ENCEPHALARTOS

JOURNAL OF THE CYCAD SOCIETY OF SOUTHERN AFRICA

TYDSKRIF VAN DIE BROODBOOMVERENIGING VAN SUIDELIKE AFRIKA

NO. 22

JUNE/JUNIE 1990

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EDITOR/REDAKTEUR

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VOORBLAD/COVER

The graphic computer designed front cover was done by a young art student, Jenny Kipling of Johannesburg.

CONTENTS-INHOUD

FROM THE PRESIDENT

Bunny Wentzel resigned as co-editor of "Encephalartos" whilst Neil Munro agreed to take care of all the editorial work as sole editor. You will therefore also note that the address to which you should send your "Encephalartos" contributions have changed. Neil deserves our wholehearted support and I would like to thank him most sincerely for his willingness to take on the whole editorship. Bunny is also warmly thanked for his efforts during the short period that he has acted as co-editor.

Mr L M D Vorster, the father of dr Piet Vorster, again provided us with a balance sheet of the income and expenditure of the Society - this time for the 1989 calender year. We are very indebted to him for this service. In the statement, which appears elsewhere in this number of the journal, you will inter alia note how drastic the production cost of "Encephalartos", our major item of expenditure, increased.

From figures supplied to me by Roy Osborne, our previous President, it is interesting to note the growth of the membership of the Society:

	Membership		
Date	Local	Overseas	Total
March 1985	136	3	139
March 1986	350	25	375
March 1987	381	50	431
March 1988	500	100	600
March 1989	554	126	680
March 1990	605	156	761

I hope the membership will continue to grow so well during my term of office!

Danie Nel is doing a grand job in trying to supply interested members with cycad seed kernels. It will be appreciated very much if members will assist him in his efforts by making seed kernels available to him for distribution.

With kind regards,

Nat GROBBELAAR

VAN DIE PRESIDENT

Bunny Wentzel het as mede-redakteur van "Encephalartos" bedank terwyl Neil Munro ingewillig het om man alleen die redakteurskap te behartig. U sal dus ook daarop let dat die adres van die redaksie waarheen u bydraes vir "Encephalartos" moet stuur verander het. Neil verdien ons heelhartige samewerking en ek wil hom van harte bedank vir sy bereidwilligheid om die hele redakteurs-taak op homself te neem. Vir sy hulp gedurende die kort termyn waarop hy as mede-redakteur gedien het word Bunny ook opreg bedank.

Mnr L M D Vorster, die vader van dr Piet Vorster, het vir die 1989 kalenderjaar weereens vir ons 'n balansstaat van die Vereniging se bates en laste opgestel waarvoor ons hom baie dank verskuldig is. Die staat verskyn elders in hierdie uitgawe van "Encephalartos" en toon onder andere hoe drasties die produksie-koste van "Encephalartos", wat ons grootste enkele uitgawe uitmaak, toegeneem het.

Uit syfers wat Roy Osborne, ons vorige President aan my verskaf het, is dit interessant om op die groei in die ledetal van ons Vereniging te let:

	Ledetal		
Datum	Plaaslik	Oorsee	Totaal
Mrt 1985	136	3	139
Mrt 1986	350	25	375
Mrt 1987	381	50	431
Mrt 1988	500	100	600
Mrt 1989	554	126	680
Mrt 1990	605	156	761

Ek hoop dat die ledetal ook tydens my ampstermyn so mooi sal bly groei!

Danie Nel doen baie moeite om lede wat belangstel, van broodboompitte te voorsien. Dit sal besonder hoog op prys gestel word as lede hom in sy pogings sal ondersteun deur pitte vir verspreiding aan hom te voorsien.

Met vriendelike groete,

Nat GROBBELAAR

EDITORIAL

In order for our society to function as efficiently as possible a certain amount of input is requested from all members.

This magazine needs feedback from our members to make it interesting and informative. Our local membership is close to 700 and I particularly appeal to this group to fill in the questionnaire which appeared on the last page of issue No. 21.

This concerns our pollen exchange which is handled by Cynthia Giddy. She has very kindly offered to collate all information in that questionnaire, which is for the benefit of all our members.

I think the days of keeping one's collection under wraps and ignoring an important appeal is futile and selfish.

Please members, take ten minutes to fill in the questionnaire and return it to Cynthia and lets put one another in touch which will only be to our own benefit.

REDAKSIONEEL

Ten einde ons vereniging so effektief as moontlik te laat funksioneer, word van elke lid verwag om self 'n sekere bydrae te lewe.

Hierdie tydskrif het terugvoering van sy lede nodig om dit interessant en leersaam te maak. Ons plaaslike lidmaatskap is bykans 700 en ek doen 'n besondere beroep op hierdie groep om die vraelys wat op die laaste bladsy van uitgawe Nr. 21 verskyn het te voltooi.

Dit sal help met die ruil van stuifmeel wat deur Cynthia Giddy behartig word. Sy het vriendelik ingestem om alle informasie van die vraelys te verwerk, wat tot die voordeel van al ons lede is.

Ek is van mening die dae is verby om ons versamelings te smoor, en om belangrike sake te ignoreer is fataal en selfsugtig.

Asseblief lede neem 'n paar minute om dit te voltooi en terug te stuur na Cynthia en laat ons met mekaar in verbinding bly wat alleenlik tot ons eie voordeel sal wees.

THE CYCAD SOCIETY OF SOUTHERN AFRICA
BALANCE SHEET AS AT 31 DECEMBER 1989

	NOTES	1989	1988
		R.	R.
CAPITAL EMPLOYED			
CAPITAL FUND ACCOUNT	2	15132	9672
		15132	9672
EMPLOYMENT OF CAPITAL			
FIXED ASSETS	3	24	36
Educational Equipment			
NET CURRENT ASSETS		15108	9636
CURRENT ASSETS		19121	15055
Bank		15600	12908
Debtors		657	81
Petty Cash		5	5
Stock	4	2859	2061
CURRENT LIABILITIES		4013	5419
Prepaid Subscriptions		4013	5419
		15132	9672

THE CYCAD SOCIETY OF SOUTHERN AFRICA
INCOME STATEMENT FOR THE YEAR ENDING 31 DECEMBER 1989

	NOTES	1989	1988
		R.	R.
INCOME		27723	17548
Donations		1249	674
Donations - Seedbank		3966	2036
Encephalartos - Back Copies		2411	1074
Interest Received		1184	382
Posters	8	67	654
Plantbags	7	-	131
Subscriptions		18846	12597
EXPENDITURE		22263	12828
Bank Charges		235	125
Depreciation		12	12
Encephalartos	6	14071	9286
Encephalartos - Back Copies	5	1914	1047
Entertainment		130	56
General Expenses		938	242
Postage		337	470
Seedbank	9	4090	1155
Stationery		397	328
Telephone		81	63
Travelling		18	35
Typing		22	9
Permits		6	-
Commission		12	-
NET SURPLUS for the year		5460	4720
UNAPPROPRIATED SURPLUS - beginning of year		9672	4952
UNAPPROPRIATED SURPLUS - end of year		15132	9672

THE CYCAD SOCIETY OF SOUTHERN AFRICA
NOTES TO THE FINANCIAL STATEMENTS
FOR THE YEAR ENDING 31 DECEMBER 1989

1. ACCOUNTING POLICY

During 1989 the accounting policy of the previous year was adhered to.

	1989 R.	1988 R.
2. UNAPPROPRIATED SURPLUS		
Society	12630	7046
Seedbank	2502	2626
	15132	9672
3. FIXED ASSETS		
Educational equipment consists of cycad slides		
Cost price	64	64
Less: Depreciation	40	28
	24	36
4. STOCK		
Encephalartos	2859	1996
Posters	-	5
Postcards	-	60
	2859	2061
5. BACK COPIES		
Postage	1786	929
Stationery	128	118
	1914	1047
6. ENCEPHALARTOS - COST		
Printing	9270	5801
Postage	5444	4063
Stationery	220	514
Plus: Opening Stock	1996	904
Less: Closing Stock	(2859)	(1996)
	14071	9286
7. PLANTBAGS		
Sales	-	709
Less: Purchases	-	878
	-	131
8. POSTERS		
Sales	67	908
Less: Purchases	-	254
	67	654
9. SEEDBANK EXPENSES		
Seed Purchases	2306	434
Postage	1751	710
Stationery	33	11
	4090	1155

I hereby declare that I am not a member of the Society and that I have no interest in the financial affairs of the Society. The Cash Book and Ledger of the Society has been written up from documents and information provided to me by the President of the Society.

I therefore certify that the attached Income and Expenditure statement and the Balance Sheet is in accordance with the information provided and reflects a true and fair representation of the income and expenditure and the financial position of the Society as at 31 December 1989.

PRETORIA
3 April 1990

Signed: L.M.D.VORSTER

FOCUS ON...

In this edition we do not focus on a Southern African cycad species, as usual, but on that more distant species from East Africa:

FOKUS OP...

In hierdie uitgawe fokus ons nie, soos gewoonlik, op 'n Suidelike Afrikaanse broodboomspesie nie, maar op daardie spesie van verder weg, uit Oos-Afrika:

ENCEPHALARTOS HILDEBRANDTII

by Roy Osborne

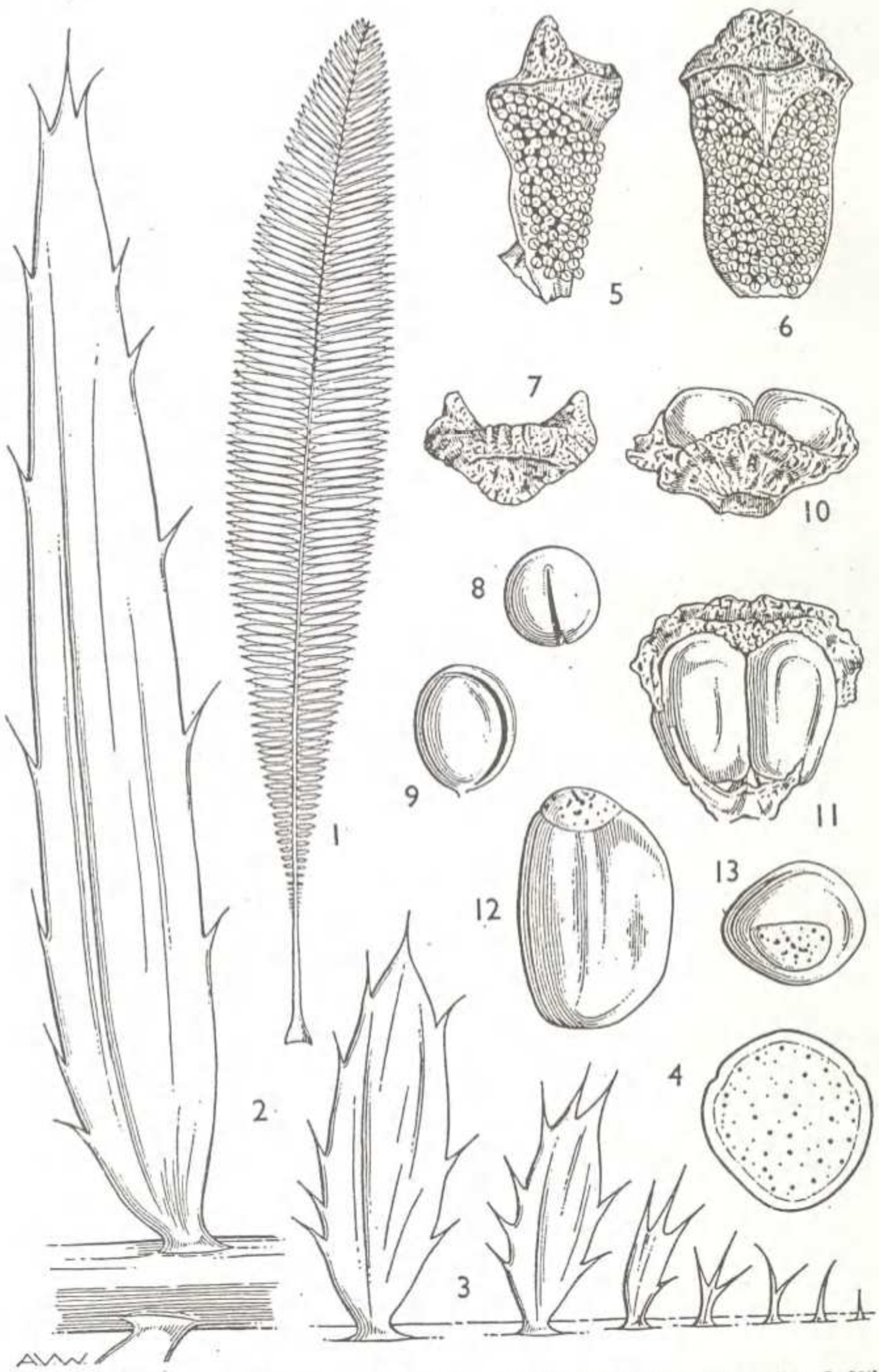


FIG. 3. *ENCEPHALARTOS HILDEBRANDTII* var. *HILDEBRANDTII*—**1**, leaf, × 1/24 ; **2**, 35th leaflet, × 2/3 ; **3**, basal leaflets, left to right 19th, 16th, 12th, 10th, 6th, 4th, 1st, × 2/3 ; **4**, T.S. of petiole, × 1 ; **5–7**, male cone-scale, side, lower and end views, × 1½ ; **8, 9**, pollen sacs, from above and side, × 12 ; **10**, female cone-scale, bulla, × 2/3 ; **11**, female cone-scale, from above, × 2/3 ; **12**, seed, lateral view, × 1 ; **13**, seed showing attachment scar, × 1.

The illustration of *E. hildebrandtii* **var.** *hildebrandtii* **which appears in Melville's chapter on the Cycadaceae in "The Flora of Tropical East Africa" in 1958.**

INTRODUCTION

The historical events relating to the discovery of the species *Encephalartos hildebrandtii* are largely a consequence of the history and geography of the eastern part of central Africa in the late 19th Century; rivalry between the German and British colonial influences, difficulties with transport and commmunications, tropical diseases, and confusion in matters of interpretation by European botanists making pronouncements without adequate reference to habitat material. Only now, with recent discovery of other eastern and central African species, is the picture becoming clearer. The preparation of this report for **ENCEPHALARTOS** has been perhaps the most challenging of our "Focus on...." reviews to date, testified to some extent by the number of references which had to be studied in its preparation.

THE BRITISH DISCOVERY OF *Encephalartos hildebrandtii*

Credit for the "western" discovery of our feature species must go to Sir John Kirk, British Consul-General of Zanzibar from 1866-1886. Kirk was a keen naturalist and kept up a constant correspondence with the staff at Kew Gardens. He had himself established a 40-acre private garden at Mbweni, Zanzibar. In a letter on 20 March 1868, Kirk announced that he had discovered a new *Encephalartos* at Dar es Salaam, Tanzania, and had moved a large specimen to his island home, also sending some leaf and seed material to Kew at that time. Other material followed and some seeds sent in September 1870 were successfully germinated at Kew. In 1877 Kirk explored the Tanzanian northern coastal and adjacent inland areas and found another population of *E. hildebrandtii* (as it was later to be named) near Tanga. The following year a trunk sent from this area by Kirk was successfully re-established at Kew. Curiously, the next population of this species he located on the northern end of his own island, Zanzibar, making two trips to the site and reporting specimens often as much as 12 - 14 ft in height, one being 20 ft high. In February 1879 he reported on the second visit in which he was taken by Captain Earl of HMS *Linden* in a steam launch. He writes:-

"We saw trees standing out in the rocky shore, but had difficultly in effecting a landing, although it was at the time calm. The raised coral rock here stands 25 ft above the sea, and is hollowed out to lean so that only at a chance spot was is possible to climb up, and then we were forced to use ropes. Once on the top it was equally difficult to move along, for near the coast the coral had been corroded into a number of spikes with very sharp angles and cavities, into which it would have been most dangerous to slip. Farther inland these cavities were partially filled with red earth, so that it was easier to move about, but to transport a tree even of less size than those we had come in quest of, was clearly impossible with the means at our disposal over such dangerous and impractical ground. We therefore selected one trunk 15 ft high clear of leaves, a male in full flower and with a crown of leaves that raised it 22 feet from the ground. This grew on the edge of the rock, so that we would not have to carry it over the spikes. It was soon found impossible, however, to take it off the roots, as these had filled every crevice of the rock holes. We cut it therefore, off the rock, securing quite enough to enable it to grow without difficulty. Most unfortunately when the work was almost done it fell and snapped asunder on a rock, one-third from the top. The lower part, however, we took on board, and I have planted it on the chance that it may shoot out, as I saw many old trunks had done. After this we secured with great labour a small plant that had not yet flowered. The stem of this is about 5 feet high. This also I have planted here. ..... The *Encephalartos* of the place we went to is singularly limited to those rocks. The country a few hundred yards back is open grass, but there not a specimen is seen."

