ENCEPHALARTOS

JOURNAL OF THE
CYCAD SOCIETY OF
SOUTHERN AFRICA

TYDSKRIF VAN DIE
BROODBOOMVERENIGING
VAN SUIDELIKE AFRIKA

NO. 8

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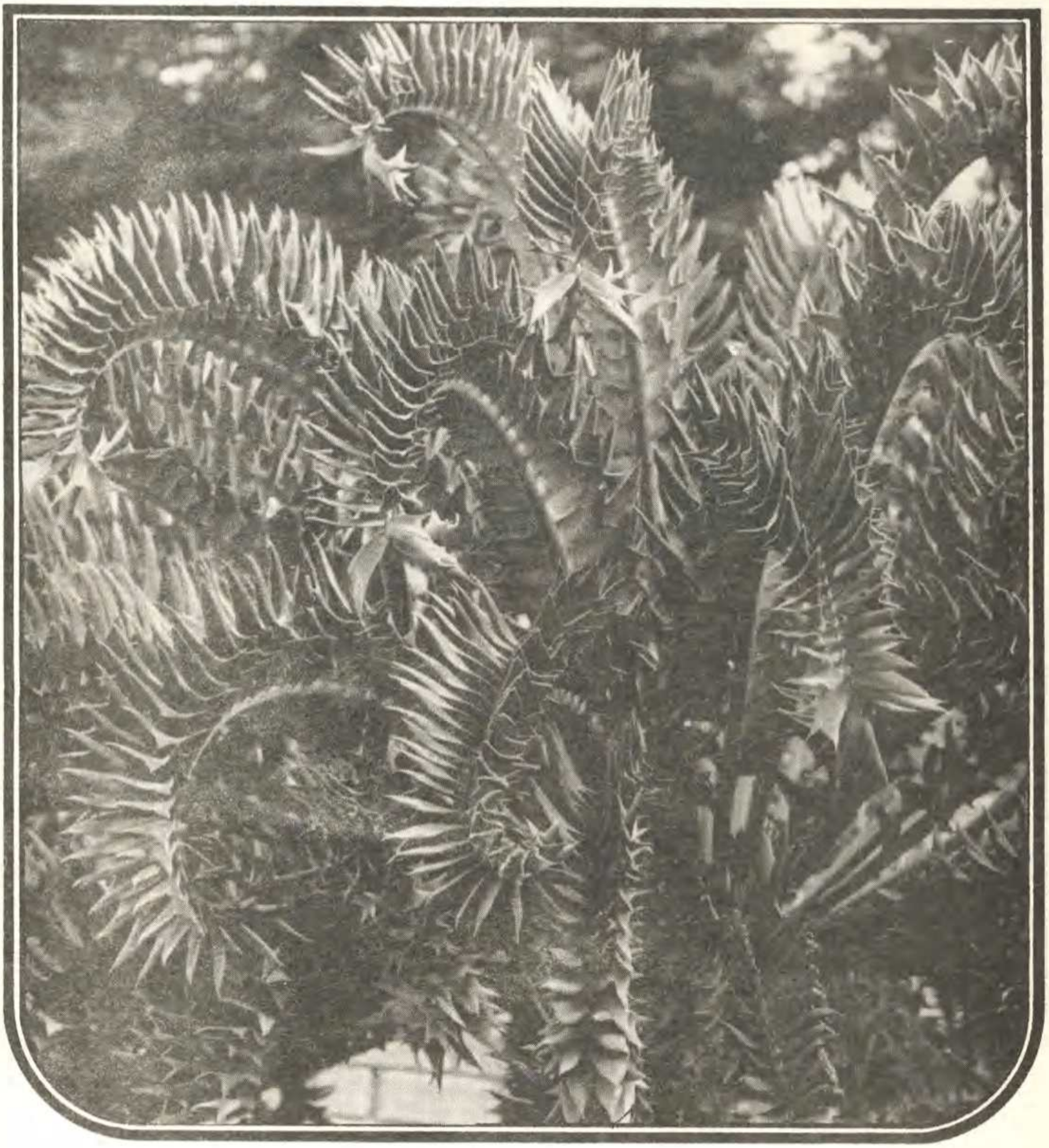

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VOORBLAD/COVER

Encephalartos latifrons

EDITORIAL

There are many things which divide man=kind: language, race, nationality, ideology, religion, economy, distance and many others. This has always been the case since man made his appearance on earth. There has always been a need for greater unity and co-operation, however. Few things provide more pleasure and satisfaction than bringing people toge=ther, across all the divisions and boun=daries.

Building bridges is today more important than ever before. It therefore provides great satisfaction to think that our Society has succeeded in bringing hundreds of people in contact with each other. In the process many bridges have been built, across divisions of language, nationality and background. Vast distances have also been bridged and our Society has members in 14 countries at present: South Africa, Swaziland, Namibia, Zimbabwe, Israel, Italy, France, Germany, Austria, Britain, the USA,Hawaii, Australia and New-Zealand.

REDAKSIONEEL

Daar is baie dinge wat die mensdom ver=deel: taal, ras, nasionaliteit, ideolo=gie, godsdiens, ekonomie, afstand en baie ander. Dit was maar altyd so van=dat die mens sy verskyning op die aarde gemaak het. Daar was egter ook altyd 'n behoefte aan groter eenheid en same=werking. Min dinge verskaf meer genot en bevrediging as om mense bymekaar te bring, oor al die skeidings en grense heen.

Die bou van brûe is vandag belangriker as ooit tevore. Dit verskaf dus groot bevrediging om daaraan te dink dat ons Vereniging daarin geslaag het om hon=derde mense met mekaar in verbinding te bring. In die proses is brûe gebou, oor grense van taal, nasionaliteit en agter=grond. Ook groot afstande is oorbrug en ons Vereniging het tans lede in 14 lande: Suid-Afrika, Swaziland, Namibië, Zimbabwe, Israel, Italië, Frankryk, Duitsland, Oostenryk, Brittanje, die VSA, Hawaii, Australië en Nieu-Seeland.

EDITORIAL
- CONTINUED -

It is a striking and pleasant thought, furthermore, that we are joined together by the cycad - that timeless inhabitant of our planet, which was here millions of years before man started his sojourn here. This thought should make us a little more humble and even more willing to work to= gether, despite our differences.

Opinions which are expressed in the editorial are those of the Editor and do not necessarily represent the policy of the Cycad Society. Likewise are opinions expressed in articles published in ENCEPHALARTOS those of the authors and not necessarily those of the Cycad Society or the Editor.

REDAKSIONEEL
- VERVOLG -

Dit is verder 'n treffende en aangename gedagte dat ons saamgebind word deur die broodboom - daardie tydlose bewoner van ons planeet,wat hier was miljoene jare voordat die mens sy verblyf hier begin het. Die gedagte behoort ons 'n bietjie nederiger te maak en nog meer bereid om saam te werk, ondanks ons verskille.

Menings wat in die redaksionele artikel uitgespreek word, is dié van die Redakteur en verteenwoor= dig nie noodwendig die beleid van die Broodboomvereniging nie. In= gelyks is menings uitgespreek in artikels wat in ENCEPHALARTOS gepubliseer word, dié van die skrywers en nie noodwendig dié van die Broodboomvereniging of die Redakteur nie.

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

VAN
DIE PRESIDENT,
REDAKTEUR,
NASIONALE
EN
STREEKKOMITEES

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

FROM
THE PRESIDENT,
EDITOR,
NATIONAL
AND
REGIONAL COMMITTEES

MEMBERSHIP

Members of the Society must now renew their membership for 1987. A form for this purpose is included at the back of this edition of ENCEPHALARTOS. Please complete it as soon as possible and return it,together with your subscrip= tion,to our Membership Officer, Marion Debruyne. Her address appears at the top of the form. Please complete the form fully and please print, as the in= formation regarding address, etc. is required to keep the membership list up to date. Please indicate your language preference by completing either the English or the Afrikaans side of the form.

According to the constitution of the Society, the names of members whose mem= bership has not been renewed by 31 March 1987, will be deleted from the membership list.

An urgent and earnest appeal is made to you to renew your membership in time. It creates serious administrative pro= blems if you don't do that. After 31 March the membership lists of both the Membership Officer and the Editor of ENCEPHALARTOS are amended and brought up to date. If you renew your membership after that, the whole process has to be reversed. Why not mail your form and subscription fee right away?

Please also remember to inform the Mem= bership Officer should you change your address during the year. That will prevent, amongst others, the mailing of copies of ENCEPHALARTOS to you, only to be returned by the Post Office. In that case you don't receive ENCEPHALARTOS and the postage is wasted.

Your co-operation will be sincerely appreciated.

LIDMAATSKAP

Lede van die Vereniging moet nou hulle lidmaatskap vir 1987 hernu. 'n Vorm vir hierdie doel word agter in hierdie uit= gawe van ENCEPHALARTOS ingevoeg. Vol= tooi dit asseblief so gou as moontlik en stuur dit, tesame met u ledegeld, aan ons Lidmaatskapbeampte, Marion Debruyne. Haar adres verskyn bo-aan die vorm. Voltooi asseblief die vorm vol= ledig en in drukskrif, aangesien die besonderhede t.o.v. adres, ens. benodig word om die ledelys op datum te hou. Dui asseblief ook u taalvoorkeur aan deur òf die Afrikaanse òf die Engelse kant van die vorm te gebruik.

Volgens die grondwet van die Vereniging, sal lede wie se lidmaatskap nie teen 31 Maart 1987 hernu is nie, se name van die ledelys geskrap word.

'n Dringende en ernstige beroep word op u gedoen om u lidmaatskap betyds te hernu. Dit skep groot administratiewe probleme as u dit nie doen nie. Na 31 Maart word die ledelyste van beide die Lidmaatskapbeampte en die Redakteur van ENCEPHALARTOS gewysig en op datum ge= bring. Indien u dan u lidmaatskap daar= na hernu, moet die hele proses weer omgekeer word. Hoekom pos u nie sommer nou dadelik u vorm en ledegeld nie?

Onthou asseblief ook om die Lidmaatskap= beampte in kennis te stel as u adres ge= durende die jaar verander. Dit verhoed onder andere dat kopieë van ENCEPHALAR= TOS aan u gepos word en dan deur die Poskantoor teruggestuur word. U ontvang dan nie ENCEPHALARTOS nie en die posgeld word gemors.

U samewerking sal baie waardeer word.

U S A RESEARCH ROUNDUP

by Roy Osborne

Earlier this year, Roy Osborne visited North America to present a paper on "Tissue Culture in Cycads" at the International Plant Tissue and Cell Culture Congress in Minneapolis. This lecture was very well received and Roy sub= mitted the following report on some of the research work pre= sently being carried out in the U.S.A. in our particular field of interest.

My first cycad 'contact' was a visit to our new member, Prof. Dennis Stevenson of Columbia University, New York. Who would ever imagine there to be a glass= house filled with cycads on the top of a highrise college building in Manhattan? Dennis, who works closely with the New York Botanic Gardens in its extensive herbarium, is deeply committed to re= search in cycad taxonomy. Good news is that he has just been told of funding for a number of future excursions into South America where he will undoubtedly add to his extensive knowledge of Zamia species. Apart from his cycad inte= rests, Dennis and his wife Jan are keen fern enthusiasts and are largely respon= sible for the fern publication 'Fiddle= head Forum'.

At the University of Minnesota I came under some pretty severe questioning from Prof. P.M. Mehra, of Punjab Univer= sity in India, when I mentioned sex re= versal of cycads. Prof. Mehra contends that sex changes are inconsistent with reports of sex chromosomes in cycads. My own view is that these chromosomes may be 'sex associated' rather than 'sex determining' and hence it could still be that some traumatic incident like drought, fire, transplanting, etc. could cause a hormonal imbalance which, at least temporarily, overrides the genetic sex expression. Some carefully-planned experimentation is urgently needed to sort out the whole question of sex ex= pression and control in cycads.

Travelling down to Florida, I was ho= noured to accept an invitation to stay at 'The Kampong', the stately former home of David Fairchild. The Fairchild Tropical Garden is of course the mecca of cycad lovers the world over. What= ever expectations one has are quickly exceeded by the magnificence in the variety, numbers and size of specimens in their collection. Nancy Hammer, Curator of Palms and Cycads at FTG, with obvious pride, showed me around the out= door cycad groups, the rainforest plan= tings and the rare plant house. Nancy herself had just returned from a cycad botanising trip to Costa Rica. At the associated Montgomery Research Centre, I met our member Dr Knut Norstog, an out= standing academic and one of the world's leading cycad scientists. Knut had many useful suggestions to make on cycad tissue culture work. He had recently had some good successes with regeneration of plantlets of Zamia in culture. Amongst his many other interests were experiments in hybridising different cycad species. He has crossed Z. spartea with Z.furfuracea and noted the classical Mendelian behaviour of the F_1 generation (relatively uniform) and the F_2 genera= tion (distinct segregation back to paren= tal characters). In another experiment Knut was testing the effect of hormones. It seems that the application of gibbe= rellic acid leads to maleness, while cytokinins lead to femaleness. Dr Nor= stog also took some time off to travel with me to one of the big commercial plant tissue culture operations, Ogelsby Plant Laboratories Inc., near Hollywood, and also to travel south to Homestead where we met Dr Richard Litz of the Uni= versity of Florida's Tropical Research and Education Centre. Richard is also working on cycad tissue culture and has made some excellent progress in getting Zamia reproductive material to produce large numbers of somatic embryos in both solid and liquid cultures.

