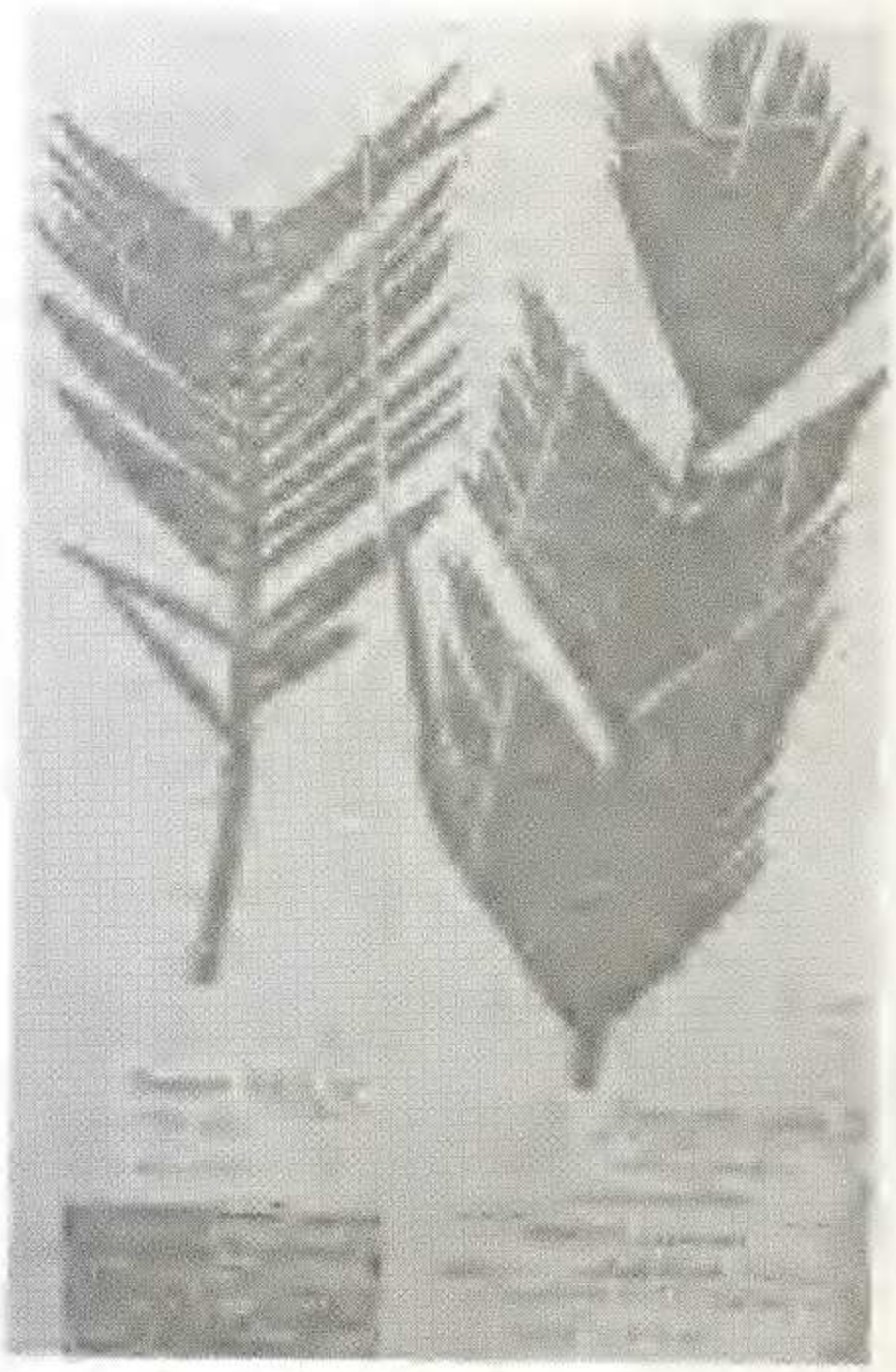


Stem detail of *E. laevifolius*.
Tightly-packed, small leaf-base scars make a characteristic pattern on the trunk.

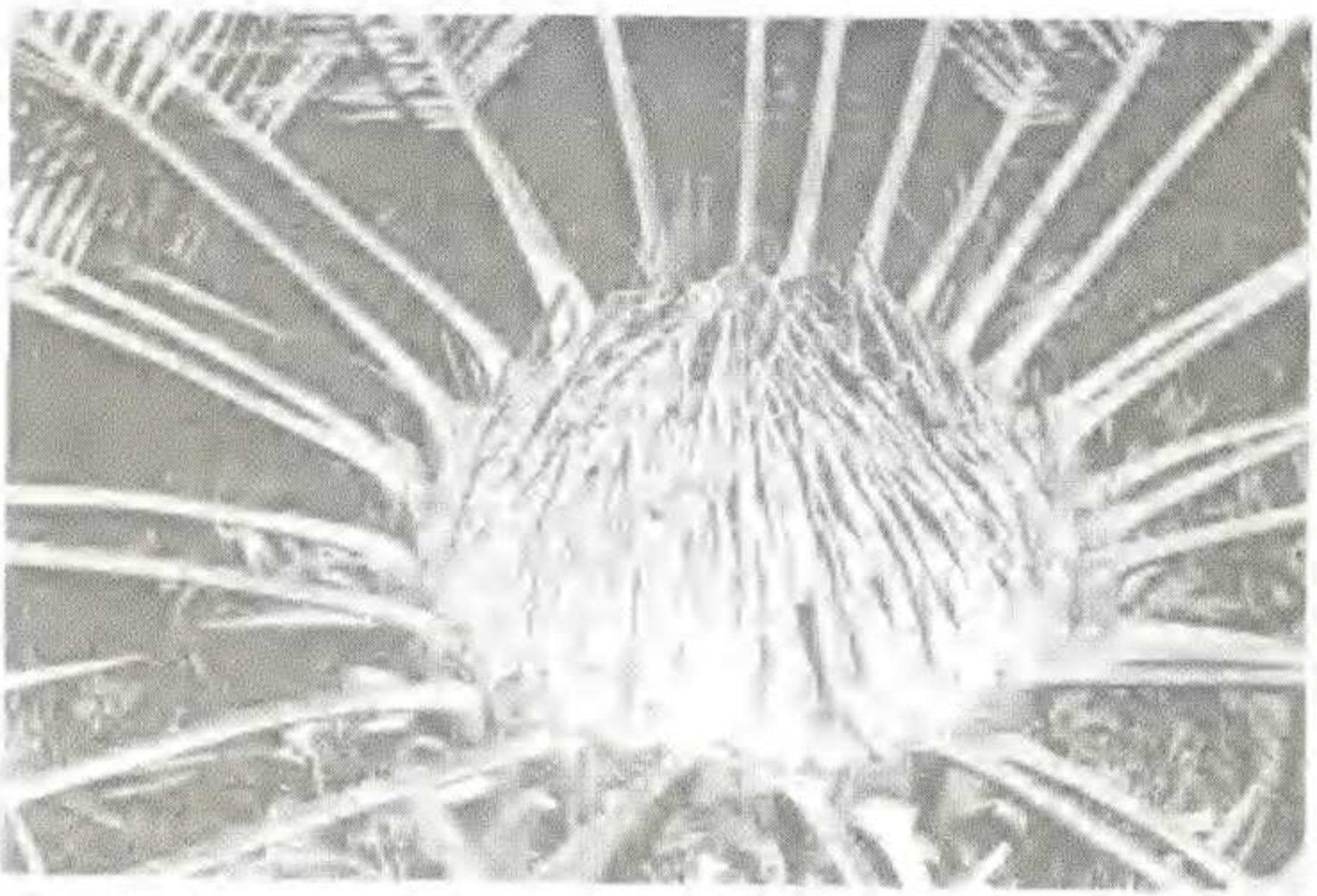
trunks are comparatively slender for a cycad of this height and are usually in the 25-30 cm diameter range. Stems often branch at, or sucker from, the base so that a group of 6-7 trunks on a single rootstock is not uncommon. Older stems often lie prostrate with the growing end recurving upwards. The leafbases are small and compressed to give a characteristic appearance to the trunk. A banding pattern is usually fairly clear and probably indicates alternation in growing conditions or coning cycles. Since there is little or no wooliness at the stem apex, the sharp, upward-pointing and persistent scale leaves (cataphylls) are clearly evident.

2. LEAVES AND LEAFLETS

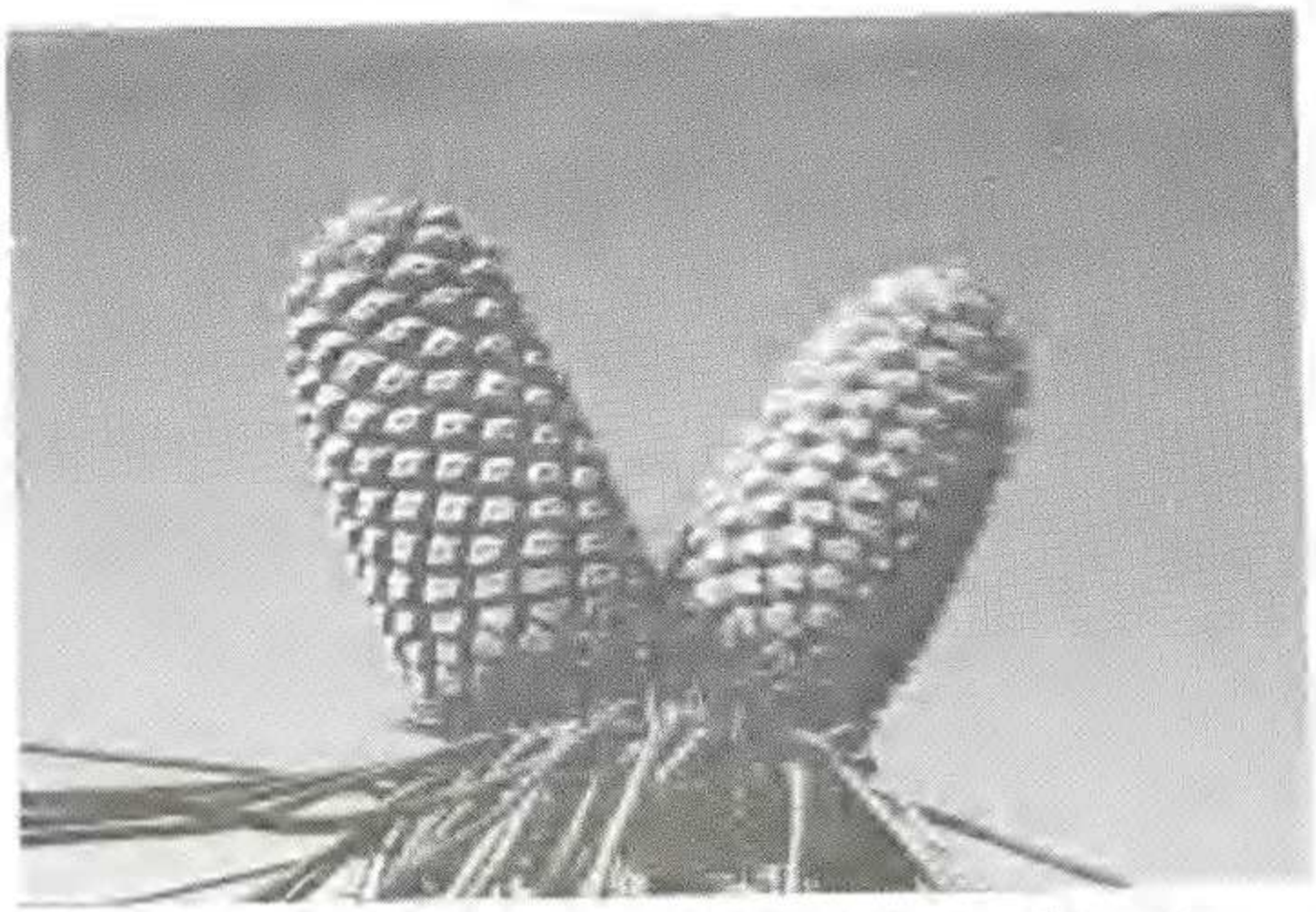
Typically about 1 meter long, the leaves on mature plants are nearly straight with only slight evidence of twists or curvature. The characteristic yellow leafstalk is bare for about 25 cm at the base. Leaflets are fairly closely-packed but without overlapping and set in a V-formation, slightly less so at the base. The leaves emerge as pale green and hairy; on maturity they loose the hairs and become a more grey-green colour. The Mariepskop plants have somewhat more lax and more greenish leaves. Median leaflets are about 12-15 cm long by 5-6 mm wide. Teeth are absent except for a single spine at the leaflet tip. About 10-12 parallel veins are clearly seen from the undersurface.



Photograph of the duplicate type specimen herbarium sheet of *E. laevifolius* collected by Todd. The names *E. lanatus* and *E. friderici-guilielmi* on this sheet testify to the past name changes.



The growing apex of a stem of *E. laevifolius* showing the sharp tough scale leaves (cataphylls). This photograph also illustrates the absence of any wooliness and the long bare petioles on each leaf.



Two of three female cones on this habitat specimen of *E. laevifolius* are seen.

3. CONES

Up to 5 male cones are borne on a single trunk. They are at first covered with short whitish hair which is soon lost to give a final smooth pale brown appearance. The male cones are 30-40 cm long and 10 cm in diameter and curve sideways at the time of pollen release. I have observed large numbers of an Antliarrhinus-like beetle amongst the cone scales in habitat plants at the time of pollen release and beleive these insects function in pollen transfer to the female cones.

Female cones, usually borne in 3's, are barrel-shaped, 20-30 cm long by 10-15 cm in diameter with yellowish hairs in the recesses between cone scales. Seeds have an orange-yellow outer coat and are about 2.5-2.7 cm long by 2.0-2.3 cm broad. Baboons, vervet monkeys, dassies, some birds and fruit-eating bats all enjoy the fleshy part of the seed and aid in seed dispersal.

Mature male cones on a specimen of *E. laevifolius* in the grounds of the Citrus and Sub-Tropical Fruit Research Institute in Nelspruit.
Photo : Kevan Zunckel.

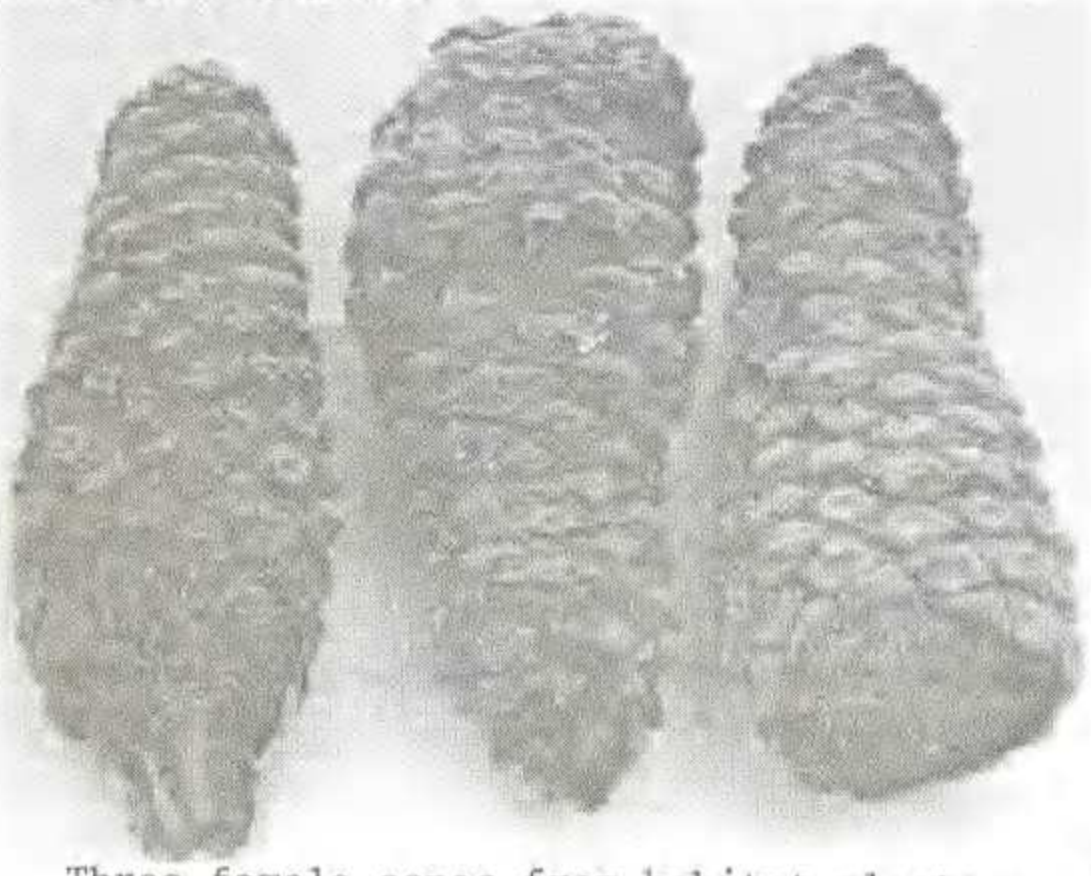
AFFINITIES

The affinities between the Transvaal species E. laevifolius, E. lanatus and E. humilis and also the Cape species E. friderici-guilielmi, were described in the E. lanatus write-up (ENCEPHALARTOS No. 16) and need not be repeated here. A useful set of points to distinguish E. laevifolius and E. lanatus is given in Cynthia Giddy's book under the former species description.

No hybrids between E. laevifolius and any other species are known despite their proximity in habitat to several other Eastern Transvaal species. A suggestion that E. heenanii is in fact a cross of E. laevifolius and E. paucidentatus has not yet been properly tested and deserves attention.

CULTIVATION

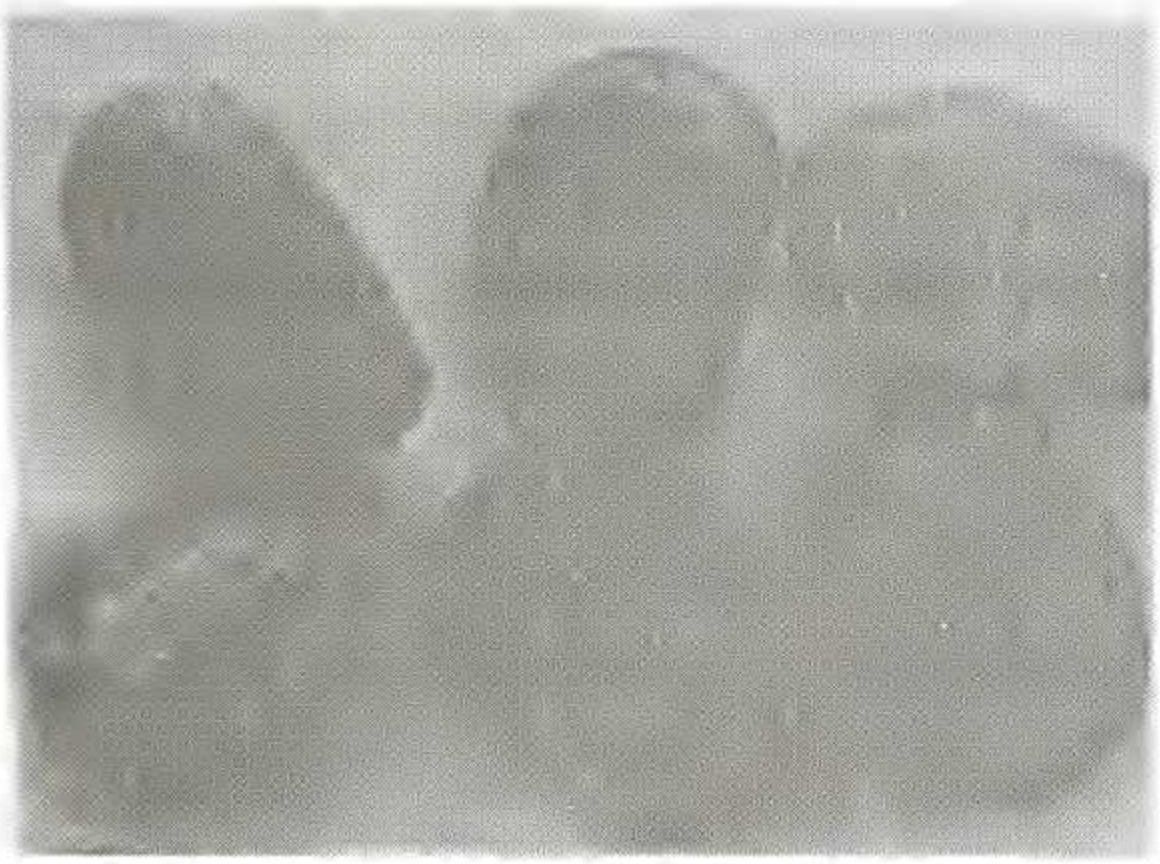
E. laevifolius grows well, but slowly, in cultivation. Its semi-deciduous habit makes younger plants rather untidy in appearance, but the final product is worth this temporary inconvenience ! The plant needs fairly sunny conditions and a well-drained site. Frequent watering in summer should be followed by much less in winter, especially if the leaves become brown. The species is frost-tolerant.