In 1884, Kirk sent male and female specimens from his garden to complement the Kew collection. Kirk's return to England then brought this stage of the proceedings to an end.

But the Kirk story would not be complete without one further reference to his astute powers of observation. It was he who was amongst the first to notice that the male cycad cones generate heat at the time of pollen release. In two letters written to Kew in January 1878, he refers to this phenomenon as follows:-

January 6th. "I have in my garden a plant of *Encephalartos hildebrandtii* now in male cone. There are six cones close together in the crown, and last night when walking home with two in my hand, I noticed a strange fact worth noting and following up, both in this and other species. The cones were in paper - I had them in a bag, the sun had set, and there was nothing to disturb the temperature, but on taking them out to show some friends at home, I found them very hot.....the air was 81.5 def F, and soon the cones rose to 98 deg, being 16.5 deg F above the air."

January 31st. "I have, since writing on the 6th inst., verified my observations on the temperature of the male cones of *Encephalartos hildebrandtii*. The temperature is highest as the pollen in being matures and when the first can be shaken out."

[It is a curious co-incidence that Willie Tang (see

ENCEPHALARTOS 20: 25-28) has recently published data on this phenomenon and has indeed used *Encephalartos hildebrandtii* as one of the main species to illustrate the thermogenesis process in cycads.]

THE GERMAN DISCOVERY OF *Encephalartos hildebrandtii*

At about the same time that Kirk was making forays from Zanzibar to the Tanzanian coast, the great German botanist and explorer, J. M. Hildebrandt (1847-1881), was travelling independently through the Kenyan coastal areas just 300 km to the north. Hildebrandt collected numerous plant specimens for various European gardens and museums. A measure of his extraordinary activity is that the British Museum has 2400 of his numbered specimens and the Kew herbarium has 2253. It is not surpising then that he collected both dry and living cycad material, which he shipped back to various European gardens, including a fair quantity of *Encephalartos* from the Kenyan coastal area, principally near Mombassa. The examples sent to Berlin were immediately recognised as a new species and described in 1874 by Professor Alexander Braun and C. Bouche (respectively Director and Curator of the Berlin Botanical Garden) as *Encephalartos hildebrandtii*. In 1879, Hildebrandt himself recounted his explorations:-

"Having travelled through the vegetation of Shangamue [about 20 km NW of Mombassa], we reached the hilly country (Jurassic limestone) covered with Acacias and short grass. Here and there were also specimens of *Encephalartos hildebrandtii*. Their bright stems reached 5 m in height. The broad deep-green crowns of spiny fronds protect the large fruiting body which provides starchy seeds in times of famine."

Meanwhile, doubt had been expressed by some about the "new" species. In 1876, Regel thought that it was simply a variety of *E. villosus*, basing his opinion on the similarity in leaf morphology between the two taxa. Braun was quick to reply with a more complete species description, in the same year, in which he specified differences in both vegetative and cone morphology, particularly with respect to the female cone scale appearance. Braun's observations were confirmed by Eichler in 1880 who had the benefit of examining a living female cone. However, the battle was far from over as Hennings in 1890 then proceeded to claim an intermediate between between *E. villosus* and *E. hildebrandtii*, having been sent a cone of this from a nursery in Schoneberg, and thus saying that all three taxa were forms of *E. villosus*. This also was refuted and it gradually became accepted that *E. hildebrandtii* was indeed a valid and important new species. During the course of this botanical controversy, seed and plant material continued to be sent from east Africa on a progressively more commercial scale; e.g. the Erfurt nurseries of Messrs Haage & Schmidt cultivated both *E. villosus* and *E. hildebrandtii* "in large numbers" and advertised in 1877 that the plants had "an outstanding decorative value" and were "recommended for the hothouse".

PRESENT DISTRIBUTION

Whilst there are still some questions as to the exact distribution of *E. hildebrandtii*, its spread is fairly well-defined in general terms. It certainly extends in fair abundance in a 350 km-long narrow band through the northern half of the Tanzanian coast, along almost the entire coast of Kenya, and on the islands of Zanzibar and probably also Pemba. Localities mentioned by botanical field-workers include sites near Dar es Salaam, Bagamoyo, Lushoto and Tanga in Tanzania, and near Mombassa, Gedi and Witu in Kenya. The writer has heard a tale that workers on the Rufiji hydro-electric project near Morogoro in Tanzania in 1955 to 1958 used female cones of cycads as targets for shotgun practice, so numerous were the plants on one mountain side. The localities thus typically fall within coastal Acacia-savannah forests, with altitudes from sea-level to about 600 m and reaching inland up to about 80 km. The climate is hot throughout the year and the mean annual rainfall varies from 1000 to 1400 mm.

Douglas Goode notes that many of the habitat areas have been cleared in the last 10 to 15 years for agricultural use but that the peasant farmers have usually left the large cycad specimens untouched, "believing them to have magical powers which can shield their villages from disease" (but perhaps also for their potential usefulness as an emergency foodstuff - see later). Thus many of the plants seen nowdays stand either at the edge or sometimes in the middle of fields planted with cereals or other crops.

The older records are somewhat difficult to follow and several place names can no longer be found on maps. Some confusion may exist as to collections of specimens in Tanzania's Usambara Mountains: in the eastern foothills the sites would certainly be consistent with occurrence of *E. hildebrandtii* but the cycad occurring somewhat further from the coast at higher altitudes in the western part of the range has now been named *E. sclavoi*. Similarly, inland from Mombassa in Kenya, the low-lying savannah would be consistent for *E. hildebrandtii*, but the cycad found further inland at about 900 m in the Maungu Hills is now known as *E. kisambo*. Another source of confusion is that Melville (1957, 1958) working on his *Flora of Tropical East Africa* included in his rather broad concept of *E. hildebrandtii* plants from central Kenya (now *E. tegulaneus*) and from the Toro district of Uganda (these plants considered by others to be closer to *E. laurentianus* or more recently to *E. ituriensis*). Yet another problem has arisen from Melville separating the species into two varieties, *E. hildebrandtii* var. *hildebrandtii* and *E. hildebrandtii* var. *dentatus*. The

latter variety supposedly has a slight difference in the appearance of the lateral ridges in the cones scales [it has nothing to do with the number of teeth on the leaflets, as some cycad enthusiasts seem to believe], but the specimens in question came from an old Arab cemetery near Dar es Salaam and were never located in the wild. Heenan claims that another two colonies of the variety *dentatus* may be found near Jinja in Uganda, but the writer suspects that the Uganda plants may represent a different species.

Probably as a consequence of the early fairly widespread importation of *E. hildebrandtii* to Europe, it is now fairly well-known in botanic gardens internationally. Equally true is that the past strained relationships between South Africa and both Kenya and Tanzania, cycad enthusiasts in this country have not easily been able to obtain seeds for propagation. However, a scattering of plants is found in private gardens in South Africa and it is one of the objectives of the Cycad Society to ensure that "fruitful" contacts are established between owners of male and female plants of this and other central African cycads.

The list of European botanic gardens where specimens of *E. hildebrandtii* are known includes most German botanical gardens, the Les Cedres gardens on the French Riviera, the Orto Botanico at Naples, the Glasnevin gardens near Dublin, the Edinburgh Botanical gardens and Kew. In the western hemisphere, plants are recorded at the Missouri Botanical garden, Fairchild Tropical Gardens near Miami, the Foster gardens in Honolulu and the Carlos Thays gardens in Buenos Aires. In the east, the Bogor Botanical gardens of Indonesia is reported to have this species. In southern Africa, the plant is to be found at the Ewanrigg gardens in Zimbabwe, at the National Botanical Institute gardens and the Pretoria University gardens in Pretoria and at the Durban Botanical and Old Fort gardens.

DESCRIPTION

Like many cycads with a fairly widespread distribution, there is consideration variation in plants of *E. hildebrandtii* from different localities. Although Hildebrandt's original collections were made near Mombassa, the writer is in agreement with Heenan that perhaps the plants at Gedi represent a "typical"population, and the details below reflect this opinion.

1. STEM

The Gedi population has stems which commonly reach a height of 2.5 m, but it is noted that Melville quoted heights up to 6 m, this latter figure also consistent with the observation by Kirk of a specimen reaching 20 feet high. Diameters of mature stems are of the order of 30 cm. The trunks are rarely branched but development of basal suckers sometimes leads to a multi-stemmed

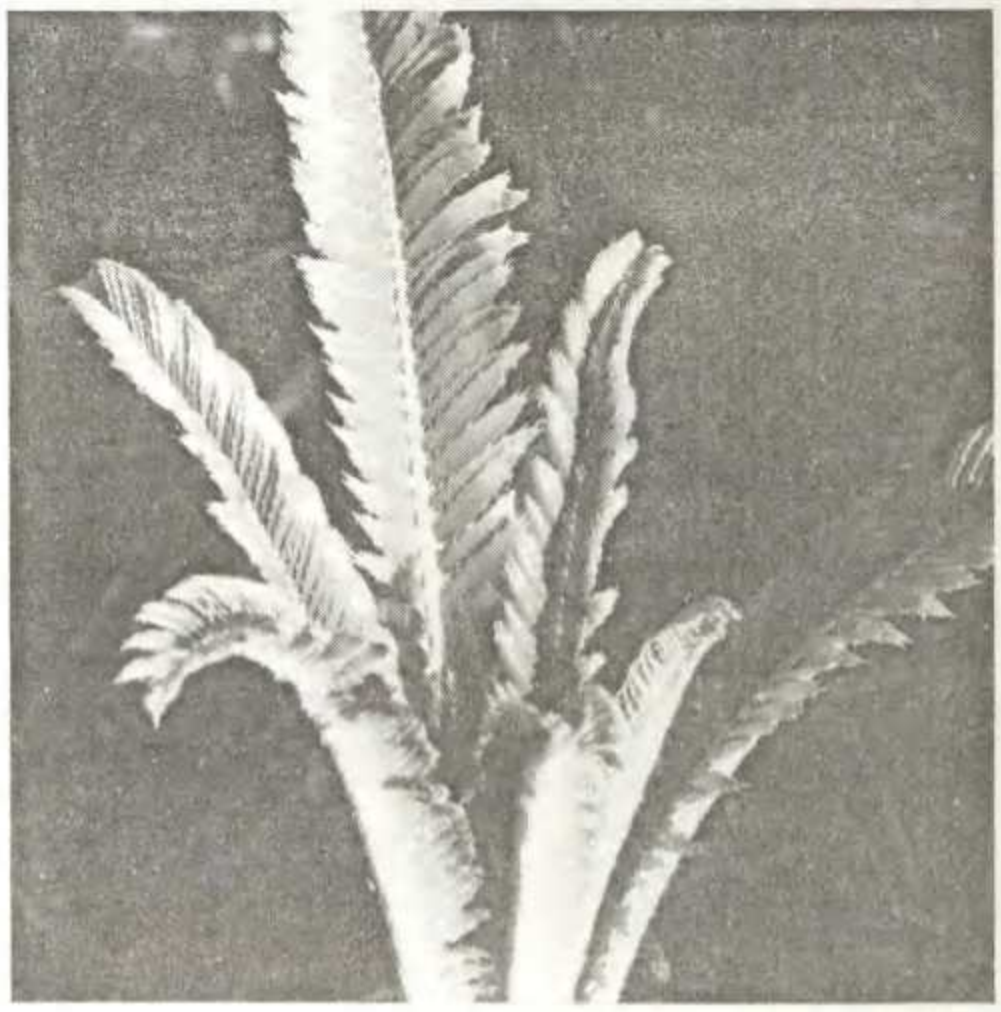
E. hildebrandtii **in habitat in a field cleared for agricultural use near Mombassa in Kenya (photo: John Lavranos).**

A young plant of *E. hildebrandtii* in a Pretoria garden.

appearance. Goode notes that the grey stem has a dry papery texture, is patterned with large and small leaf base scars, and that the crown is packed with hard greyish bracts.

2. LEAVES AND LEAFLETS

Leaves of *E. hildebrandtii* are 2 - 3 m long and are more-or-less straight. On emergence, often showing a reddish or coppery colouration, they are covered with fine white hairs which are quickly lost as the leaves mature to a glossy dark green colour. Median leaflets are about 20 - 26 cm long by 2.8 - 3.6 cm wide with up to nine teeth on each margin, generally with about 5 on the upper and 4 on the lower margin. The apex usually has one or two teeth on either side so as to give a characteristic bifurcate or trifurcate appearance to the leaflet tip. The leaflets from localities further to the south seem to have less pronounced teeth and the bifurcate or trifurcate appearance is not seen for example in plants from Tanzania. Leaflets reduce progressively in size towards the leaf base, ending in a series of small prickles and spines with only about 1 - 7 cm of unarmed petiole.



Emergent leaves from a young plant of *E. hildebrandtii* growing in Hololulu, Hawaii (photo: Leland Miyano). Leaves are either a bright green or a reddish coppery colour on emergence.

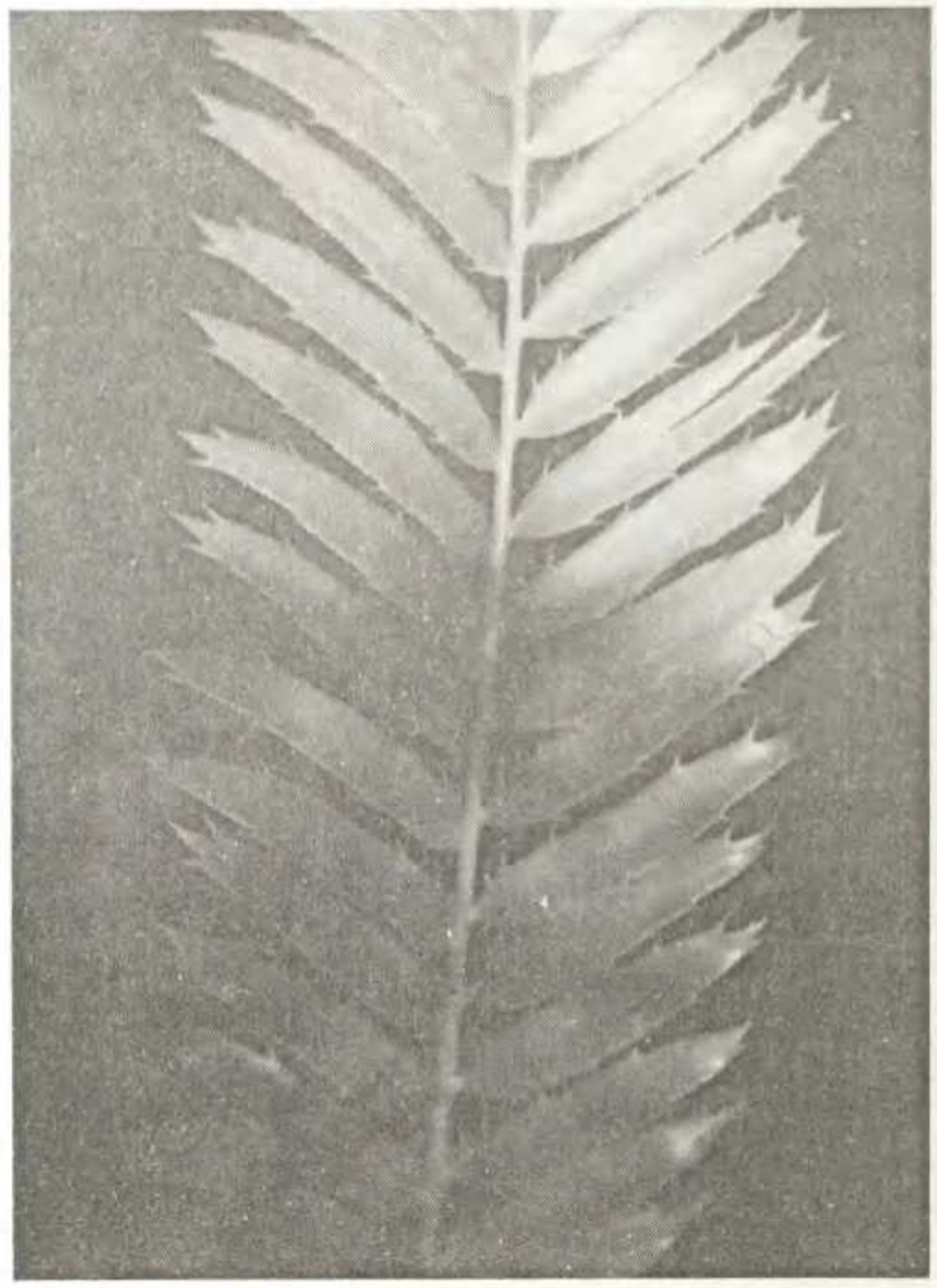
3. CONES

Male *E. hildebrandtii* plants bear 3 - 8 cones per crown and these are greenish-yellow in colour at maturity. Goode reports a pink interior colouration which is seen when the male cones extend to release the pollen, but the writer has not been able to confirm this. The fully-developed male cone is between 20 and 50 cm in length and fairly narrow at only 5 - 9 cm in diameter. They are supported on 5 - 25 cm long peduncles. The cone scales have a well-defined terminal facet. The phenomenon of temperature rise in the male cone at the time of pollen release has already been mentioned.