Raising the flag ... early morning ceremony in the 'Cycad Circle', Fairchild Tropical Garden

Also in Miami, I met our member Willie Tang, who has just completed his M.S. thesis at the University of Miami; his work here being involved with cycad reproductive biology. A fascinating aspect of his work has been the insect and wind exclusion studies in Zamia pumila, which gives real evidence that it is insect pollination and not wind pollination which operates, at least in this species of cycad. Indeed, general opinion amongst cycadologists is that insect pollination is much more significant than previously thought, and this may be true of all cycads. Willie has also confirmed a 24hour temperature cycle in male cones which seems to be tied in with an odour release, which in turn may be a signal to insect pollinators. A message which comes through abundantly clearly is that, if we want fertile seed from garden-grown cycads, it is essential to practice hand pollination.

Another point on the reproductive biology is the rather odd situation in which the pollen of one cycad species can stimulate the female cone of another into seed production without fertilisation actually taking place. This process has important implications; one as a means of propagation of rare species when pollen of the 'correct' male is not available, and another in that we may have to re-evaluate some of the so-called hybrids which have been previously reported. For example, some of the supposedly crossed Zamia X Ceratozamia plants widely reported some time ago, are almost certainly pure Zamias which have been induced to bear fertile seed by the presence of Ceratozamia pollen.

Travelling north to Gainesville, I visited Bart Schutzman, graduate student in the Department of Ornamental Horticulture of the University of Florida.

From left to right:
Chuck Hubbuch (FTG Nursery Manager), Nancy Hammer (FTG Curator, Palms and Cycads) and graduate student Willie Tang with Macrozamia moorei in the background.

Bart is known in cycad circles for his authorship of the Mexican species Zamia splendens. His work on meso-American species continues and he expects to describe two new species, Z. soconuscen=sis and Z. chamberlainii, shortly. Like many taxonomists, Bart is unhappy about the present status of Z. pumila and he believes that there are four 'good' species within this taxon in Florida alone. Amongst his other interests, Bart includes interspecific hybridisa=tion, numerical taxonomy, chromosomal studies, micromorphology of leaf sur=faces and sex control experimentation. If that is not enough, he manages a really tip-top collection of Zamias in the campus glasshouse!

On the USA West coast my prime contact was, of course, with our members Loran and Eva Whitelock. I was delighted to be met by Loran in a Mercedes with the distictive number-plate 'CYCAD 1'! The Whitelock garden is outstandingly spec=tacular - perhaps this is the finest collection in the world? Loran has de=voted a great deal of time in cycad ex=ploration and photography and has a grasp for taxonomy which surpasses that of many professionals. Adding to the list on recorded sex changes, Loran told

Graduate student Bart Schutzman with his carefully-tended collection of Zamias in the glasshouse at the University of Florida in Gainesville, Florida.

Member Loran Whitelock dwarfed by a specimen of Encephalartos woodii in his Los Angeles garden.

me of a specimen of Encephalartos lebom=boensis which changed from male to fe=male some ten years after being trans=planted. Keen on novel ideas for pro=pagation, Loran reports successful root=ing of leaf cuttings of Cycas, Zamia and Encephalartos, and we discussed possible ways to promote bud or shoot development on these rooted leaves. More successful had been an experiment in which leaf ba=ses from the trunk of E. villosus deve=loped plantlets through a callussing, rooting and budding sequence. Loran and I are presently collaborating on joint projects involving pollen studies and seedcoat morphology, both of which could make an important contribution to cycad taxonomy. Another worthwhile task which Loran has accomplished, was the moving of the original Chamberlain (of 'The Living Cycads') collection from Chicago to its more appropriate new home at the Los Angeles State and County Arboretum. Both the Arboretum and the nearby Huntington Botanic Gardens have excellent cycad col=lections in which Loran's influence is evident.

Loran Whitelock's distinctive car registration plate.

My final cycad session in California was a meeting with member Dr Tim Gregory and his charming whife, Teri. As as expe= rienced cytogeneticist, Teri will co-ope= rate on a project in cycad karyology, while biochemist Tim is keen to undertake pollen viability and storage tests, as well as more sophisticated DNA/DNA hybridisation experiments.

This trip was altogether most interesting and informative. It is with mixed fee= lings that I returned home to see just how little cycad research is going on here and how difficult it is to get any sort of funding for this work. Our only advantage is that we do have more than one indigenous cycad!

FROM THE BOOKSHELF

"BIBLIOGRAPHY OF THE LIVING CYCADS"
by Robert W. Read and Marie L. Solt

This booklet is a must for every student of cycads and all research workers in the field. Published in August 1986, it constitutes Volume 2 (Number 4) of LYONIA, the journal of the Harold L. Lyon Arboretum (Address: 3860 Menoa Road, Honolulu, Hawaii, USA 96822).

The work is a comprehensive listing of all known publications on cycads. Based on a preliminary bibliography be= gun in 1964, the list of references has been painstakingly assembled from nu= merous sources. It is unlikely that many texts have escaped the eyes of the compilers. The bibliography itself is 117 pages long, arranged in conventional author-alphabetical sequence, and followed by a subject and species index.

The whole bibliography and annotations have been stored on a DBASE 11 computer programme which indicates the intention of periodic updating of this immensely valuable reference work.

ROY OSBORNE

FOCUS ON... FOKUS OP...

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

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

ENCEPHALARTOS LATIFRONS

by Maans Kemp

INTRODUCTION

Encephalartos latifrons is a majestic South Africancycad; very attractive and very rare. It never fails to make an im=pression,even in cultivation. The few who have had the good fortune to see it in its natural habitat, will never forget the experience.

NAME

E.latifrons was named by Lehmann and bo=tanically described and illustrated for the first time in 1837/1838. The species name "latifrons" means "broad leaves" and is an appropriate name as E. latifrons has the broadest leaves in the genus, with the exception of some forms of E. ferox.

There seems to have been some confusion of E. latifrons with E. horridus in the past. Miquell in 1842 and Schuster in 1932 refer to E. horridus var. latifrons, for example. No-one who has seen spe=cimens of these two very distinct spe=cies will confuse them.

DISTRIBUTION

E. latifrons occurs (or, more correctly: used to occur) in scattered groups in the districts of Bathurst and Albany in the Eastern Cape province. The plants grow on rocky outcrops and hill slopes, usu=ally amongst scrub bush vegetation.

FIGURE 1

Detail of the very characteristic leaflet pattern of E.latifrons.

FIGURE 2

Large specimen of E. latifrons in habitat with the tallest stem approximately 3 m tall.

The rainfall ranges from 1000 to 1250mm per year, on average, and is fairly evenly distributed during the year. Frost does not occur. Summers may be hot and fairly dry.

There existed an early report of E. latifrons occurring in the Uitenhage district, but this was almost certainly a mistake, possibly as a result of incorrect labelling.

DESCRIPTION OF PLANT

1. STEM

   Stems of E. latifrons are up to 3 m tall, and even as tall as 4,5 m in exceptional cases, with a diameter of 30 to 45 cm. Stems may be single, but are more usually branched from the base, sometimes forming a number of stems and suckers. Before new leaves emerge, the crown of the stem becomes woolly.

2. LEAVES

The beautiful broad leaves of E. latifrons may be 1 to 1,5 m long, with the top half or third recurved or completely curled back. The mature leaf is hard and rigid, with a glossy dark green colour. The glossy rachis is clear and yellow. The young leaf is covered by fine hairs which are lost with age. The petiole is 10 to 20 cm long and the leaf base has a conspicuous yellow-white collar.

The leaflets are attached to the rachis in a V-form, which is narrower towards the top of the leaf. The leaflets at the middle of the leaf are 10 to 15 cm long and 4 to 6 cm broad, excluding the lobes. The leaflets are 1,5 to 2 cm broad where they are attached to the rachis. The tips of the leaflets (and of the lobes) are pointed and fairly sharp.

The upper margin of the leaflet is usually smooth, but may sometimes be toothed. The lower margin of the leaflet carries 2 to 4 triangular lobes which are twisted out of the plane of the leaflet. The leaflets overlap upwards, especially in the top third of the leaf. Viewed from the side, the lowest lobes point downwards and the upper ones upwards, to form an interlocking pattern, which is very characteristic of the species. The leaflets are usually prominently nerved, especially on the under-side. The leaflets become more widely-spread on the rachis towards the base of the leaf and become reduced in size. Only the very lowest ones sometimes become prickle-like, however.

Some variation occurs in the appearance of the leaves, as is found in many other species. Some leaves are more sharply recurved than others, while the leaflets may be generally smaller