Three female cones from habitat plants near Nelspruit, all showing the debilitating effects of the *Fusarium* fungus.
Photo : Kevan Zunckel.

CONSERVATION

E. laevifolius is listed as endangered in the 1980 Threatened Plants List. Several factors justify this classification. Firstly, much of the previous potential or actual habitat area has been put to forestry use. In this connection it is pleasing to note that the Forestry Officials are now taking an active interest in monitoring the species. Kevan Zunckel, for example is submitting a thesis on the conservation management of E. laevifolius for an M.Sc. degree in Environmental Science at the University of Cape Town : he is particularly concerned with sex ratios in each colony, fauna and flora interactions, burning cycles and a fungal problem (see later). A second threat to the plants has been the unfortunate raids by plant racketeers, and despite the restricted access to the area, this plundering continues. Yet another problem the species is facing is that of a fungal pathogen, a species of Fusarium now thought to be F. polyphialiticum, which attacks the ripening female cones rendering the seed non-viable. (The same problem sometimes occurs in E. ghellinckii and is also probably the explanation for the "anomalous cone" development in E. inopinus reported in ENCEPHALARTOS No. 13 (p.41) and No. 14 (p. 22). From my own observations, I have seen plenty of good synchronous coning but no signs of previous seed crops and only very few seedlings or young plants. The main population at Kaapsehoop has not been completely surveyed but is probably less than one-thousand in number.



Seeds of **E. laevifolius**. The grooved pattern on the sclerotesta is similar to that of **E. ghellinckii**.
Photo : Kevan Zunckel.

Part of a large number of *E. laevifolius* seedlings raised by the Transvaal Provincial Authority's Pretoria nursery.

ACKNOWLEDGEMENTS

I would like to express thanks to Nat Grobbelaar, Colin Pinker, Clare Reid, Jan Rossouw, Piet Vorster and especially Kevan Zunckel for their assistance in the preparation of this text. Except where indicated otherwise, photographs were taken by the author.

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FROM THE PRESIDENT

Membership of the Society continues to grow steadily and I am pleased to report we have already more than made up the deficit created by the loss of the 1988 members who failed to renew their memberships this year.

The Society's main activity revolves around the publication of ENCEPHALARTOS and it is pleasing to hear the continued good reports on our journal's content and presentation. Especially satisfactory now is the more-or-less continued inflow of material from readers; we are all indebted to those who have been good enough to contribute so willingly of their time and knowledge in this regard.

This time of the year is that when many of the *Encephalartos* species cones start to shed their seed. If you have been resourceful enough to have successfully pollinated a cone, will you spare a thought for Danie Nel's urgent and continuous need for seedbank material?

Your Executive Committee is presently re-evaluating the aspects of the pollen-exchange facility and it is now proposed to take this a stage further. In the future we hope to establish a number of *regional pollen banks* which will hold refrigerated supplies of pollen for the benefit of members. Further details of this operation will be made available in due course.

Wishing you all good reading and "broodboomgroete".

Roy Osborne
President 1988/89.

VAN DIE PRESIDENT

Die ledetal van die Vereniging neem steeds toe: dit verheug my om te kan aankondig dat die getal lede wat ons by gekry het ruimskoots vergoed vir die verlies aan lede wat nie hulle 1989-ledegeld betaal het nie.

Die kern van die Vereniging se werksaamhede bly steeds die publikasie van ENCEPHALARTOS, en dit is verblydend om te verneem van die gunstige verslae oor die inhoud en aanbieding van ons tydskrif. Besonder bevredigend is die so te se volgehoue insending van materiaal deur ons lesers; ons dank aan almal wat hulle tyd en kennis in hierdie opsig so onbaatsugtig opgeoffer het.

Hierdie tyd van die jaar begin die keels van baie *Encephalartos* spesies hulle saad afwerp. Indien u daarin geslaag het om 'n keel te bestuif, vergeet dan asseblief nie Danie Nel se dringend en voortdurende behoefte aan materiaal vir sy saadbank nie.

Teenswoordig herbeskou u Bestuur aspekte van die uitruilstelsel van stuifmeel, en die gedagte is om dit nou 'n stap verder te voer. Ons beoog om in die toekoms 'n aantal *stuifmeelbanke op streekgrondslag* daar te stel waarin 'n bevrore voorraad stuifmeel vir die gerief van lede geberg word. Meer besonderhede hieromtrent sal mettertyd verskaf word.

Lekker lees en broodboomgroete.

Roy Osborne
President 1988/89

CYCAD 90

Members are reminded of CYCAD 90, the Second International Conference on Cycad Biology, to be held in Queensland, Australia, over the period 22-27 July 1990. Any members interested in attending must please contact one of the organisers as soon as possible if they have not already done so.

African representative : Dr R Osborne (20 Maryvale Rd, 3630 Westville, South Africa)

Conference Chairman : Dr K Norstog (11935 Old Cutler Road, Florida 33156, USA)

Conference Secretary : Prof Dennis Wm. Stevenson (New York Botanical Garden, Bronx, New York 10458, USA)

Arrangements Chairperson : Mrs Pat H Coutts (M C Box 5495, Townsville 4810 Queensland, Australia)

Scientific Sessions Chairman : Prof A Moretti (Orto Botanico, Via Foria 223, Napoli, Italy)

KIRSTENBOSCH COURSE POSTPONED

Due to circumstances beyond their control, the organisers of the 3-day course in Cycad Biology at Kirstenbosch (as advertised in ENCEPHALARTOS 18) have had to postpone the arrangements. The course, originally scheduled for July 20-22 this year, will probably now be held in December. Interested persons are asked to contact Dr Fiona Getliffe Norris (tel 021-771166) for further details.

TWO NEW AFRICAN CYCADS

Two new *Encephalartos* species have recently been described in the botanical literature.

Encephalartos sclavoi De Luca, D. Stevenson & Moretti is a 1 m tall cycad named in honour of French naturalist Jean-Pierre Sclavo who first discovered this plant in the Tanga District of Tanganyika, near the Kenyan border. According to the authors, its extremely tough leathery leaves, the revolute leaflet margins, and the "venetian blind" leaflet arrangement, are the key distinguishing features of this new species. The description, by Dennis Stevenson, Aldo Moretti and Paolo de Luca, appears in *Delpinoa* new series, of 1987-1988. Reprint requests should be addressed to Dipartimento di Biologia Vegetale, Facolta di Scienze, Universita di Napoli, Napoli 80139, Italy.

Encephalartos cerinus Lavranos & Goode is a new Natal species, regrettably already nearly extinct in its Tugela Ferry locality. An attractive low-growing cycad, it is said to be related to *E. villosus, E. ngoyanus* and particularly *E. umbeluziensis*. The name "cerinus" alludes to the thick waxy coating on its leaves and cones. The description, by John Lavranos and Douglas Goode, appears in *Durban Museum Novitates* 14: 153-156 of 1989. Reprint requests should be addressed to the Durban Natural History Museum, P O Box 4085, Durban 4000.

ENTOMOLOGISTS' CONFERENCE

The Seventh Congress of the Entomological Society of Southern Africa was held at Pietermaritzburg over the period 10-13 July 1989. Two of our members were amongst the participants. John Donaldson of the National Botanic Gardens (Kirstenbosch) presented an illustrated lecture on the effects of cone morphology on the evolution of host choice in cycad seed predators. He discussed such items as cone scale thickness, seed penetrability and seed size, in their relation to the time of the year and area of the cone as attacked by *Antliarhinus zamiae* and *A. signatus*. Rolf Oberpreiler of the Plant Protection Research Institute gave a review on weevils associated with cycads. His excellent slides introduced the delegates to the taxonomy (and taxonomic problems) of the curculionid weevils and other insects which feed on cycad seeds, cone scales, leaves and trunks. It was worrying to hear that the Australian cycad-trunk-boring insect *Demyrsus* has now been found in South Africa, presumably having been imported on a *Macrozamia* plant which had not been properly treated or inspected before shipment from Australia.

Rolf Oberpreiler made a special plea - which he asked us to reproduce in ENCEPHALARTOS - for cycad enthusiasts to supply samples of insects or insect-infected cycad material together with notes on the plant species, locality and any other pertinent details. These samples should be sent to him at: The National Collection of Insects, Plant Protection Research Institute, Private Bag X 134, PRETORIA 0001.

Co-editor Bunny Wentzel intends producing a cloth badge as illustrated for sewing onto wind breakers etc. More details and prices will be available in the next issue of Encephalartos.

Export of cycads to Madeira slated

Permission was given by the State for the export of 725 "priceless" cycads worth about R700 000 to Madeira, because all conditions set out in an international conservation agreement had been met, **Minister of Constitutional Development and Planning, Mr Chris Heunis**, said.

But **Mr Rupert Lorimer (DP, Bryanston)** said it appeared the exporter, Johannesburg businessman Mr Joe Berardo — "a friend of the National Party" who seemed to have "influence" — had apparently managed to "bend the regulations and export priceless specimens" classified as "endangered".

Speaking during a mini interpellation debate on a question by Mr Lorimer, Mr Heunis said according to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (Cites), trade in certain cycad species was allowed if certain conditions were met.

These were that the export must not be detrimental to the species; that the exporting country must be satisfied the specimens were not obtained illegally; that the specimens were prepared and shipped in a way which minimised risk of damage; and that the importing country had issued an import permit.

Mr Heunis said: "In the case of the export of cycads to Madeira, all these requirements had been met and accordingly there was no reason not to issue the Cites permit."

Mr Lorimer said that whatever the technicalities of the argument, he could not understand how these "priceless, living fossils that were possibly starting their growth when Van Riebeeck arrived at the Cape" could have been allowed to leave South Africa.

He believed it amounted to a contravention of the spirit and probably the letter of the Cites agreement and he appealed for a Government investigation.

He said he could not believe an export permit could have been granted unless "pressure was exerted by someone ... and it must have come from high up". "What special pull did Joe Berardo have?" he asked.

Mr Clive Derby-Lewis (CP, Nominated) asked whether it had been established that the plants had really ended up at the Madeira botanical gardens, or whether they were actually in the grounds of a new hotel being built there with South African capital.

Eastern Province Herald
14 July 1989

Rare cycads valued at R300 000 confiscated

By LOURENS SCHOEMAN

A MAJOR breakthrough against the illegal removal of endangered Eastern Cape plants was made when cycads worth more than R300 000 were recovered at a roadblock in the Free State.

The 110 cycads, worth at least R3 000 each, were found locked in the back of a truck that was stopped near Wepener recently.

More than R1,6m worth of cycads were removed from the Eastern Cape since October last year, according to the Chief Conservation Officer (Law Enforcement) of the Dept of Nature Conservation in the Eastern Cape, Mr Jaap Pienaar.

He said yesterday that the cycads found in the truck all exceeded three metres in length, with some longer than five metres.

"This means they are all several hundred years old," said Mr Pienaar.

"Some of them are the biggest cycads I have ever seen.

"We have unending problems with the illegal removal of cycads and their transportation to other provinces.

"In the past 10 months, including the most recent find, more than 550 cycads have been illegally removed.

"Several hundred of these very rare and nearly extinct trees are removed illegally from their natural habitat in the Eastern Cape every year. The losses run into millions of rands.

"The people who remove the cycads have no interest in their history or the importance of saving them from extinction.

"All they care about is the cash they get when selling them," he said.

He added that his department was not primarily concerned about the financial loss involved when cycads were removed.

Its main concern was that the species was being brought closer to extinction, he said.

Mr Pienaar said although the exact origin of the 110 recovered cycads was not known, it was possible that most of them came from the East London area.

A nature conservator at the Koppiesdam Nature Reserve, Mr Tom Mostert, found the cycads on the truck at the roadblock.

"When we stopped the truck, we asked the driver to open the back to enable us to inspect the contents, but he refused to do so," he said.

"The police broke the lock on the doors of the truck and I then realised what important cargo they were carrying, apparently without the necessary permits."

A Wepener police spokesman Wepener confirmed the incident last night.

A CYCAD EXPERIENCE IN EQUADOR

BY DICK ENDT

In most countries where cycads occur naturally there is a public awareness about these plants. This is reflected by the presence of cycads in places, such as public parks and private gardens. It would not be difficult to obtain information about these plants as a foreign tourist visiting such a country.

In South America this is different. First of all there is the relative difficulty in understanding language. Secondly, unless you happen to know a botanist, no one would have ever heard of a plant called cycad.

I have visited Ecuador on a number of occasions but have never encountered a cycad plant, not even a **Cycas revoluta**. The only clue I had about the existence of cycads in Ecuador was the book "Flora of Ecuador" by Erwin Patzelt, published by the Banco Central in Quito. This book has an excellent photograph of the Ecuadorian native cycad, **Zamia lindenii**, but has no reference to where they are to be found, other than saying they grow under tropical or subtropical conditions.

It was pure luck therefore in August 1988 to come across these plants on an African oil palm plantation in tropical west Ecuador near a town called Santo Domingo de los Colorados. Mr. Brainard, an American, has created a beautiful park-like garden around his home, where amongst many exotic tropical plants I encountered a number of cycads such as **Zamia furfuracea**, **Cycas circinalis** and **Cycas revoluta**. I could not believe my eyes when I discovered he had three or four **Zamia lindenii** as well. I was told these cycads are native in this region. These plants are quite large with trunks up to 2 meters in height. The rough trunks are covered with epiphytic plants, almost smothering the head of vigorous green shiny leaves. The leaf stalk itself was more than two meters in length. The leaflets are smooth, bright green in colour. Parallel veining is visible but not prominent. The leaf margin is slightly serrated to mark the terminal ends of the veins.

The most striking aspect of this cycad are the numerous cones borne in the crown of the plant. They appeared in various phases of growth, the mature (female) cone extending outside the leaf canopy becoming pendulous at final maturity and dehiscence. Male cones are equally numerous but are much smaller, both of similar cigar shape. The cones are borne on distinct stalks which allows the cone to reach right over to a pendulous position. The male cones are brown in colour, the female brown at an early stage of growth changing to grey green at maturity. The female cone would be about 50cm in length by about 10 cm in diameter. We observed two cones that were approaching maturity, in order to obtain seeds it was decided to remove one of the cones. The cone had started to disintegrate at one point while the rest of the cone was quite firm. The separation of the seed was quite a job, the pink flesh around the seed was still firm and elasticy. Fortunately when I arrived home about three weeks later the seed, or should I say, some of the seed proved viable. Two months after collecting the seed germinated and after three months the first leaf appeared. This is pretty remarkable considering our climate in New Zealand is cool at this time of the year.

Mr. Brainard suggested we go to the nearby botanic reserve called Rio Palenque Science Centre. This place is remarkable in that this 200 ha virgin forest was saved from destruction while all the surrounding land was cleared of vegetation many years ago. This reserve was created or at least saved by Dr. Calaway Dodson, curator of the Missouri Botanic Gardens. This forest area is under intensive botanic study by members of M.B.G. In this area too we found **Zamia lindenii**. Apart from plants of local origin many were introduced from other parts of Ecuador, orchids in particular which are extremely numerous in this country.

We were faced by another big surprise, another cycad species native to Ecuador, as yet unnamed. This plant, planted near Dr. Dodson's house is quite different to **Z. lindenii**. This cycad was collected in North Western Ecuador, in tropical high rainfall conditions. It is epiphytic in growth habit probably because ground conditions would be too wet for survival of this plant. The plant at Rio Palenque was planted in open soil and appeared to be healthy. The leaves were rather similar to **Zamia skinneri** with leaves narrower than the latter. As the photograph indicates the plant is of rather small stature, no taller than 1.5m.

I have no details of the characteristics of the cones as this was the only specimen I saw. There is still much land to be explored botanically in Ecuador. Many plants have yet to be described. There is a challenge here for further exploration and soon, as much of the forest is being decimated by fire and axe.

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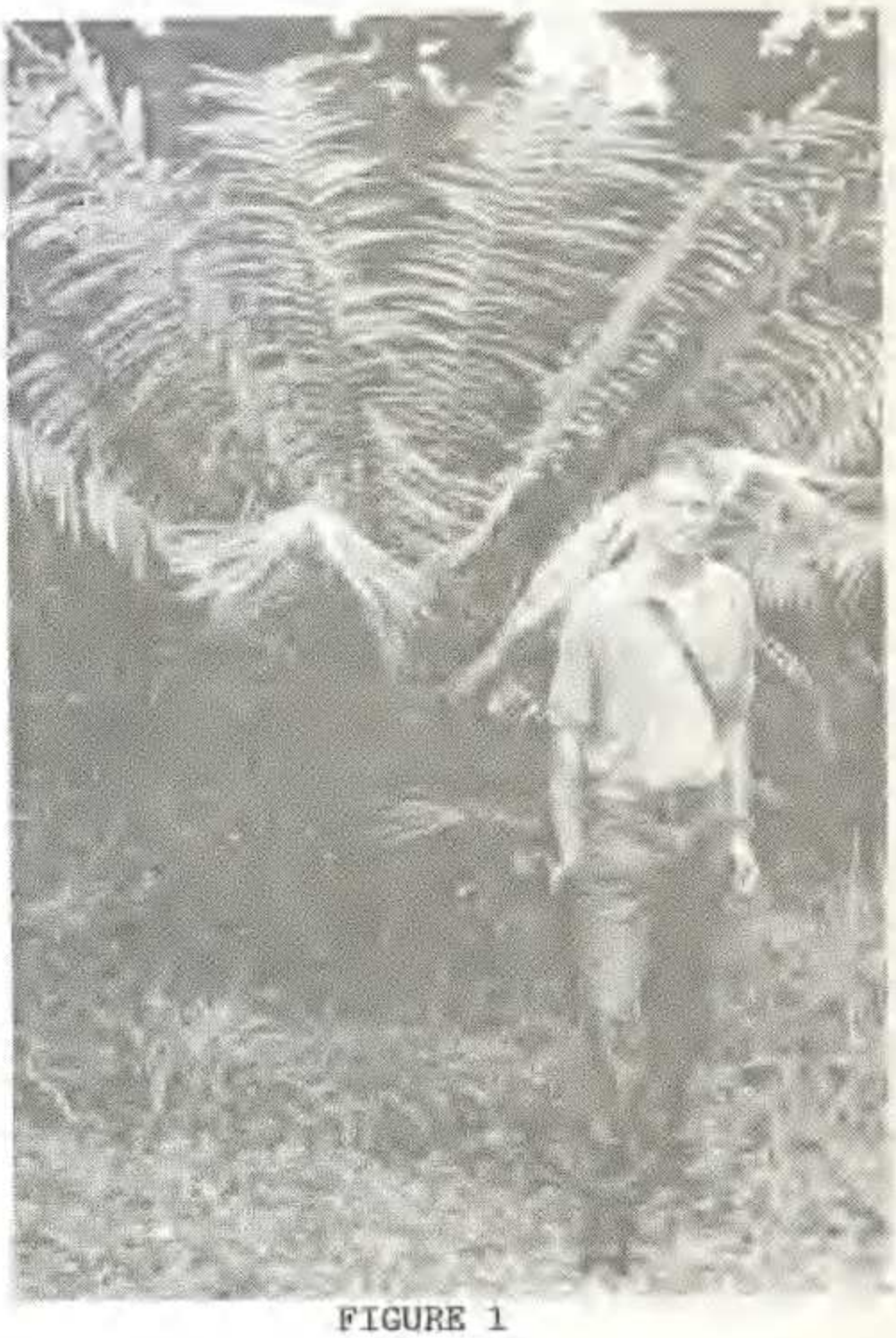

FIGURE 1

Figure 1

Gerald Endt standing near a **Zamia lindenii** Santo Domingo de los Colorados.