The female plants bear between 2 and 4 cones per crown. These are yellow in colour, 28 - 60 cm in length by 15 - 25 cm in diameter and supported on a peduncle only 4 - 6 cm long. The cone scales are smooth with clearly marked terminal facets and well defined lateral ridges. The colour of the seeds has been reported as bright red or vermillon but recent workers feel that the colour is more typically a bright yellow to orange. Seeds commonly measure about 3.8 x 2.6 cm and contain a kernel about 3.3 x 1.9 cm with a fairly prominently ribbed surface.

AFFINITIES AND HYBRIDS

E. hildebrandtii seems to be most closely related to the two species nearest to it geographically, i.e. *E. sclavoi* in Tanzania and *E. kisambo* in Kenya. All three taxa are share certain similarities with several other Central African taxa. Current, as yet incomplete, studies in computer-based numerical statistics by Grobbelaar,



Part of a mature leaf from a Pretoria garden specimen of *E. hildebrandtii* showing the bifurcate and trifurcate leaflet tip appearance characteristic of plants from the Mombassa coastal area.

Vincent and Osborne suggest that *E. gratus, E. hildebrandtii, E. kisambo, E. septentrionalis* and possibly *E. ituriensis* constitute a related grouping. At present there is no report of any natural hybrids between *E. hildebrandtii* and any other species but Piet Vorster believes he has an artificial *E. gratus*(F) x *E. hildebrandtii*(M) hybrid which shows characters intermediate between the two parents.

CULTIVATION

There seem to be no particular quirks about the garden cultivation of *E. hildebrandtii*; using its habitat as a guideline one might suggest that suitable garden conditions would include a fairly sandy or well-drained, somewhat alkaline, soil and a semi-shaded site protected from strong winds. The plants would undoubtedly respond to regular watering and a reasonable supply of nutrients. This species is not frost hardy.

CONSERVATION

The present status of this species, as listed by the IUCN Threatened Plants Unit (TPU) is "insufficiently known". However, the plants do seem to be well dispersed through a large area and, significantly, have commanded the respect of the indigenous farmers, as mentioned previously. There does not seem to be a particularly active trade in the export of plants from either Kenya or Tanzania and hence this species appears not to be threatened at this time. One hopes that this will continue to be the case in future times.

ECONOMIC USES

The number of indigenous names for *Encephalartos hildebrandtii* ("Mkwanga", "Msapo", "Mkamwa", "Mgwede", "Muka", "Balacha", "Icheli") is an indication of its fairly widespread useage. Early reports tell that the seed kernels were boiled, dried and ground to a type of flour. In times of famine, the central portion of the stem was chopped into segments which were allowed to stand and ferment for about a week, then washed with hot water, sun-dried and pounded up to make or porridge or boiled in water to make a gruel known as "Ugali". It appears the plant is no longer used to same same extent as it was a few decades ago.

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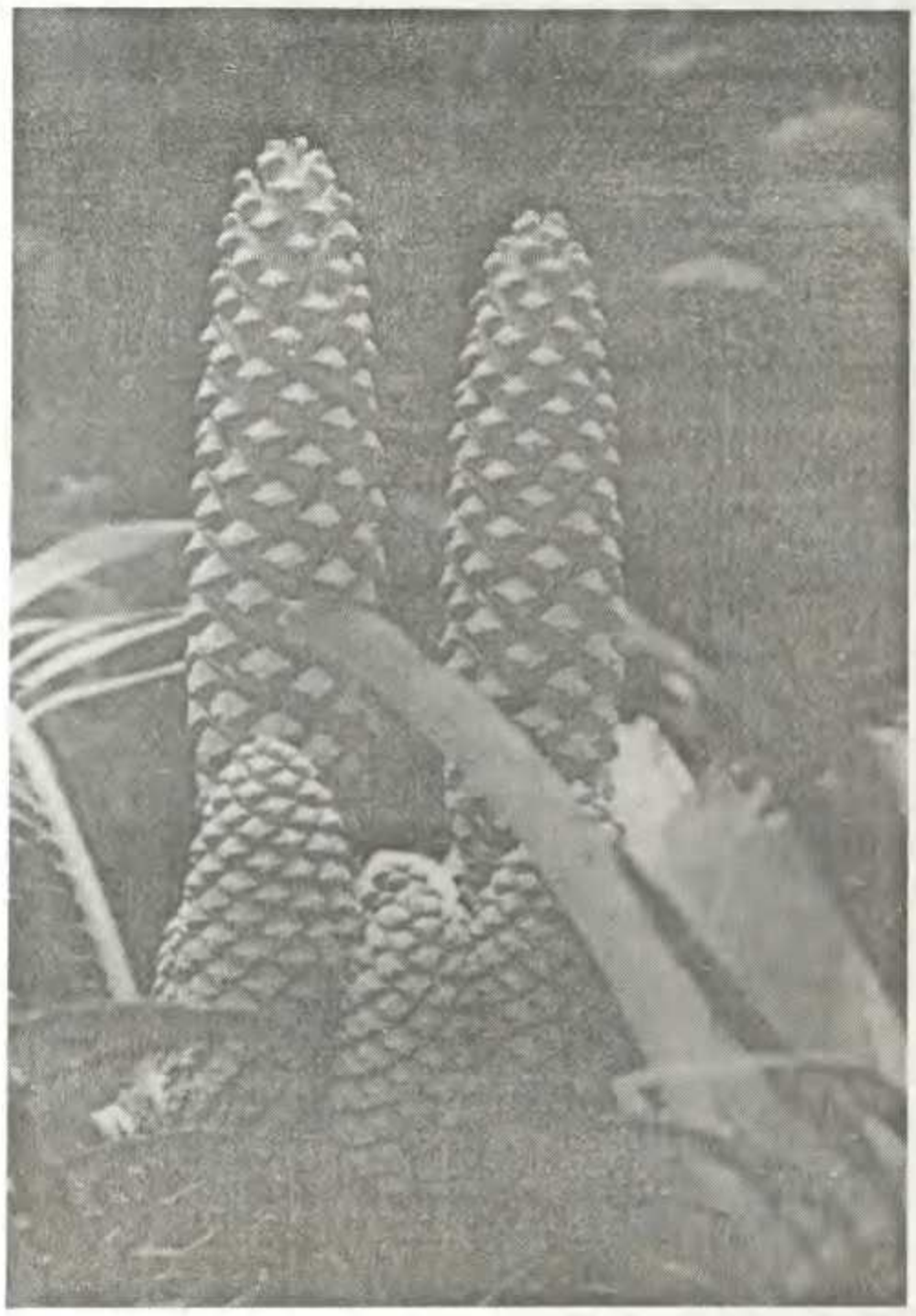

Emergent male cones of *E. hildebrandtii* on a plant in the Durban Botanical Gardens. This plant bore 8 cones and the difference in the relative stages of maturity is clearly evident.

Ripe female cones of *E. hildebrandtii* on a plant in the Durban Botanical Gardens.

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ACKNOWLEDGEMENTS

I am indebted Dr Helmut Schlegel, Julius Brunner, Prof Karl Pegel, John Lavranos, Dr Piet Vorster and Douglas Atwater who assisted in various ways with the preparation of this text. Unless specified otherwise, photographs accompanying the text were taken by the author.

A healthy three-year old seedling of *E. hildebrandtii*.

MORE ON CYCAD CONE GUMS

In ENCEPHALARTOS 13: 22-24 we featured details of the work by Prof Alistair Stephen (University of Cape Town) and his assistant on the composition of the gummy exudate from cycad cones. (See also *South African Journal of Science* 84: 263-266 of 1988). A new report has appeared on this subject. Entitled "The systematic value of the monosaccharide composition and distribution pattern of cycad mucilages" and written by Dennis Wm. Stevenson of New York Botanical Garden and Gesualdo Siniscalco Gigliano of Orto Botanico in Naples (both members of the Society), it appears in *Biochemical Systematics & Ecology* 17: 185-190 of 1989. The works gives results of the sugar analyses of the gums from various male and female plants of different *Ceratozamia, Chiqua, Dioon, Microcycas* and *Zamia* species. A general conclusion is that these results will contribute to the complex question of how cycad genera are related to each other. For instance, the analyses indicate that the new South American cycad genus *Chigua* is closely related to *Zamia*. Reprint requests should be addressed to G. Siniscalco Gigliano, Orto Botanico, Via Foria 223, 80139 Napoli, Italy.

OBTAINING SPERMATOZOIDS FROM CULTIVATED CYCADS

by HELGA SCHUCHMANN

Among living seed plants, only cycads and *Ginkgo* produce multiciliated male gametes. Those of *Zamia pumila* can be obtained for laboratory demonstrations by relatively simple means.

Abstract: Cycad spermatozoids are large multiciliated motile gametes of considerable phylogenetic importance. They can readily be obtained from cultivated Zamia pumila *specimens using hand pollination procedures.*

The cycads are a small assemblage of 11 genera and about 160 species of primitive, cone-bearing gymnosperms. A unique feature of their reproduction, the production of motile, multiciliated male gametes, is shared among living plants only with the maidenhair tree, *Ginkgo biloba*. Such multiciliated spermatozoids were first described in Japan about 90 years ago and created considerable excitement in scientific circles because for the first time a clear relation was seen between the reproduction of seed plants and that of ferns and fern allies, which also produce multiciliated male gametes (Ogura 1967, Norstog 1987).

In a botany course at the University of Mainz, West Germany, we wanted to demonstrate the ciliated spermatozoids of cycads, especially those of the genus *Zamia*, whose members have the largest male gametes in the plant kingdom (Norstog 1975). Because *Zamia* is not naturally pollinated in our greenhouse we had not been able to observe spermatozoid development, but during a visit to Fairchild Tropical Garden, Miami, Florida, I collected live spermatozoids from *Z. furfuracea* and was able to make permanent slides of them. As we nevertheless still wanted to obtain live spermatozoids from our greenhouse specimens of *Zamia pumila* in Germany, I looked for a methodology. There seemed to be no reports describing spermatogenesis in greenhouse cycads, all investigations having been done with field material (Webber 1901, Coulter and Chamberlain 1903, LaRue 1948, 1954, Norstog and Overstreet 1965). Giddy (1978) however tells of hand-pollination of cycads in South African gardens, while Norstog and Stevenson (1980) and Niklas and Norstog (1984) mention hand-pollination of several cycad genera cultivated at Fairchild Tropical Garden. Using methods described by Norstog (pers.comm.) we pollinated female cones of *Zamia pumila* and obtained fertile ovules from which we dissected male gametophytes and live motile spermatozoids (Schuchmann 1985). Our procedure was as follows:

Artificial pollination of greenhouse specimens of *Zamia*

Pollination trials were made with one female and two male plants of *Zamia pumila* during the winter of 1981-82 and the spring of 1985. The first year the female cones were receptive (as evidenced by separation of the megasporophylls) before the male cones had begun to shed pollen. Therefore we removed unopened microsporangia from the male cones, crushed these in a syringe filled with tapwater plus a trace of detergent, and injected the suspension several times into the opened female cones (i.e. between the separated microsporophylls. See Fig. 1). Later, when the microsporangia had dehisced, fresh pollen was gathered, mixed with water and detergent, and used as before.

In 1982 we harvested 8 to 33 fertile ovules from four pollinated cones (i.e. 18-53% of the ovules present in the cones). In 1985 two female cones had 33 and 36 fertile ovules (52 and 55% successful pollinations).

The development and dissection of pollen tubes

Development of pollen tubes (male gametophytes) in *Z. pumila* takes about 5 months. In the pollinated cones, male gametophytes at different stages of development were found; some relatively undeveloped, some partially developed, some fully developed and some which had already burst. Usually there were 1-2 pollen tubes per ovule and seldom 3-7 (Webber, 1901, observed 4-8 and rarely 13-14 in his field material). Towards the end of this period, a few ovules were carefully removed from near the base of one cone. The micropylar ends of these ovules were cut off and the cup-shaped part of the nucellus above the endosperm was carefully drawn off with tweezers. At this stage, pollen tubes at the bottom of the cup-shaped nucellus were visible with the naked eye. In fully-developed pollen tubes, spermatozoids could be seen as a dense white mass at the distal end of the tube. Next, the nucellus with the pollen tubes was placed in a depression slide containing 20% sucrose solution and examined under a dissecting microscope.

Action of live spermatozoids

After dissection of the pollen tubes, the spermatozoids could easily be seen within the tubes and their motility observed (see also Norstog and Overstreet 1965). Furthermore, the tubes sometimes burst open, or could be teased open with a fine needle or razor blade, releasing the freely-swimming spermatozoids. [Note: If pollen tubes are not yet present, one can wait a few days and remove other ovules. On the other hand, if pollen tubes have already burst, the remaining ovules should be collected and examined immediately].

Motility of spermatozoids

Observed under the stereomicroscope, spermatozoid motility could often be detected as the pollen tubes came into contact with the sucrose solution. First the cilia begin to remove and then the spermatozoids start rotating. One could observe their separation from the sterile cell (Fig 2) and then their separation from each other (there is one pair of spermatozoids per pollen tube). Sometimes they rotate vigorously and move up and down within the pollen tube but later the rotation slows down until only the cilia vibrate. This process continues for an hour at the most.

Spermatozoids which are released into the sucrose solution swim freely and exhibit the same movements as those in the pollen tubes (Fig 3). Ciliary movement sometimes appears frantic and at other time quite gentle, and the spermatozoids generally rotate as they move. In one case we noticed this rotation was clockwise for a while and then reversed to anticlockwise. [This is a particularly interesting observation as the ciliated band is always synistral (Norstog 1975) and one would anticipate only clockwise rotation]. Also observed was a rapid pulsation at the cell apex. The apex is said to project forward or to be pointed when the cell is moving and to be retracted with flattened apex when the cell is at rest (Webber 1901, Norstog and Overstreet 1965, Norstog 1975). However, we observed the apex to be flattened in moving sperm but pointed when the cell dies. Otherwise our observations agree with those made on field material as previously quoted.

Conclusions

The ideal method of obtaining cycad spermatozoids is from live material, but artificial pollination also provides a technique for both observing the developmental stages and for fixing specimens for further study.

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Acknowledgement

I would like to thank Dr Knut Norstog for his helpful assistance with this text.

Helga Schuchmann *worked from 1973 to 1987 as a technical assistant at the Institut für Spezielle Botanik, Universitat, 6500 Mainz, West Germany.*

IN MEMORIAM : MARY GUNN

We note with regret the passing of Mary Davidson Gunn (1899-1989) on 31 August 1989 at the age of 90. Miss Gunn was almost wholly responsible for the collection of botanical literature at the Botanic Research Institute, Pretoria, a task which she pursued with dedication throughout her working life. Mary, a colleague of the late Drs Inez Verdoorn and Cythna Letty (collective known as the "Three Graces"), will be remembered with fondness by all those who appreciate the South African floral heritage. To our readers, Miss Gunn is best known for her work in conjunction with Dr Leslie Codd which resulted in the book "Botanical Exploration in Southern Africa" (reviewed in ENCEPHALARTOS 5: 19).