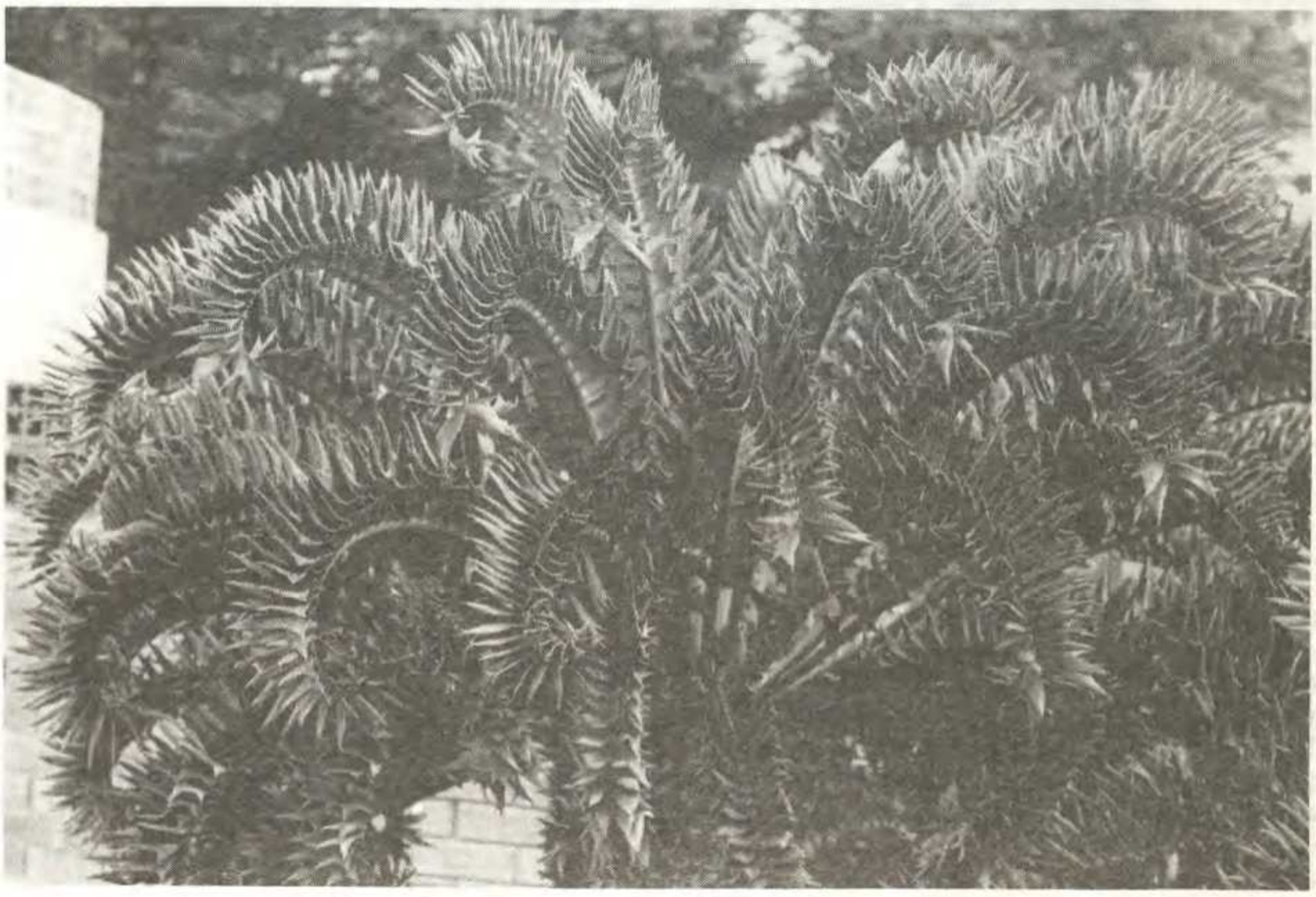

FIGURE 3

Curled-back leaves of E. latifrons

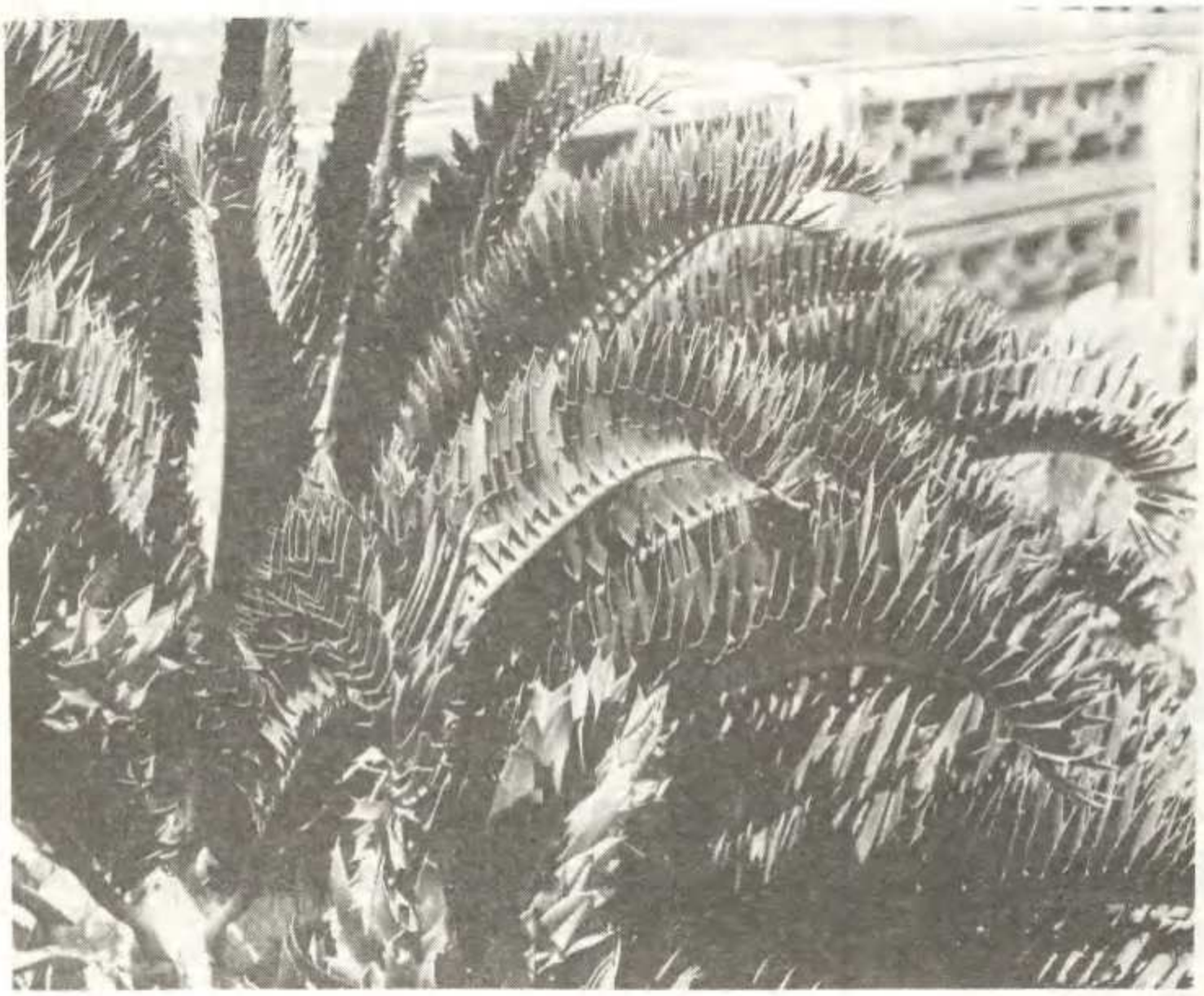

FIGURE 4

Leaf detail of
E. latifrons

in some than in others. Some collec=tors believe that there are observable differences between the leaves of male and female plants.

3. CONES

One to three cones may be formed. The colour of the cones is dark olive-green or dark blueish-green. The cones are carried on very short stout stalks. The cone scales are sparsely covered with fine hair.

The male cone is almost cylindrical in shape and 30 to 50 cm long and 8 to 17 cm in diameter. It becomes nar=rower towards both ends. The scales at the middle of the cone are approxi=mately 6 to 7 cm long and 3 to 3,5 cm broad, with prominent 2 cm-long beaks which are curved downwards or sideways. The upper and lower surfaces of the scale are variably ribbed.

The female cone is barrel-shaped, 50 to 60 cm long and 25 cm in diameter, with a mass of up to 27 kg. The median cone scales are about 8,5 cm long and 5,5 cm broad. The scale face protru=des 2 to 2,5 cm and is deeply furrowed, wrinkled and pimply. There are usually approximately 15 spirals of scales.

The seeds are red in colour and large; approximately 5 cm long and 2 to 2,5 cm in diameter, They are angled as a result of compression and have a fleshy beak.

GROWTH RATE

E. latifrons has the reputation of being a very slow grower. Professor Charles Joseph Chamberlain came to this conclu=sion during his visit to Trappes Valley, near Grahamstown, in 1912 (Chamberlain, C.J. "The Living Cycads").

He spoke to "a pleasant, gray-haired lady", the owner of a house where two specimens of E. latifrons and three of E. altensteinii were growing in the garden. According to her, the plants were planted there "when she came to that house as a bride forty-six years before". She thought that the specimens of E. altensteinii might have grown 25 cm ("a foot") during that time, but "that the E. latifrons did not seem to have grown any, although they always had green leaves".

FIGURE 5

Male cones of E. latifrons

Most owners of mature specimens of E. latifrons agree that they grow slowly, but the same is true of other species in the genus. It does seem that leaves are not formed regularly and that two or more years may pass between the formation of sets of leaves. This would result in a slower growth rate than in plants which form leaves annually.

AFFINITY

The only other species with which E. latifrons could be confused, and to which it is obviously most closely related, is E. arenarius. The following guidelines may be used to distinguish between the two:

1. E. latifrons only occurs in the inland Albany and Bathurst districts and its distribution area does not overlap with that of E. arenarius, which occurs only in the coastal Alexandria district.

2. E. latifrons is a tall-growing species with stems up to 3 m tall, while E. arenarius stems are only up to 1 m tall.

3. The leaves of E. latifrons have a shiny dark-green colour, while those of E. arenarius have a duller-green or bluish-green colour, with a bloom, especially when young.

4. The leaflets of E. latifrons form an interlocking pattern, especially in the top third part of the leaf. The leaflets of E. arenarius are also lobed, but are widely spaced.

5. E. latifrons forms up to 4 cones while E. arenarius bears single cones.

6. The cones of E. latifrons are olive-green or bluish-green in colour, while E.arenarius has light green cones.

HIBRIDIZATION

Natural hybrids between E. latifrons and E. altensteinii have been reported, although these seem to be very rare. The leaflets of the hybrids overlap markedly like those of E. latifrons but lack the lobes on the leaflets. The leaves show the bright green colour of the E. altensteinii parent.

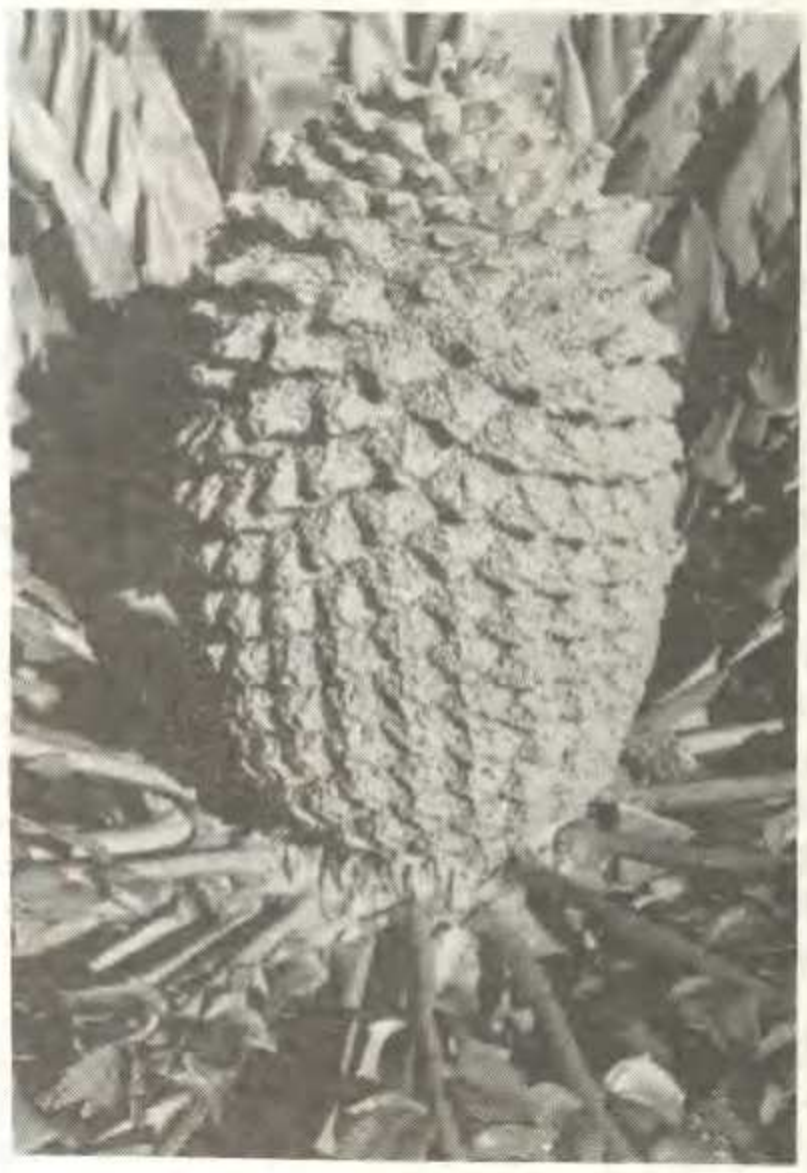

FIGURE 6

Female cone of E. latifrons

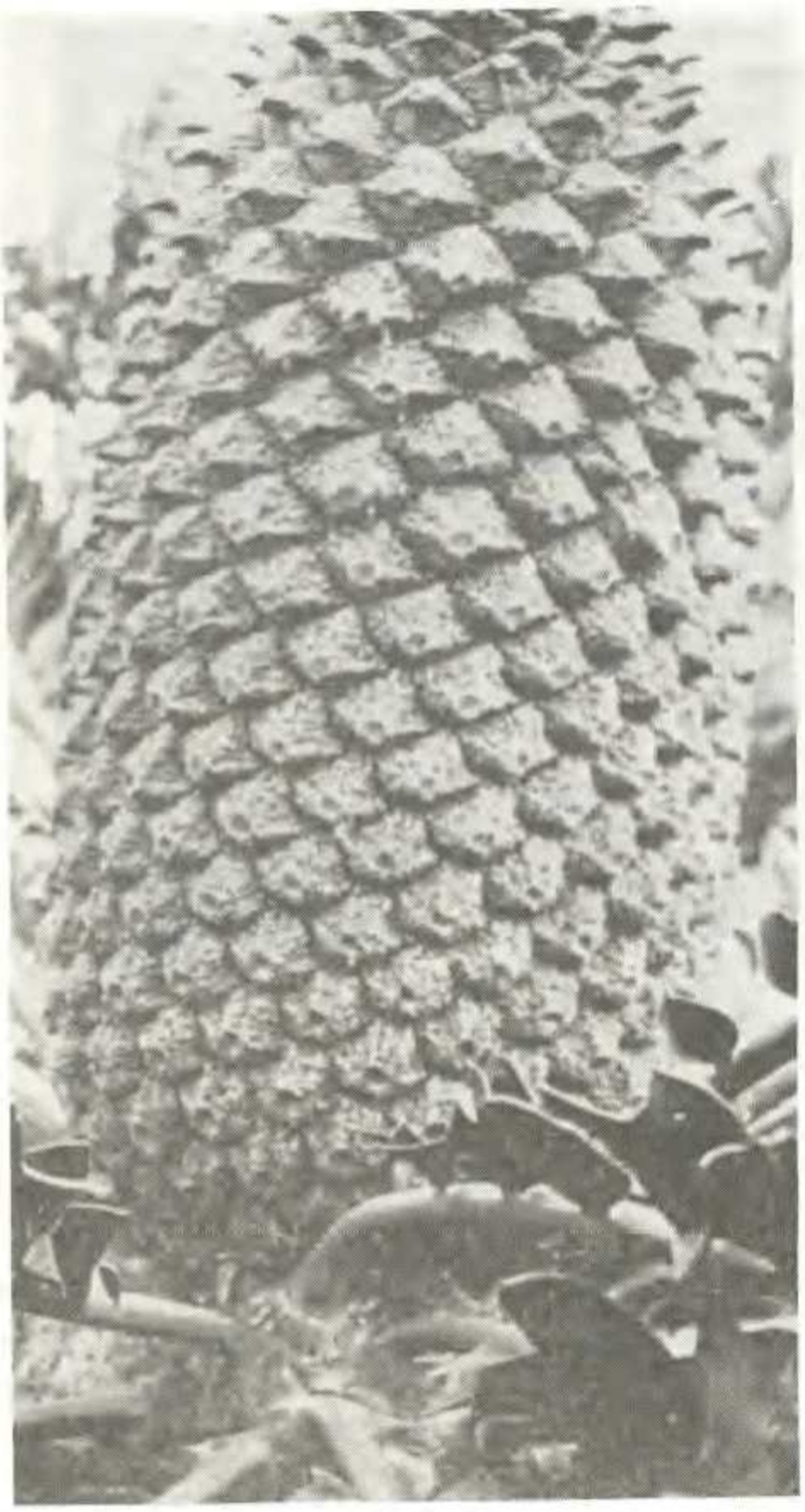

FIGURE 7

Detail of female cone surface.

The author has seen seedlings of an artificial cross, said to be between E. latifrons and E. arenarius. The plants were too small to allow any conclusions regarding characteristics, however.

IN THE GARDEN

The relatively few collectors who possess mature specimens of E. latifrons have found that they grow well in cultivation, as is obvious from the healthy plants in the fine collection at Kirstenbosch Botanic Garden in Cape Town, which was started more than 70 years ago. The plants need very good drainage, however. They would also require sufficient moisture and protection from frost. They are dramatic in any garden.