FIGURE 2

Figure 2

Maturing female cone of **Zamia lindenii**. Note the length of the cone stalk and pendulous position of cone.

Figure 3

Unidentified cycad at Rio Palenque Science Centre. Gerald Endt is the admirer.

Figure 4

Close up of leaf of unidentified cycad at Rio Palenque Science Centre.

FIGURE 3

FIGURE 4

COMMENTS ON DICK ENDT'S ARTICLE

Dennis Stevenson, writing from the New York Botanical Garden, has offered the following comments on Dick Endt's article on the Ecuador *Zamias*.

"*Zamia lindenii* Regel ex Andre is, is my opinion, a synonym (conspecific in this case) for *Z. poeppigiana* Mart. & Eichler. I base this on two reasons. First, the types of these two names are identical. Secondly, material collected and annotated by Andre in Ecuador, some years after the description, is also identical to the type collected by Poeppig. Because the older name is *Z. poeppigiana* it is the one that should be used. The species ranges from Eastern Ecuador through Northern and Central Peru."

"With respect to the second species mentioned by Dick Endt, I have no idea what it is since there is not enough information available in his photographs. I suspect it may be either *Z. lecointei* Ducke or juveniles of *Z. poeppigiana*. I have spoken with many collectors who have been in this area and they assure me there is no epiphytic *Zamia* in this region. It should be noted that *Zamia poeppigiana* in this area often grows on the bases of old tree stumps and fallen trees and was originally described as being epiphytic but in fact is not."

CYCAD LANDSCAPING
BY LELAND MIYANO

Cycads, when used in a landscape, lend a dignity to a garden seldom matched by other plants. Perhaps, I have become overtly biased in my opinion. The special feelings I get from Cycads are born of several factors. Cycads are, generally, rare plants. In this regard they become our responsibility; both to ensure their survival in habitat and also to ensure long life for those plants in cultivation. I consider Cycads very slow dinosaurs that need the best environment in which to flourish. As focal points in a garden, it is our obligation to make the statement, "these plants are special". If good garden design is a priority, my first bit of advice would be "do not collect too many species". The result of too many different plants in a small space is a salad! Unfortunately, that is what I have built, so hopefully one can learn from my mistakes.

The focus of this article however, is to pass information I have learned from growing Cycads in Hawaii. Being a tropical, high rainfall area, I hope that some of my Horticultural practices will be adaptable to the readers' growing conditions.

I always consider drainage first, if one has naturally well-drained soils - excellent. My situation has montmorillonite clan soils; sometimes called adobe (you could make ceramic pots from it). It is a very expansive soil that becomes gelatnized when saturated. Cycads do not appreciate this soil. If I am lucky, I follow a natural slope and dig a planting hole, being sure to cut away the downhill slope (by not cutting away the downhill slope, you will create a sump in clay soils. You may not foresee bad results until a prize plant rots).

After planting with a well-drained mix of native soil and 50% or more pea-gravel (I use crushed basalt) I back-fill the downhill slope with the same mix and compress well. I do not like to use perlite for in-ground installations because, over time, the mix tends to drift or wash out. Also, with larger plants, the Cycads could fall over. By using the natural contour one saves substantial amounts of labour and money.

Seldom does one have the luxury of well-countoured land; especially with today's development mode of making land flat. Therefore, we must resort to mound building. The same principles apply regarding drainage. Do not trap natural drainage patterns by "daming the flood" with your mound. Water must flow freely off your property (hopefully not to wash away your neighbours) when a shape is determined for your mound, contour the subsoil so that no "sumps" are created. Compact this layer so that percolating water is shed. Arrange your rocks to complement your plants, not compete with them. Add a good layer of well-amended soil mix. This can be 2´ - 3´ deep, depending on your budget or your energy. The better your preparation, the better your plants will respond.

Seepage drains can be installed as per manufacture specifications as an option. Generally these are flexible perforated pipes 4" in diameter laid 18" below final grade with a 12" layer of drainage rock around it. If you use seepage drains, you must determine a downslope position for the run-off water to flow.

If you wish, an irrigation system can be installed at this time. Another very important factor to consider is the amount of sun delivered to the site. I can always modify the shade of an area, but I would be hard pressed to increase the sunlight. Work closely to nature in your garden - grow species invited to the area.

Assuming you sited the garden in full sunlight, I will use full sun species as examples. To start, site your focal point plants first. Say you had three **Natalensis**, create a triad perpendicular to the axis of you sight or direction of travel. Next, place your secondary or mid-ground Cycads; in this case, **E. Domingensis (Pumila)** which grows 3´ - 4´ tall primarily fronds. Use an odd number, but place them so your eye is directed to the large **E. Natalensis**. **Zamia Pumila (Floridana)** can be used as a foreground planting. If you grow many plants from seed, you could make a groundcover. Ground- covers can be anything from a rock mulch to a low creeper. Always be mindful of low maintenance and non-aggresive material which will not compete with your Cycads.

In siting your garden, be aware of large aggresive trees which may sap your Cycads of space and nutrients. I cut mine down.

In closing, nothing gives me more pleasure than to see my Cycads growing well in my garden.

I wish all who attempt Cycad gardening well, because it involves blood, sweat and tears; or labour, money and dedication; but after all aren't our Cycads worth it?

The author's address is:

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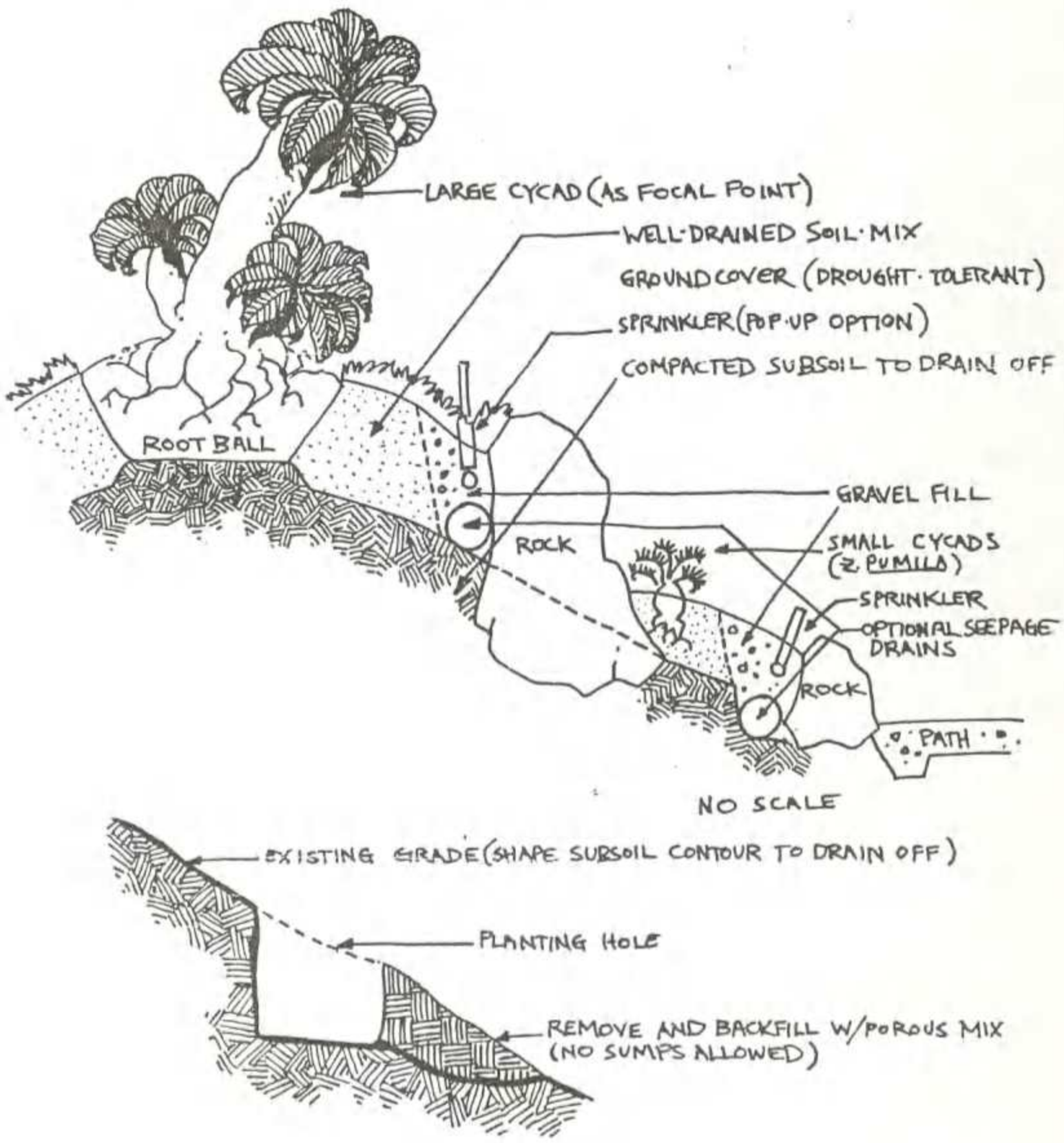


THE BUNDESGÄRTEN SCHÖNBRUNN
BY JULIUS BRUNNER

The Bundesgärten Schönbrunn are among the world's oldest botanical gardens. Their origins go back as far as the 18th century when Austria was not an independent country, but only one part of the monarchy Austria-Hungary, which comprised the territories of Czechoslovakia, Hungary, Austria, parts of Jugoslavia and of Italy, Vienna being its capital.

It was in the Mediterranean territories that the first cycads were collected (e.g. Cycas revoluta). According to reports some plants were brought to Vienna from London's Kew Gardens in those days.

Prince Eugene of Savoy (1663 - 1736), a famous and successful general, who had won many battles for Austria-Hungary, was the first to establish a botanical garden in Vienna. Near his residential palace Belvedere, he kept both animals (lions, tigers, giraffes, monkeys, etc) and plants (palms, orange trees, cacti, etc). After Eugene's death the collections were transferred to the palace gardens at Schönbrunn by the Emperor Franz Joseph 1. (1830 - 1916). Orangeries and a big greenhouse specifically designed for the cultivation of palms, the Palmenhaus, were built. At the same time when journeys to Southern countries were reserved for the nobility it was particularly due to Prince Eugene and Emperor Franz Joseph that flora and fauna which people knew only from descriptions and drawings were brought within their reach.

The oldest plant grown in Schönbrunn is a 500 year old Myrta. In 1788 a Fockea carpensis was brought to Vienna. This plant had always been considered impossible to propagate until it was accidentally fertilized.

In the Second World War, in February 1944, the panes of the Palmenhaus were destroyed by the blast of a bomb that hit a house in the vicinity. Considering the fact that the temperature was below-0 degree centigrade we can hardly believe that most plants could be saved. They were stored in dark, unheated, but frost-free cellars.

Unfortunately, some of our Encephalartos specimens are not in the best condition as they were not properly cared for by all cultivators during their 200 year existence in Schönbrunn.

Cultivation of exotic plants in our institute requires a good deal of patience and knowledge as a number of difficulties have to be faced: The sun rises late and sets early in winter, the heating period lasts for about six months and many plants grown in greenhouses are prone to nematodes. However, due to modern pesticides and special fertilizers plants can now be cultivated very well.

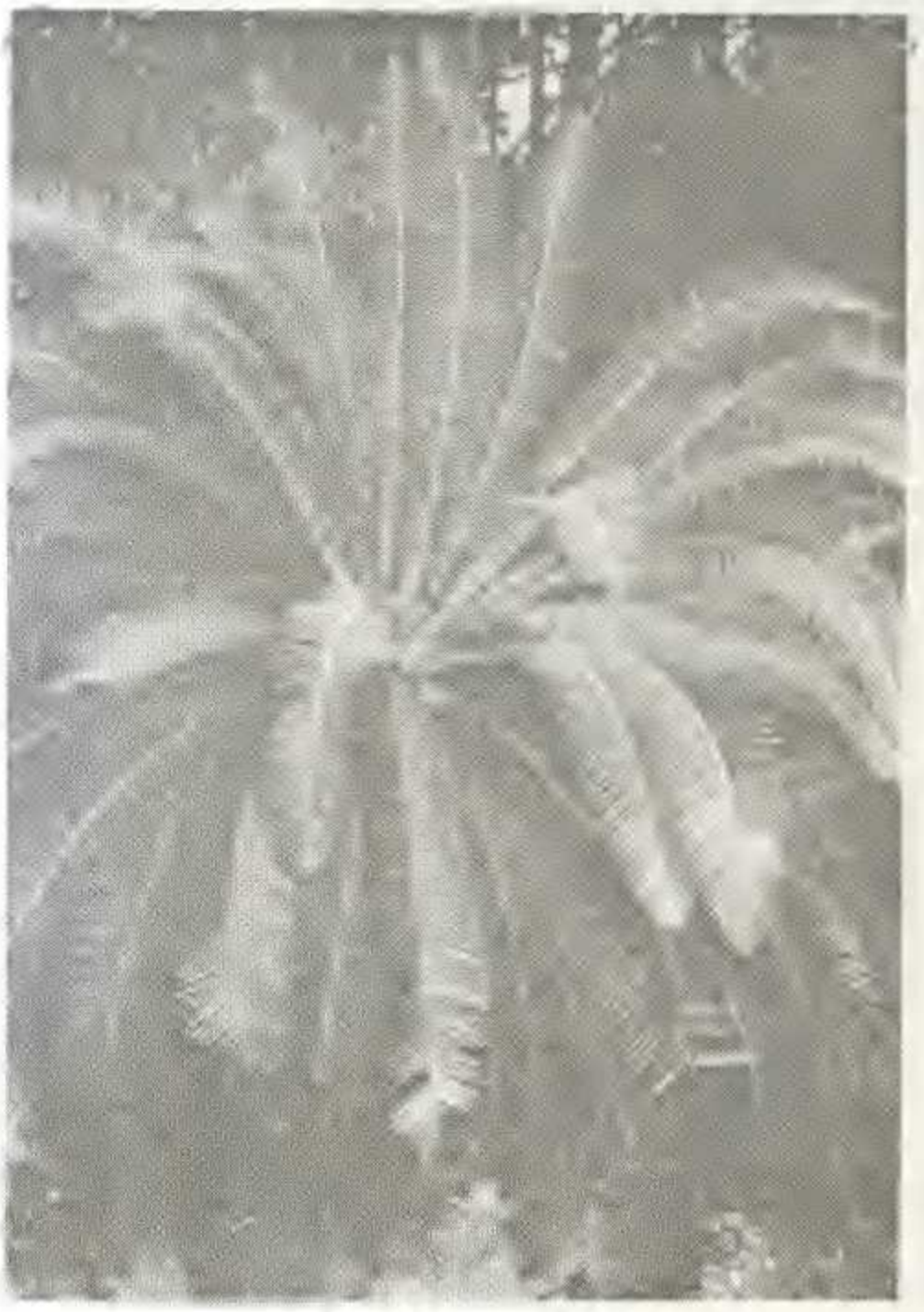
There are also many other things that have changed in Schönbrunn since the days of the monarchy. As many exotic plants can be propagated en masse and are therefore sold cheaply even in supermarkets, and due to the fact that many people spend their holidays in countries where such plants are common, interest in public gardens has decreased. Hence, management had to do some rethinking in

order to attract people in the future, thus, the Bundesgarten Schönbrunn concentrates on showing plants which are unknown to the average visitor.

Furthermore, the cultivation and propagation of thousands of species is continued in a huge complex consisting of numerous greenhouses and adjoining buildings which are not open to the public. More than 40,000 plants, among them 800 species and innumerable hybrids of orchids, are presently being cultivated there. The Bundesgarten Schönbrunn rank with the most important European botanical gardens today.

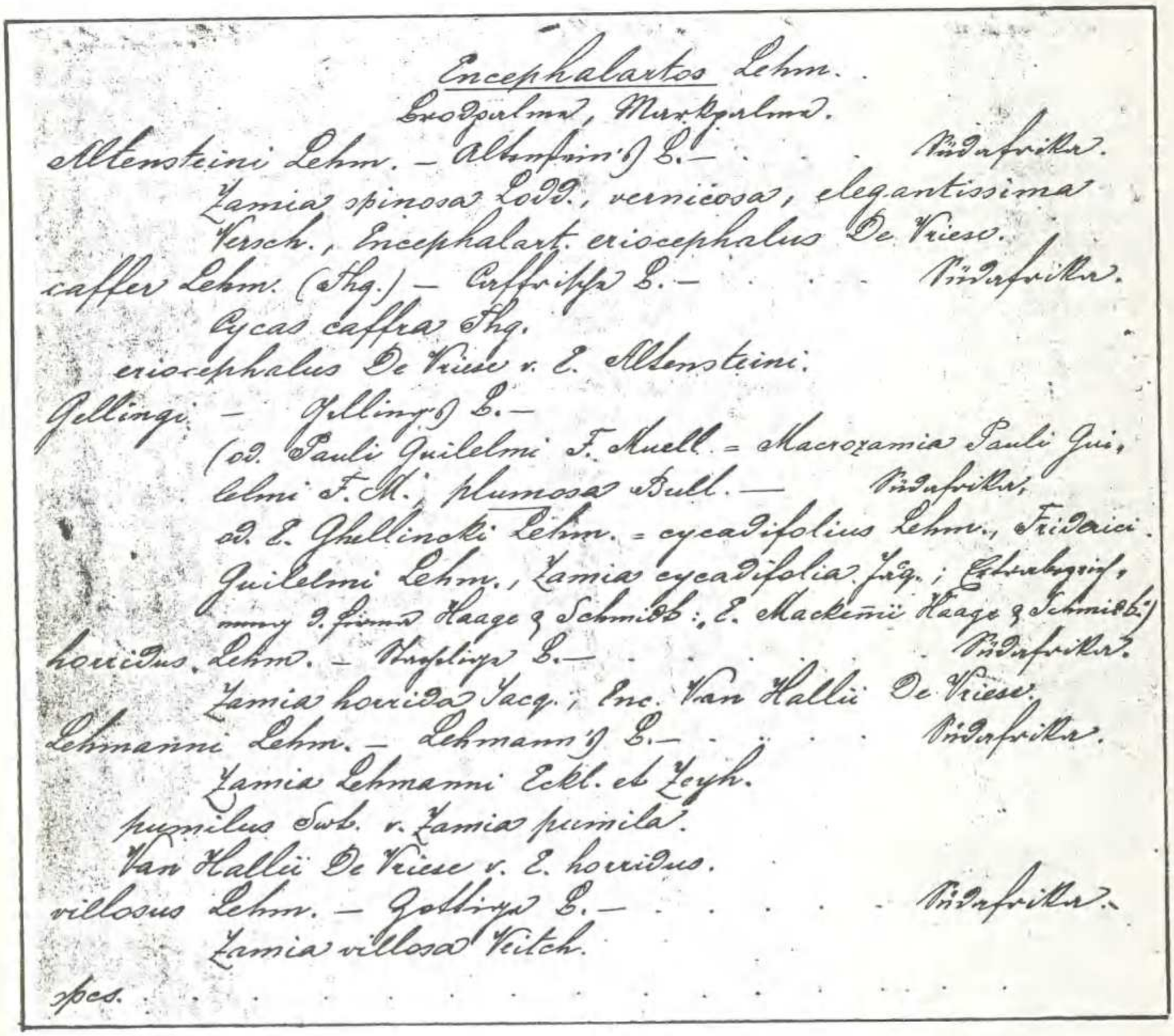
CYCAS circinalis

ENCEPHALARTOS altensteinii



Unidentified Dioon

Photographs by Julius Brunner



Encephalartos Lehm.
Eucycadeae, Macrozamieae.
Altensteinii Lehm. – Altenstein's E. – Südafrika.
Zamia spinosa Lodd., vernicosa, elegantissima Versch., Encephalart. crioccephalus De Vriese.
caffer Lehm. (Thg.) – Caffrische E. – Südafrika.
Cycas caffra Thg.
crioccephalus De Vriese v. E. Altensteinii.
Ghellinckii – Ghellinck's E. –
(ex. Pauli Guilelmi F. Muell. = Macrozamia Pauli Guilelmi F. M.; plumosa Bull. – Südafrika.
ex. E. Ghellinckii Lehm. = cycadifolius Lehm., Fridarici Guilelmi Lehm., Zamia cycadifolia Jacq.; Ottenburgensis, nunc E. friedrici Haage & Schmidt; E. Mackenii Haage & Schmidt.) Südafrika.
horridus Lehm. – Rauhe E. – . . . . . Südafrika.
Zamia horrida Jacq.; Enc. Van Hallii De Vriese.
Lehmannii Lehm. – Lehmann's E. – . . . . Südafrika.
Zamia Lehmanni Eckl. et Zeyh.
pygmilus Swb. v. Zamia pumila.
Van Hallii De Vriese v. E. horridus.
villosus Lehm. – Zottige E. – . . . . . Südafrika.
Zamia villosa Veitch.
spec. . . . . .