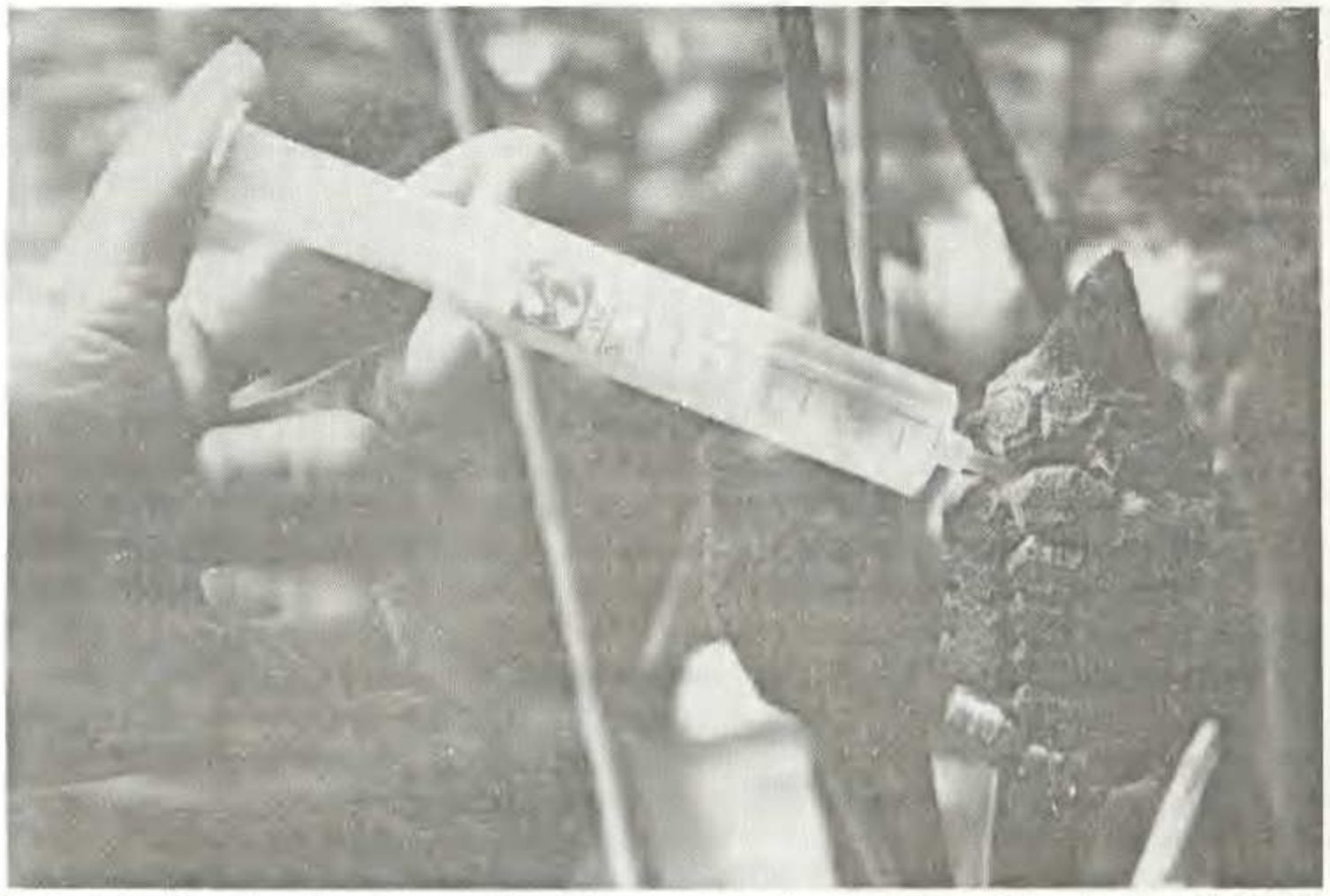

Fig 1: Injection of pollen suspension into receptive female cones of *Zamia pumila*. Note the separation of the megasporophylls which shows that the cone is pollen receptive.

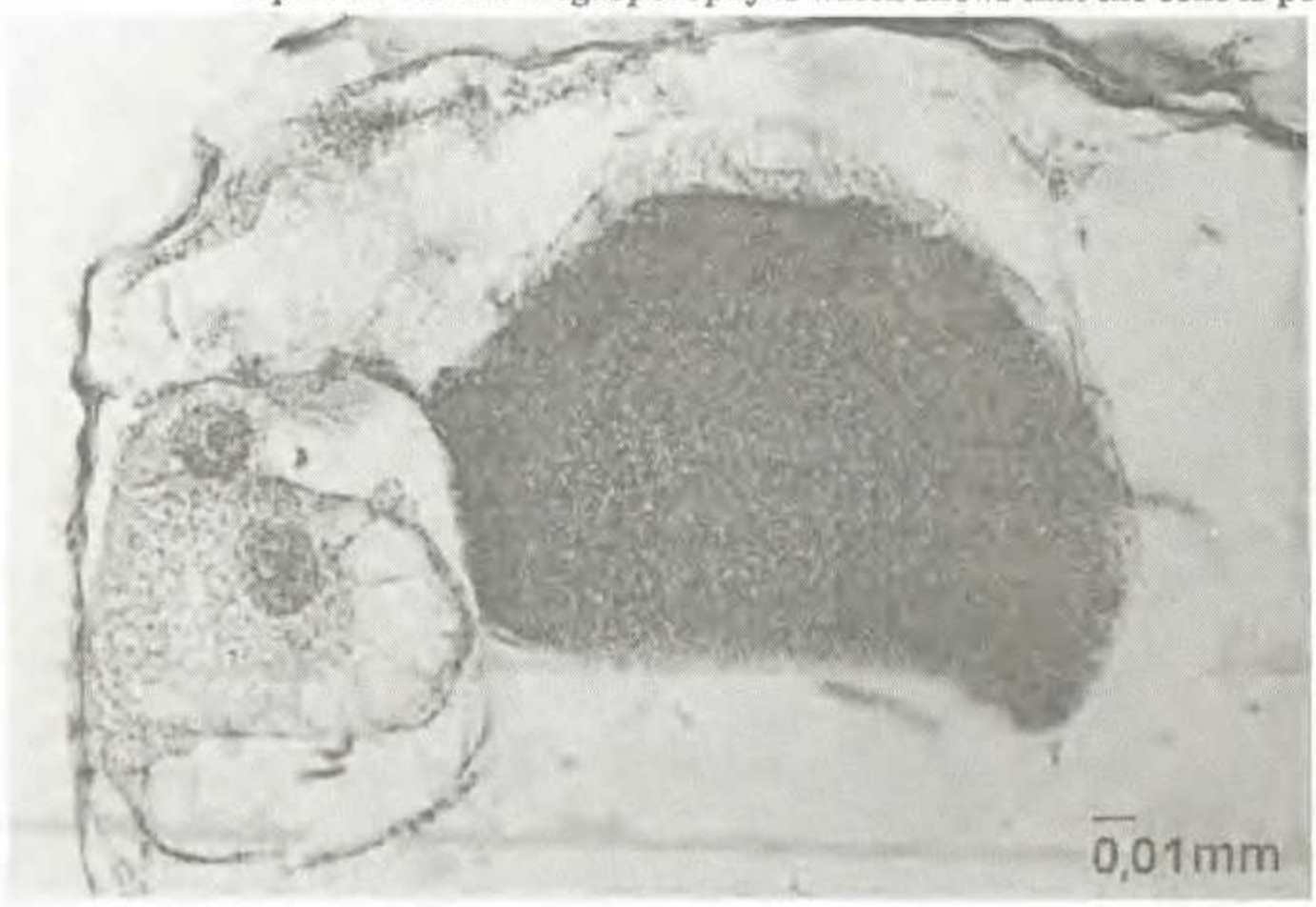

Fig 2: Longitudinal section of pollen tube of *Z. furfuracea* showing one of two spermatozoids (right) and the sterile cell (left).

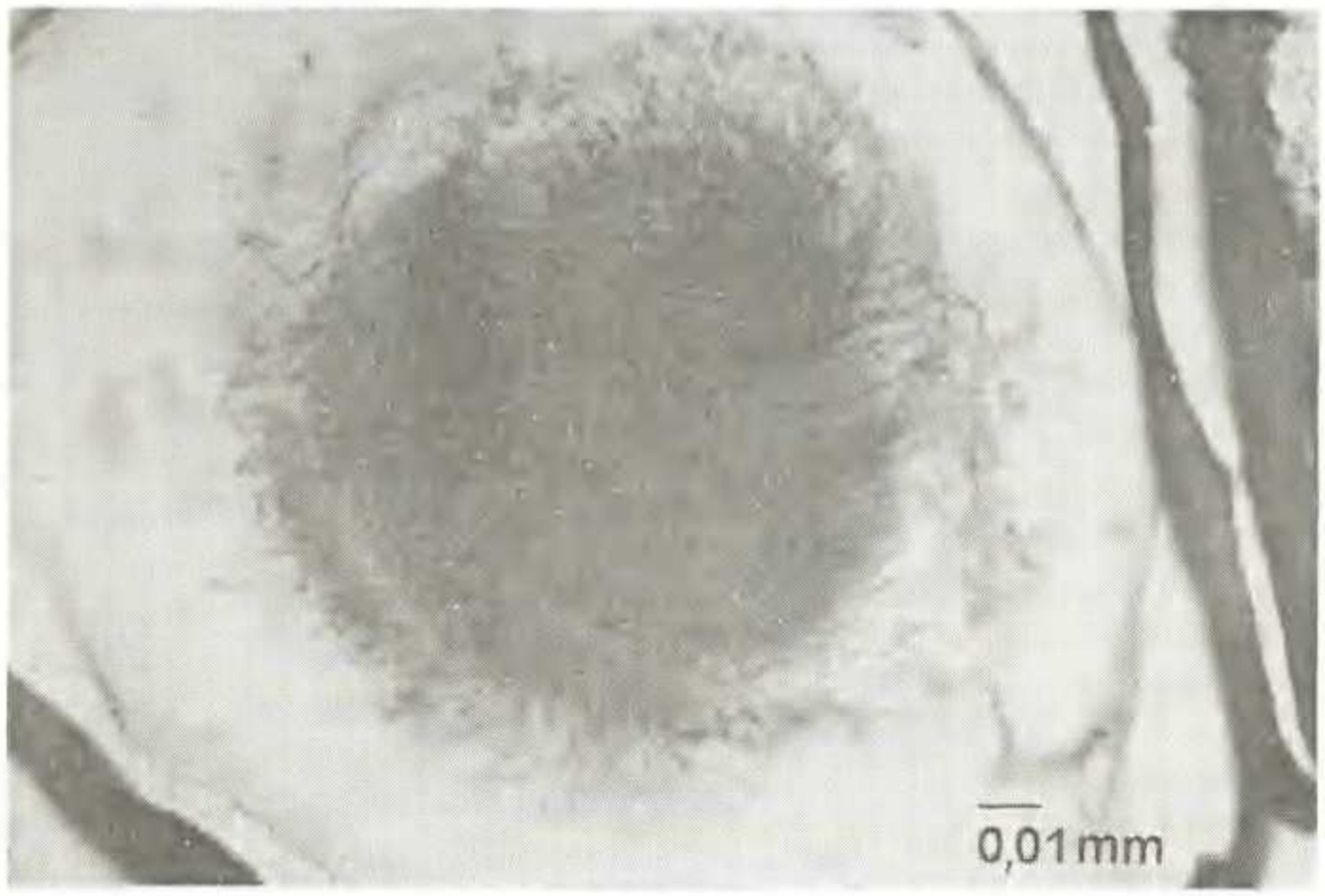

Fig 3: Spermatozoid of *Z. furfuracea* within a pollen tube. Note the synistral aspect of the spiral band and its many cilia.

From Carolina Tips 33: 21--11 (1970)

ZAMIA FROM SEED

JAN HOOFT, Horticulturist
From the Botany Department,
Carolina Biological Supply Company, Burlington, North Carolina 27215

Seed of the most primitive living seed plant can now be successfully germinated in the classroom.

We are proud to present a method recently developed for *Zamia* in our Burlington laboratories.

Although many writers report that cycad seed are easily germinated, our early experience with *Zamia* was disappointing. Chamberlain (1961) reports that, to secure the best germination, seed should not be covered with soil. However, Wagner (1963) states that in their natural environment *Zamia* seed lying on the surface do not germinate, but germinate readily when

FIGURE 1 Mature female cone of *Zamia*.

taken down into the sandy soil by a scarab beetle which feeds upon the outer covering. In our greenhouse, different germination methods were tested. Only the method described here yielded consistently good results.

IMPORTANCE OF ZAMIA

The cycads are considered to be the most primitive of living seed plants, and may well be called "living fossils." Of the nine genera of cycads known, only *Zamia* is native to the continental United States, and

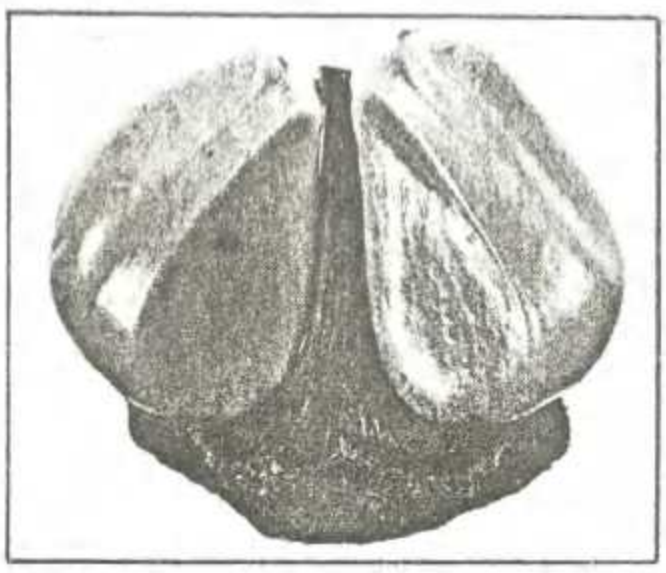

FIGURE 2 Lower surface of *Zamia* megasporophyll with two mature seed.

is found in the sandy pine barrens of Florida. Because of its ready availability, *Zamia floridana* is most often chosen as the representative genus of the order Cycadales.

THE PLANT

Zamia floridana rarely attains a height of more than 4 feet. The plant consists of a short conical stem on which is borne a crown of leathery, pinnately compound leaves resembling those of a fern. The roots are rather thick and fleshy.

Zamia is dioecious; male and female cones (strobili) are borne on separate plants. Like other gymnosperms, *Zamia* is wind pollinated.

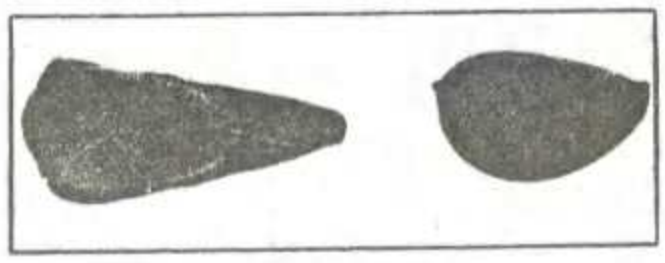

FIGURE 3 Mature *Zamia* seed. The leathery covering has been removed from the seed on the right.

The female cone (Fig. 1), borne on a short stem, consists of numerous megasporophylls. Each megasporophyll bears two ovules, and each fertilized ovule becomes a seed (Fig. 2). At maturity the female cones are from 5 to 6 inches tall.

THE SEED

The mature seed is approximately one inch long. It includes the embryo embedded in a massive endosperm which is covered by the seed coat. The seed coat has three layers: a thin, papery inner membrane; a hard, stony middle layer; and an outer

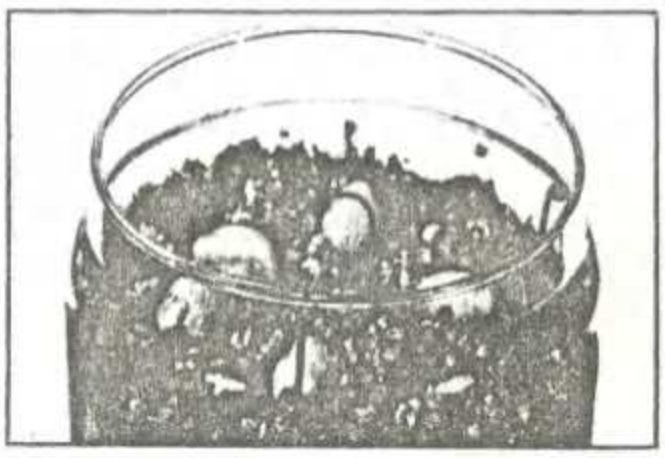

FIGURE 4 Excised *Zamia* seed germinating in vermiculite.

bright orange, leathery covering. The mature embryo consists of a plumule, two cotyledons (primary leaves), a short hypocotyl (stem), and a radicle (embryonic root) covered by a hard protective sheath, the coleorhiza.

GERMINATION

Mature *Zamia* seed can germinate readily under proper conditions. They do not require a long period of afterripening as do many angiosperm seeds. Viability, however, is not retained for long; seed stored at room temperature for 1 year lose their viability.

With fresh seed, our investigation indicates that the leathery covering and stony layer are impermeable to water and interfere with germination for 5 or 6 months. Removal of the leathery covering shortens germination time to 50 or 60 days, where-

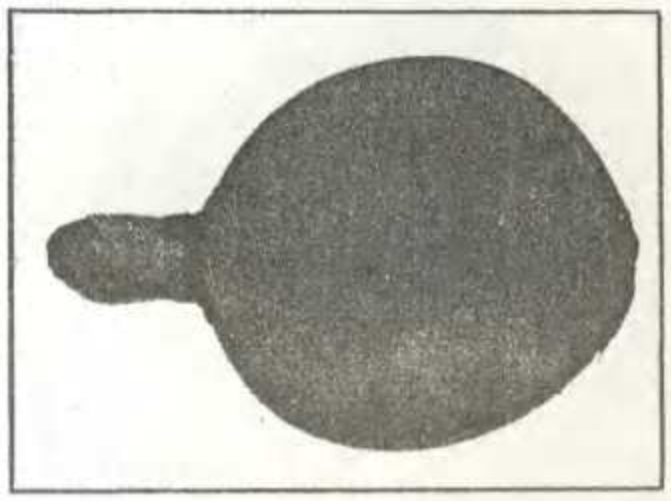

FIGURE 5 Excised *Zamia* seed showing emerging radicle covered by the coleorhiza.

as removal of the leathery covering and stony layer permits immediate germination.