CONSERVATION

E.latifrons is one of the rarest cycad species,and has probably never been abundant during the past century. The first director of the Kirstenbosch Botanic Garden,Prof. H.H.W. Pearson, wrote in 1916: "This species appears to be on the verge of extinction. It is only known to occur in two localities, in which the plants are now very hard to find." (Pearson, H.H.W.; "The Kirstenbosch Cycads".) Prof. C.J. Chamberlain echoed this observation when he wrote in 1919, after a visit to E. latifrons localities in 1912: "Field studies are laborious, since the plants are isolated, usually half a mile or even a mile apart." (Chamberlain, C.J.: "The Living Cycads") In 1934 Chamberlain wrote: "E. latifrons ... is not abundant anywhere, but scattered specimens occur..." (Chamberlain, C.J.; "Gymnosperms, structure and evolution").

It is unlikely that reproduction by means of seed has occured in nature since the above observations were made. Apart from the scarcity of the plants and the scattered nature of their distribution, reproduction must also have been hampered by the fact that female cones are apparently formed infrequently. One cannot fail to notice that, although tall, mature plants can be seen in a number of public and private gardens, there seem to be virtually no young plants in cultivation. The smaller plants which do exist, seem to have originated as suckers or from artificial pollination (a very limited number).

The small number of E. latifrons specimens which existed when Chamberlain visited them in 1912, have all found their way to collections in South Africa and abroad, despite the fact that the species has been a declared endangered species in the Cape Province for a long time. Not only were plants removed from private farms, but virtually all those protected on land belonging to the Forestry Department were stolen. In at least one case a tall plant was removed and left lying in the veld, where it was discovered by Forestry officials. They planted it, but it did not survive.

FIGURE 8

Group of E. latifrons specimens in a garden

It seems that politics has also contri=buted to the removal of many plants from nature. It is said that specimens of E. latifrons (and other species) which occurred on farms owned by white farmers and which were bought out by the govern=ment for the consolidation of the Ciskei black homeland, were in many cases all taken out before the ownership was trans=ferred.

All these factors, as well as the very high black market price of E. latifrons, have had the result that this species has become extinct in nature, for all practical purposes.

It is hoped that all persons or institu=tions who are in possession of mature specimens of E. latifrons will do every=thing in their power to ensure that fe=male cones are pollinated artificially and that the fertile seed or seedlings are made available to persons who will treasure them. Perhaps there will one day be sufficient young plants available for some to be returned to their place of origin.

FIGURE 9

E. latifrons in a garden

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-Figures 1, 5 and 6 reproduced from "Cycads of South Africa" by Cynthia Giddy, with the kind permission of the author.

-Figures 2 and 7 reproduced from "Bothalia", Vol. 8, Part 4, 1965, with the kind permission of the editor and the Botanical Research Institute.

-Other photographs by the author.

POLLINATING CYCADS

by Willie Tang

Despite the common belief that cycads are wind-pollinated, most of the cir= cumstantial and experimental evidence on the topic suggests that insects are necessary for successful pollination in the majority of the species (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11). Perhaps the most compelling evidence I have seen is that at Fairchild Tropical Garden, Florida, many species will not produce fertile seeds despite the fact that coning male and female plants occur side by side. If cycads require only wind for pollination, this would not be the case, unless you make the unlikely assumption that wind in South Florida is different from wind in the native habitats of these plants. Therefore, for anyone wanting to sexually propa= gate exotic cycads, hand-pollination is probably necessary.

Most cycads are actually quite easy to hand-pollinate once you know what to look for. To help familiarize you with the hand-pollination of cycads, I have outlined below some descriptions of cycad cone structure and techniques for hand-pollination.

DISTINGUISHING MALE AND FEMALE CONES

1. Male and female cones occur on se= parate plants. There are no excep= tions.

2. Male cones are generally cylindri= cally shaped and narrow. Female cones are cylindrical, conical or oval and are almost always wider and larger than male cones.

3. Male cones have scales that are smaller and more numerous than female cones.

WHEN TO POLLINATE THE FEMALE CONE

When the female cone becomes receptive to pollen, cracks will form on the cone. The configuration of these openings varies from genus to genus and from species to species. Below is an illu= strated list of crack patterns and examples of species that exhibit them.

The crack pattern in Bowenia is unknown to me. Observations conducted continu= ously at one to four day intervals on a coning female Lepidozamia peroffskyana in cultivation at Fairchild Garden, failed to detect any formation of cracks. This either means that receptivity in this species is very brief, that this was an anomalous cone, or that my observations were faulty.

Female Cycas do not have cones but a cluster of sporophylls. It is difficult to tell when receptivity occurs. Several applications of pollen are suggested at the period when the sporophylls just begin to loosen apart.

POLLINATING FEMALE CONES

A number of methods have been successfully used to hand-pollinate cycads. Most in= volve injecting the pollen into the female cone either in dry form or mixed with water. The technique I find most versatile and convenient, especially when only a small amount of pollen is availa= ble (this is almost always the case with Zamia and Stangeria), is using an eye= dropper with a large bulb (50cc). Such a bulb is standard chemistry equipment and can probably be obtained from a drug store. To suck in the pollen (e.g. from an envelope where it can be readily sto= red), squeeze very gently on the bulb.

'Spiral'

Encephalartos manikensis
E. paucidentatus

'Complete'

All or most scales separate.
Ceratozamia mexicana, C. hildae, and probably the rest of the species in the genus.
Encephalartos hildebrandtii
Macrozamia lucida
M. moorei

'Vertical'

This is a variant of 'complete', but with the main cracks running vertically along the cone.
Microcycas

'Lid'

Encephalartos ferox (see figure 1)

'Bottom'

Only scales at base of cone separate.
Dioon edule, D. spinulosum, and probably the rest of the species in the genus.

'Top and Bottom'

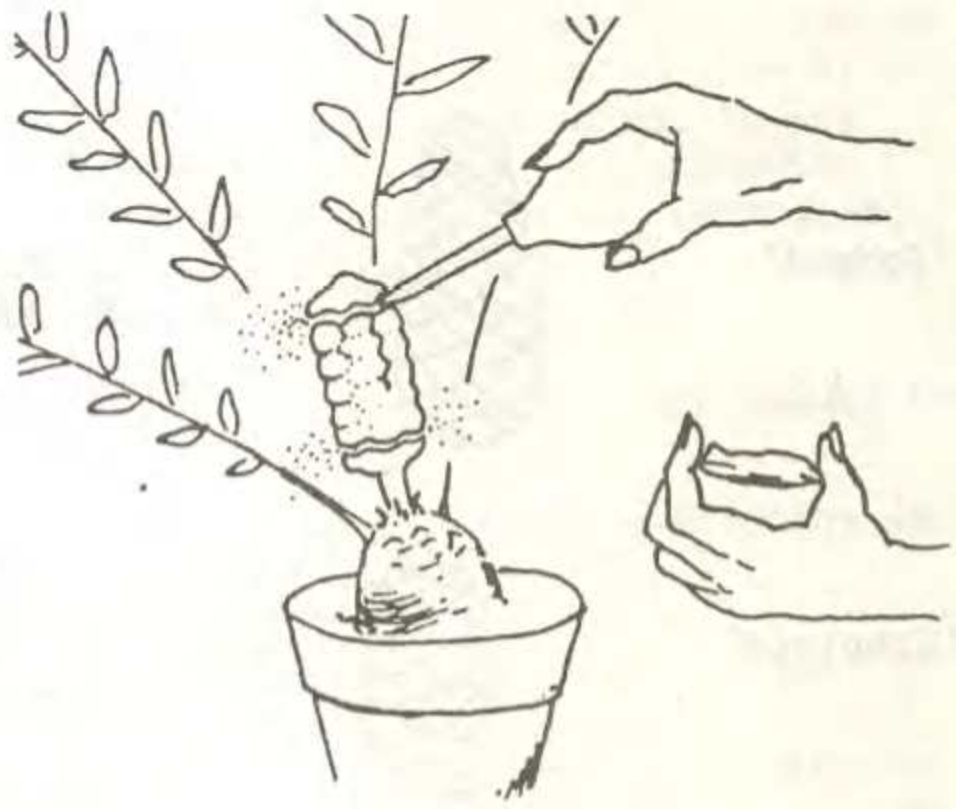
Sometimes only a top or bottom crack will appear. Additional vertical and horizontal cracks may also accompany the main ones depending on the species or the size of the cone.
Most Zamia have this pattern.

'Valve'

This is peculiar to Stangeria.
Tightly overlapping scales will separate slightly to form channels into the interior of the cone.

Insert the tip of the eyedropper into a crack of the receptive female cone and squeeze hard. If pollen blows out of the other cracks, you have probably made a good injection (see figure). Repeat at different cracks. If you have a large amount of pollen, a tomato sauce bottle will do the job.

Cracks will remain open from one to three weeks. It is best to pollinate the female cone early, when it has just opened. This usually results in a higher success rate. Repeated injections over several days may also result in greater pollina= tion success. In some species the crack will not fully close after receptivity has past.



POLLINATING ENCEPHALARTOS FEROX

Poor results at pollinating Encephalartos ferox at Fairchild Tropical Garden in the past, lead a number of the people working there to believe that South Florida may be unsuitable for sexually progagating this species. Perhaps the winters here are too cold for proper development of the embryos. This lead me to examine this species more closely in the autumn and winter of 1983-84.

The female cone of this species is un= like those of most of the other Encepha= lartos I have seen. The upper $\frac{1}{4}$ to $\frac{1}{3}$ of the cone is sterile, containing no ovules. When it is ready to be polli= nated, cracks, spiral in orientation, will form only on this upper sterile portion. The scales on the lower part of the cone remain tightly compressed. Figure 1 shows a cut away view of the female cone. There is only a narrow space, 1 to 4 mm wide, between the cone axis and ovules for the pollen to reach the micropyles deep within the cone. Cutting open one of these cones after injecting dry pollen through its top cracks showed that almost all of the pollen lodged within the sterile apex and only a small percentage actually entered the narrow passage between the axis and ovules.

With the cone's structure in mind, I tested a different pollination technique. I cut away a few of the scales adjoining the cracks at the top to expose its interior to view (see figure 2) and scooped pollen directly into the narrow opening between the axis and ovules and then blew the pollen deeper inside the cone with a large-bulbed eyedropper. The results of this technique in compa= rison with others is displayed in table 1.

What do the results mean? They are not just academic! The E. ferox seeds which were recently sent to many of the mem= bers were successfully produced using this new technique. These seeds are of the curled leaflet variety from Mozam= bique. Perhaps if you possess or have access to a female E. ferox, you may want to try this method!

Figure 1.

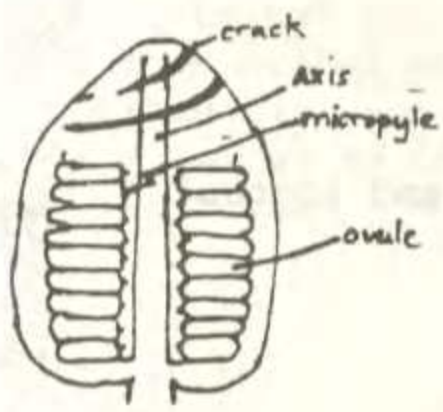


Figure 2.

Table 1.

TECHNIQUE	CONE	# seeds checked (randomly sampled)	% seeds viable
pump dry pollen into cracks	A	25	36.0%
	B	34	8.8
pollen mixed with water, pumped into cracks	C	30	6.7
	D	30	0
scoop pollen directly into the interior (new technique)	E	11	81.8
allow only natural wind pollination	F	25	0
	G	30	0

HOW CAN YOU TELL IF YOU'VE BEEN SUCCESS= FUL?

In Ceratozamia, Zamia, Microcycas and many Macrozamia, pollination is followed by rapid growth of the cone. Substantial growth of Dioon, Stangeria, Bowenia and Lepidozamia cones also occurs after pol= lination. In Cycas you can see the seed develop on the sporophylls. In Encepha= lartos and some of the Macrozamia (e.g. M. moorei) all the seed are fully formed in size prior to pollination and there is no way to tell if you've been successful until the seeds are shed.

Full sized seeds do not guarantee ferti= lity, especially in Encephalartos.

FURTHER READING

"Pollination of cycads" by Stanley Kiem (5) gives a further discussion on the subjects outlined above. It is reprinted in the July 1982 issue of the Cycad News= letter (U.S.).

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(Reprinted from "The Cycad News= letter" (USA), Volume VIII, no. 2, September 1985, and Volume VIII, no 3, November 1985, with kind permission of the author and the editor, Mr Garrie P. Landry.)

Willie Tangs' address: Biology Department, University of Miami, PO Box 249118, Coral Gables, Florida 33124, USA.

FROM THE PRESIDENT

The Society continues to grow steadily, with the membership well in excess of 400 in November this year. It is interesting to compare our numbers with the other Palm and Cycad Societies. The Australian Society is marginally larger than ours, with a membership of over 500, while the U.S. (International) Cycad Society has approximately 275 members. I am especially pleased to welcome amongst our new members, some of the world's leading 'cycadologists', including Dr Knut Norstog, Research Associate at Fairchild Tropical Garden, Prof. Paolo de Luca, leader of the very active cycad research group at the University of Naples and Prof. Dennis Wm. Stevenson, distinguished cycad taxonomist at New York's Columbia University and researcher at the New York Botanic Gardens Herbarium. Their interest in our Society is largely due to the excellent reputation our journal, ENCEPHALARTOS, has achieved.