Part of the 1892 handwritten inventory of *Encephalartos* species at Bundesgärten Schönbrunn. The list includes *E. altensteinii*, *E. caffer*, *E. ghellinckii*, *E. horridus*, *E. lehmanni* and *E. villosus*. Many of these specimens were destroyed in World War II.

Editors Note: It is interesting to see that Dyer (Bothalia 8: 442, 1965) mentions the collection of Encephalartos cycadifolius, E. horridus and E. longifolius specimens by the Viennese collector-garden Scholl. These specimens were shipped for cultivation in the "Royal Garden of Schoenbrunn" just before 1800, where they were later described and illustrated by the famous botanist Jacquin.

This article appeared in the 1944 issue of the Journal of the Botanical Society of South Africa and is reproduced here by their kind permission.

The Magic of the Cycad Forest

By FRANCES MILNER

DAVID, Charles, and I turned south at Smit's Drift, which crosses the Malip's River, drove through Malopo's location, and marvelled anew at the splendid beauty of the Iron Crown, a battlement of the Drakensberg Mountains. Finding a road running west, we breasted the steep and winding ascent, till we ran on to a broad spur, from which one's delighted eyes could rove over many thousands of miles, from the fine masses of the mountains in the south, marking the pointed headland called Mamathola, Mount of the Singing Birds; ranging eastwards to where lay the Game Reserve, lion-haunted, sweeping the expanse of sky until our eyes lighted on two rounded kopjes lying warm and distant, called by Rider Haggard Sheba's Breasts. "There," said Charles, "is Queen Modjadjie's Kraal. The heart of Africa seems to beat within her breast, a cruel heart some say, but the great Queen who has ruled that large tribe of Lobedus for forty years, by witchcraft maybe, must also know statesmanship." "What is the dark point pushing up from the rest?" I asked. "That is the Hill of Execution, and on it, and covering the spur for over 5 miles, is the unique cycad forest; there is no other like it in the world."

I must have looked longingly at David, for he and Charles exchanged a smile, and Charles said: "I have been granted an audience with the Queen; I am going to the Royal Kraal to-morrow, and could take you. It is a great honour, let me tell you; she is very inaccessible. Would you like to see the letter, written by one of her Indunas?—'Queen Modjadjie greets Mr. Charles. Queen Modjadjie will be pleased to see Mr. Charles to-morrow.'" And so it was arranged.

To-morrow came, and full of excitement we set off; through the aromatic saligna forests, lifting their gipsy-brown finger-tips skyward, up to the wild ridge from which, to the south, we had a marvellous panoramic view of the Drakensberg Mountains, and to the east we gazed across the wild territory ruled over by the mysterious Queen Modjadjie, reigning over her widely dispersed Lobedus with despotic power.

Turning east we entered the Selukwe River valley, where the road led us through high ramparts of rock, which hid the glories of the Low Veld, bearing on its distant bosom blue kopjes like islands in an unfathomable sea. Tree ferns over six feet high clustered in the vleis, like brown men with feathered head-dress; we passed a young girl clad in strings of beads and a small piece of cloth, carrying on her gracefully poised head a huge kaffir pot ornamented with a diamond pattern cut in the clay; a child with turkey feathers stuck in its woolly hair. Bracken grew by the roadside, sweet smelling but lacking the gorgeous colours of a more temperate clime. Now we caught a glimpse of the Molototse river which flows through Modjadjie's location. The way became very stony and steep. Very little effort had been made to cultivate the barren ground, though here and there was a patch of pumpkins guarded by a small skinny boy perched on a shelter rudely built of sticks and grass. "From what?" I queried; "I have seen no birds or small animals here." "Queen Modjadjie does not protect the wild life," said David, "but she looks after the murulu trees. They bear a plum-like fruit, very aromatic in flavour and having so large a stone that the amount of flesh surrounding it, looking like soap jelly, is hardly worth the eating; these are used to ferment the kaffir beer, which serves the native both for drink and medicine."

The gorge of the Molototse is a wide one, and high cliffs on either side swept onwards to end abruptly in a pale shimmering view of the Low Veld. We caught the light from a waterfall springing from some secret cavern in the rocks. True, there was no mysterious tunnel as in Rider Haggard's "She" as we approached the Royal Kraal, but a steep twisting stony way, up which our car clawed its ascent like a cat up a wall. Charles stopped the car under the shade of a huge fig tree. Now began a stony up and down walk of a mile and a half to the cycad forest.

Modjadjie's Location used to cover 600 square miles, extending from Mokeetsi, the Great Letaba and the Molototse rivers. This large area has shrunk to some 150 square miles, *fide* Mr. Krige.

"The colony of cycads (whose botanical name is *Encephalartos transvenosus*)" said Charles as we trudged along, "is confined to the south-east slope of a 'squirrel ridge' some five miles in length. It is very curious that this extraordinary and luxuriant colony of cycads should be so limited, with only a few isolated exceptions in the immediately surrounding slopes and valleys. There are but three other specimens, said to grow in the sacred rain 'temple' and burial ground of the Lobedu queens; for the rest, they crowd densely on this one rocky spur of the surrounding foot-hills, and it is significant also that they grow mainly on the east-south-east slope of the hill." "Not so significant," said David; "that is the main rainy quarter." "They grow densest down the deep ravines or gorges that score the flank of the hill," continued Charles, taking no notice of David's interruption, "and these deep ravines are literally choked with the glossy green-fronded crowns."

In a moment or two the rocky path ended and we stepped on to a gently sloping ascent leading up to the forest and Hill of Execution. Never having seen the "Modjadjie Palm," as this cycad is incorrectly

called, except in a garden, the first sight of these great giants of a bygone age took our breath away. They clustered together in charming groups, lifting their varied tinted leaves towards the hot blue sky, reflecting its mysteries in their dark glossy surface. The cycads were informed with great beauty; we felt as we looked at them as if we were in a dream; as we climbed higher their numbers increased, and towering above us they were outlined in majesty against the blue of the distant Low Veld. Now and again there sprang from their crowns the huge seed-bearing cones, some breaking apart, their bright vermilion seeds scattered among the dark fronds, or lying on the ground beneath. The average height of this colony of *Encephalartos transvenosus* would be perhaps from twelve to fifteen feet, with all lesser degrees of youngsters descending to seedlings a few inches high, the latter sprouting freely in between rocks and in crevices, for the colony thrives in a natural rock-garden of slabs and boulders penetrating and overlying a deep rich humus, exceedingly well drained. These cycads take centuries to grow; we took the approximate height of the tallest we saw by posing David beside it, he being six feet three, from which we judged this giant must be all of 24 feet! Specimens planted in gardens, under the best conditions, take thirteen years to grow one foot of trunk!

The cycads, scattered here and there about the world, furnish the botanist with a link between the flower- and fruit-bearing trees and the ferns, mosses, sea-weeds and fungi, all destitute of pistils and stamens, and having concealed or obscure fructifications. Encephalartos is a cycadaceous plant belonging to the order Gymnospermae. Cone production in the Modjadjie Cycad begins in early Spring; the crown of the tree, about the size of a soup plate, is seen to be covered with a brown growth like cotton wool, about four inches thick: the seed cones—two to four in number—can be noticed pushing up through this protection, and they also are covered with a silky sheath. The majority of the cones are 2 feet long and 1 foot in diameter at the base; they are composed of a spongy yellow core, surrounded by hundreds of curious bracts 3 inches by 2 inches each firmly holding two fleshy seeds 2 inches by 1 inch, of a vivid vermilion. The upper part of the bract is shaped like a ram's head, the rough yellow-brown back of the "head" forming the beautifully patterned outside of the cone. In the centre of the spongy cone is a hard stalk, 3 inches thick at the base. Some of these cones weigh 60 lbs. and as soon as they are ripe they disintegrate and throw their brilliant treasures on the ground. From the bud stage to the ripened seeds takes a year, but in this semi-tropical part of South Africa this cycle can occur at different times of the year. The male cycad carries his life-giving pollen in narrow cones 12 inches by 4 inches springing from the axils of the lower leaves; not for him is the splendid display of his brilliant consort, though his cone resembles hers in design; the small bracts, about 1 inch by ¾ inch, are thickly covered on their outer surface with tiny cases opening like mussel shells, and shedding the dust-like pollen.

The trunk of this Encephalartos is extremely rugged, covered with a rugose diamond pattern denoting the bases of former fallen fronds, which spring with great regularity round the trunk, always keeping the form of a circle. From the centre springs each new frond, curling upwards like that of a fern, very well protected by a silky sheath. The leaflets are intensely glabrous, and slightly recurved. The fronds grow to some six feet in length on well-grown trees, and each leaflet is set flat in the frond, alternating up the rachis, neatly spaced, and the lower ones several inches long, gradually narrowing to the tip and never over-lapping one another. The leaflet is armed with strong teeth, varying from three to seven a side, with a really useful weapon spiking the topmost!

Australia owns the giant cycad Macrozamia, plants of which were considered the largest cycads in existence until Modjadjie's forest was discovered.

Exploring further we scrambled as far as we dared over the broken edges of the spur, the sides of which were cut into chasms by the furious storms which sweep against it from the south-east. Some of the great cycads clinging to the verge had failed to resist the onslaught, and were tossed across the chasms forming (to me) intriguing bridges. David did not care much for my small adventurings, and he and Charles led the way upwards to the point of the spur from which fell away a sheer precipitous smooth face of rock, overhanging a drop of several hundred feet far down into the cycad- and bush-choked jungle below. At this sinister spot, during the reigns of the former Modjadjie and her predecessor who (according to the late Rev. Fritz Reuter of the Berlin Mission, the first European to settle in Modjadjie's country during the eighties of the last century) were tyrants and fiendishly cruel despots, victims of the royal displeasure were hurled from this Execution Rock to their death below.

After paying our respects to Queen Modjadjie—and our visit would make another story in itself—we thoughtfully turned for home, feeling that we were leaving a scene of archaic wonders. The setting sun was turning the shining fronds of the cycads to purple and the great clouds were piling in the east like golden galleons. I thought of these mammoths of a bygone age, comparing them with the giant creatures of the Low Veld; the elephant, crashing its way through the bush with calf at foot, the thousand year old cycad standing amid the wreckage of its fallen comrade, from under whose rotting girth spring the infant plants which, in years to come, may see the apotheosis of civilisation for which the heart of man strives.

Note : With some detective work by Fiona Getliffe Norris and Clare Reid, we suspect that "Charles" in the above article is C.T. Astley-Maberly while "David" may be the writer's husband.

Royal Cycads

To many collectors, cycads are the royalty of fossil plants — and there are good reasons for the prestige they bear.

BY JUNE CULP ZEITNER

Symmetrical, artistically patterned, rare, often found complete, and bearing an air of imagery and mystery, cycads inspire great aesthetic appreciation among collectors. The fossil plants were abundant from Alaska to California and from the Rocky Mountains to the swamps that became Washington, D.C. in the distant times when dinosaurs ruled the earth.

There were two orders of this ancient group. One order, like the dinosaurs that grazed on it, became extinct. But from the study of specimens remarkably preserved by silica, we have learned a lot about the flora and geology of the North American continent from about 130 million years ago, during the Mesozoic era.

What are Cycads?

Towards the middle of the family tree of plants, a large branch was diverted from the main trunk. This branch subdivided into one that gave rise to the Ginkgoes and conifers and another that was the cycads. The cycads had two orders, the Cycadales, which are still living, and the Cycadeoidales, which we know only as fossils.

Although cycads resemble palms, the two are not closely related. The cycads are gymnosperms or cone bearing plants, and they grew in a mild, equitable climate with abundant water. The elegant fern- like leaves formed a crown or umbrella at the top of a gracefully shaped trunk rather like a giant pineapple.

Most fossil cycads are near 7 in hardness, having been replaced by some form of quartz, often chalcedony or agate. The colours are warm, varying from pinkish to reddish, to rust, or brick, from chestnut and buff to deep mahogany brown.

It is the patterns that are the most appealing. Both the exterior and interior markings show diamond- shaped polygons. The uniform rhombic leaf scars are arranged in a complex spiral, starting with one row from left to right and the next curving from right to left. The leaf scars penetrate to the axis of the trunk and are at right angles in the central portion. The patterns are often so regular and perfect that they appear to have been drawn by an engineer or an artist. The colours, often extremes of dark against light or vice versa, may produce a stunning contrast.

Cycads are found in several parts of the world. Complete cycad trunks have been discovered in several U.S. states, and in a few places, prints of the leaf stalks exist. Leading U.S. localities are South Dakota, Maryland, Utah, Wyoming, Idaho, California, Oklahoma, Oregon, and Texas. There are also a few other true localities - and a lot that are false. That is to say, true cycads have been found near Montague, Texas, for example, but the objects called "cycads" in Karnes County, Texas, are really ferns.

Four distinct layers make up the cycad trunks. The innermost layer is the pithya medulla, next is the woody fibrovascular layer, followed by the cortical, and last comes the outer layer or libro cambian. The organs found in the scales are filaments and anthers. The fruits are cones, of great symmetry and beauty.

Attached leaves have not been found, though coiled, immature leaves within the trunk have been. These, together with the partial imprints of mature leaves, tell us that the long leaf stalks were pinnate with two ranks of leaflets, sometimes opposite, sometimes alternate. In some species, the leaflets were slender and at right angles to the stalk; in other examples, they point upwards to the tip of the stem. Some fronds have dome-shaped terminations; many are pointed. The veining tends to be straight and parallel. Most field collectors on first seeing a cycad leaf imprint are likely to think it a fossil fern.

Spectaculars from South Dakota

Possibly the foremost cycad locality in the world is the Black Hills of South Dakota. So many wonderfully preserved cycad trunks have been found in Fall River county that at one time a large area was designate as Cycad National Monument. This status was discontinued, however, when it was found that all visible cycads had already been collected and were mostly located in eastern U.S. museums. Since the initial discovery a century ago, several thousand specimens have been found.

Paleobotanists from all over the world have visited the site near Minekahta, but numerous excellent cycads have been discovered purely by accident. In the Minnekahta location, though, they were purposely sought out: one Friday night, for instance, my husband announced that he was going with a friend the next day to that locality to find a cycad for our museum. Sure enough, the next evening he came back with one, just as he'd planned. He had also spotted another too large to carry, which he intended to recover at another time.

Cycads were so plentiful in that area that back in the 1940's a group of Forest Service workers stopped one day for their noon meal under the pines. They sat down on some convenient stones, their minds only on food, drink, and rest. Refreshed, they got up again and only then discovered that they had been sitting on cycads.

The exact location is Perker Peak, south of Minnekahta. By the 60's and '70's, however, the area had largely been depleted of cycads - but not entirely. A fine group was recently discovered by a road crew. Among this group were several of record size, weighing up to a thousand pounds, and preserved in detail.

Many species are represented among the South Dakota cycads; most typical is **Cycadeoidea dacotensis.** They are conical or oval in shape with prominent, deep, leaf bract scars. In girth, they are round, commonly measuring between 35 and 50 inches at the largest part. Heights were often between 15 and 30 inches. The tops are dome shaped and are sometimes compressed and elliptical. **Dacotensis** specimens may weigh several hundred pounds, with 100 to 150 pound specimens being quite numerous. The colours are dark to reddish brown. Another prominen. Dakota cycad is named **minnekahtensis** for the community nearest the site. This species has a much branched, irregular trunk, is lighter in colour, and larger in size, weighing up to 500 pounds.

An elegant species is appropriately named **Cydadeoidea pulcherrima**, meaning beautiful. These fossils are ellipsoidal with girths of about 60 inches. A ring of short, uniform, domed branches appears just below centre, which forms conical protuberances with spherical patterns. They are light ash in colour. The surface of **pulcherrima** is smoother than that of **dacotensis** or **minnekahtensis.**

There are still other South Dakota locations for cycads, covering almost the entire length of the Black Hills range. Among them are Hell's Canyon, Hermosa, Blackhawk, Sturgis, Spearfish and Belle Fourche. Cycads have also been found in the badlands areas east of the Black Hills. These have mostly been fragments rather than entire trunks, although Peter Larson of the Black Hills Institute of Geological Research found a nearly complete, well agatized trunk in the badlands. Others have been found by field collectors. A child picked up a small, perfect one during the Midwest Federation field convention in 1969 knowing only that it was pretty.
Specimens of the South Dakota cycads are in many museums around the world and in several private collections in the state, particularly in the Black Hills area. The Museum of Geology of the South Dakota School of Mines in Rapid City has a notable collection, including some of the best specimens of the recent discovery as well as cycads brought to light many years ago. At the Hot Springs show some years ago, the Hill family used to astound visitors with their entire impressive collection display. Important cycads from the Black-hawk-Piedmont area are exhibited at the Black Hills Petrified Forest. Owner Jerry Teachout has several fine specimens in his museum.

One of the most popular displays at the South Dakota State Gem Show of the Western Dakota Gem and Mineral Society has been the exceptional collection of the R.A. Boyce family. Dr. Boyce shows live cycads as well as choice examples of fossils from major localities. All south Dakota localities are highlighted in the Boyce collection. The size range varies from fist size to trunks of well over a hundred pounds. Polished specimens accent pattern and such details as developing seeds and cones.

Oddities in the collection are cycads with straight trunks and a Montana cycad with small, rounded holes instead of the customary diamond shapes. Cycad leaf imprints from numerous localities add to this fine collection.

Potomac Formation

Considering that the Black Hills cycad sites are remote and often rugged areas in National Forest lands, it is strange that the second most famous location for cycads in America should be a distinctly urban area: from Baltimore through Washinton, D.C. and into Virginia. This formation, known for its fine cycads and other fossil plants, is named for the Potomac River. Complete cycad trunks are found in the red, iron-rich beds of sand. Fossil remains of sequoia, ginkgo, and ferns from this formation help complete our picture of warm wet forests dominated by cycads in the upper Jurassic.

Major cycad discoveries were made in the Baltimore area in the early 1860's. Some of these excellent trunks went to the Johns Hopkins University museum. Somewhat smaller on average than the South Dakota specimens, the Baltimore cycads grew on the shores of swamps inhabited by Mesozoic reptiles.

Just as a cycad species was named for the state of South Dakota, so was one named for Maryland: **Cycadeoidea marylandica.** The terminal bud of **marylandica** was set in a slight depression in the conical, now pinkish trunk. Cycads have been found in Maryland in Fredericksburg, Bowie, Laurel, College Park, Fort Foote and Rossiers Bluff. So interested were the farmers in areas where cycads were found that they brought even small fragments to scientific attention. Some had been ploughed from the fields and others cam from iron ore pits. Residents interviewed by scientists described their cycads as looking variously like a big pine cone, a roundish sponge, a thatched beehive, a pineapple or a wheat stack. Some of the cycads were iron stained and at least one was lignitized.