To secure germination of viable *Zamia* seed, we suggest the following procedure:

1. Partially fill a storage dish with wet vermiculite.
2. Scrape the leathery covering from the seed (Fig. 3).
3. Using a clean knife, puncture the seed coat, cut, and peel it away. Be careful not to damage the endosperm or your fingers.
4. Treat the excised seed with a fungicidal agent to prevent molding. We have had excellent success with our Seedsafe solution.
5. Place the excised seed in the storage dish and push it partially into the vermiculite with the longitudinal axis of the endosperm parallel to the surface, so germination may be observed without disturbing the seed (Fig. 4).
6. Cover the dish and keep it at room temperature, away from direct sunlight.

A slight amount of condensation on the inner surface of the cover indicates sufficient moisture is present. If the vermiculite appears too dry, add a small amount of water.

The first obvious indication of germination occurs within 48 hours as the radicle covered by the coleorhiza emerges from the endosperm (Fig. 5). After a few days, the radicle ruptures the coleorhiza and begins to grow downward (Fig. 6). The two cotyledons remain partially within the en-

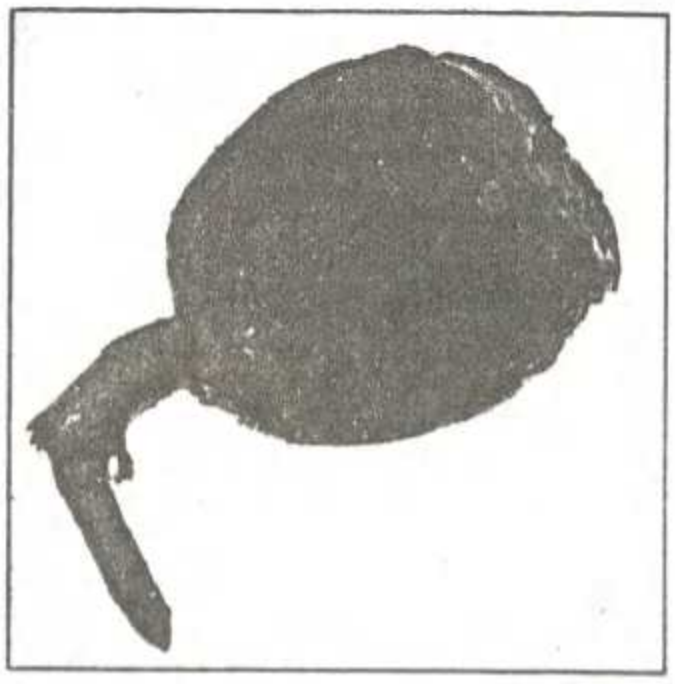

FIGURE 6 Excised *Zamia* seed showing radicle growing downward from the ruptured coleorhiza.

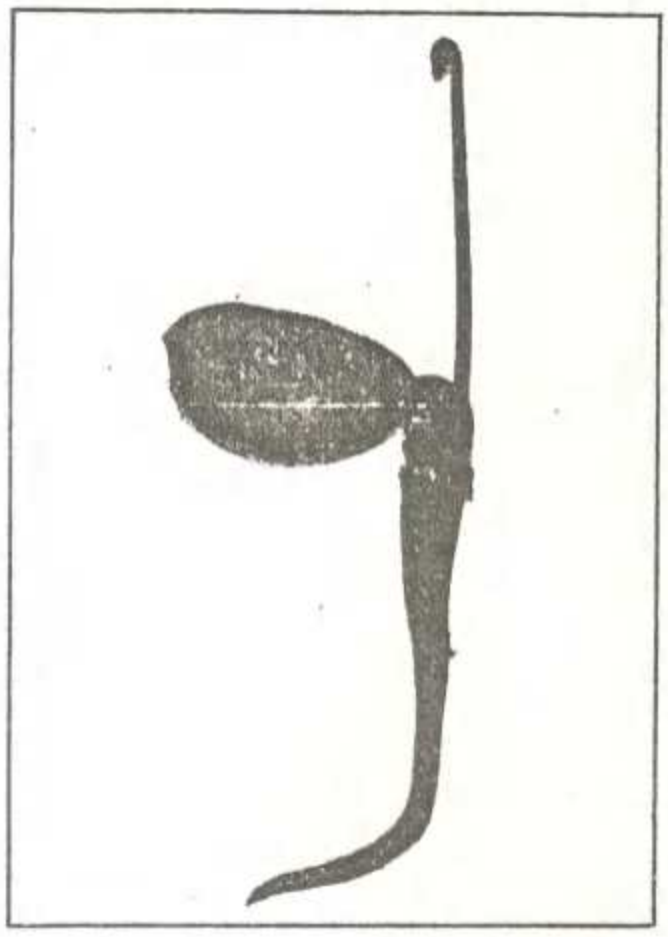

FIGURE 7 One-month-old *Zamia* seedling.

FIGURE 8 Potted *Zamia* seedling.

dosperm from which they absorb nutrients, and they elongate sufficiently to push the plumule outside the endosperm. The plumule begins to grow upward after 15 to 20 days, and then it develops into a long petiole with a coiled leaf blade on top (Fig. 7).

SEEDLING CULTIVATION

When the leaf blade has uncoiled, the young seedling can be planted in Carolina's standard potting soil with the crown slightly above the soil surface (Fig. 8).

Zamia grows well in a cool greenhouse and requires little care. Although it grows best in a humid atmosphere, be careful not to water the young plant too much as the tender root is susceptible to rotting. *Zamia* grows rather slowly; usually only one leaf is produced the first year, rarely two. Generally, cones are not produced until the plant is at least 10 years old.

Zamia should be repotted every second year. An occasional dose of a weak liquid fertilizer will ensure proper health.

FURTHER READING

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CORALLOID ROOTS AGAIN

Nat Grobbelaar, in association with University of Pretoria research colleagues J Marshall and S James, has produced yet another paper on the physiology of cycad coralloid roots. Entitled "Seasonal changes in the nitrogenase activity and other metabolic parameters of cycad coralloid roots", the report shows that the nitrogenase activity and respiration rate of coralloid roots of *Encephalartos altensteinii* are significantly higher in summer than at other times of the year. The paper appears in *Bot. Bull. Acad. Sin.* (a Chinese Botanical Journal), Vol 30: 285-289 of 1989. Reprint requests should be addressed to Prof Grobbelaar.

CYCAD SEED PATHOGENS

by Julius Brunner

My recent reading of various articles in *Encephalartos* and *The Cycad Newsletter*, together with an article entitled *Cycas im Wintergarten* from the *Frankfurter Palmgartenzeitschrift* and some letters from an Australian cycad enthusiast, reveals references in common to the difficulties in propagating cycads and their danger of extinction. It is my belief that the poor results obtained in cycad germination do not necessarily originate in the incorrect methods of treating the seed, but in the quality of the seed itself.

Although I am not familiar with cycads in the habitat situation, I am well acquainted with their seeds. I have removed the hard shell from about 200 megagametophytes and illustrate some of the problems I noticed in the accompanying photographs. Figure 1 shows a seed which is parasitised by an insect larva; until the insect starts eating the embryo, the seed can be saved. Figures 2-4 show various kinds of fungal attack. The seed shown in Figures 2 & 3 is so badly infected by the fungus that it would not germinate, but it is interesting to note that the seed has responded to the pathogen by setting up a sort of barrier between the sound and the infected part.

Another important observation is that the fungus generally has its origin in the micropylar cavity - this can be particularly well observed in infertile seed. The author of the article in *Frankfurter Palmgartenzeitschrift* ascribes this to the absence of male plants. In some cases this may be true, but I suspect that in other cases the male pollen was present, but has been destroyed by a fungus. The fungus which I come across most often when dissecting cycad seed leaves a black, dusty deposit, as shown in Figure 4. It is extremely aggressive and megagametophytes can be destroyed even after germination. Thus a constant monitoring of seed is necessary. If a plant whose megagametophyte is infected has developed its first leaf, then the megagametophyte must be removed immediately. It is important that the excision must be made in the uninfected area. A plant thus derived of its megagametophyte will not grow as quickly as others, but it will survive.

Apart from this "black soot" fungus, there are kinds of yeast fungi which change the whole megagametophyte into a foul-smelling pulp. The commencement of this deterioration is shown in Figure 5. Other pathogens of cycad seed may be various kinds of viruses. Although they are not common, they can still do considerable harm. The most obvious symptom of virus attack is a hypocotyl which does not grow but only thickens and is covered with scaly proliferations near the megagametophyte.

I can merely speculate on the way these pathogens gain entry to the seeds. With insects the entry is quite obvious and these can be controlled by insecticides. It is, however, difficult to say how fungi gain entry to the hard shell which is absolutely impermeable. (I think that the material of which the shell is made would be worthwhile for more useful things, like raincoats !). One explanation for the existence of internal fungi may be that the fungal hyphae were present in the mother plant. But I think that another possibility might be transfer of the fungal spores via the micropylar opening at the time of pollination. [Referring to the orchids - in which I have specialised - I can report that it is essential to remove parts of the blossoms must be removed in order to guarantee "troublefree" pollination and the development of germinable, sound seed. Protocorms of orchids deliberated infected by the "soot" fungus are decomposed within 24 hours.] Perhaps in the case of cycads, fungicides could be applied, as a precautionary measure, at the time of pollination.

I would be most interested to hear the opinion of other readers on the matter of seed pathogens. Improvement in the frequency of successful germination would be a major step forward in the important business of cycad propagation.

Julius Brunner
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[Editor's note: Danie Nel, the Society's Seedbank Officer, informs us that each batch of seed processed through our seedbank is immersed successively in an insecticide and a fungicide solution, both at the time of receipt of the seed and at the time of dispatch.]

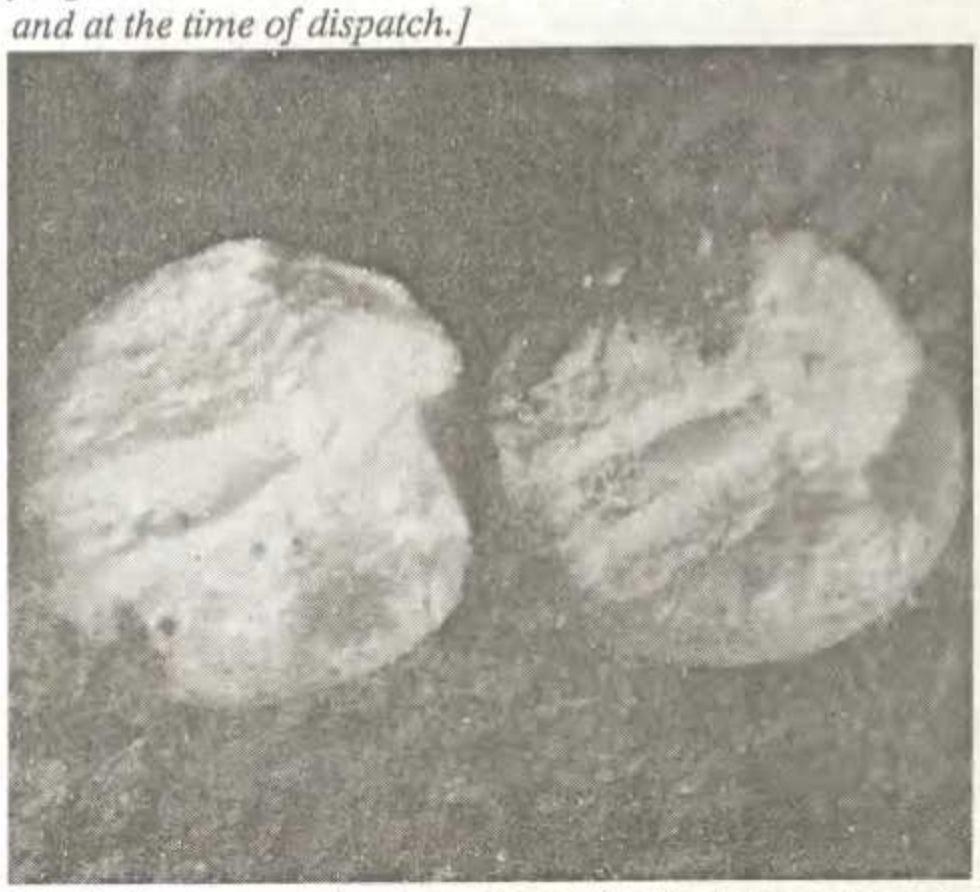


Fig 1: *Cycas* **seed showing signs of attack by an insect larva**

Fig 2: *Cycas* **seed showing evidence of fungal attack of the surface of the megagametophyte**

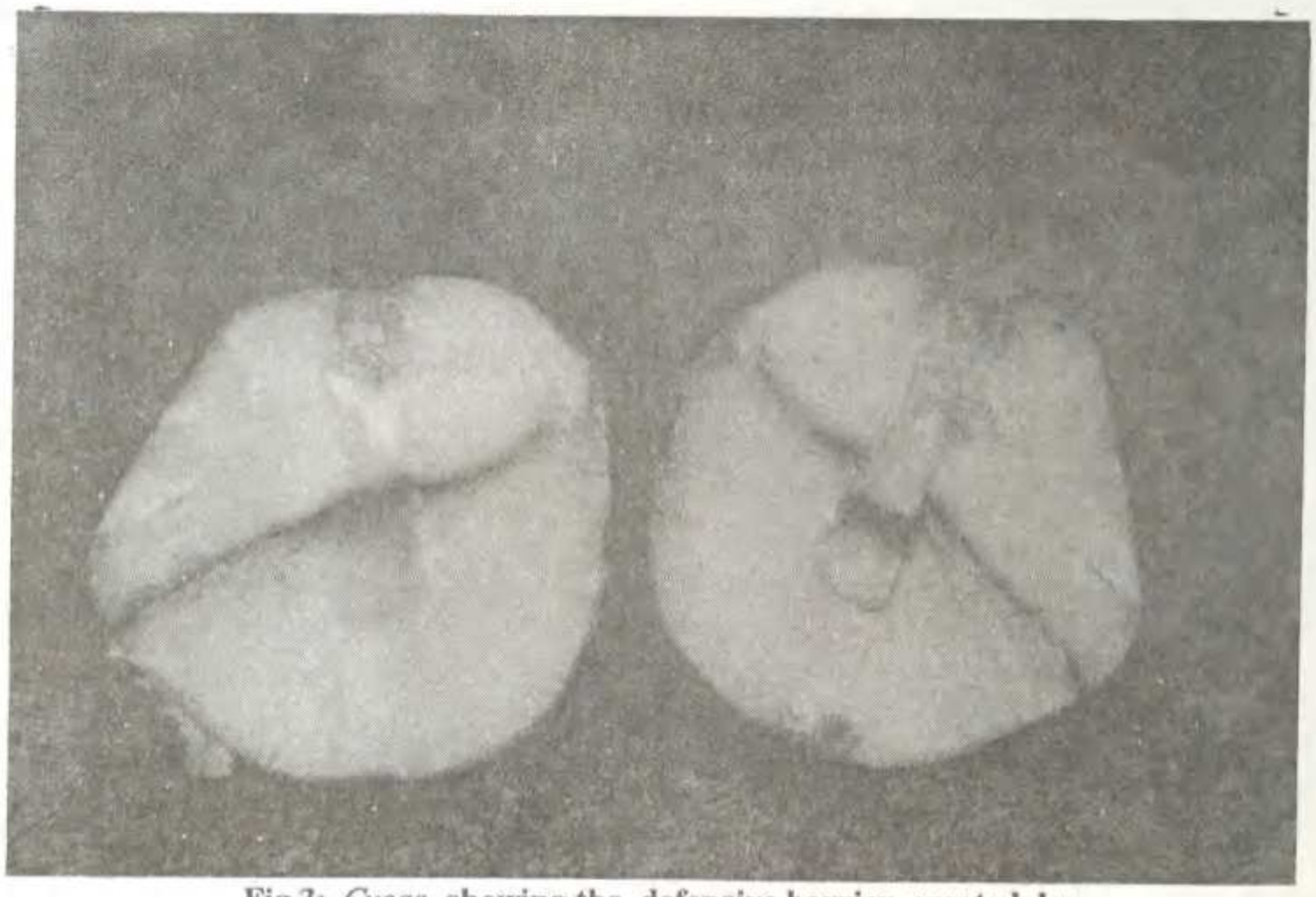


Fig 3: *Cycas* **showing the defensive barrier created by the tissue in an attempt to contain the fungal attack**