Financially, the Society is very healthy and I anticipate the year will close with us having a cash reserve of about R3 000. Our Committee has agreed to the re-appointment of Mr W. Nel as auditor and the year-ending financial report for 1986 will be presented in the next issue of ENCEPHALARTOS. Since we are in a fairly sound position, your Committee has recommended that there should not be any increase in membership fees for 1987. At the risk of repeating pleas elsewhere in this journal, could I ask members kindly to renew the membership promptly - we wish to keep the necessity of reminder letters to an absolute minimum. In terms of the Society's constitution, membership will be terminated if fees are not in hand by the end of March 1987.

I would like to express our sincere thanks to the members who have recently made donations to the Society, both directly and via the seedbank. Our appreciation is also due to those who have kindly made seed available to the seedbank, which is being so competently and enthusiastically managed by Danie Nel.

VAN DIE PRESIDENT

Die Vereniging is steeds aan die groei, met 'n lidmaatskap van heelwat meer as 400 in November vanjaar. Dit is interessant om ons getalle te vergelyk met die ander Palm en Broodboomverenigings. Die Australiese Vereniging is ietwat groter as ons s'n, met 'n lidmaatskap van oor die 500, terwyl die V.S.A.(Internasionale) Broodboomvereniging ongeveer 275 lede het. Ek is veral bly om sommige van die wêreld se leidende broodboomkundiges in ons geledere te verwelkom, insluitende Dr. Knut Norstog, Navorsingsbeampte by die Fairchild-Tropiese Tuin, Prof. Paolo de Luca, leier van die baie aktiewe broodboom-navorsingsgroep by die Universiteit van Napels en Prof. Dennis Wm. Stevenson, uitstaande broodboomtaksonoom by New York se Columbia-Universiteit en navorser by die Herbarium van die New Yorkse Botaniese Tuine. Hulle belangstelling in ons Vereniging is grotendeels te danke aan die uitstekende reputasie wat ons tydskrif, ENCEPHALARTOS, bereik het.

Die Vereniging is finansieel baie gesond en ek verwag dat ons die jaar sal afsluit met 'n kontantreserwe van ongeveer R3 000. Ons Komitee het besluit om weer mnr. W. Nel as ouditeur aan te stel en die finansiële verslag vir die jaar 1986 sal in die volgende uitgawe van ENCEPHALARTOS gepubliseer word. Aangesien ons in 'n redelik gesonde posisie verkeer, het u Komitee aanbeveel dat daar nie 'n verhoging in ledegeld vir 1987 sal wees nie. Al loop ek die risiko om versoeke elders in hierdie tydskrif te herhaal, doen ek 'n vriendelike beroep op lede om hulle lidmaatskap onverwyld te hernu - ons wil die nodigheid om herinneringskennisgewings uit te stuur tot 'n absolute minimum beperk. Volgens die Vereniging se grondwet sal lidmaatskap beëindig word as die ledegeld nie teen die einde van Maart 1987 ontvang is nie.

Ek wil graag ons opregte dank uitspreek teenoor dié lede wat onlangs skenkings aan die Vereniging gemaak het, direk of d.m.v. die saadbank. Ons waardering gaan ook na diegene wat so gaaf was om saad beskikbaar te stel aan die saadbank, wat op so'n bekwame en entoesiastiese wyse deur Danie Nel bestuur word.

Members should note that our present Executive and some Regional Committees are in office for the two-year period, January 1986 to December 1987. For the benefit of new members, our present Executive Committee is listed below:

Roy Osborne (President), Marion Debruyne (Membership Officer), Piet Vorster (Additional Member), Frank Marx (Eastern Cape Representative), Danie Nel (Natal Representative and Seedbank Officer), John Burchmore (North Eastern Transvaal Representative), Cynthia Giddy (Pollen Exchange Officer), Maans Kemp (Editor, ENCEPHALARTOS)

In closing, may I echo the message of Maans Kemp in his editorial column in ENCEPHALARTOS No. 7: the contributions made by the members are the energy input of the Society. Consider how YOU can assist our growth and development.

ROY OSBORNE

Lede moet asseblief daarvan kennis neem dat ons huidige Uitvoerende Komitee en sommige Streekskomitees se ampstermyne oor die tydperk Januarie 1986 tot Desember 1987 strek. Ter wille van ons nuwe lede word ons huidige Uitvoerende Komitee hieronder geplaas: Roy Osborne (President), Marion Debruyne (Lidmaatskapbeampte), Piet Vorster (Addisionele Lid), Frank Marx (Ooskaapse Verteenwoordiger), Danie Nel (Natalse Verteenwoordiger en Saadbankbeampte), John Burchmore (Noordoos-Transvaalse Verteenwoordiger), Cynthia Giddy (Stuifmeelruilbeampte), Maans Kemp (Redakteur, ENCEPHALARTOS).

Ten slotte, mag ek Maans Kemp se boodskap in sy redaksionele kolom in ENCEPHALARTOS No. 7 beklemtoon: die bydraes wat deur die lede gemaak word, is die energie-inset van die Vereniging. Oorweeg hoe u in ons groei en ontwikkeling kan help.

ROY OSBORNE

SAADBANK

Dankie vir die briewe van lede met woorde van aanmoediging vir die saadbank, asook vir die ondersteuning deur middel van talle navrae in verband met saad.

Die volgende saad is nou beskikbaar: Encephalartos natalensis, E. villosus, E.ferox en Stangeria eriopus.

DANIE NEL
(SAADBANKBEAMPTE)
Bowkerweg 120
ESCOMBE
4093

Tel.no.:031-442505

SEED BANK

A word of thanks for the letters from members with words of encouragement for the seedbank, as well as for the support in the form of the many enquiries concerning seed.

The following seed is now available: Encephalartos natalensis, E. villosus, E. ferox and Stangeria eriopus.

DANIE NEL
(SEEDBANK OFFICER)
120 Bowker Road
ESCOMBE
4093

Tel. no.:031-442505

CYCAD POLLEN STUDIES

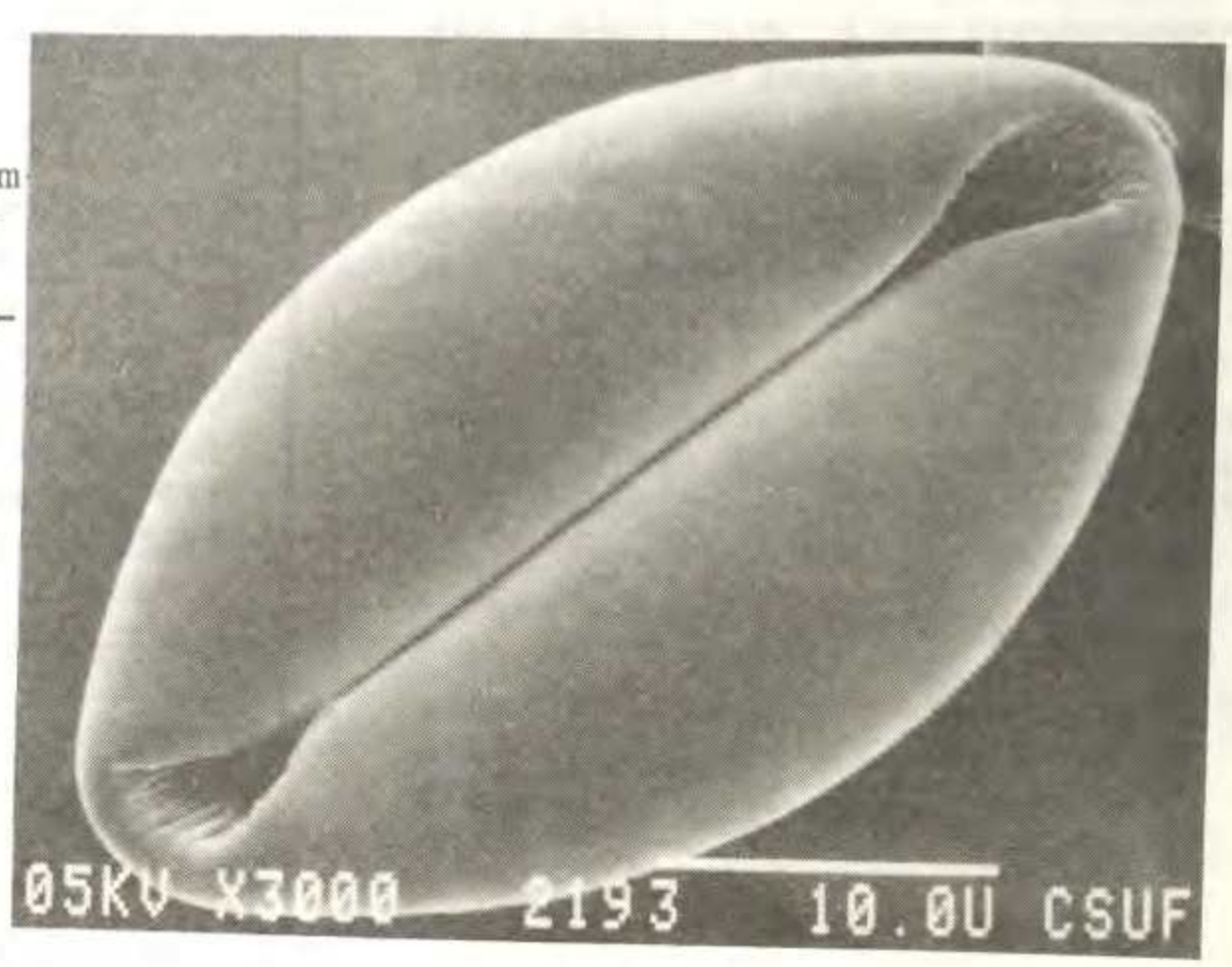
by Loran Whitelock

During the last twenty years, the study of present-day and fossil pollen (palynology) has developed into an important botanical discipline. Scanning electron microscope (SEM) techniques allow examination of this type of material in hitherto unattainable detail. Data from such studies can now be integrated with input from classical vegetative and reproductive morphology and further enhanced with biochemical analyses to give an extensive overall picture on which to base taxonomic and phylogenetic decisions.

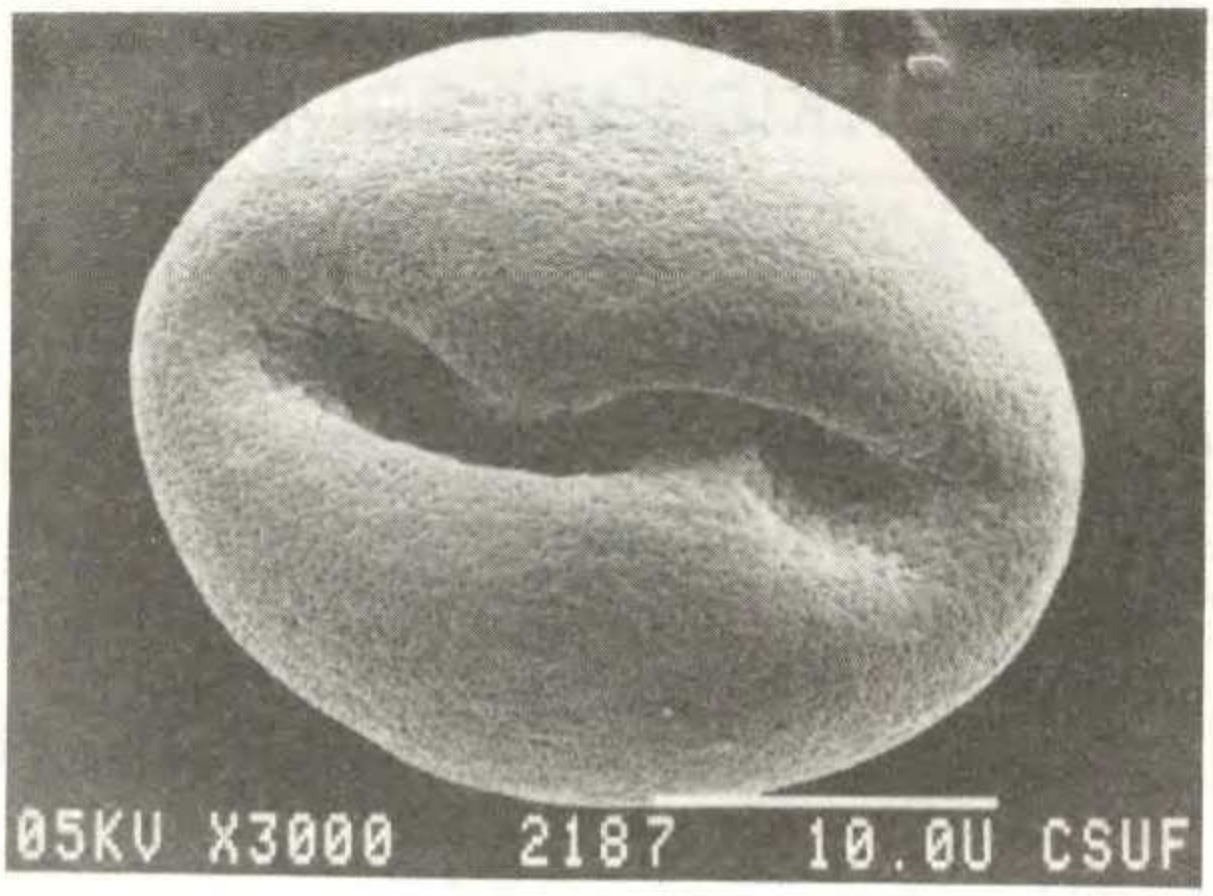
Although there is quite some work published on cycad microspore structures (for references see Read and Solt, 1986, LyoniaVol.2 No. 4), it seems that the taxonomists have not yet made substantial use of palynology in cycad applications. I believe that a systematic SEM study of the microspores from each of the cycad taxa could do much to assist; especially, for example, in the present confused taxonomy of Cycas and Zamia. This programme has now been started and I must acknowledge the kind co-operation of Dr Robert A. Koch, Director of the Electron Microscope Laboratory, California State University, Fullerton, in this connection.