Two of the Maryland cycads became rather famous in that area a century ago. One was rather large, well preserved, somewhat flattened, and had a large hollow where the terminal bud had been. For years it went unrecognized in a farmyard- where it served as a watering fount for chickens. The other was thought to be concretion projecting from a cliff. A farmer named Link had been aware of it for several years. One spring it finally fell to the gulch below, where Mr. Link picked it up and took it to his house. When scientists arrived to examine the specimen, Link was able to show them the hole in the cliff where the cycad had been lodged for so many geologic periods.

Several cycads were found in the District of Columbia and at Alum Rock and Woodbridge, Virginia. Leaf prints, stem imprints, and cones and seeds from the Potomac group are found all the way from Elkton, Maryland, to Mount Vernon in Virginia.

But That's Not All

South Dakota and the Potomac are prominent among U.S. cycad localities but they are not the only ones. Freezeout Hills, Wyoming, not surprisingly, is a site for the species **wyomingensis.** The museum of the University of Wyoming at Laramie has an excellent collection of Wyoming cycads, which were first discovered about a century ago. Young fronds have been found armored by the leaf bases of the well silicified trunks of these Carbon county specimens. Other finds continue to be made, occasionally by gem collectors, since this is jade country. A second Wyoming locale is near Hulett, Crook county.

Cycad leaf prints from Alaska indicate that our farthest state to the north once had a very different climate. Ginkgo and fern leaf imprints are also found here.

The Jurassic of Buck Mountain in Douglas county, Oregon, has yielded numerous cycad leaf prints from several species. Beds rich in fossil plants are located on Thompson Creek on this mountain rising to 3400 feet. Plant fossils are found in the slate strata.

In northern California, the Shasta formation has produced both fossil trunks and leaf prints. **Cycadeospermum californicum** is a typical California cycad.

In the Kottanie formation of Montana, a nut-like seed was found belonging to the cycad **montanense.** Trunks are found near Alzeda near the Hulett, Wyoming, and Belle Fourche, South Dakota sites. The cycads of the Cimarron in western Oklahoma have been authenticated by paleobotanists from Yale. Since cycads are such great treasures to collectors, there has been a concentrated search for them by amateurs. This search has also led to the misidentification of concretions, fossil algae, fossil coral, and oddly marked jasper nodules as cycads. The late rockhounds, Jim Slack and Ned Kennedy were among the successful cycad hunters. The canyon country near Kenton is also a productive area. An Oklahoma rancher was said to have used a cycad as a door stop for many years. It was identified when he threw it in the back of his pickup for ballast and drove to town.

Many of the Utah cycads are completely silicified with good colour and highly contrasting patterns. They are from the Morrison formation of the Jurrasic, which has yielded so many beautifully agatized dinosaur bones.

Several cycads were reported to have been found in Colorado about 12 or 15 years ago. However, whether or not the identifications have been confirmed by paleobotanists is uncertain.

You Too May Find One

Many collectors are not familiar with the characteristics of cycads and have probably passed over many valuable specimens while looking for something else. This is made even more likely by the fact that in some areas the trunks are camouflaged by moss or lichen, and in others they may be coated with caliche.

The first thing to do when looking for cycads is to become familiar with this regal group of extinct plants by reading books on fossil flora and going to museums that display cycads. Rock shops in states where cycads are found are also a good place to study them.
To find specimens, look in areas noted for petrified wood of the Mesozoic. The symmetrical diamond- shaped patterns are the primary thing to bear in mind. Also be on the lookout for the graceful conical, spherical, or pineapple shapes and spiral leaf bracts. With a hand lens, it is quite possible to differentiate fossil wood from concretions and from animal kingdom fossils such as coral.

It is very helpful, once having found such a prize, to make a map of the lucky location. If possible, take a picture of the specimen at the site. Then get a scientist from a museum or university near the site or near your home to examine and authenticate the find.

Here we have merely touched on the rarity and wonder of these unusual fossil plants, but it should be enough to develop a taste for their value. Surely no one reading of their beauty and record of ancient plant life would acquire a cycad to use it for a door stop or for a fountain for chickens!

REPRINTED FROM "LAPIDARY JOURNAL" JULY 1988 WITH THE KIND PERMISSION OF THE AUTHOR AND THE EDITOR

STANGERIA SEX CHANGE

A new record has come to our attention of the highly unusual and biologically fascinating phenomenon of sex changes in cycads (see **ENCEPHALARTOS** 2:20-22; 2:24; 8:34-35 and 13:42). The information which follows has kindly been supplied by Miss Clare Reid of the Botanical Research Institute:-

"The *Stangeria* plant in question was grown by me from seed. When I moved to Pretoria in 1979, the plant came too, but my twelfth floor flat was too hot and dry. Per kind favour of Dave Hardy I transferred it to the Botanic Research Institute's orchid house where it grew apace. Sometime thereafter the crown produced female cones and did so for a number of years. Then a second crown was produced and in 1988 I noticed that the original central crown had female cones while the side crown had male cones."

Unfortunately the full significance of this event was not realised at the time and hence no photographic evidence is available. However, the plant has now been identified for careful monitoring should it repeat this behaviour. Miss Reid is quite certain that the second smaller crown was in fact an offshoot from the central caudex and not a separate plant in close proximity.

IN MEMORIAM

It is with regret that we record the passing of member Maurice Wood, who collapsed and died at his workbench in Pietermaritzburg recently. Our thoughts are with Nancy and other members of the Wood family.

VISITING MACROZAMIA PAULI-GUILIELMI

SUBSPECIES PLURINERVIA BY JOE PERNER

Early January 1989 whilst on holiday in New South Wales, Australia. which to my wife's dismay, turned out to be an 18 thousand Km cycad finding expedition of 15 species of **Macrozamia** 3 **Cycas** and 1 **Lepidozamia** through N.S.W. and South Queensland.

I set my sights on locating another very rare and difficult to find cycad.

One year previously I had heard from a friend in Brisbane that these **Macrozamia** were found in the Tenterfield district of northern-east N.S.W. not far from the Queensland border on the Roberts Range. After driving up many side roads and finding nothing we, my wife and three children, found a track which took us up into the foothills of the Roberts Range. We arrived at a beautiful site in a valley with a flowing creek and water-fall surrounded by virgin Eucalypt bushland and made camp. I decided to press on in my trusty cycad-expedi-tion-scarred 4WD at first light the next day, leaving the family to enjoy a sleep-in as the morning was very damp and foggy. As I progressed, the very rough track turned into a glorified mountain goat trail with loose rocky areas in places and slippery muddy areas in others, making the steep slopes quite hazardous to negotiate. After travell-ing the track for over two hours stopping at likely spots, not knowing if there were any colonies in the area, I found an area that looked promising near the top of the Range on the South East side. The Range was still shrouded in fog. The bush looked different to the bush I had passed through, there was a thicket of a type of Iron Bark Eucalypt tree with very coarse charcoal grey bark with grey- green leaves and bright apricot-red blossoms with swarms of very noisy, shrill, Rainbow Lorrokeets feed-ing on the nectar of the blossoms. The area "seemed to smell" of **Macrozamia**. After walking 25 metres up the slope from the vehicle there they were - my instinct served me well!

There was a colony of approximately 300 plants spread out over an area of around 3-4 acres in sparse groups with isolated plants between the colonies. I noted that the colony did not extend outside the area of quite large Iron Bark trees with wattle undergrowth. I also noted that they grew in a thick carpet of leaf and tree litter in sandy black soil between loose rock fragments on a gradual South East slope and did not extend much further up the side of the mountain to where the slope steepened and became quite rocky, the species of tree also changing on the rocky slope.

In the colony of around 300 plants I found around 20 male cones at various stages of maturity and decay. I also found 7 female cones at various stages of development, from just emerging to one cone almost mature. From one cone I extracted 34 seed, the cone measuring approximately 200mm x 80mm. This cone protruding from the subterranean caudex with the leaves laying almost horizontal was quite a sight. The colouration of the cone - cone scales was a powder blue-green, the seed colour was a port-tan protruding from between the scales. Regeneration was taking place, there were up to 15-20, 2 leaf seedlings around several parent plants. The plants carried an average of 5-8 leaves from 650mm to 700mm long with 4-5 twists of the rachis and carrying around 100 leaflets per leaf giving the leaf a foxtail affect not dissimilar to **Macrozamia stenomera**. Where the leaflets joined to the leaf stalk was a yellow colour on some plants to a burnt orange on others, the leaflets were around 80mm long and 8mm wide with entire margins on sides and around 3-5 teeth at apex of leaf on the median leaflets, the colouration was a pleasant blue-green and glossy above and duller underneath. The petiole was quite stout and was covered in a brown tomentum to where the rachis emerged from the ground. The petiole under the tomentum was ochre-yellow to ground level. The subterranean caudex was surrounded with a collar of dark brown coralloid roots and was the size and shape of a large pineapple.

also found several multi-crowned plants which is quite unusual for **Macrozamia**, a peculiarity I have also observed in **M. stenomera** from the Nandewa Range in Central Northern N.S.W. This **Macrozamia** also has the twisted rachis, its leaflets are divided up to 8 times giving it a foxtail affect.

One specimen I have of **M. plurinervia** has 6 crowns - four of which have put up new leaves since being put into its new home. One multiple- crowned caudex measured approximately 450mm in diameter and I dug down around 400mm before giving up because of large rock fragments in the ground, the caudex hardly seemed to decrease in diameter, this caudex could possibly have been hundreds of years old.

Anyway, (back to reality after tearing myself away) arriving back at camp took me 1 hour 15 minutes to cover 7Km distance from the colony to the camp, 8 hours after I left. Here I was told that the matches to light the fire were in the car. I am sure I will eventually be allowed to live it down.

Macrozamia pauli-guilielmi sub-species **plurinervia**, Roberts Range, north-east New South Wales, Australia.

Picture: Joe Perner

CYCADS: TISSUE CULTURE

The possibility of tissue culture techniques as a means to mass propagate cycads, particularly the rarer species, continues to attract attention. A recent publication by Dr David Webb, a North American research worker, and Roy Osborne, explores the ins-and-outs of this subject. The document forms a chapter in the book "Biotechnology in Agriculture and Forestry", Volume 5, Trees II, edited by Professor Y.P.S. Bajaj, and published in 1989 by Springer-Verlag in Heildelberg, Germany. The text is a highly-technical review of all the work carried out on this subject and will be immensely useful to specialist workers in this field. It is, however, not recommended for light reading!

CYCAD CONE DEVELOPMENT

Dennis Stevenson of New York Botanical Garden has published a Chapter entitled "Strobilar ontogeny in the Cycadales", which appears on pages 205-224 of the book "Aspects of Floral Development" edited by Leins, Tucker & Endress. The paper is a highly technical report on the developmental morphology involved in (1) vegetative branching and (2) cone formation in cycads. Reprint enquiries should be addressed to Prof Stevenson at NYBG, Bronx, New York 10458.

The Palm House and the Cycad Collection at the Royal Botanic Gardens, Kew

Susyn Andrews

After 6 years renovation (1984 - 1990), the Palm House at Kew will be re-opening in the summer of 1990. This Victorian glasshouse was constructed between 1844 and 1848 by the English architect, Decimus Burton and the Irish engineer, Richard Turner. Designed to display palms and tropical plants, it has always been a focal point of public attention.

This magnificent building has been completely restored by the engineering consultants Posford Duvivier, the architects The Property Services Agency and the contractors Balfour Beatty, and replanting began in April 1989 (see opposite 'The Daily Telegraph' 5/4/89) with the re-housing of the oldest pot plant in the world, an Encephalartos specimen, which was brought to Kew in 1775 from South Africa.

In addition to an innovative marine display area below the Palm House, humidification will be introduced and the area of planting beds greatly increased. The new plantings will represent American, Asian and African rainforests which are currently among the most threatened habitats on earth.

All the forest cycad species will be planted out in a mixed community in the Palm House, while most of the xerophytic cycads will remain for the time being in the Temporary Palm House by the Tropical Nursery.

In each wing, there will be a conservation display area which will show plants cultivated in clay pots on benches and in teak tubs on gratings, exactly as the first Curator, John Smith would have done in the 1850's. These will include our historic specimens of Masson's Encephalartos, together with an E. woodii and a male and female plant of E. ferox.

The central transept of the Palm House will contain Ceratozamia, Zamia and Dioon while Encephalartos villosus (a male and female plant), Stangeria and Cycas thouarsii will be planted in the South Wing and Lepidozamia, Cycas circinalis, C. rumphii and var. seemanii placed in the North Wing. Our collection of Macrozamia will remain in the Temperate Nursery.

Hopefully under these new conditions, there will be a much improved growth rate in the cycads, 50 per cent of which are facing extinction in the wild.

The emphasis throughout the living collections has changed from pure display to the preservation of ecological and conservation related themes. The Palm House will now become an unique example of Victorian architecture and an invaluable area in which endangered plants from around the world can be grown.

Susyn Andrews is the horticultural taxonomist at R.B.G. Kew.

The oldest glasshouse plant at Kew, an African Cycad which has been there since 1775, on its way to be rehoused in the Palm House, built in 1848, which has been restored over the last three years. The replanting programme for more than 900 plants is expected to take a year

A NEW CYCAD SECTION OF SOCIETY OF THE INDIAN PLANT TAXONOMISTS

by
Rita Singh
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In January 1989 a group of Cycadologists from the Department of Botany, University of Allahabad, visited some Cycad localities in South India and Western Ghats of Deccan Plateau with Professor Divya Darshan Pant as leader.
Accompanying the expedition were Professor D.D. Nautiyal, Head of the Botany Department, Allahabad University, Dr. D.K. Chauhan, Dr. S.P. Tiwari, Dr. R.S. Pandey, Dr. Pradeep Srivastava and the author of this report (Rita Singh).

The team first went to the Algarkovil Reserve Forest which is part of the Srivilliputhus Forests Range of Tamil Nadu in the Nilgiri Hills. Among other things the forest is famous for its luxuriant growth of **Strobilanthes kunthanus** (Nees)T. and ex Benth. (Acanthaceae), its wild elephants and giant Malabar squirrels. It is important to mention that **Strobilanthes kunthanus** flowers only once in 6 years and our team was fortunate enough to see their gregarious blooming which was giving the forest a gigantic blaze of blue colour. The actual Cycad localities (Seembu and Birusadi) can be reached after a continuous, almost vertical, climb of about 4 kms. from the Algarkovil river base. The hill at the lower level is dominated by shrubs and herbs belonging chiefly to the Papilionaceae, Labiatae, Acanthaceae and Malvaceae. We climbed up to heights which are only about 200 or 250 feet below the actual Cycad locality in the areas called Chokambarai, Kalagmalai motaii and Swamitaran. There were mainly covered by ubiquitous dense vegetation dense vegetation of head-high lemon grass, **Cymbopogon nardus** (L.) Rendle, which was greatly helpful to us in our ascent through the slippery, rocky, pebbled and sandy ground. From Swamitaran we would see the dangerously steep exposed rocky hill slopes with clusters of **Cycas** trees and very near to the same spot we found mercilessly cut trees of **Cycas**, including one of the tallest specimens we have ever witnessed in the field. Its trunk was about 13 feet tall and its girth was about 6 feet. We were accompanied by forest guards with their loaded guns to protect us from any wild elephants. They told us that **Cycas** plants are locally known as "Engee" and their fronds are used for decoration of homes during festivals and marriages and also for preparing broomsticks by the tribals. The male cones, which emit very strong odour, are also used by the villagers for driving away rice bugs from their rice fields! At Seembu locality we could see only about 25-30 trees of **Cycas** which were growing singly or in clusters between the grasses. Their trunks showed no rhomboidal scars because their surface was charred by the annual burning of grass cover. In fact, the stems of most of the plants which we observed appeared to be almost geophilous and they seemed to be surviving only because of their half buried bulbils which were sometimes as thick as their parent trunks. Indeed, they reminded us of **Cycadeodea** trunks figured by Wieland in his "American Fossil Cycads". After this locality we climbed further to Birusaid where we were completely overawed by the stupendous sight, in a single glance, of a huge population of more than two hundred wild **Cycas** clumps growing between the gullies of the exposed rocky slopes. On the basis of their leaves, megasporophylls and dried up male cones we identified them as **Cycas circinalis** L.

After completing our collection at Algarkovil our team reached another locality, Nagmangla, near Bangalore in Karnataka State. The locality has a thourougly exposed rocky terrain adjacent to a motor road and can be easily approached from the road on foot. We found a number of plants of both sexes of **Cycas circinalis** L. The males were bearing young or old dried-up cones and some of the females had apical megasporohyll clusters with an enormous number of seeds.

The plants grew in clumps of 5-6 or more trunks usually of the same sex. As we reached the place after dusk, in spite of vigourous efforts we were able to find any viable seeds although we did collect some hollow or termite-eaten seed kernels.

The devestation scenario of **Cycas** at this spot was even more perturbing than it was at Algarkovil because this niche is very near to a motor road and the cultivated lands of the surrounding villages. We were told that the local villagers use the male cones for driving bed bugs! Thus the inhabitants of both Cycad localities we visited are unknowingly destroying the wild natural habitats of this vanishing relic of the past.

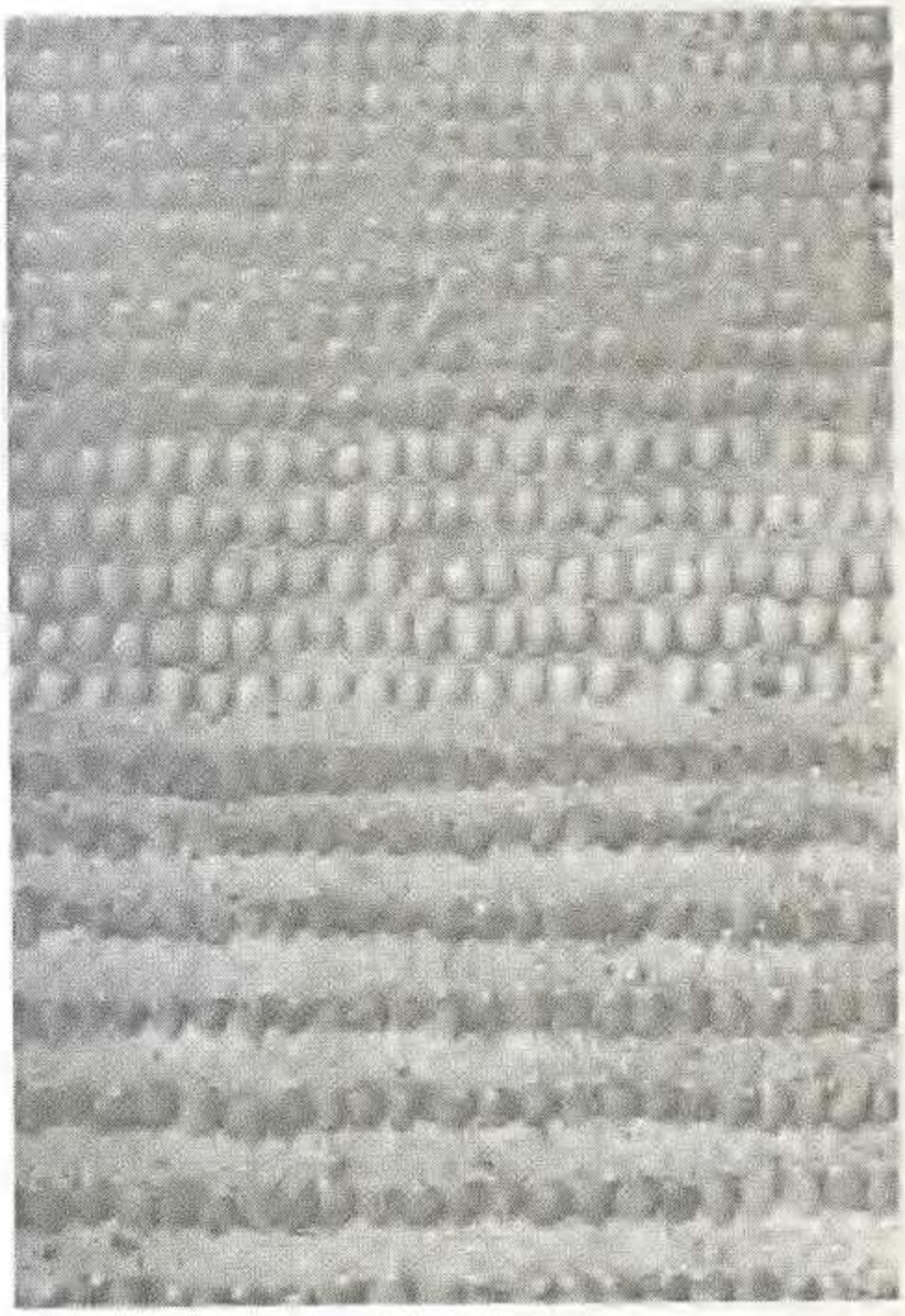
We were so much overwhelmed by the destruction which we saw at both the localities of **Cycas** that, soon after our return to our headquarters at Allahabad, we decided to work for the protection of Cycads growing in different Indian localities. In this we wish to follow the example set by the Cycadologists of South Africa, America and Australia and we have now formed a **CYCAD SECTION"** of the **SOCIETY OF INDIAN PLANT TAXONOMISTS** with Professor D.D. Pant as Founder President and Professor D.D. Nautiyal as Vice-President.