Fig 4: *Cycas* **seeds showing the powdery black deposit which is the product of fungal attack**

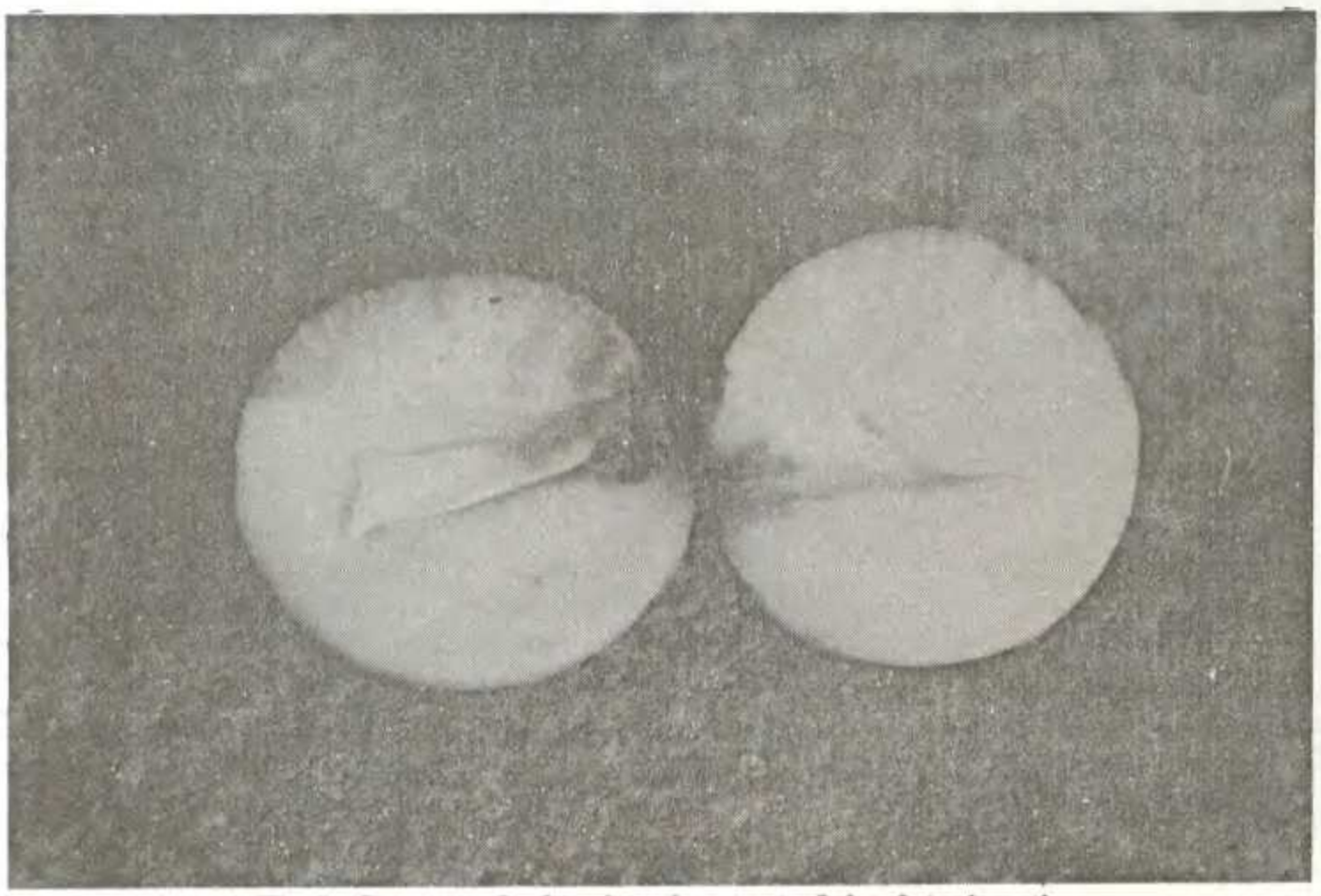
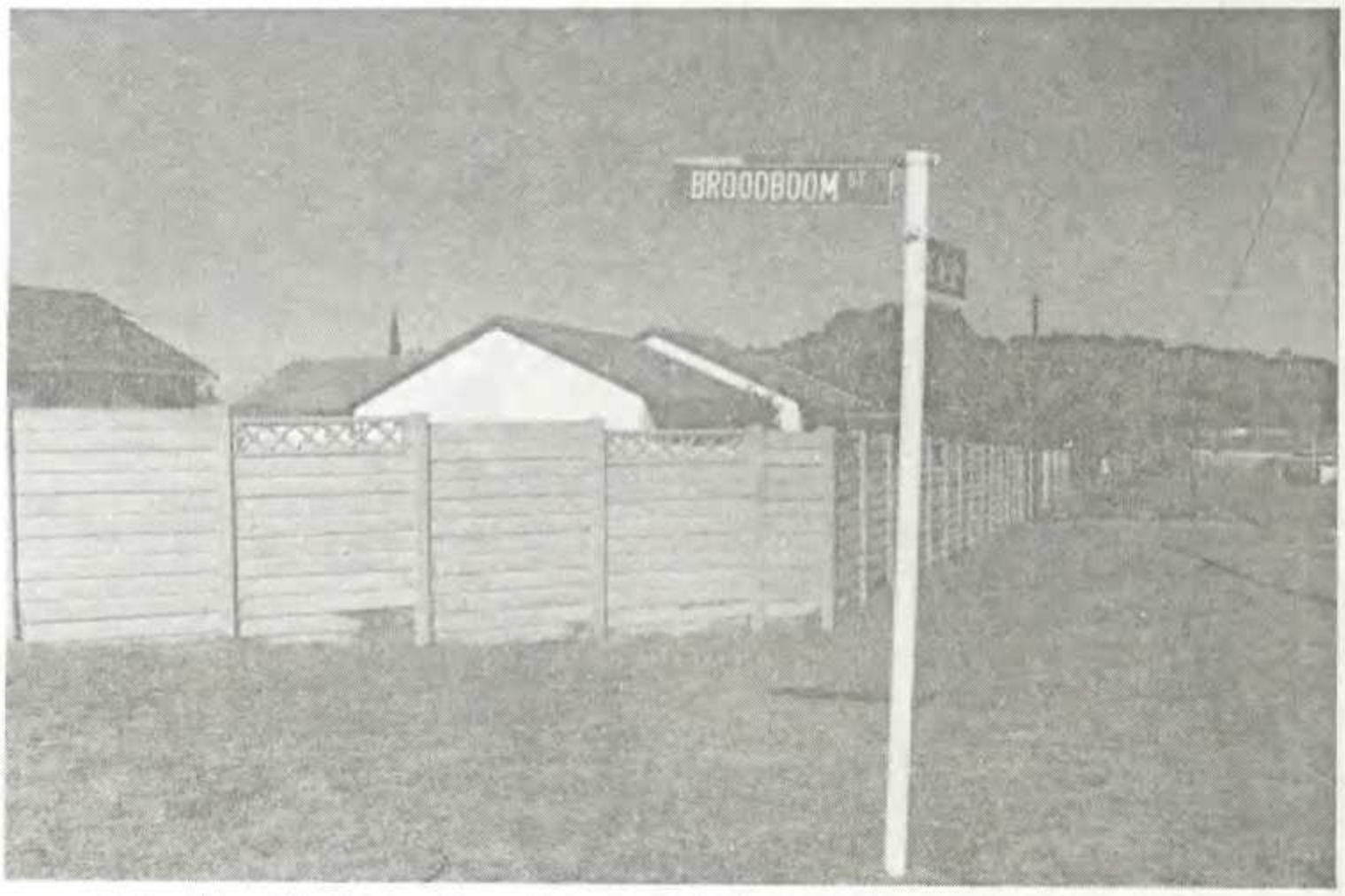


Fig 5: *Cycas* **seed showing the start of the deterioration caused by a yeast fungus infection**

BITS AND PIECES STUKKIES EN BROKKIES



People living in the quaint suburb of Albemarle, Germiston will be familiar with this street which runs parallel to the N3.

SAVE THE CYCADS ! PART 2

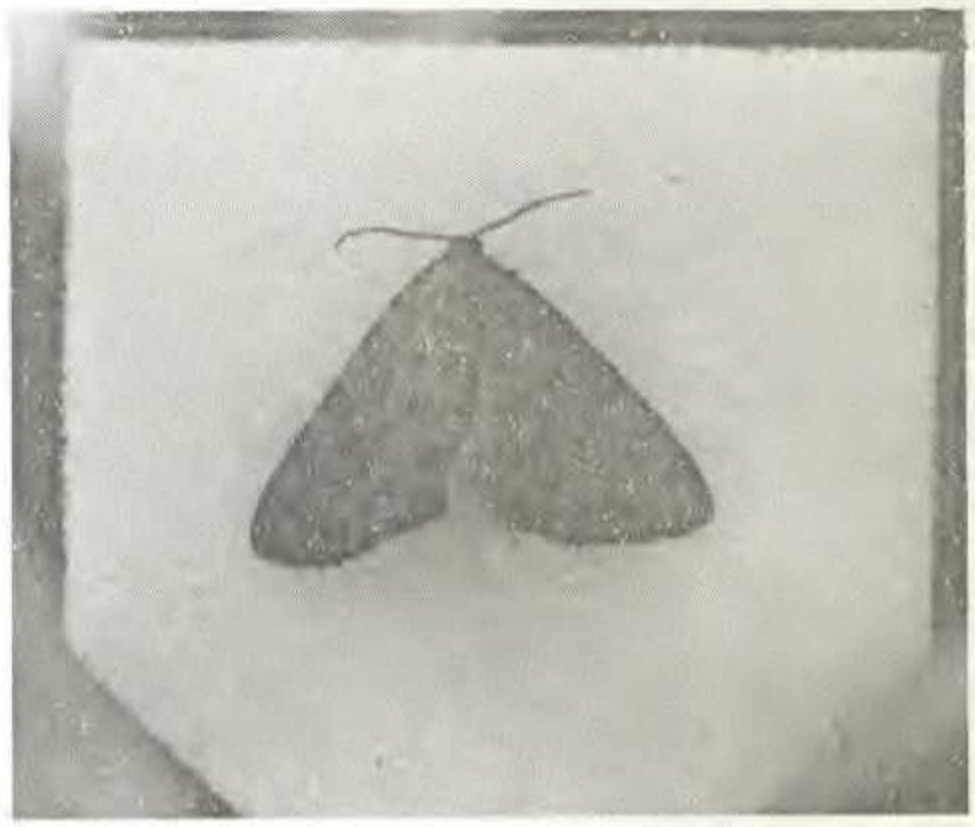
In ENCEPHALARTOS 21 we gave a short report on the S.A. Wildlife Society's "Save the Cycad" Fund as announced in an article in the Nov-Dec issue of AFRICAN WILDLIFE. Authors John Comrie-Grieg and Keith Cooper have followed this up with a thought-provoking article entitled *Cycad Conservation - and the "Madeira connection"* which appears in the Jan-Feb issue (Vol 44, No.1, pp 21-23) of the same magazine. Extensive reference is made to the Joe Berardo cycad shipment to Madeira, and some fascinating statistics appear on various other cycad conservation investigations. The authors stress the value, as a genetic resource, of cycad collections in private hands in South Africa. This article is recommended reading for all concerned with cycad conservation.

CYCAD 90 - PLANS "LOOKING GOOD"

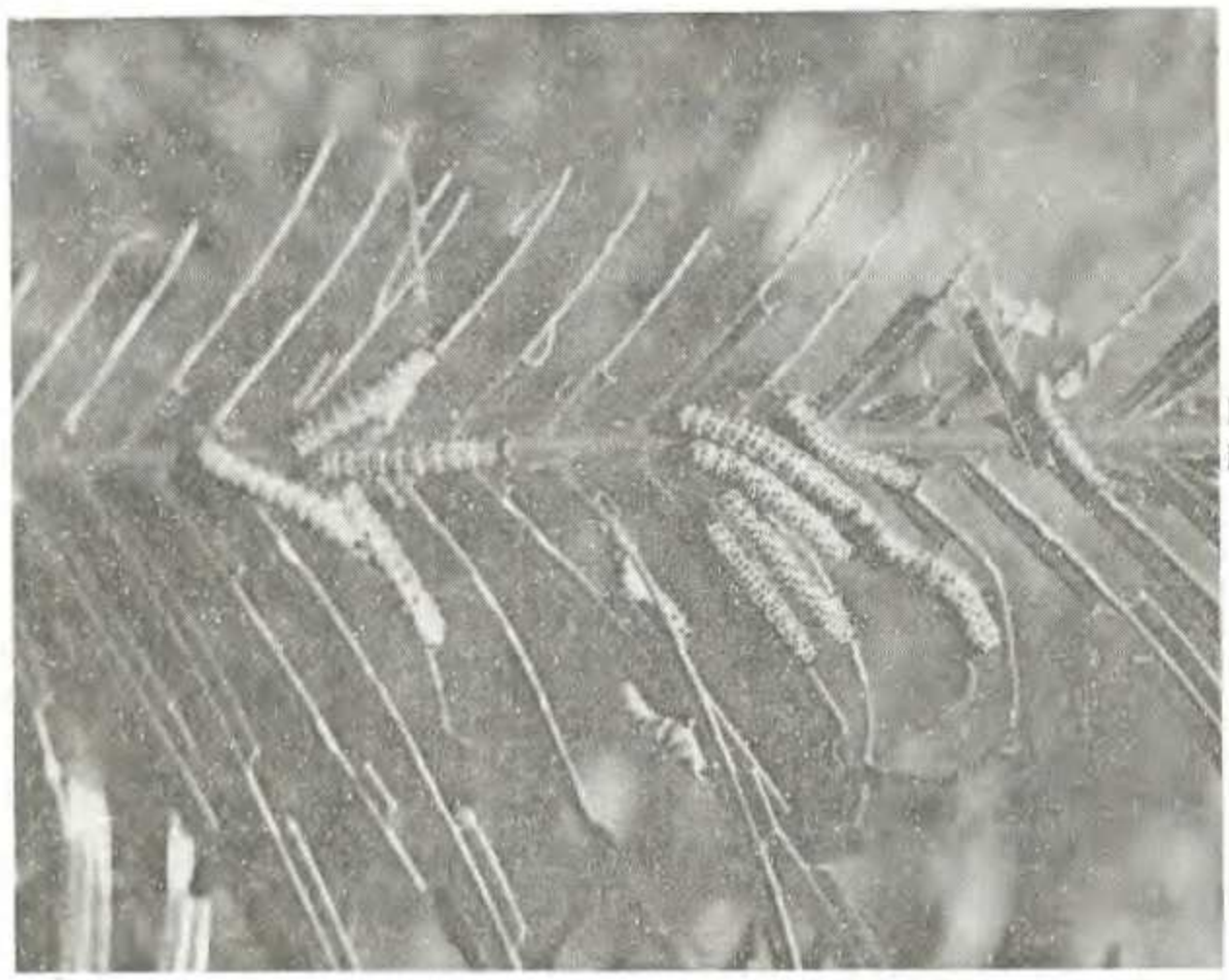
Final plans are now well in hand for the July CYCAD 90 Conference in Australia. There will be a strong representation from South Africa which will include John Donaldson, Cynthia Giddy, Douglas Goode, Nat and Hanneke Grobbelaar, Roy Osborne and Piet Vorster. The Zimbabwean delegation comprises Charles Chakavarika and Ian Turner. This team will make a total of about 15 scientific presentations in the form of lectures or posters. Apart from the academic sessions, our delegates will have the opportunity to visit some of the Australian *Cycas, Lepidozamia* and *Macrozamia* habitats. A comprehensive report back will appear in a forthcoming issue of ENCEPHALARTOS.

LEOPARDS ON THE PROWL

Long-suffering Natal coastal cycad enthusiasts have again this summer been plagued by the leopard moth, *Zeronopsis leopardina* (see ENCEPHALARTOS 18:45). Constant vigilance is needed to prevent large, sometimes valuable, cycads from being decimated by the moth's larvae. The moths are active during summer and their larvae feed exclusively - and voraciously - on the foliage of all cycad genera except possibly *Stangeria* and *Ceratozamia*. Recent observations by Miss Carrie-Ann Osborne show that the fully-grown "caterpillar" goes into a resting chrysalis stage, but that in warm weather the new adult moth can appear in as little as ten days. The implication of these observations is that several successive generations of leopard moth can appear in any season; all of which is bad news for our Natal cycadophiles.



Despite its attractive appearance, one clutch of eggs from this moth can hatch out to destroy a large cycad plant within 24 hours.