Observed under high magnification, cycad microspores are beautiful in their simplicity: They are without the complex ornamentation which is characteristic of the pollen of most Angiosperms. They occur as spherical or elliptic units with a bilateral symmetry in which the major feature is a single longitudinal groove, or colpus, which arises during the formation of the individual pollen grains from the microspore mother cell. This furrow appears to expand or contract under conditions of different humidity. Apart from the overall shape and the geometry of the colpus, another diagnostic feature is the surface character of the outermost layer, the sexine, which may be plain, pitted or otherwise decorated.

It will come as no surprise that the two African genera, Encephalartos and Stangeria, so completely different in many other respects, represent extremes in microspore morphology. It is therefore appropriate to illustrate this preliminary report with a photograph of each.



Microspore (pollen grain) from Encephalartos arenarius, magnification X 3000, scale bar indication 10 microns, length-to-width ratio 1.75, colpus regular, surface smooth.



Microspore from Stangeria eriopus, magnification X 3000, scale bar indication 10 microns, length-to-width ratio 1.22, colpus irregular, surface pitted.

It should be emphasised that this study has so far dealt with single samples from each taxon. It is now neccessary to enlarge the scope of this survey to include all species and individuals within each species. This will allow observation of variation within species and ensure against findings which may by atypical.

(The kind assistance of Prof. Esmé Hennessy, Dr Piet Vorster and Mr Roy Osborne in the preparation of this text is acknowledged.)

Loran Whitelocks' address: 452 ½ Toland Way, Los Angeles, California 90041, USA.

NURSERY NEWS

In ENCEPHALARTOS no. 6 (June 1986) we invited nurseries to provide us with information for publication in ENCEPHALARTOS. In this edition we feature the first nursery which has responded: SPORTWENI CYCAD NURSERY. The Sportweni Cycad Nursery is owned by Leon Scholtz, a member of our Society. It is located at Umtentweni, (near Port Shepstone) on the Natal South Coast, on the national road. Members who visit the South Coast on holiday, etc. are very welcome to visit Leon at the nursery.

The address of the nursery is PO Box 139, Umtentweni, 4235, and the telephone number is 0391-50576.

Seedlings of up to eight years old are available at prices that range from R10 to R50. The following species are available: Encephalartos altensteinii, E. arerarius, E. caffer, E. cycadifolius, E. eugene-maraisii, E. ferox, E. friderici-guilielmi, E. ghellinckii, E. horridus, E. lanatus, E. lebomboensis, E. lehmannii, E. longifolius, E. natalensis, E. ngoyanus, E. paucidentatus, E. princeps, E. transvenosus, E. trispinosus and E. villosus.

(Other nurseries, owned by members of the Society, are again invited to send us information for publication in future editions of ENCEPHALARTOS.)

BITS AND PIECES STUKKIES EN BROKKIES

NEW SPECIES OF ENCEPHALARTOS

Following several years of extensive work 'in the field', Jean-Pierre Sclavo from Nice, France, and the Italian botanists at the University of Naples, report good progress in their studies of central and east African Encephalartos species. Two new species will shortly be described in the botanical literature: E. voiensis (named after the Voi area in Kenya) and E. sclavoi (in honour of M. Sclavo). We hope to report further details with photographs in a later issue of ENCEPHALARTOS.

S.A.A.B. CONGRESS

The 1987 annual congress of the South African Association of Botanists is to be held at the University of Natal's Durban campus over the period 12 to 17 January 1987. Several of our academic members will be participating. Any last-minute enquiries may be made to Dr. Alan Amory, Secretary of the Organising Committee of S.A.A.B., University of Natal, Durban.

WORLD CYCAD CONGRESS

The President of our Society, Roy Osborne, has been invited to address an international cycad congress which will be held in Nice, France, at Easter next year. The meeting is jointly sponsored by the Town Council of Nice and the Naples Botanical Garden and will comprise two sections. The first section consists of an exhibition of cycad plants, together with posters, maps, slides and films on the biology and distribution of cycads. The second part is an informal scientific symposium at which other invited speakers will include Paolo de Luca, Knut Norstog, Peter Lindblad, Mario Vazquez-Torres, Sergio Sabato, Aldo Moretti, Gesualdo Siniscalco Gigliano and Jean-Pierre Sclavo. Any enquiries should be directed to M. Sclavo at Villa 'La Finca', Plateau du Mont-Boron, 06300 NICE, France.

MICROCYCAS CALOCOMA FOR SALE

The Cycad Society (U.S.) has advised us that they have a number of one-year old seedling plants of Microcycas calocoma, the very rare Cuban species, for sale. The plants are in 4 litre containers and are growing well. The price, including shipping, is US $ 200 each. Enquiries should be made to Garrie P. Landry, Department of Biology, University of Southwestern Louisiana, PO Box 42451, Lafayette, Lousiana 70504-2451, U.S.A.

WELWITSCHIA BOOK

Following the mention of that fascinating plant, Welwitschia mirabilis, in ENCEPHALARTOS No. 6 (page 11), there have been enquiries about how to find out more about this plant. The book we referred to, by Prof. Chris H. Bornmann, is titled 'Welwitschia - Paradox of a Parched Paradise' and is 71 pages long with 40 colour plates. It was published in 1978 by Struik Publishers, PO Box 1144, Cape Town 8000. Enquiries can be made to the publishers, your local bookseller or library.

NUWE WILDERNISGEBIED

'n Groot nuwe wildernisgebied, met 'n oppervlakte van 34 000 hektaar, is in die Oos-Kaap geskep deur die aankoop van 'n 6 000 hektaar-plaas wat twee groot bosbou-natuurreservate langs die Baviaanskloof- en Kougaberge verbind. Die daarstelling van die wildernisgebied, wat ook vir broodboomliefhebbers van belang is, is gesamentlik bewerkstellig deur die Departement Omgewingsake en die Suid-Afrikaanse Natuurstigting. Behalwe ander skaars en bedreigde plante en diere, sal twee broodboomspesies, Encephalartos longilolius en E. lehmannii in die wildernisgebied beskerm word. Ander plante wat hier voorkom, sluit in 17 Protea-spesies, die bedreigde Aloe pictifolia en die hoogsbedreigde sederboom, Widertingtonia schwarzii.

EXCELSA

EXCELSA is the annual publication of the Aloe, Cactus and Succulent Society of Zimbabwe. The 1986 edition (no. 12) contains three articles on cycads, together with many other articles on a variety of topics. The latest edition, as well as back copies as far back as no. 3, are available for sale. Members of the society automatically receive EXCELSA, as well as a quaterly newsletter. The subscription amounts to 10 Zimbabwean dollars per year for individual membership.

Persons who wish to join the society or who would like a price list of back copies of EXCELSA, may write to the National Honorary Secretary, The Aloe, Cactus and Succulent Society of Zimbabwe, PO Box 8541, Causeway, Zimbabwe.

ALOE 88

In 1975 the Aloe, Cactus and Succulent Society of Zimbabwe organised an International Succulent Plant Congress and the world's first Aloe Congress, which was attended by 400 delegates from 30 countries. The society is now planning its second such congress; Aloe 88. The week-long congress itself will take place in Harare and will include lectures by the world's leading succulent plant authorities. During the week there will be various excursions, including visits to botanic gardens as well as to a private garden "which has probably the largest and most comprehensive cycad collection in the world".

The congress will be preceded by a show and plant sale and will be followed, if there is sufficient demand, by an official tour which will include the Victoria Falls and other places of interest, especially for plant-lovers.

Persons who are interested in attending Aloe 88, which will take place from 18 to 23 July 1988, or who require more information or would like to deliver a lecture during the congress, must write to: The Convenor of Aloe 88, PO Box 8514, Causeway, Harare, Zimbabwe.

OORSESE SAADBESTELLING

In ENCEPHALARTOS no. 4 (bladsy 19) het ons berig dat Oos-Kaapse lede van die Vereniging, onder leiding van Leon Meiring, dit oorweeg het om 'n gesamentlike bestelling van Australiese broodboomsaad te plaas, indien daar voldoende belangstelling was. Lede van die Vereniging is genooi om met Leon in verbinding te tree. Leon sê graag baie dankie aan almal wat van hulle laat hoor het. Aangesien die belangstelling nie voldoende was nie, en ook omdat die Vereniging se saadbank intussen gevestig geraak het, is daar besluit om nie met die gesamentlike bestelling voort te gaan nie.

CYCADS OF AUSTRALIA

In ENCEPHALARTOS no. 6 (page 13), we reported that Cynthia Giddy had kindly offered to order copies of "Australian Plants", Vol. 3, no. 101, December 1984, which contains Len Butt's feature "Cycads of Australia" (see Roy Osborne's review in ENCEPHALARTOS no. 4, page 9). By her ordering in bulk, a lot of money was saved on bank charges and postage. The bank charges alone would have cost individual members approximately R6,00 per order.

Cynthia has ten copies of this beautifully-illustrated booklet left for sale to members, at R7,00 each. Please contact her at PO Umlaas Road, 3730; tel. no. 03325-478 to obtain your copy.

DYER'S MONOGRAPH IN BOTHALIA

We have been advised by the Director of Agricultural Information that Dr R.A. Dyer's "The Cycads of Southern Africa" in Bothalia, Volume VIII, Part 4 of 1965, is now out of print. We hope that the Department of Agriculture will consider a reprinting of this useful publication and we will inform members if this occurs.

SEX LIFE OF CYCADS

BY ROY OSBORNE

All our readers will know that cycads produce male and female cones and that successful pollination of the female leads to viable seeds in due course. But the sex life of the cycads is both much more complex and much more interesting than many would suspect. The next few paragraphs will give you a voyeur's in= sight into their most intimate details!

Let's start with the mature adult plant. It is probable that a combination of factors like the nature of its genes, the level of hormones and environmental fac= tors, dictates whether the plant is going to be a male or a female. The subject of sex change has been dealt with in a pre= vious article in "Encephalartos", and will not be repeated here.

THE MALE CYCAD

The male cycad bears a cone which is a structure of spirally-arranged scales which are essentially greatly modified leaves called microsporophylls. They vary appreciably in size: Encephalartos male cones approach one metre in length in some species, while certain Zamia males are less well-endowed at only 2-3 cm. Close to the time of maturity, the central axis of the male cone extends so that the numerous pollen-sacs or mi= crosporangia become visible on the under= surface of each exposed cone scale. With= in each of these pollen-sacs the first sex act takes place. In certain cells the normal complement (for Encephalartos) of 18 chromosomes, arranged in 9 pairs, undergoes a reduction and rearrangement process called meiosis to give cells con= taining only 9 single chromosomes. This meiosis process occurs not only in cycads but is a fundamental part of the sex life of all living organisms. The product in the case of male plants is a cell which develops into a pollen grain or micro= spore. In cycads, the microspore nucleus now divides to give a prothallial cell, a generative cell and a tube cell, all en= closed within the microspore wall. At this three-celled stage (see Fig. 1) the pollen-sacs burst open and male liberation occurs! Each microsporangium can produce many thousands of pollen grains e.g. in Encephalartos villosus Professor Charles Chamberlain estimated 26 000 to be re= leased. Taking this a stage further, we might multiply that by 500 microsporangia on each sporophyll, and multiply that again by 300 sporophylls per cone, we come to the conclusion that each cone can produce a staggering 3 900 000 000 pollen grains!

At the time of pollen liberation two other processes can happen about which we know very little. In some species, like Encephalartos altensteinii, the whole cone literally gets 'the hots' - Amy Jacot Guillarmod once recorded a temperature of 37°C in a cone when the ambient temperature was 20°C. In other species such as Cycas thouarsii, a cha= racteristic sickly-sweet odour is given off - this may have the benefit of at= tracting insects which assist in pollina= tion. Actually, the whole question as to whether pollen is transported by insects or is wind-borne is still under debate; possibly both play a role in some species while others achieve pollination only through one specific agency.