Besides protecting Cycads the SECTION will also so research work on varous aspects and its programme will include:

1. An extensive and intensive survey of the localities where species of **Cycas** are found;

2. Comprehensive study on their morphology and anatomy;

3. Study their ecology and reproductive biology.



MYSTERY PICTURE

Guess what this picture shows?

1. Close-up detail of a new ethnic dress fabric?

2. The experimental - and highly confidential - breeding beds of the Novel Mushroom Reseach Institute?

3. The display cabinet of the tick collection at the Transvaal Museum?

REGIONAL REPORTS : NATAL REGION

On 4 June 1989, seventeen members and fourteen guests braved the cold and wet weather to visit "Dulumbi", Kranskop, the property of Friedel and Alta Redinger.

Everybody met at 10h00 at the Kranskop Hotel. Some of the bystanders remarked that we must either be mad or addicted to cycads to go on an excursion on such a miserable day.

But after a cup of hot coffee we were ready to go. On arrival at the vicinity where the cycads grew we were all enraptured by the sight of the magnificent Encephalartos natalensis, arrayed against the backdrop of the cliffs, we thought they were arranged especially for us. All the plants are in excellent, healthy condition and we were amazed by the fact that 95% are in cone, both male and female, with a lot of seedlings.

I will do a great injustice to the plants to try and describe them here, they must be seen to be fully appreciated. The environment is beautiful, a valley that runs through hills covered in mist. With the calls of "Loeries" (birds of the bush) ringing in our ears, we left the area with mixed feelings. Back at the home of Friedel and Alta, we saw barberque fires already burning in the Barn. After the braai, Friedel told us about the history of Kranskop, showed some photographs and told us what they were doing to educate the white as well as the black people on nature conservation, to protect the cycads for descendants.

We were very appreciative and glad to see what the Redinger's family do to preserve the survival of the beautiful Encephalartos natalensis. The committee decided to arrange an excursion to Kranskop again for those members that were absent.

Danie Nel
Natal Chairman

Members of the Natal section braving a wet cold winter's day to pay homage to E. natalensis at "Dulumbi", Kranskop, on the Society's excursion on 4 June 1989.

Photo: Roy Osborne

Mystery picture - Answer:-

The picture shows parts of the thousands of cycad seeds set in the sand/cable heated germination beds at Cynthia Giddy's Nursery. Careful examination will show the the seeds are planted almost vertically, with the micropyle down to prevent desiccation. Most of the professional growers are now using this technique.

Variation in Female Cones of Zamia pumila

By Willie Tang

Like all organisms plants exist in populations, and biologists interested in evolution or taxonomy ultimately ask: what are the patterns of variation within and between populations? Once gathered, information on variation can be used to determine whether populations belong to the same or to separate species. To avoid the pitfalls of subjectivity biologists select and study characters that can be measured and interpreted similarly by everyone. With this in mind we ask: what kind of variation do we see in cycad cones?

My specialty and the subject of this paper is the *Zamia* of Florida, known currently as *Z. pumila* (1). Below I describe variation in size and sporophyll arrangement in female cones in four populations. Three of these are wild populations in subtropical southeast Florida; I have named them Fairchild, Miami, and Everglades and they are described in other publications (2, 3). The fourth population (named Metrorail) is a group of plants cultivated in southeast Florida that originated from northeast Florida (2, 4); it is of a form sometimes recognized as *Z. umbrosa* (5). Unlike the southeast Florida form which usually grows in sand pockets in limestone substrate, the umbrosa form lives in sandy soils and often produces large multi-branched stems and has wider leaflets than the southern form.

Cone Size

Unlike female cones of *Encephalartos*, which reach full size at the time of pollination, *Zamia* cones continue to grow after pollination and final size depends on how many seeds develop to maturity. To get a standard measurement of female cone length and width I chose to make measurements at the time of receptivity to pollination (6). Results for the Metrorail population are displayed in Fig. 1. There is a strong correlation between cone length and width, however, variation in width (mean and standard deviation: 47.0 ± 4.0 mm, range: 40-60 mm) is less than length (89.5 ± 17.6 mm, 56-156 mm). The range in cone width is 33% of the maximum measurement while that for length extends over 64% of the maximum. These figures support the prediction by Tang (7) that female cones will vary more in length than width.

Sporophyll Arrangement

Number of rows and columns in female cones are displayed in Fig 2. The number of columns per cone in the Fairchild, Miami, and Everglades populations are similar, but are different from that for the umbrosa population. Table 1 confirms this pattern statistically. The Fairchild population, however, displays significantly more rows per cone than the other two wild populations. As in cone size, we find that sporophyll number along the length of the cone varies more than along its width; row number ranges more than three fold (3-10) while column number ranges two fold (6-12).

Table 1. Means, standard deviations, and sample sizes for number of columns and rows for female cones from four populations of *Z. pumila*

Population	# columns	# rows	Sample size
Metrorail	9.0 ± 1.4*	5.9 ± 1.4	34
Fairchild	7.6 ± 1.2	5.9 ± 1.5	68
Miami	7.6 ± 1.2	4.6 ± 1.1	48
Everglades	7.1 ± 1.1	4.7 ± 1.1	29

*Significantly different at P<0.05, Kruskal-Wallis ANOVA

Conclusion

As in all organisms we find that in *Zamia* cones there is variation. Some of this variation is undoubtedly environmental. Better growing conditons, for instance, produce larger healthier plants with bigger cones. However, cultivated plants of *Z. pumila* from throughout its range in the Caribbean growing at Fairchiild Tropical Garden retain differences in cone size and morphology suggesting that much of this variation in *Zamia* is genetically based. This study suggests that variation in cone width and column number is small enough within populations but large enough between populations of *Z. pumila* to serve as taxonomic tools. As a side note, female cone apex shape was also examined in this study. In fewer than 80 cones examined from the umbrosa population and fewer than 100 cones examined from the Fairchild population, the entire range of female cone apex shapes described by Stevenson (8, 9) was found within each population. This suggests that cone apex shape in this taxon may be of limited value as a taxonomic tool.

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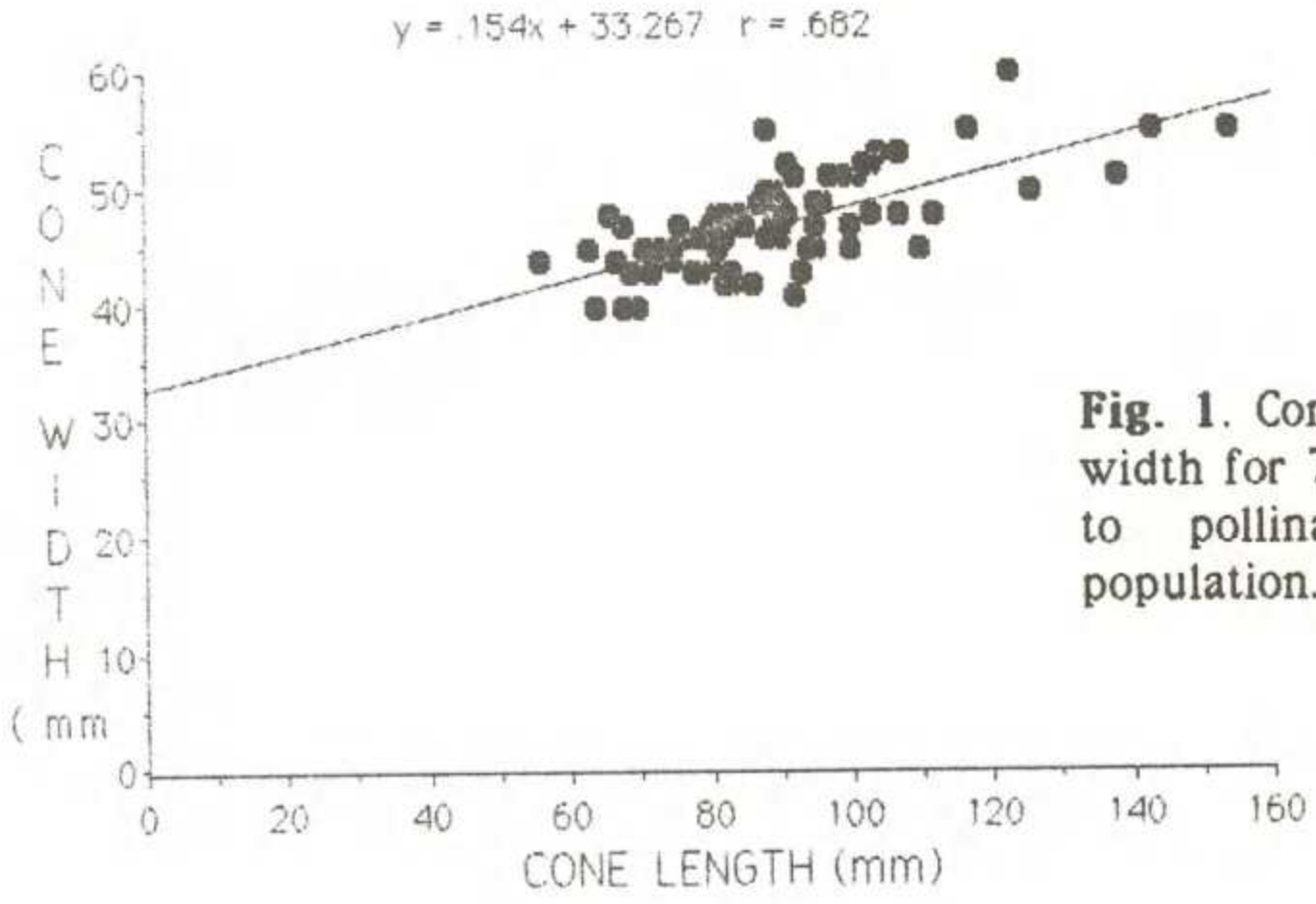

Fig. 1. Cone length plotted against cone width for 78 female cones at receptivity to pollination from the Metrorail population.

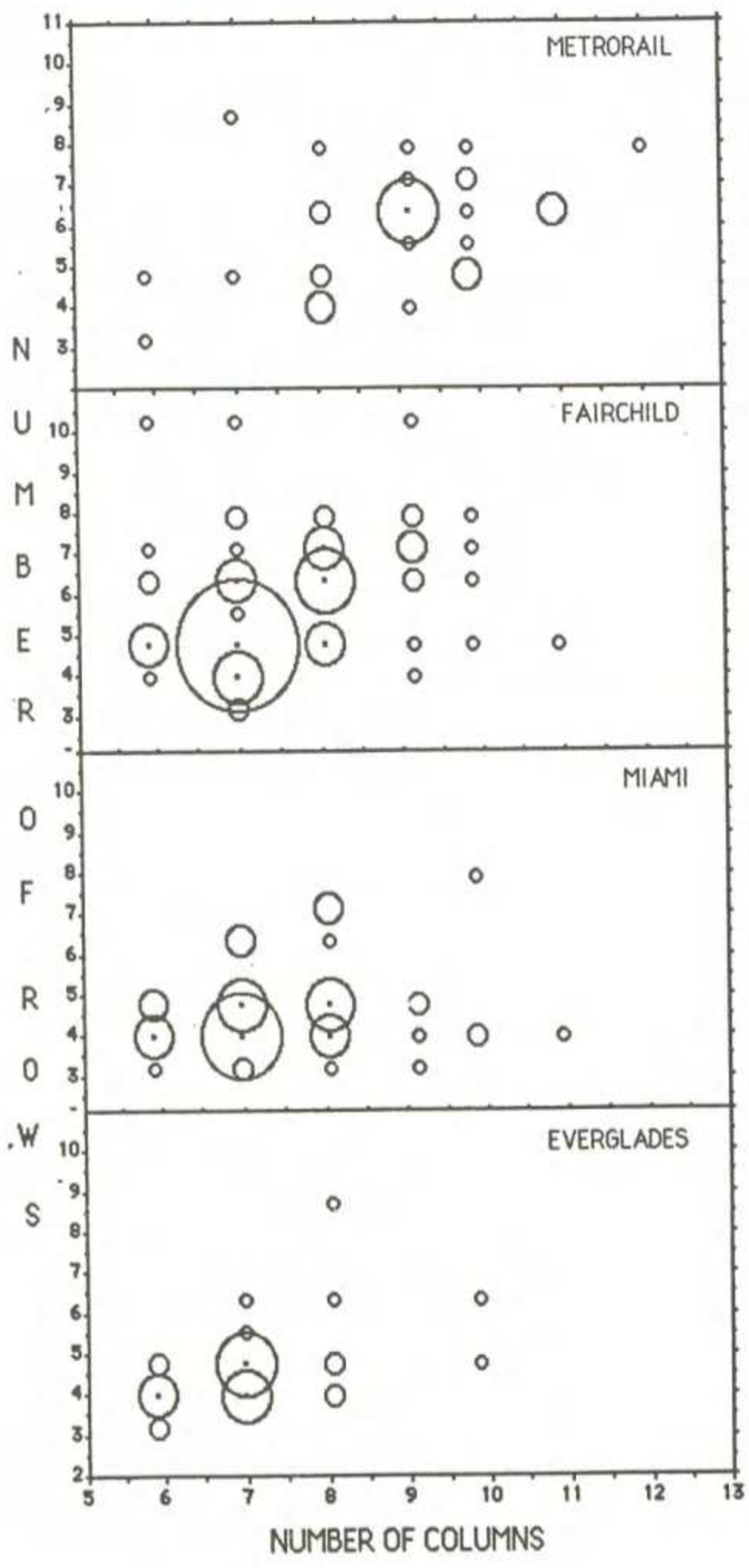

Fig. 2. Number of columns per cone plotted against number of rows per cone for females of four populations of *Z. pumila*. Circle diameters indicate the number of cones coinciding at each point.

INSECT POLLINATION OF CYCADS BY

Knut J. Norstog and Priscilla K.S. Fawcett

Fairchild Tropical Garden Miami, Florida, U.S.A.

Although it has been thought by many botanists that cycads are wind-pollinated plants, from time to time there have been reports that insects, usually beetles, might be implicated in their pollination (see for example Rattray, 1913; Baird, 1938; Norstog and Stevenson, 1980). More recently Norstog, Stevenson and Niklas (1986), Tang (1987), and Norstog (1987) have provided convincing evidence that two species of Zamia are in fact effectively pollinated by weevils, and a note in a recent issue of ENCEPHALARTOS (Stobart, 1989) speaks of experiments to determine the effectiveness of beetles in pollinating Encephalartos altensteinii. Now we have further evidence of the importance of a weevil, Rhopalotria mollis, in the pollination of Zamia furfuracea and we believe we have incontrovertible evidence that the cycad and weevil are completely dependent upon each other in a tightly linked symbiotic relationship (Norstog and Fawcett, 1989). What we postulate is that if the weevil were to go extinct so too would the cycad and vice versa. Let us explain.

Zamia furfuracea like most other cycads bears what we may call "tight cones." By that we mean that the female cone is closed against incursions of foreign bodies, including those of insects, for nearly all of the reproductive cycle. It is, therefore, inconceivable that wind-borne pollen readily would enter such a cone because even at pollination time access to the cone's interior is provided only by a narrow crack between adjacent cone scales. Similar situations prevail in most other cycads. We have conducted many "exclusion" experiments in which we have attempted to exclude either wind-borne or insect-borne pollen, or both, from entering female cones, and what we find is that when wind, but not weevils, is excluded, pollination is up to 100%. However, when weevils (but not wind) are excluded, pollination is largely ineffective.

We might add here that it proved nearly impossible to exclude weevils from female cones -- they managed to squeeze through nylon-mesh openings half the diameter of their bodies and even to crawl past tightly drawn closures of plastic bags enveloping entire female cones. This last observation certainly counters any argument that these insects are simply chance visitors. Even so, we do not yet know just what irresistible "here-I-am pollinate me message" the female cones are broadcasting. Probably it is a scent of some kind, and we should mention that the weevils are very good flyers and no plant of Z. furfuracea seems to escape their attention.

The little weevils that pollinate Z. furfuracea first appear on pollen cones in late June (Fig. 1). We see them feeding on the starchy tissues of the sporophyll tips, we observe the males and females mating, and we see the females depositing their eggs at the bottom of feeding holes left in the sporophyll tips by earlier feeders. We have followed egg-hatching and seen the tiny grubs feed voraciously on the soft and succulent tissues of the sporophylls. We have observed that when more than one larva is

present in one sporophyll they inevitably meet as they chew away their food supply, then the presumably more aggressive ones eat the others. Even though as many as six larvae may be present in a single sporophyll, there is only one survivor. The "fortunate" one then hollows out the sporophyll stalk and builds itself a stout enclosing cylinder composed of its dung cemented together with a slime it secretes from its skin. What happens next is, however, still more amazing!

Early in the coning season, the larvae build their pupa cases as described above and then rapidly metamorphose into pupae and in a few more hours into mature adult weevils. The whole process from egg laying to emergence of adults takes 9-10 days. Then the cycle is repeated several times during the coning period of the cycad. Although both larval and adult weevils are voracious feeders, in no case do they ever feed on pollen or even damage the pollen sacs. Is this avoidance an ingrained behavioural product of the evolution of a mutualism which maximizes the reproduction of both the plant and its pollinator? Who can say? This, however, is not the whole story!

Toward the latter part of the coning period of the cycad, a change takes place in the behaviour of some of the larvae. They become quite fat and waxy looking and these well-fed individuals build very stout pupa cases with walls about twice as thick of those formed by earlier larvae. These "late" larvae do not immediately metamorphose but instead remain in a kind of suspended development which is termed diapause. They are not truly dormant for they wiggle about when disturbed but they lack some kind of signal enabling them to change from larvae to pupa to adult. We find diapausic larvae in disintegrating male cones months after pollination and, in fact, they remain in their pupa cases until 9-10 months later when the next annual season for cycad coning occurs. We don't actually know if all the weevil larvae then become adults, but because nature seldom puts all her eggs in one basket we suspect that some larvae may remain in diapause for yet another season and perhaps even other seasons beyond that.

This scenario we have just related is not the whole story by any means. We think we know why weevils only feed on male cones and never on female cones. For one thing, male cones have a lot of starch while female cones have very little. We also think that female cones may possess some means of confronting would-be feeders with an array of toxins which are neutralized in the male cones by being nicely wrapped up in little packages called idioblasts, but the idioblasts in female cones appear to have discharged their contents. In some way, we think the weevils either do not eat the idioblasts, or, if they eat them, they excrete them undigested. The larvae eat everything, idioblasts and all, but we think they too excrete idioblasts. If so, maybe these excreted idioblasts in the dung are incorporated into the pupa cases so that the larva is snugly encased in a little box which is poisonous to any tiny predator having the temerity to feed on the boxed-in larva. Of course, there is a good deal of speculation involved here and the truth may not be at all as we have imagined it to be.