Larvae of the Leopard moth feeding on *Cycas thouarsii* leaves.

CYANOBACTERIA IN ENCEPHALARTOS TRANSVENOSUS

Several kinds of filamentous nitrogen-fixing bacteria live symbiotically in the roots of *Encephalartos transvenosus*. A current report entitled "Comparative morphological and physiological studies on cyanobionts of *Encephalartos transvenosus*" by J. Marshall, T.C. Huang and Nat Grobbelaar (*South African Journal of Botany* 55: 574-580 of December 1989) describes their morphology and physiology. Reprints of the paper may be requested from Prof. Grobbelaar.

CYCAD CONE DISINTEGRATION

The processes which lead to the disintegration of female cones of *Encephalartos* spp. are not simple abscission processes, but seem to involve a complex interplay of water transport phenomena with consequent changes in tension at various points in the cones. These processes are described by Nat Grobbelaar in a paper entitled "Disintegration of *Encephalartos* megastrobili" published in the *South African Journal of Botany* 55: 581-585 of December 1989. Reprint requests may be addressed to Prof. Grobbelaar.

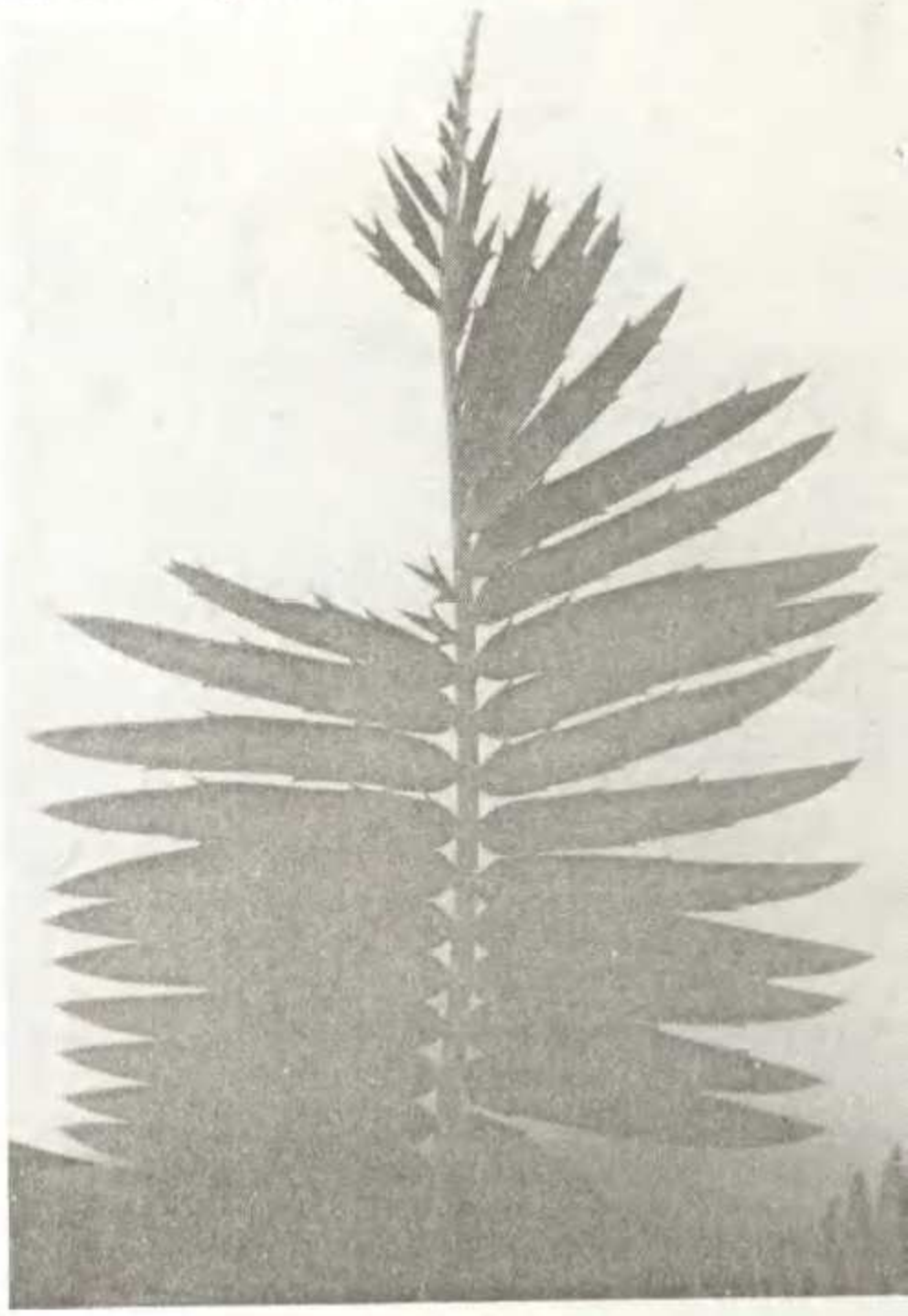
UNUSUAL CYCAS THOUARSII CONING

The accompanying photograph, taken by Roy Osborne from a plant in his Westville garden, shows a *Cycas thouarsii* female "cone", normal in all respects except for a single leaf which developed in place of one of the sporophylls. This seems to illustrate that the seed-bearing structures are indeed highly modified leaves.

The female "cone" of Roy Osborne's *Cycas thouarsii* showing a single normal leaf replacing one of the sporophylls.

UNUSUAL "LEBOMBO" LEAVES

Ken Watson, a keen cycad member from Pinetown in Natal, reports that a 5-year old plant of *Encephalartos lebomboensis* has this summer produced several leaves with odd terminal sections, as shown in the accompanying photograph. These leaves have lost a number of their usual leaflets and have instead developed much reduced structures like basal prickles or even small callus-like nodules towards the leaf apices. Ken maintains that he has not used any hormonal sprays or insecticides on or near the plants. Have any readers had similar experiences?



The odd terminal leaf section from Ken Watson's *Encephalartos lebomboensis*.

LETTERS BRIEWE

Dear Sir,

Mr. Graham Cox's article, **How old is that cycad?**, in ENCEPHALARTOS 21: 16--17 contains very valuable material. His data is broadly consistent with measurements made elsewhere. Unfortunately he omitted to tell us where those plants grew. If in Durban, it is all very well to reason that it is a beautiful climate for cycads and that they should grow optimally, but that would definitely not apply to species which naturally occur in cooler and drier areas. Nevertheless, his observations support my own that species like *Encephalartos altensteinii*, *E. natalensis, E. paucidentatus,* and *E. transvenosus* can easily increase their stem length by 30--50 mm annually *once the stems have attained their maximum diameter.* On the other end of the spectrum, there is no denying that the group comprising *E. ghellinckii, E. cycadifolius, E. friderici-guilielmii, E. laevifolius, E. lanatus*, and *E. humilis* are impossibly slow, whether from seed or otherwise. To witness, on the lawn of the Union Buildings in Pretoria stand some *E. friderici-guilielmii*. On a photograph taken in about 1920 their trunks appear to be about 300 mm long. In 1980 they were no more than 900 mm tall, yet they had shared in all the fertilizer and irrigation applied to the lawn. Elsewhere in the garden *E. altensteinii* increased their trunk length by about 1,8 to 2 meters in the same period, and some of these grew under very severe conditions. Secondly, the maximum growth rate recorded for well-tended *E. laevifolius* in the Pretoria Botanic Garden was about 10 mm per year, measured over a 15 year-period. Lastly, the late Dr. Dyer gave me two of the seedlings of *E. cycadifolius* depicted on p. 417 of his monograph. These germinated in 1960, and now, 30 years later, the stems are no more than 100 mm in diameter, though I have nursed them lovingly over a period of 25 years.

Mr. Cox also mentions an increase in stem diameter, in this case expressed as girth. There is a myth, often repeated in botanical textbooks, that cycads cannot increase their trunk diameters because they have no secondary thickening. Some 13 years ago I acquired an *E. altensteinii* with a miserable trunk, 600 mm tall but only 150 mm in diameter. Today that same trunk measures almost 400 mm in diameter over its whole length, and still seems to be expanding.

Piet Vorster

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LETTERS BRIEWE

Dear Sir,

In recent issues of ENCEPHALARTOS (19: 4, 20: 39, 21: 29) mention was made of the *Encephalartos laevifolius* on Mariepskop. In ENCEPHALARTOS 19: 4 it was stated that only four clumps remain, whereas I counted 16 in 1969. This is however erroneous, and the latest census by Mr. K. Zunckel revealed 17 extant clumps, though the total number of stems comprising these clumps have decreased since 1969.

Referring to Mr. Scriba's letter in ENCEPHALARTOS 21: 29, I have not forgotten the incident where a truckload of plants was supposed to have been removed by people in the employ of the then Transvaal Division of Nature Conservation. Like him I am unhappy that nothing ever came of our reporting the matter. Those plants vanished into thin air: one or two were seen at the Klaserie office of Nature Conservation's repository, the Hartebeeshoek Nursery; and neither the then Botanical Research Institute nor the National Botanical Gardens ever received any material. I believe that at about the same time, i.e. early 1970, a relative of one of the military officers stationed at Mariepskop was charged with trading Mariepskop plants in Johannesburg.

When I discovered the plants in 1969, there was no sign of poaching. When I revisited the locality in January 1972, after the alleged removal of plants referred to above, all 16 clumps were still there, though it was clear that apparently smallish suckers had been removed in number. As can be seen from the accompanying photographs (p. 25) which were taken at the time, these plants were really monsters, almost impossible to move over such difficult terrain.

In 1970 the military authorities at Mariepskop assured Mr. Scriba and myself that they would look after the plants, as the only access to the plants is through the area controlled by the military. In view of Mr. Zunckel's recent census there is no reason to accuse them of not honouring their pledge, and I apologize to the military authorities for any embarrassment caused by my letter in ENCEPHALARTOS 20: 39, prompted by erroneous information.

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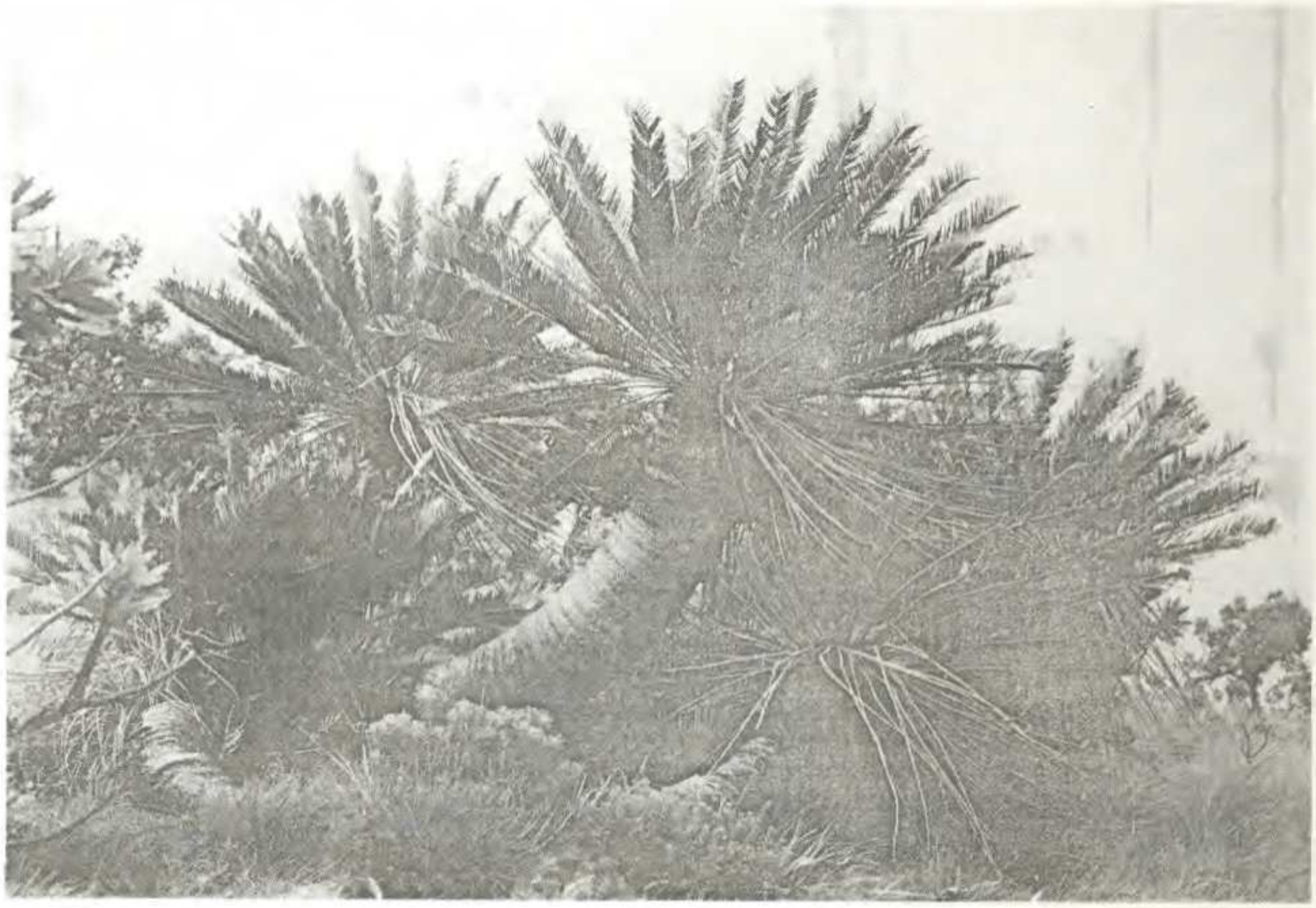
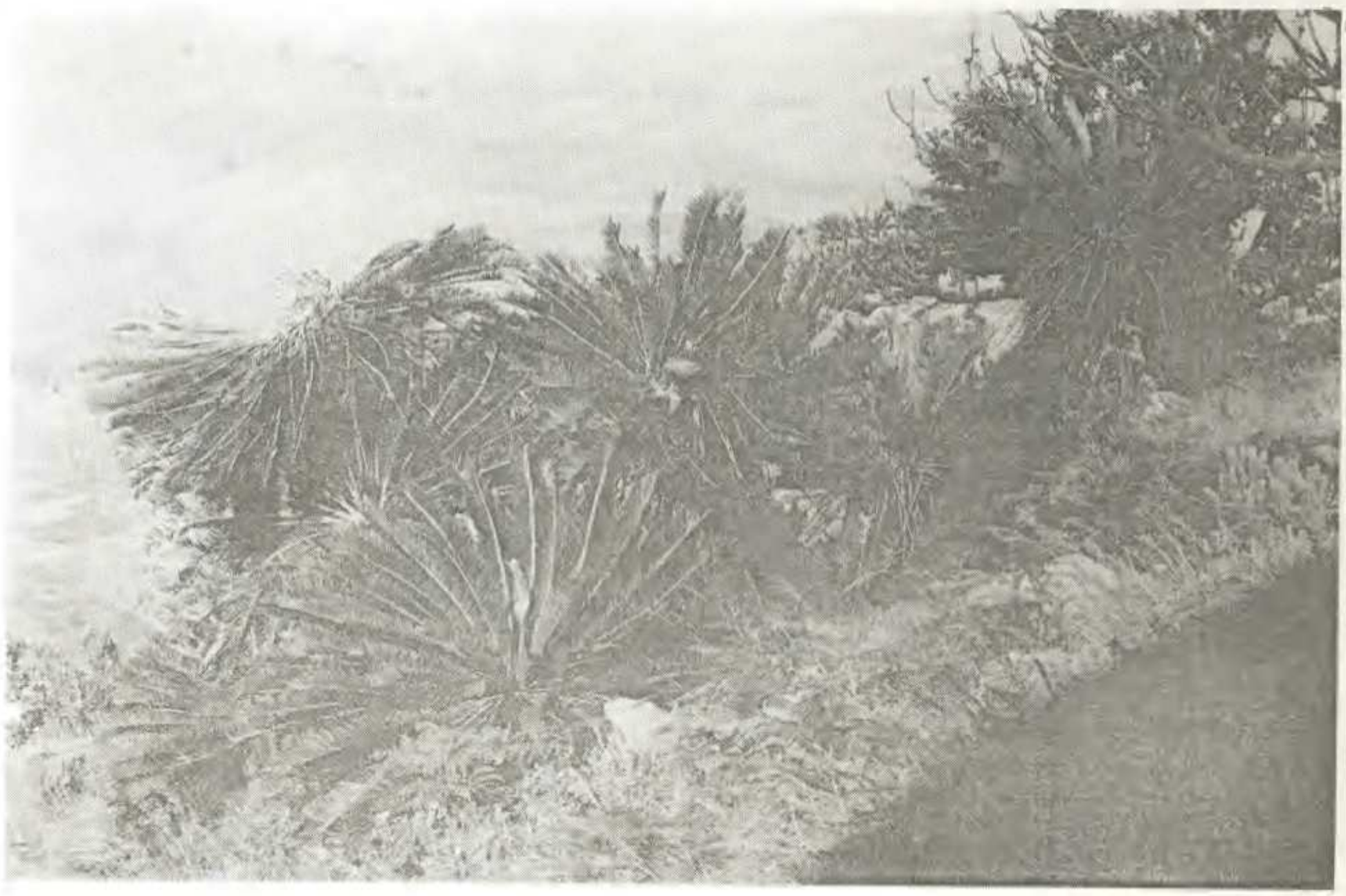


Two of the 16 large clumps of *Encephalartos* on Mariepskop, photographed in 1972. These plants are similar to *E. laevifolius* from further south except for having dark green rather than bluish fronds, and bearing rather more hairy cones.