THE FEMALE CYCAD

The development of the female follows a similar pattern in many respects to that of the male. The female cone structure is also an arrangement of modified leaves - easily recognised as such in Cycas but very much more reduced to hard scales, these megasporophylls also arranged spi= rally on a central axis, in the case of Encephalartos and most other cycads. The size of some female cones is remark= able, especially say in comparison to the female cone of the ordinary pine which they structurally resemble. Some of the larger Encephalartos species have cones of a mass up to 40 kg and each cone may bear 500 seeds. In the case of such plants there is a massive 'energy cost' to the parent in the production of the female cone. Some scientists believe that this is why female plants sometimes

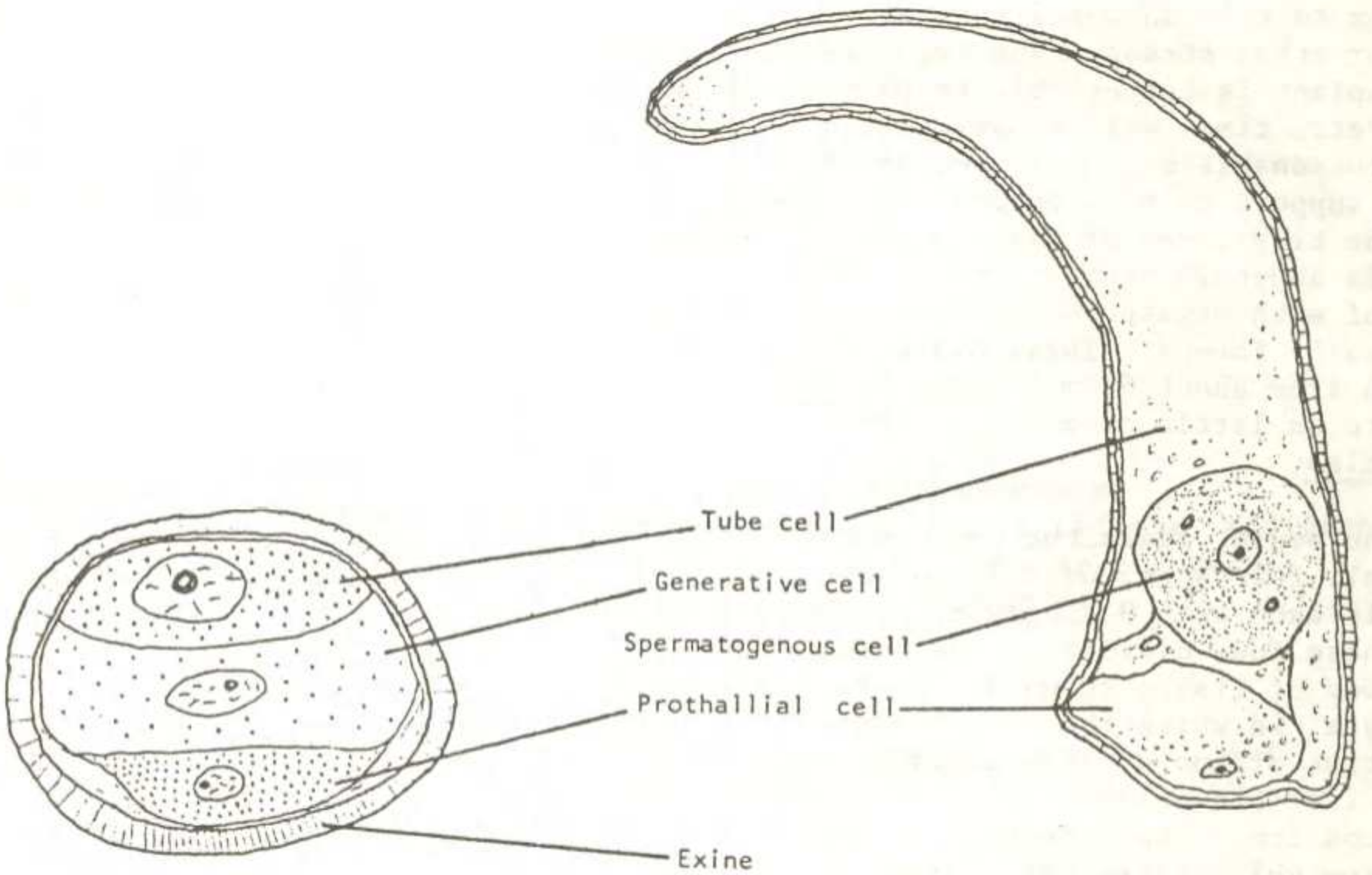


FIGURE 1: Development of the male gametophyte in cycads (much enlarged).
Left: The pollen-grain in transverse section showing the three-celled stage at the time of dehiscence.
Right: Extension of the pollen tube after pollination; the spermatogenous cell is still to divide to form two motile spermatozoids..
(Redrawn from Swamy, 1948).

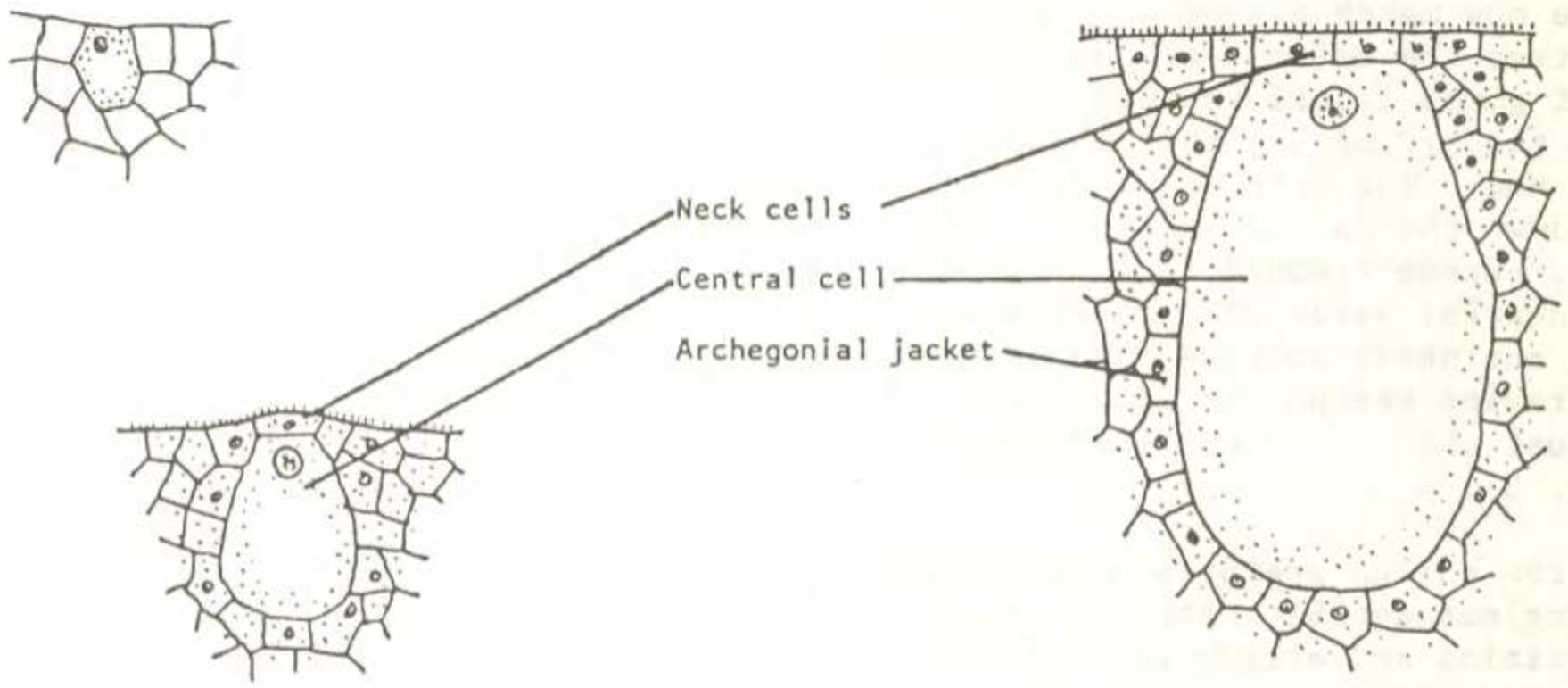


FIGURE 2: Development of the female archegonium in cycads (much enlarged).
Left: An archegonial initial differentiated in the female gametophyte.
Centre: Division into a primary neck cell and a central cell.
Right: The archegonium shortly before fertilisation; the central cell nucleus is still to divide to form the ventral canal cell nucleus and the egg cell nucleus.
(Redrawn from Chamberlain, 1935).

change sex to male in conditions of drought or other stress. The logic is that the plant is better able to survive these adverse times when behaving as a male. A reasonable body of evidence is cited in support of this theory. By con=trast, the tiny cones of Zamia pygmaea weigh only about 25 grams. On the under=surface of each megasporophyll two ovules are typically formed. These ovules vary in length from about 6 cm in some Cycas species to as little as a few mm in the small Zamias.

Inside the ovule, again the chromosomes of one cell rearrange, usually to give four cells each with 9 single chromosomes. One of these four divides extensively to form a body of tissue known as the female gametophyte in which the 2 to 6 female reproductive organs or archegonia diffe=rentiate (see Fig. 2). A large central cell is the conspicuous feature of each archegonium which ultimately forms the egg. The egg nucleus is perhaps the largest nucleus of its kind in the plant kingdom, reaching a diameter of 0,5 mm in Dion (previously Dioon).

POLLINATION

At about the same time that the male cone releases its pollen, the female cone axis also elongates slightly and small sepa=rations occur between the cone scales. The ovule now makes use of a special de=vice to trap the male: each ovule exudes a drop of gummy liquid through a small opening, the micropyle, at its inward-pointing end. The male pollen grains, falling down the spiral staircase inside the cone, become trapped in these drop=lets of nuptial juice which then slowly dry out, shrinking back into the ovule and so drawing the pollen grains into a cavity just above the female archegonia (see Fig. 3).

Each of the pollen grains now germinates by sending out a tube which both anchors it in position and allows it to draw in food reserves from the surrounding female tissue, rather like a parasitic fungus (see Fig 1). Of the original three mi=crospore cells, it is the generative cell which now gets to work, dividing to form a spermatogenous cell which in turn pro=duces two sperm cells. The sperm cells of cycads, up to 0,25 mm in diameter, are the largest in any living organism - and they are self-propelled like those of animals but unlike those of most higher plants. They move by means of very many tiny hairs (cilia or flagella) arranged along spiral bands on the outside of the sperm body. Dr Knut Norstog, in his work involving electron microscopic examination of these hairs, estimated that a single Zamia sperm may have as many as 20 000 such flagella.

The sperms of cycads are large enough to be seen by the naked eye.

H.J. Webber, describing fertilisation in Zamia, wrote:

> "it is an interesting sight to see the two giant spermatozoids moving around vigorously in the pollen tube, bumping against each other and the wall of the tube in their reckless haste."

Professor Charles Chamberlain continues even more graphically:

> "After the sperms begin to move there is a rapid increase in the turgidity of the tube, which sooner or later ruptures .. most of the starch and liquid con=tents escape with a spurt ... the first sperm may escape in two or three se=conds ...the other may be half a mi=nute in getting out."

The nucleus of the sperm now couples with the egg;this is the climax of the ferti=lisation act. Since each partner in the fusion contributes its 9 single chromo=somes, the product is a cell which can now arrange its chromosomes into the 9 pairs configuration of its two parents, restoring the original numerical status quo but allowing opportunities for ge=netic variations which can be so im=portant in evolutionary terms.

EMBRYO DEVELOPMENT

The fused nucleus from the fertilisation step now begins a series of rapid divi=sions to form a large body of tissue in which the embryo starts to develop. Two types of cell are evident: the embryo proper and behind it a set of vertically=arranged elongating cells. These are the origin of the massive coiled suspen=sor,an umbilical cord some 2 to 3 cm long, so characteristic of the cycads. This stage of development co-incides with the time the cone disintegrates and the seed is shed. In cross-section (see Fig. 4) the presence of the coiled sus=pensor is obvious and the only true - albeit destructive - test of seed via=bility.

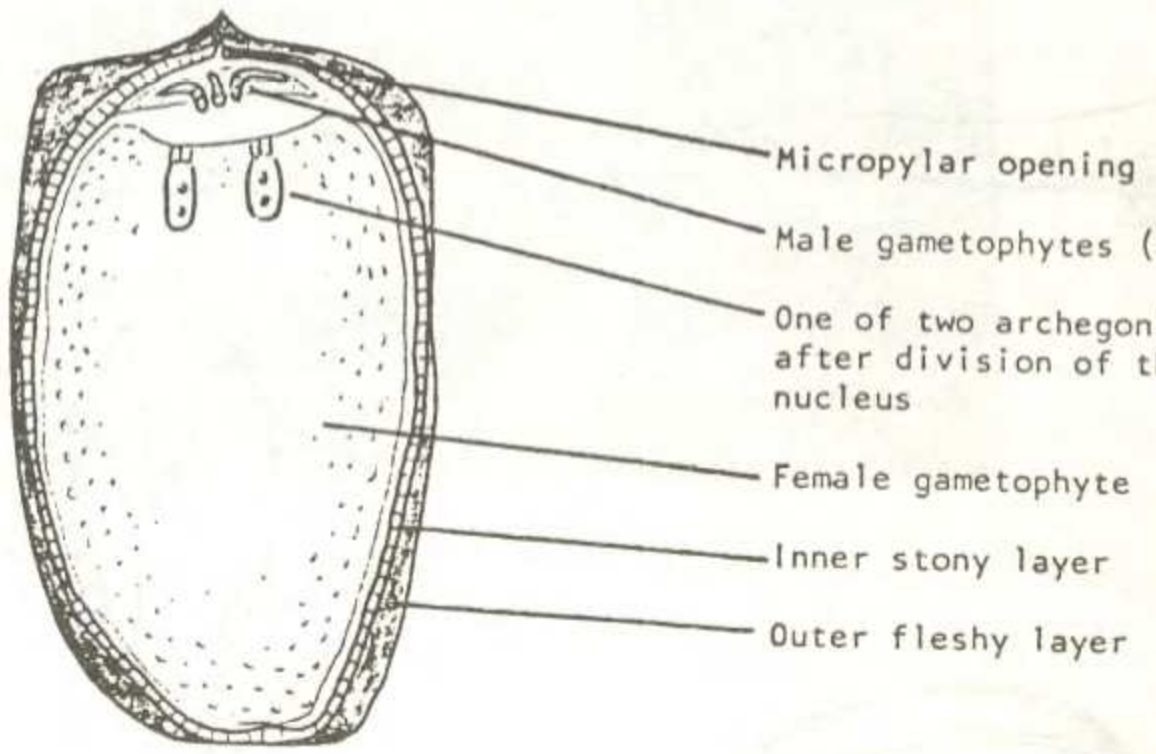


FIGURE 3: Longitudinal section through the ovule shortly before fertilisation (Actual size).