Recently we have encountered almost a plethora of reports of insect pollinators of cycads

which seem to be based on assumptions that if one finds insects in cycad cones one can assume that they are the pollinators. It reminds us of the rash of claims of bacterial diseases that followed on the heels of Pasteur's discovery of the anthrax bacillus. Every bacterium found in blood, stools, sputum, etc. was pronounced to be the cause of all the ills of humankind. Eventually, it fell to Robert Koch to restore some order to this chaos by stating his famous postulates; i.e., isolate the bacterium from the patient; grow it in pure culture; infect a laboratory animal (mouse, rabbit, etc.) with the suspected bacterium; find that the animal then becomes diseased, and then reisolate the bacterium from the sick (dead?) animal and once again grow it in a laboratory culture. Maybe we need something like this to prove the case for suspected insect pollinators of cycads. At the very least one should note the following: 1) The consistent association of an insect species with the cones of a specific cycad. 2) That the insects occur on and in both male and female cones. 3) Whether pollen adheres to the body of the insect. Then, if possible, exclude the insect from some female cones and note the effect on fertility.

What we have learned about the pollination biology of Zamia furfuracea and Rhopalotria mollis may have extremely important applications to other cycads. We think there is at present enough circumstantial evidence to say that most, possibly all, cycads are insect pollinated. Furthermore, from our observations and those of others we think there is strong evidence that each species of cycad may have its own specific insect pollinator. Think of the implications! Could it be that if we find that two "species" of cycads have the same pollinator, they may not really be distinct species at all? Does the insect know more about cycad taxonomy than we humans? Or -- if geographically isolated species have the same pollinator, do we inadvertently bring about an unnatural hybridization when we bring them together in our gardens?

Perhaps the most important point of all in the relationship between cycads and their pollinators has to do with survival in the wild. When we bring cycads into cultivation in botanical gardens, sometimes half a world away, we no doubt leave the pollinators behind. That's the reason most imported cycads are infertile in cultivation and have to be hand-pollinated. Should we try to bring their pollinators along as well? Would this be permitted by our quarantine regulations? I imagine to do so would require iron-clad proof that the pollinator is completely host-dependent and would not parasitize other plants. We probably therefore always will have to hand pollinate our captive cycads. But what about those species that go extinct in the wild.? Surely their specific pollinators then also are doomed. Suppose, as we sometimes glibly state, that when the species is extinct in the wild we eventually try to reintroduce it into its native habitat. How will it then reproduce itself without its natural pollinator? It seems to us that we must very rapidly develop a crash study program of cycad pollination or face disaster insofar as wild cycads are concerned. We would like to invite all "friends" of cycads to contribute information on cycads, insects, and possible pollina-

tors, but only if these efforts have a sound scientific basis (for proper procedures refer to the note in ENCEPHALARTOS by Stobart).

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Figure 1. Reproductive cycle of R. mollis in male cones of Z. furfuracea. a. Feeding and copulating adult weevils. Note feeding holes. Females deposit 1 egg in each such hole. b. Eggs at the bottom of feeding holes. Adults shelter and feed within the cone. c. Larvae feed on tissue of the sporophyll end; when one encounters another cannibalism occurs so that finally only one survives. d. Surviving larva excavates and lines a pupa case in the stalk of the sporophyll. e. pupation occurs in 1-3 days. f. further metamorphosis occurs within hours and adult emerges by boring a hole through the end of the sporophyll. f. Later in the season, sporophylls of late-developing cones exhibit green colouration at their ends. These areas are avoided by feeding and egg-laying weevils and eggs are deposited in lateral feeding holes. g. larvae excavate toward sporophyll stalk accompanied by cannibalism. Some larvae then repeat the rapidly metamorphosing stages shown in d-f, but others (h,i) become fat and waxy, build thick-walled pupa cases and remain in diapause without further metamorphosis. This stage may last as much as a year.

pto

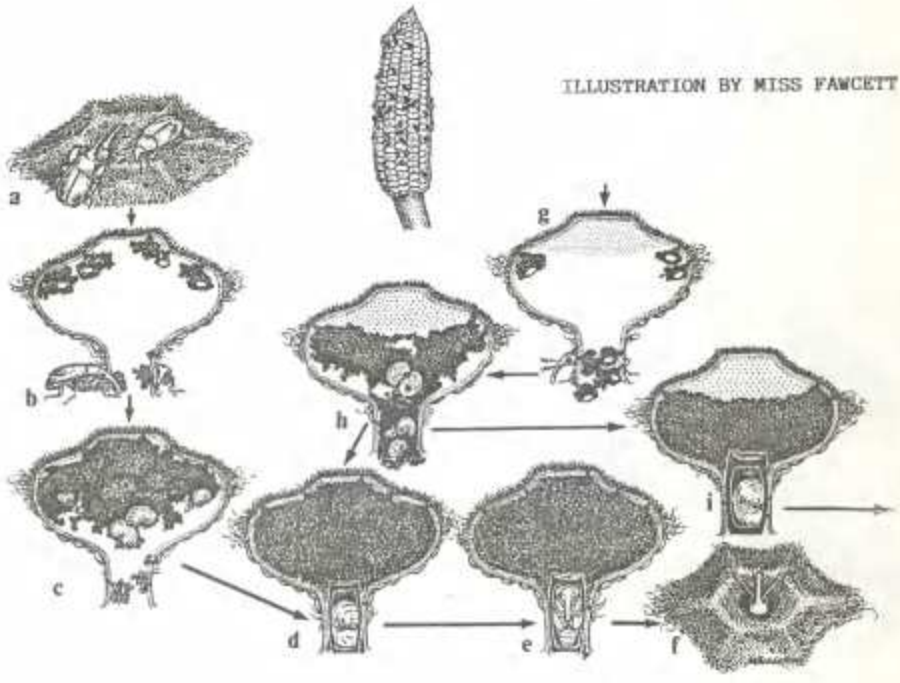

ILLUSTRATION BY MISS FAWCETT

SAADBANK

Die volgende saad is nou beskikbaar by die saadbankbeampte, Danie Nel Bowkerweg 120, Escombe 4093 : Tel 031-442505 (saans).

Encephalartos villosus

Verwag saad van Australie

SEEDBANK

The following seed is now available from the seedbank officer Danie Nel, 120 Bowker Road, Escombe, 4093 : Tel 031-442505 (evenings).

Encephalartos villosus

Expecting seed from Australia

What is a man without Fauna and Flora? If all the Fauna was gone and all the Flora was removed and dead, man would lose his spirit and forever lay down his head. For whatever happens to our Fauna and Flora will surely happen to man as well.

We are all inseparably linked in the chain of life, and whatever befalls the Fauna and Flora of the world will also befall the sons of the world.

By: Bunny Wentzel

Well saved!

HERALD

LAST week's breakthrough in the war on the illegal removal of cycads from the Eastern Cape merits full praise.

The 110 trees found on that truck near Wepener were worth an average of R3 000 apiece. All were several hundred years old. A senior conservation official said of the smugglers: "All they care about is the cash."

Those plants are part of this region's heritage. We hope the seizure of that load heralds the end of this ugly pillaging.

BEES AND CYCADS
BY NAT GROBBELAAR

One is commonly told that insects like bees are attracted to sources of nectar and pollen by the smell and/or colour of the object (usually a flower) which produces the nectar and/or pollen. I was therefore very surprised during the past autumn to find numerous bees collecting pollen from Encephalartos villosus male cones in several Pretoria gardens. It so happened that there were several male cones of E. lehmannii in one of the gardens which were also shedding pollen at the time. Despite the fact that both the E. villosus and E. lehmannii male cones have a distinct musty smell at the time of pollen release, no bees were seen on or around the E. lehmannii cones.

On closer inspection, it was obvious that the sporophylls (scales) of the E. lehmannii cones have separated so slightly that bees would not be able to get right up to the sporangia on the abaxial sporophyll surfaces to collect pollen. I therefore removed a pollen releasing male E. lehmannii cone from the parent plant and removed the sporophylls from alternate rows of the cone so that bees would not have any trouble to get at the pollen. I then placed the cone amongst the four pollen shedding male cones of an E. villosus plant and waited to see what was going to happen.

For the first five minutes the bees completely ignored the E. lehmannii cone on their way to and from the E. villosus cones. But then a bee coming in to collect pollen, apparently by accident, landed on top of one of the E. lehmannii cone's sporophylls which had a layer of pollen on it. The bee fumbled around for a while and got itself pretty dusted with pollen. Then, all of a sudden, it actively started to collect pollen and when its pouches were full, it flew away after briefly circling around the cone. After about three minutes a bee (probably the same one) went directly to the same spot on the E. lehmannii cone and started to collect pollen. This time, however, it collected pollen mainly from the sporangia on the lower surface of a sporophyll. Before it left, another bee arrived and started to collect pollen and before long there was a steady stream of bees visiting the E. lehmannii cone.

From the above it seems as though bees are not attracted to male cycad cones, but if the happen to "stumble" onto a ripe cone and discovers the rich source of pollen, then it collects it and transmits a message to other members of the hive which then joins in the spoils. Alternatively, bees are attracted to ripe male cycad cones by its smell, but if they can't get at the pollen, they remember to disregard the smell of that particular cycad species' male cone and even transmits the message to fellow workers from the same hive.

Be it as it may, it is obvious from my little experiment, that

should the pollen of cycad species other than E. villosus be made accessable to honey bees, they will actively collect it and cart the pollen off to their hive. They do therefore not appear to have a strong preference for the pollen of a particular cycad species, but will gather the pollen if the sporophylls separate sufficiently widely for them to get at the sporangia.

When the cones of an E. woodii in the same garden elongated a few weeks later and started to shed pollen, the bees actively gathered pollen from them too. The cones were a metre in length and their widely spaced sporophylls provided easy access for the bees to the very considerable amount of pollen that it produced.

Apart from these two species, I have never observed the gathering of pollen by bees on any other cycad species. Perhaps the other cycad enthusiasts have noticed pollen collecting bees on the male cones of other cycad species. If so, I would like to obtain the details from them.

Honey bees on a pollen collecting visit to an E. villosus male cone in a Pretoria garden.

Photograph by Nat Grobbelaar

COUTTS VISIT SOUTHERN AFRICA

Dave and Pat Coutts, well-known Australian cycad enthusiasts, visited southern Africa earlier this year. They spent some time with members Ian Turner (Zimbabwe), Cythia Giddy and Roy Osborne (Natal) and Bruce Bursey (E. Cape) before flying off for a few restful days in various Indian Ocean islands. Pat and Dave will be the hosts for the **CYCAD 90** Conference in Queensland next year.
(Photographed in Durban Botanic Gardens by Roy Osborne).

EASTERN CAPE CYCADS
BY NEIL MUNRO

Nothing is more inspiring to me than to walk in the veld to view cycads in their natural habitat.

I was fortunate recently to visit the farm of Mr. Len Forrester, a spritely 75 year old, on his magnificent farm Riverside at Cathcart.

This well managed farm of 2000 hectares is the home of his Sussex beef cattle and large flocks of sheep. The grandeur and climate lends itself to some of the biggest cycads of **Encephalartos friderici-giulielmi** (see Encephalartos No. 18).

Mr. Forrester, with the step and surety of a mountain goat, led us on a most interesting tour of his farm which is bisected by the Thorn River.

Although it was mid winter several of the plants we viewed were starting to cone and to conserve this magnificent species, Mr. Forrester actively collects and sells fertile seed.

The first group of cycads we viewed were within 1 km of the homestead on a hill of calcytic sandstone, the grass cover was excellent and no recent veld fires have had to be tamed.

Crossing the Thorn River and on to a western slope the biggest concentration of the cycads was to be found on the farm. With so many interesting specimens in all shapes and sizes the camera became very busy and 3 rolls of film later, it was time to return to the homestead and bid the Forrester's farewell. With their love of the cycads and sound farm management these cycads are not threatened and will continue to thrive in their natural habitat. Mr. Forrester will gladly receive visitors to the farm providing prior arrangements are made. His telephone number is 04562-2003.

Two healthy specimens at the top of the sandstone hills.

Mr. Len Forrester dwarfed by two magnificent specimens

Note the break in the trunk of this 5m specimen

General view of the beautiful farm, Riverside.

A female specimen coming into cone.

All photographs by :
NEIL MUNRO

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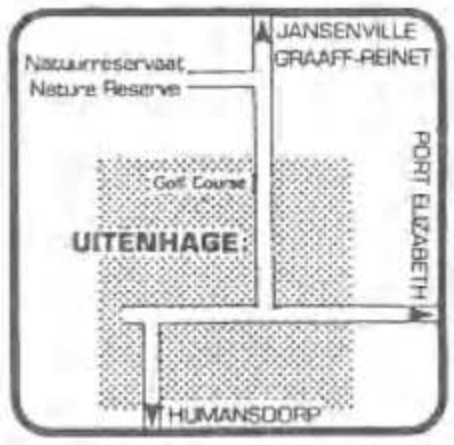


REFERENCE — VERKLARING

Footpaths; Public Roads — Wandelpaaie; Openbare Paaie

Service Roads; Fences — Dienspaaie; Drade

Contour Interval 10m Kontoertussenruimte

Scale 1:10000 1 cm = 100 m Skaal

Designed, compiled and drawn for Uitenhage Town Council by MAPCAPE, Swamp Daisy Farm, P.O. Box 108, Kleinmond 7195 Tel (02823) 3344

Ontwerp, opgestel en geteken vir Stadsraad Uitenhage deur MAPCAPE, Swamp Daisy Farm, Posbus 108, Kleinmond 7195 Tel (02823) 3344

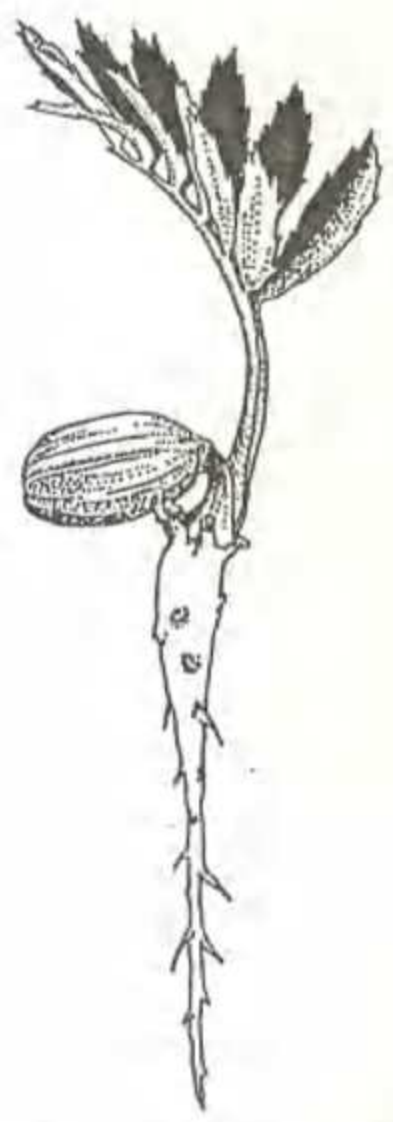
Kartografie deur Cartography by **Peter Slingsby**

Co-Editor Neil Munro up to his knees in **E. horridus**

Anybody who visits Port Elizabeth and has a few hours to spare and would like to view **Encephalartos horridus**, need only drive out to the Uitenhage Nature Reserve, a mere 30 minutes from the city centre.

The ever helpful manager Mr. George Human will issue a map of the footpaths which on following, will lead one to the **E. horridus.** Bush encroachment is a problem on this reserve and it almost appears as if the plants are struggling to grow, hot berg winds, minimum rainfall and the present drought also make these plants look jaded. The best place to see the plants is at Aloe Corner where they grow in profusion among the quartzite rock. This is an easy walk and can be reached after a mere 30 minutes from the car park.

Map reproduced by kind permission of MAPCAPE, Box 108 Kleinmond 7195.



The ultimate of every collector to produce their own fertile seed.

FIJI'S CYCAD : CYCAS RUMPHII forma SEEMANNII

Text from a report by Albert C. Smith in *Flora Vitiensis Nova* 1:89-91 of 1979, published by the Pacific Tropical Botanic Garden, Hawaii.

DISTRIBUTION: Although the sole genus, *Cycas*, is in need of a satisfactory revision, it probably contains about 20 species occurring from Madagascar and eastern Africa to eastern and south-eastern Asia, Malesia, tropical Australia, and the western Pacific. Some species are widely cultivated as ornamentals, and perhaps also for the edible starch of the pith of their trunks. Only one species occurs in Fiji.

1. CYCAS L. Sp. Pl. 1188. 1753; Seem. Fl. Vit. 268. 1868; Pilger in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. **13:** 74. 1926; Schuster in Pflanzenr. **99** (IV. 1): 64. 1932.

Characters of the family.
Type Species: *Cycas circinalis* L., the only original species.
Distribution: As of the family.

Useful treatments of Genus: Pilger, R. Cycas. Engl. & Prantl, Nat. Pflanzenfam. ed. 2, **13:** 74-75. 1926. Schuster, J. Cycas. Pflanzenr. **99** (IV, 1): 64-84. 1932. Laubenfels, D.J. de. Cycadaceae. Aubreville & Leroy, Fl. Nouv. Caled. et Depend. **4:** 7-10. 1972.

1. **Cycas rumphii** f. **seemannii** (A. Braun) Kanehira in J. Jap. Bot. **14:** 587. 1938; J.W. Parham, Pl. Fiji Isl. 40. *fig. 19.* 1964, ed. 2. 68. *fig. 19.* 1972.

Cycas circinalis sensu Seem. in Bonplandia **9:** 259. 1861, Viti, 442. 1862, Fl. Vit. 268. 1868; Drake, Ill. Fl. Ins. Mar. Pac. 353. 1892; Yuncker in Bishop Mus. Bull. **178:** 19. 1943, in op. cit. **220:** 45. 1959; non L.

Cycas seemannii A. Braun in Sitzungsber. Ges. Naturf. Freunde Berlin **1876:** 114. 1876.

Cycas seemannii A. Braun ex Carruthers in J. Bot. **31:** 2. *t. 330.* 1893; F. v. Muell. in Chem. Drug. Austral. Suppl. **5:** 34. 1882.

Cycas rumphii sensu Kanehira in Bot. Mag. (Tokyo) **45:** 273. 1931; non Miq.

Cycas circinnalis subsp. *seemannii* Schuster in Pflanzenr. **99** (IV. 1): 71. 1932.

Cycas circinalis subsp. *seemannii* Schuster ex Kanehira, Fl. Micrones. 59. 1933; Sykes in New Zealand Dept. Sci. Indust. Res. Bull. **200:** 35. 1970.

Cycas rumphii var. *seemannii* J.W. Parham in Agr. J. Dept. Agr. Fiji **19:** 94 *fig. 7.* 1948, in op. cit. **29:** 32. 1959.

The only cycad indigenous in Fiji is an unbranched tree 1-12m high, with a trunk diameter of 10-30cm; it has been noted to bear fruits, which are green, becoming reddish brown and 5-8cm long at maturity, between April and December. It occurs from near sea level to about 600m in various types of forest, usually in dry places, on rocky open slopes and grassy ridges, somewhat scattered in its local distribution, but more frequent in *talasinga* areas than elsewhere.