Dear Sir,

We are all familiar with the tribulations of trying to germinate cycad seed. Except in *Zamia,* one seldom succeeds in getting seed to germinate in the same year in which it was harvested. The worst case I ever experienced, was a batch of a *Cycas* in the *C. rumphii* complex, which had apparently no developed embryos when I received them, and of which the first germinated after 2 years and the last after 5 years and 8 months. This is thought by various authors to be the result of three factors:

1. The embryo needs a period of several months to mature before germination can take place.
2. The hard shell (sclerotesta) prevents sufficient water and/or oxygen from reaching the embryo.
3. The fleshy covering (sarcotesta) is suspected of containing a chemical inhibitor to germination.

On recently receiving some freshly collected seed of *Encephalartos transvenosus*, with the still juicy sarcotesta intact, I was therefore surprised to find on cleaning the seeds that quite a few had already started germinating, within the sarcotesta. This suggests the following:

1. The embryo was already fully developed when the cone disintegrated.
2. The sarcotesta did not contain a chemical inhibiting germination in *E. transvenosus*.

Of course this observation cannot be said to be the norm for *E. transvenosus*, neither can it be extrapolated to other species.

Piet Vorster

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Dear Sir,

Mr. Julius Brunner's article **Sowing cycad seed in a way that guarantees germination** in ENCEPHALARTOS 21: 18 is worth considering, though there are problems. As can be seen from the enclosed article on germination of *Zamia pumila*, a broadly similar method has been in use for some years. The problem is that only in *Zamia* is the embryo fully developed and ready to germinate by the time the seed is shed from the cone, whereas in all the other genera the embryo requires a development period of several months before germination. If the shell (sclerotesta) is removed prematurely, it means that the encasing endosperm is exposed to infestation until such time as the embryo has completed its development. Mr. Brunner seems to have overcome that problem by keeping his unshelled seeds under entirely aseptic conditions, but that is not easy to achieve. Another real problem is to get the shells off without wounding either the endosperm or oneself. For this reason I would not advocate this technique for backyard application to seed of genera other than *Zamia.*

Recently I received some rare *Zamia* seeds of which more than half had cracked shells. In my experience such seeds seldom germinate in the seed bed, no doubt due to infestation through the cracks. In view of the rarity of the material, I removed the shells, sterilized in household bleach, treated with giberellic acid to stimulate germination, and incubated in vermiculite at 27^{o} C. To my amazement almost all germinated within 24 hours, whereas the intact seeds in the seedbed, under the same temperature, started germinating only after four weeks, and then rather tardily.

Piet Vorster

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Mr. Ian Turner's article **Cycads in China** in ENCEPHALARTOS 21: 11-14 is tantalizingly interesting. Amongst other things, it in fact amounts to announcing the rediscovery of *Cycas micholitzii* var. *micholitzii,* hitherto known only from the type material collected in 1904. The living plant which Kew Gardens received at the time, is also no longer extant.

Piet Vorster

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Arizona authorities deal with a new kind of criminal

Cactus rustlers in for a prickly time

In present-day Arizona there is a new breed of rustler out there — stealing cactus for collectors — but Arizona authorities vow to make life prickly for them. **PETER PRINGLE** of the Independent news service reports from Washington.

NEXT time you watch a dusty old western, spare a thought for Cereus giganticus, the tall cactus that is so named because it looks like a giant candlestick and was often used as a backdrop for camp fire sets in early films.

More than likely, the cactus came from the Arizona desert and, after the film was made, ended up in the garden of some Hollywood tycoon.

Arizonans didn't like losing their cactus, so in 1927 they made it illegal to dig them up from public lands. They even set up a small force of "cactus cops" to patrol the desert where the plants can grow up to 6m, weigh 200 tons and live for 200 years. For a while, the cactus patrols kept the thieves at bay, but now cactus rustling has become big business.

The problem has reached the office of Congressman Mo Udall, the long-serving member of the House of Representatives from Arizona. When he returned to work this week, along with his 534 colleagues, the first item on his agenda was to alert the federal authorities to the new rash of cactus thefts.

"Someone pulls up one of those saguaros, which is the local Spanish name, and they are walking away with something that started to grow in the last days of the administration of Benjamin Harrison which was a century ago," Mr Udall wrote to the Secretary of the Interior, Manuel Lujan. Unless something is done to curb the poachers' activities, the cactus could become an endangered species, warned Mr Udall.

The droughts of recent years have increased the demand for cactus all over the south-west. Some collectors are satisfied with the perfectly round, bright green cacti, with no spines — the kind that come out of hothouses. The more adventurous go for the coveted saguaro, which grows so slowly it takes about five years to sprout a few inches from seed. Much of the burgeoning cactus trade is legal, and Arizona sells thousands of permits to private property owners who want to sell the saguaros they find on their own land.

But too many collectors, for the liking of Mr Udall and other conservationists, are not interested in the cacti unless they show the marks of having grown up in the real world. "They can be very picky," says Faith Campbell, who heads the plant preservation project for the Natural Resources Defence Council in Washington.

She said 35 varieties of cactus are now on the international endangered species list, along with orchids and cycads, the squat, ancient plant commonly known as dinosaur food.

The hottest item among cactus collectors is the crested saguaro, a rare genetic freak that produces an ostrich-like plume on top of the main branches. Only about 100 of these monster mutants are known to exist and at least 21 of them have been reported stolen in the past 18 months.

The rustlers typically strike at night, but also during the day. They rarely get caught and are not deterred by the relatively small fines. Last year, Arizona state agents issued only 77 citations for stealing cacti, and it has been rare for any cactus thief to be fined more than R500. When the cactus patrol caught Guadeloupe Falcon and his four accomplices, they were hacking away at the bottom of a two-armed saguaro, which they intended to strap on to the back of their truck belonging to a local plant dealer. Mr Falcon was arrested, but disappeared before he could stand trial. And the judge dismissed the case against the dealer who hired Mr Falcon because the dealer was not at the scene of the crime.

The big saguaros fetch anything from R2 500. In the most famous case, the police tracked down a 6m crested saguaro to a Las Vegas nursery where the owner, who claimed he was unaware it had been stolen, was selling it for R35 000. The thief eventually received a fine of R1 500 and six months in jail.

Not only thieves are giving the saguaro a hard time. Botanists recently discovered a blight that causes premature ageing and thinning. Environmentalists suspect dirty air as being the cause — acid rain, car exhausts and pollutants from lime kilns that used to operate in the Arizona desert, but no one is quite sure.

The saguaro occasionally fights back against man. Cactus rustlers regularly end up with their hands full of spines, and when local good ol' boys recently used a saguaro as a target for firing practice, the wounded plant retaliated. As one of the gun-slingers posed for his picture in front of the cactus, it fell on top of him and killed him. — Independent news service.

Man gevonnis oor 93 broodbome

RANDBURG. — 'n Man wat drie jaar gelede 93 broodbome van sy erfplaas in die Laeveld na sy huis op Randburg gebring het om te voorkom dat hulle gesteel word, is gister in die Randburgse landdroshof tot R300 of drie maande tronkstraf (opgeskort vir drie jaar) gevonnis.

Theunis Johannes (Tinus) van Vuuren, 40, bestuurder van 'n diamantslypery in Bloemfontein het skuld erken op 'n aanklag van onwettige vervoer van beskermde plante van een gebied na 'n ander. Van die bome was meer as 300 jaar oud.

In pleitverduideliking voor landdros SP Bezuidenhout het Van Vuuren aangevoer die broodbome het eers aan sy ma behoort. Hy het dit 20 jaar gelede geërf toe sy dood is. Toe hy in 1987 op die plaas bankrot speel, het hy die bome van die plaas Castekop in Barberton se distrik na sy huis in Randburg met 'n vragmotor gebring.

Die departement natuurbewaring wou om tegniese redes nie 'n permit aan hom toestaan vir die vervoer van die broodbome nie. Omdat 46 van sy bome reeds gesteel was, wou hy nie die ander bome op die plaas agterlaat nie. Hy het 93 bome uitgegrawe en dit saamgebring.

Omdat hy dikwels verhuis het, het hy nog nie kans gehad om die bome te plant nie.

Die broodbome is aan die Transvaalse Provinsiale Administrasie verbeurd verklaar.

Landdros Bezuidenhout het in sy uitspraak gesê Van Vuuren het 'n ordonnansie oortree wat bedoel is om 'n waardevolle erfenis te beskerm. Dit tel in Van Vuuren se guns dat hy nie in die broodbome handel wou dryf om homself te verryk nie. Die bome was sowat R15 000 werd.

Mnr Bezuidenhout het gesê met die verbeurdverklaring van die bome het Van Vuuren reeds sy straf weg.

TRANSVALER ★ VRYDAG 23 FEBRUARIE 1990

CYCAD 90 NEWS

At least 78 persons from 15 countries will attend the Second International Conference on Cycad Biology from 22 to 28 July in Queensland, Australia. No fewer than 10 of these will be from Southern Africa. Between them they will contribute 15 lectures or posters to the conference.

Apart from a possible pre-congress excursion in the Darwin area, a post congress tour to southern Queensland and northern New South Wales to see some of the indigenous cycad species in their natural habitat, will almost certainly be arranged.

The lectures and posters will deal inter alia with the taxonomy of the cycads of the world including fossil cycads; the conservation of cycads in nature; physiological and chemical studies on cycads; and the population dynamics of cycads.

Dr Roy Osborne is the local member of the Conference Organising Committee and can be contacted directly for further information. His home telephone number is (031) 866953.

THE NATAL MERCURY, JANUARY 27, 1990

Two held after plants removed

Crime Reporter

TWO white men were arrested in Durban's Berea Park yesterday when police discovered three valuable cycas and other plants in their bakkie.

Policemen investigating the presence of the vehicle in Berea Park found two men, aged 20 and 34, inside covered in dirt from head to foot.

They then searched the vehicle and found three large cycas plants in the back of the vehicle, together with spades, ropes and other tools used to excavate the plants.

The cycas, related to the cycads, comes from Asia and has smoother leaves.

According to Assistant Parks Recreation and Beaches Director Alan Pembroke, the total value of plants removed amounted to almost R2 000.

Botanic gardens unite for diversity

A STRATEGY to link several hundred botanic gardens across the world into a global network, thereby making plant conservation more effective, was launched in London last week. The Botanic Gardens Conservation Strategy comes at a time when a quarter of the world's plants are in danger of becoming extinct over the next 25 years. Also, many of the remaining species are likely to show little genetic variation.

"Botanic gardens cannot save rainforests but they can conserve a lot of the plants that grow in them," said Vernon Heywood, director of the Botanic Gardens Conservation Secretariat. "United, the botanic gardens of the world are a major and untapped source of plants for conserving genetic diversity."

Following the model of the World Conservation Strategy, which has underpinned nature conservation over the past decade, this new strategy for plants offers a blueprint for conservation in gardens and arboreta in both temperate and tropical countries. There are some 1500 gardens and arboreta around the world, but until now their work has been largely uncoordinated.

In the past, botanic gardens in tropical countries played a vital part in developing the new crops that nurtured empires—rubber, coffee and oil palm, for example. Today, they are ideal places in which to develop new crops that might be needed as the global climate changes.

The UN Food and Agriculture Organisation and the International Board for Plant Genetic Resources already have programmes and facilities for conserving the genetic material of basic crop plants, but there is no equivalent for wild plants. The new programme says that botanic gardens should concern themselves more with species used in medicine, along with fruits, vegetables and spices used on a smaller scale.

"The case for conserving plants is compelling," said Ronald Davey, the Queen's physician. Apart from species that provide food, many contain compounds that form the basis of drugs. Morphine, atropine, penicillin and the cancer drug vincristine, all come from plants and many of today's designer drugs were inspired by plant substances, he said. More than 80 per cent of the world's population still uses remedies from natural sources. Some medicinal plants are heavily exploited and need to be conserved, both to ensure that they survive for traditional use and so that scientists can analyse them for their active ingredients.

"The strategy aims to put the conservation of wild plants on a scientific and technical basis," said Heywood. The secretariat will build a database to keep track of who is doing what and advise gardens on how best to implement the strategy in their country. The strategy encourages gardens to share the costs of expensive facilities. **Stephanie Pain**

THE PRETORIA NEWS Wednesday September 27 1989

Care for cycads — they face extinction

On the way out: the Encephalartos heenaii is one of several species of cycads that face "extinction" should the public not respond to appeals for assistance from the Transvaal Provincial Administration's Directorate of Nature and Environment Conservation.

Staff Reporter

WHILE the decline of the elephant and the rhinoceros due to illegal hunting and trading is enjoying much attention these days, one of South Africa's most precious natural treasures, the cycad, is fast becoming a collector's item.

An appeal has gone out to the public from the Transvaal Provincial Administration's Directorate of Nature and Environment Conservation to assist in both fertilisation and cultivation programmes to boost dwindling stocks of the plants and to help apprehend cycad thieves.

Scientists from the directorate recently made the disconcerting discovery that one of the very last colonies of encephalartos dolomiticus no longer exists in its natural environment.

This species of the spiky-leafed plant can now only be found in private collections.

Botanists distinguished the dolomiticus cycad and two other species from the original E. Eugene maraisii some time ago. The four species were then described according to the taxonomic differences in the various geographic populations — E. Eugene maraisii, E. middelburgensis, E. dyerianus and E. dolomiticus.

By means of a recent Transvaal Executive Committee resolution, the three "new" species are now included as specially protected plants in Appendix 12 of the Nature Conservation Ordinance.

Due to the illicit removal of the dolomiticus cycad from nature, however, this beautiful plant will probably now be classified as "extinct" according to the conservation status categories of the International Convention on the Trade in Threatened Plants and Animals (IUCN), said a TPA spokesman.

The dolomiticus cycad is however no exception. Collection of all kinds of cycads has assumed alarming proportions and of the 28 indigenous South African cycads 16 occur in the Transvaal, and of these six are in danger. There are several species of which not enough plants are left over to form viable populations, said the spokesman.

The indications are that the species Encephalartos heenanii, E. inopinus, E. latifrons, E. arenarius, E. Eugene maraisii and E. middelburgensis also face extinction.

An example of the extent to which cycads have been snatched from their natural habitat is the fact that 25 percent of the total population of inopinus plants is kept in one private garden in the Transvaal. There are at present more inopinus plants in private gardens than in nature.

The cycad fever that has gripped people is now evident in the auctions at which these plants fetch the highest prices. The TPA nursery at Hartbeeshoek has itself suffered losses — in the past year alone this provincial nursery has had three visits from plant thieves. In one raid alone thieves got away with cycads to the value of R10 000, said the spokesman.

The spokesman said that the Transvaal Directorate of Nature Conservation welcomed a decision by the government to establish a special police unit to combat the illicit trade in ivory, rhinoceros horns and cycads.

The directorate, said the spokesman, had therefore appealed to the public to first cultivate among themselves a general appreciation of and concern for that which is theirs, and secondly to help eliminate the illegal plant collectors.

The directorate made a special request to those people who have specimens of E. dolomiticus in their gardens to assist their botanists in the artificial fertilisation and cultivation programme that must now be undertaken.

A serious appeal is made to all members of the public to be on the lookout in natural surroundings and in towns for conduct that seems suspect and to report cases of illegal plant collecting without delay.

REWARD

A reward of 25 percent of the fine imposed for unlawful collection can be offered in terms of the Nature Conservation Ordinance to persons who help the police or nature conservationists to trap plant thieves.

Heavy fines are increasingly imposed by the courts. A man was recently sentenced to a fine of R20 000 plus a suspended three-year term of imprisonment for the theft of 27 cycads. He also had to pay a further R20 000 in damage to the owner of the plants.

Collectors who think they can protect the cycad just as well in their own gardens, and so ensure its survival, are labouring under a misconception, said the spokesman.

THE CYCAD SOCIETY OF SOUTHERN AFRICA
DIE BROODBOOMVERENIGING VAN SUIDELIKE AFRIKA

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AMPSDRAERS

ELECTED/VERKOSE

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