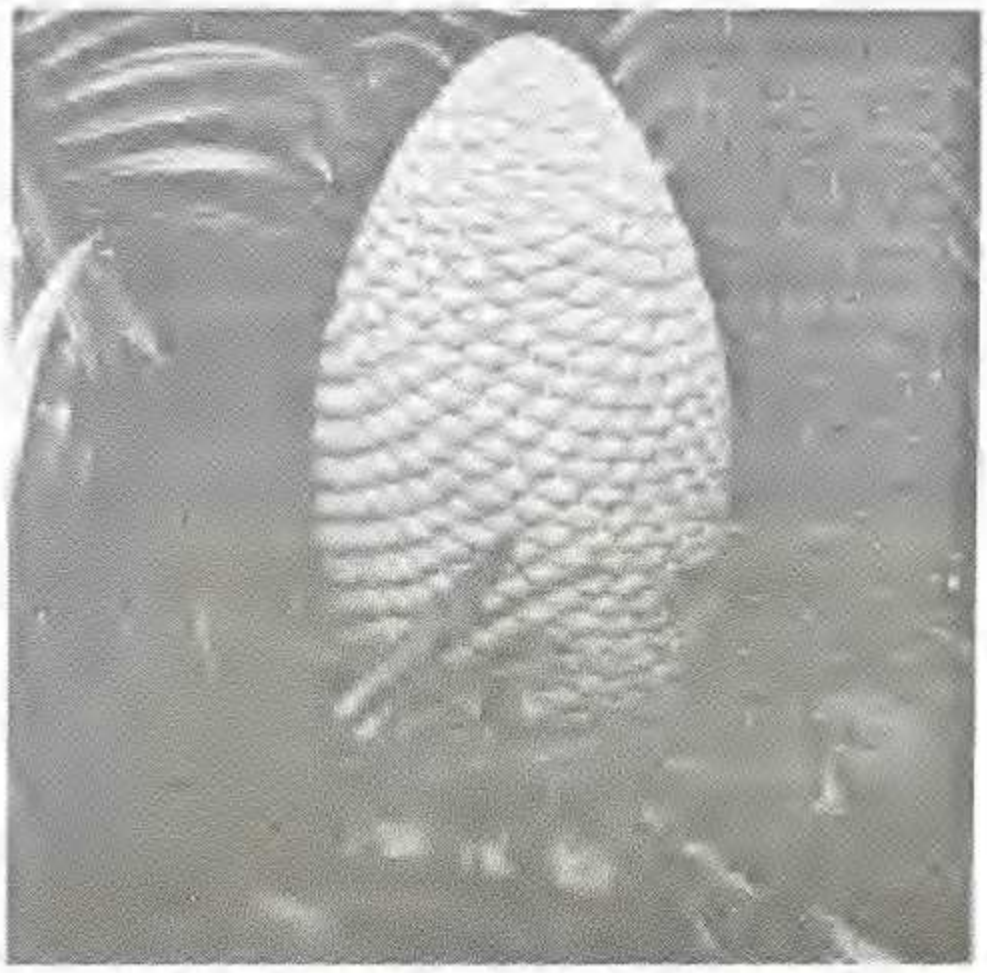
LECTOTYPIFICATION: In describing *Cycas seemannii*, Braun did not cite a specimen, but from the epithet one may infer that he had a Seemann collection in hand. This would have been *Seemann 572*, of which I here designate the K sheet as the lectotype. Neither it nor the isolectotype at BM bear locality data, but Seemann (in 1868) mentioned the number as being from Viti Levu and Ovalau.

DISTRIBUTION: Although *Cycas rumphii* has a wide distribution extending from Malesia (including the Philippines) and Micronesia eastward to Tonga, its f. *seemannii* is known definitely to occur in Fiji, Tonga, and Niue (introduced), and probably in the Solomons and New Hebrides as well. Kanehira (in 1938, cited above) described two Micronesian forms as being different from f. *seemannii*, which he also excluded from New Britain and New Guinea. I have examined 18 collections from Fiji, but it is probably more abundant than this implies.

LOCAL NAMES AND USES: *Longolongo* is the most frequently used Fijian name, but the following are also recorded: *langolango, langalanga, roro, tuawawa niu,* and *wiro.* The seeds are edible when prepared into *mandrai,* a type of bread, and the staminate cones are also said to be edible. The pith of the trunk is starchy and edible; Seemann mentions that it was reserved for the exclusive use of the chiefs. It is also often grown in towns and villages as an ornamental.

AVAILABLE COLLECTIONS: YASAWAS: Waya: Naruarua Gulch, west of Mbatinaremba, *St. John 18045.* VITI LEVU: Mba; Vicinity of Nalotawa, eastern base of Mt. Evans Range, *Smith 4486;* Navuiyari, *DA 2396;* Nawairoro, Ndreke, *DA 14751.* Nandronga & Navosa: Vicinity of Mbelo, near Vatukarasa, *Degener 15286;* Mbemana, Ruwailevu Tikina, *H.B.R. Parham 137.* Rewa: Suva (cultivated), *DA 10263. Viti Levu without further locality, MacGillivray 190.* OVALAU: Slopes overlooking Levuka, *Gillespie 4465.* NGAU: *Milne 230.* VANUA LEVU: Mathuata; Scanggangga Plateau, *DA 13198;* Mathuata coast, *Greenwood 644;* mountains near Lambasa, *Greenwood 644A.* Thakaundrove: Maravu, near Salt Lake, *Degener & Ordonez 14262;* hills west of Mbutha Bay, Natewa Peninsula, *Smith 822.* MATUKU: Ridge near Ngilingilia Mt., *Bryan 276.* VANUA MBALAVU: Limestone slopes on northern end, *Bryan 578.*

Whether *Cycas rumphii* Miq. is to be included in *C. circinalis* L. or not is apparently still open to question. Stapf (in Kew Bull. **1916:** 1-8. 1916) has given a good comparison of *C. thouarsii, C. rumphii,* and *C. circinalis,* from which one may conclude that our species is definitely *C. rumphii,* distinguishable from *C. circinalis* by its comparatively narrow pinnae, its megasporophylls distally with numerous, sharp, narrow teeth arising from a flat, broad claw, and its comparatively small seeds. Merrill (Interpret. Rumph. Herb. Amb. 74. 1917) implies that the two species are close, but that *C. circinalis* should be interpreted by the specimens from India and Ceylon, considering it best, pending a critical revision, to retain the Moluccan form as *C. rumphii,* a decision with which Backer & Bakhuizen van den Brink (Fl. Java **1:** 87. 1963) concur Schuster and Pilger (in the references given above under the genus) also maintain the species as distinct, as does Kanehira. However, Fosberg and Sachet (in Smithsonian Contr. Bot. **20:** 6. 1975) take *C. circinalis* as an inclusive and highly variable species in Micronesia, submerging *C. rumphii* and Kanehira's forms in it. De Laubenfels (1972, cited above) also uses *C. circinalis* to include *C. rumphii.* This broad interpretation does not seem warranted, as most students have readily enough distinguished *C. rumphii* from *C. circinalis.*

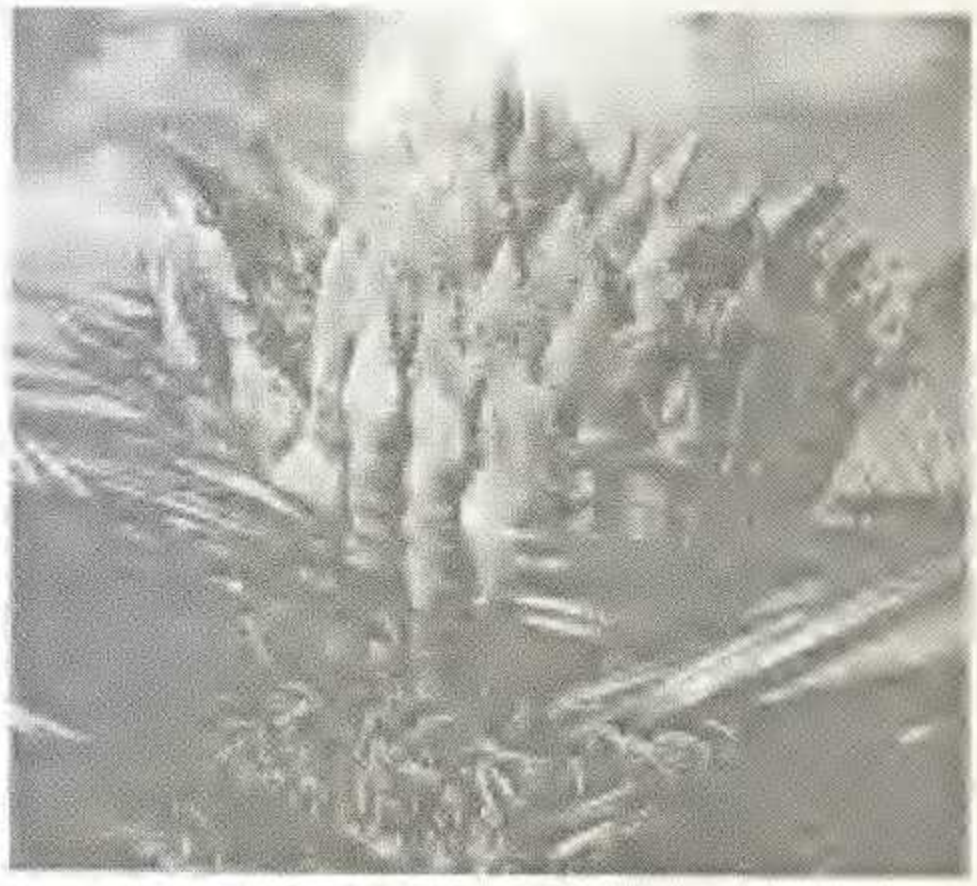


Cycas rumphii forma seemannii male cone.

Photograph: J.L. Dowe

Cycas rumphii forma seemannii

Photograph: J.L. Dowe



Cycas rumphii forma seemannii untertilized female sporophylls

Photograph: Andre de Does

Cycas rumphii forma seemannii healthy crop of seeds.

Photograph: J.L. Dowe

COMMENTS BY DR PIET VORSTER

This cycad is of particular interest as there are quite a few seedlings from Vanuata in South Africa. The male cone depicted is immature, but even so, both male and female cones look remarkably similar to C. thouarsii. Unfortunately the author omits a most important distinguishing characteristics: C. rumphii forma seemannii has no prickles along the petiole. He also errs in repeating the speculation that C. circinalis is not distinct from C. rumphii. I was surprised that he makes no mention of the plants occuring naturally on New Caledonia, the so-called Cycas "neocaledonica", which I have been unable to separate from the Vanuata material. As yet I have been unsuccessful in obtaining material from Fiji.

ENCEPHALARTOS KISAMBO A NEW SPECIES FROM KENYA

Robert B. Faden of the Smithsonian Institution in Washington and H.J. Beentje of the National Museums of Kenya have published a description of a new cycad. Writing in the March 1989 issue of the Occasional Papers of the National Museums of Kenya (Volume 2, Number 1) they name *Encephalartos kisambo*. This impressive cycad has been known to some of us previously under various colloquial names, e.g. "Archeri", "Voi", "Voiensis" and was referred to by Heenan in the mid 1970's as "Encephalartos species B". The plant is found in the Maungu Hills in the Taita-Taveta District in the south-eastern part of Kenya.

We hope in due course to feature this species in one of our "Focus On .." articles. A limited number of reprints of the scientific description are available on request from Dr Robert B. Faden, Department of Botany, National Museum of Natural History, Smithsonian Institution, Washington DC 20560, USA.

CORALLOID ROOT PHYSIOLOGY

The nitrogen-fixing properties of cycad coralloid roots is a subject which continues to attract much research interest. The most recent report is by Prof J S Pate of the University of Western Australia in collaboration with our Swedish member Peter Lindblad and C A Atkins. Entitled "Pathways of assimilation and transfer of fixed nitrogen in coralloid roots of cycad-*Nostoc* symbioses", it appears is *Planta* (1988) 176: 461-471. The thrust of the work has been the identification and quantification of the amino acids produced in the coralloid roots and passed onto the plant.

The researchers used a variety of techniques to explore the structural and physiological processes in the Australian *Macrozamia riedlei* and various other cycads including other *Macrozamia*, *Lepidozamia*, *Bowenia*, *Encephalartos* and *Cycas* species. Of special chemotaxonomic interest was the observation that all *Macrozamia*, *Lepidozamia* and *Encephalartos* spp. (i.e. all Zamiaceae) produced citrulline and glutamine as major products, but that citrulline was absent from *Bowenia* and *Cycas* species.

Reprint requests should be addressed to Prof J S Pate, Botany Department, University of Western Australia, Nedlands, WA 6009, Australia.

SIMILARITY BETWEEN WELWITSCHIA mirabilis AND ENCEPHALARTOS

by NEIL MUNRO

On a recent visit to the Namib Desert park I was fortunate to be able to study and admire the fascinating **Welwitschia.**

This desert plant has unique xeromorphic features. It belongs to the cone-bearing Gymnosperms the ancient naked-seed group which includes the cycads and conifers. **Welwitschia** is not only an ancient plant but is also very long lived and the oldest specimens on view, which has been fenced off, is estimated to be 2000 years old.

The secret of survival of this ancient plant is the millions of stomata (pores) which are distrubted on upper and lower leaf surfaces. These then absorb water from the morning fog which rolls in from the cold Atlantic and which can extend up to 150 km inland, although these plants are confined to a narrow strip of coast-line.

Another feature in similarity is that cycads and **Welwitschia** are dioecious and many male and female plants were in cone during my visit.

Also observed was a red sucking insect **Probergrothius sexpunctatis** on many of the female cones and as they scurried about their business on the fallen seed an eerie rustling noise was created. This insect, originally thought to be a pollinating agent of **Welwitschia** has since been disproved.

Most of the fallen seed is lost due to fungal infection or eaten by small desert creatures such as mice.

The few seeds that do remain viable then have to wait for favourable conditions that rarely occur in the desert to germinate. This means that fairly heavy rain must fall over a period of several days, and this probably explains why no young plants were in the area that I visited.

Photograph: Neil Munro

FROM THE BOOKSHELF

Of the approximately 22000 plant species indigenous to South Africa, hundreds contain toxic substances. Some accumulate poisons in their leaves, bulbs or (like the cycads) seeds effectively to deter animals from feeding on them. Some manufacture their own internal insecticides while other release inhibitors into the surrounding soil to eliminate competitive vegetation. Eugene and Glen Moll have produced a handy pocket-guide on "Poisonous Plants", delightfully illustrated by Rose Strebel. Released this year by Struik Publishers, it retails for about R 12. Highly recommended.

Other recommended books on the same subject :

Joan Munday's **"Poisonous Plants in South African Gardens and Parks - a field guide"**. Published in 1988 by Delta Books, this sells for about R 30.

Johannes Vahrmeijer's **"Poisonous Plants of Southern Africa that cause Stock Losses"**. Published in 1981 by Tafelberg, this retails at about R 35. Good photos.

Roy Osborne.

BOTHALIA WANTED

Leland Miyano (619 Hakaka St., Honolulu, Hawaii, 96816 USA) wants to buy a copy of *Bothalia 8* (Dr Dyer's monograph on the Cycads of South Africa). Has anyone a spare copy for sale ? Please contact Leland directly.

KORRESPONDENSIE

Mnr. die Redakteur.

Ek antwoord graag op die brief van Day Smuts in **Encephalartos** 18. Die persoon teken namens "verskeie ander lede" van die Eugene Marais Tak. Ek neem aan dat hulle nie bereid was om hulle name te publiseer nie!

Nietemin sou dit interessant wees om te weet of dit 2 of 50 was, met ander woorde watter persentasie van die Eugene Marais Tak so "ten sterkste beswaar maak" teen my indrukke van 'n broodboomveiling? Ek neem ook aan dat die saak by 'n vergadering van die Eugene Marais Tak bespreek was en dat Day Smuts gevra is om aan **Encephalartos** te skryf. Lede is in **Encephalartos** 16 versoek om verlof te vra voordat die Vereniging se naam gebruik word. Miskien kan die Voorsitter ons inlig?

Day Smuts het heeltemal gelyk, my indrukke is totaal eensydig, daarom juis was die titel "Impressions at a Cycad Auction". Dit was dus bedoel om persoonlik en subjektief te wees, my siening van die geleenthed. Dit was geensins bedoel om 'n verslag te gee van getalle (110 broodbome, 20 boomvarings, 65 saailinge), pryse (R112 600), aantal kopers (29), of muskieriges (rapsie oor die 200), ens. nie.

Vir my was die veiling 'n ontnugtering. Fabelagtige pryse waarvoor almal tot dusver maar gegis het, was nou 'n werklikheid en daarmee is daar onmiddelik 'n kosprys geplaas op elke broodboom in die veld, in openbare tuine, en in my en u tuin. Dit het gestalte gegee aan die versoeking om nou ook van hierdie groen diamante te bekom, want hulle is mos groot geld werd!

Kom ons versamel, kom ons bekom uit die natuur of ander tuine, kom ons beklink 'n transaksie, kom ons stuit die dalende rand. Kom ons vergeet dat hierdie plante oud was voor ons hier was, om kan mos nou handel dryf met ons erfenis.

Want so fluks soos die afslaer plante verkoop het, het ander oor 'n koppie tee en vetsl na die vendusie, ander transaksies beklink, want onthou daar was ook diegene wat slegs na die pryse kom luister het sodat hulle na die veiling die kopers en veral die verkoopers kon nader met 'n beter kopie. Of soos u dit so mooi stel, sodat hulle "ook die genot gegun kon word om volwasse plante te besit".

In die dae daarna het ek nie minder as 7 oproepe gehad van broodboomeienaars wat wou weet, hoe was die pryse, hoe kan hulle ook 'n veiling reël, watse rede moet mens vir Natuurbewaring gee, 4 coens wou sommer hulle versamelings saamgooi vir 'n veiling!

Day Smuts, u het gelyk, my indrukke was totaal eensydig. Ek aanvaar dit en is trots daarop. Langs hierdie weg wil ek ook almal wat gebel, geskryf, en my persoonlik gelukgewens het met my siening van die vendusie, bedank.

Cynthia Giddy

Cynthia Giddy

SIAMESE TWINS AMONGST CYCAD CONES

Nat Grobbelaar

An oddity that does not crop up often was recently noticed in the Pretoria Botanic Garden of the Botanical Research Institute. It is an Encephalartos villosus plant bearing two female cones that are fused along their whole length (see photo alongside). The plant forms part of the large collection of E. villosus individuals in the garden. Because the cones are probably fertilized by now, the Institute's cycadologists are reluctant to perform a separation of the twin least one or both perish together with the many embryo's that they harbour - a considerably more serious matter than separating two infants joined merely by their heads!

Photograph: Nat Grobbelaar

NURSERY NEWS

Guy Wrinkle, operating as **Guy Wrinkle/Exotic Plants** (11610 Addison Street, North Hollywood, California 91610, USA) offers 55 species and varieties of cycads, in seven genera, that have been grown from seed. The plants are 2-15 years old and are established in pots from 4" to 5-gallon sizes. They are priced from $5 up. The nursery also sells artificially propagated succulents, bromeliads, orchids, palms and species bulbs for collectors, landscapers and botanic gardens. A listing of these plants is available for $1.00 which is refundable on request with your first order. Visitors are always welcome and should please call (818) 766-4820 to make an appointment.

Don Giese operating as Giese Cycad Nursery, 8 Nico Malan Drive, King Williamstown, 5601 - Tel. No. 0433-22628, offers a variety of Encephalartos 2 to 3 year old seedlings. Presently available - E. natalensis, E. ferox, E. transvenosus, E. paucidentatus, E. lebomboensis and E. lanatus. Export orders, with all the required documentation can be arranged. Visitors are welcome by appointment.

Due to technical difficulties, the proposed Xmas cards as offered in Encephalartos No. 18 will not be available as planned. Hopefully this offer will be repeated next year.

MIRACLE E. natalensis

This was a 1 1/2 meter cycad planted in my garden in 1974. A year later I noticed the plant leaning over slightly. I pressed around the stem about midway and to my horror the plant had rotted, most probably due to bad handling when previously transplanted.

So I duly cut the plant by 1 meter, leaving a stump of 700mm. I then rubbed the top with flowers of sulphur, let it dry for a week and then painted it with a very thick layer of tree sealer. Finally I put a plastic bucket over it to keep it dry.

Being in a lost corner of the garden, I inspected it from time to time and eventually took it for dead. One day to my utmost surprise (approximately 2 years later), my gardener called me with great excitement, babbling away pointing to the plant. It had produced 6 calluses and 4 of them sprouted small leaves as seen in the photo which was taken in 1988. I removed all the old leaves so one can see the calluses which are now large heads that produce leaves every year. However, it has not coned so I do not know the sex of the plant at this stage - it is indeed a miracle!

By: Bunny Wentzel

Mr. R. Arnoldi proudly displays his **E. natalensis** he bought on the controversial Vryheid auction. This magnificent plant has responded to good care and recently produced 7 male cones.

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