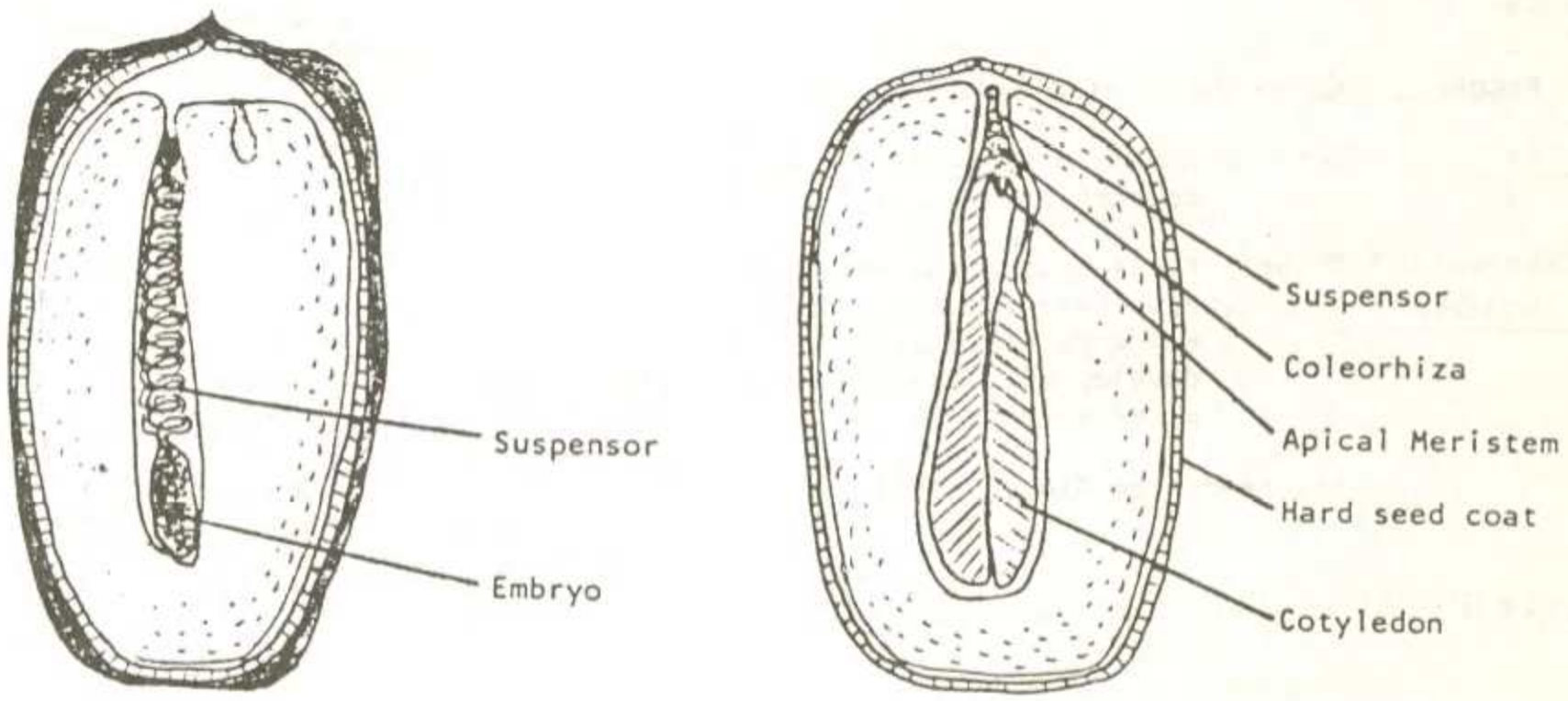


FIGURE 4: Embryology of cycads (actual size).

Left: Early stage of embryo development, at about the time of shedding of the seed, showing the characteristic coiled suspensor.

Right: Later stage of embryo development, shortly before germination.

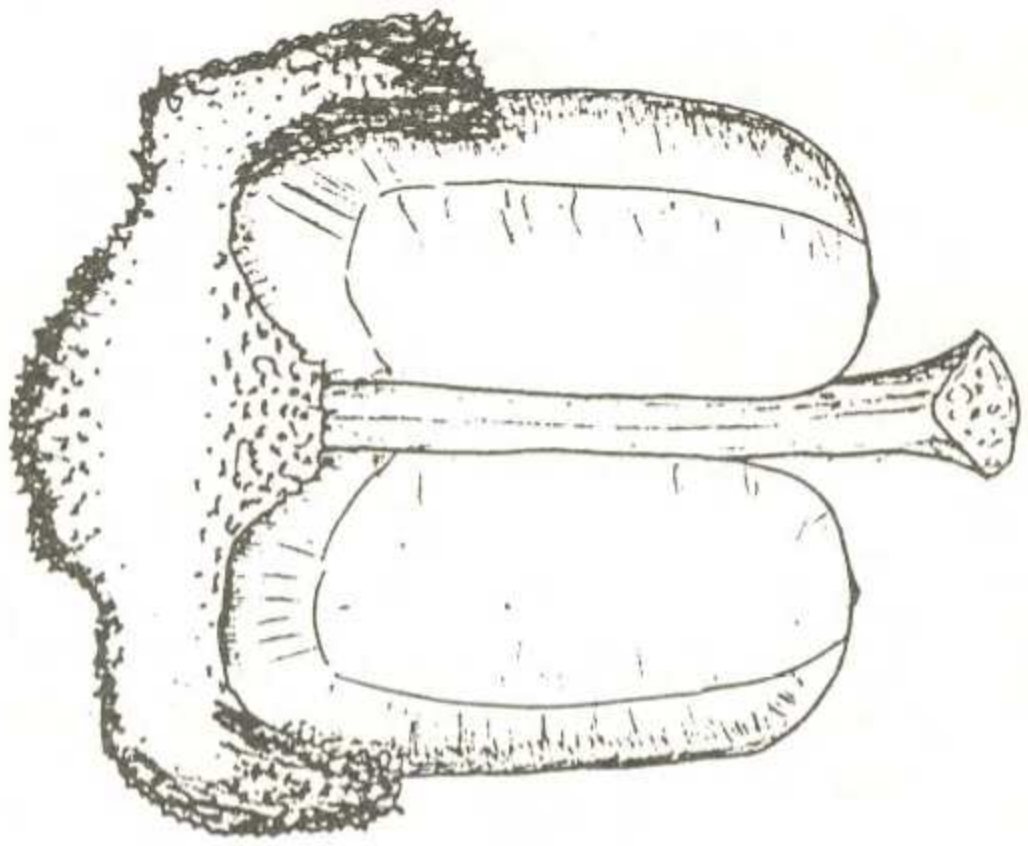
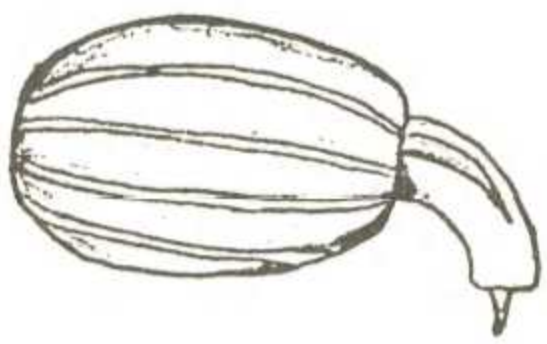


FIGURE 5: Megasporophyll from female cone showing attachment of two ovules.

(Actual size)



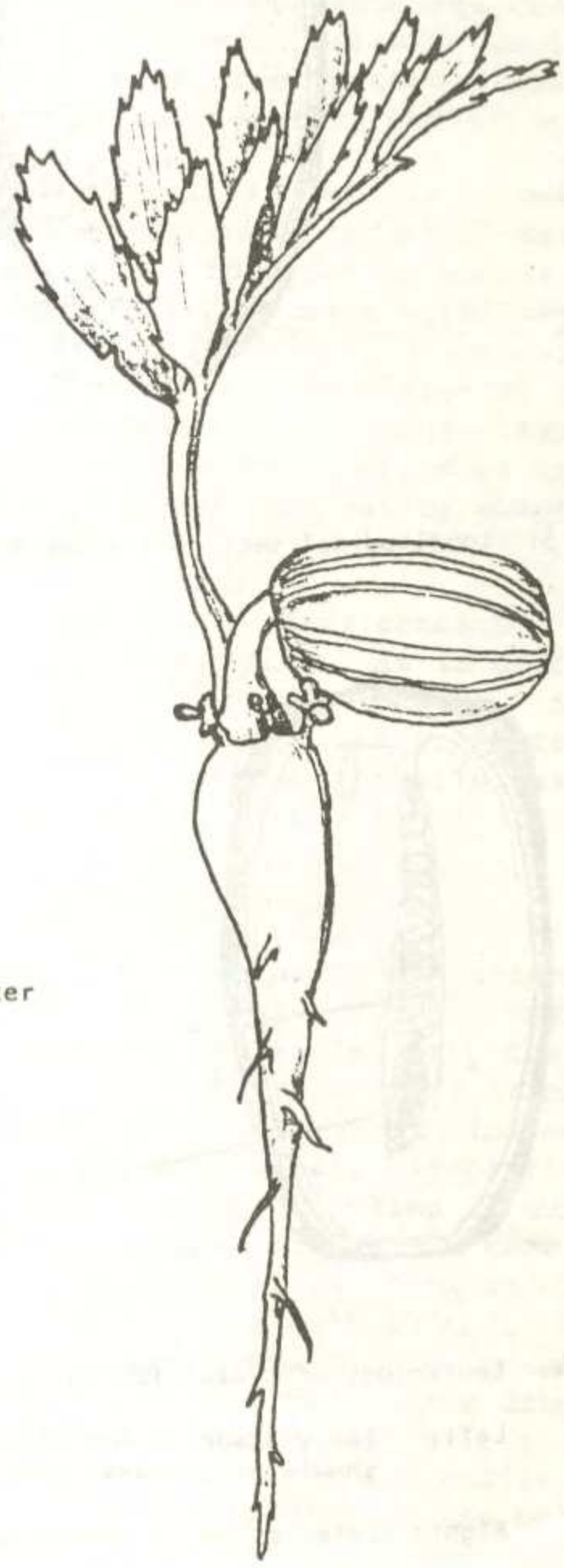


FIGURE 6: Germination of cycads (reduced × ½)

Left: Root tip emerging through coleorhiza.

Right: First-leaf stage with well-developed tap root and evidence of coralloid root development, about 3 months after after germination.

(Redrawn from Giddy, 1984).

After the seed has dropped from the cone, development continues (unlike most other plants where the seed goes into dormancy). The embryo becomes bigger and bigger, pushing the coiled suspensor back towards the micropyle. The embryo itself differentiates into a relatively large pair of cotyledons enclosing the juvenile growing bud, below which is a zone of tissue known as the coleorhiza (see Fig. 4). Further expansion means that the coleorhiza starts pushing harder and harder against the stony seed wall, forcing open the original micropylar orifice, ultimately to burst through (see Fig. 6) - the stage which we recognise as germination. An oddity of the cycads is that the pair of cotyledons never leaves the seed, staying inside to continue a process of absorbing food from the well-developed reserves inside the seed wall.

SOME EVOLUTIONARY IMPLICATIONS

The development of spores on the undersurface of a leaf is a characteristic well-known in the ferns. Evidence from the fossil records suggests that a group of now-extinct 'seed ferns' once existed where the spores were of two different types, male and female. This difference in the sexes, absent in the ferns but initiated in the seed-ferns, is further exaggerated in the cycads, but the processes are essentially the same. One difference is that, in the cycads, the female spore is retained within the ovule - it never becomes independent and never gets released from the parent. This loss of independence of the gametophytic generation is considered an evolutionary advance and has the benefit that the plant can survive in much harsher environments. The logical extension of this is seen in the higher plants where the male and female organs become further reduced and more specialised into parts of the flowers.

In cycads, some other gymnosperms like Pinus, and occasionally some higher plants like the Oak, an outstanding feature is the duration of the sex act. The process from pollination to fertilisation can take up to 7 months. How impatient the human race is in comparison!

An understanding of the processes described above is essential to all botanists but can be even more useful to the cycad enthusiasts. Knowing the details, we can apply our knowledge in artificial pollination techniques and seed germination experiments. The knowledge also helps us appreciate just how unusual and fascinating the cycads are.

The kind assistance of Dr Fiona Getliffe Norris and Professor Charles Breen in preparation of this text, is acknowledged with thanks.

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REGIONAL NEWS STREEKNUUS

Oos-Kaap / Eastern Cape

JAARVERGADERING

Ongeveer twintig Oos-Kaapse lede en be=langstellendes het dié streek se jaarver=gadering op 1 November 1986 by Die Bronne-ontspanningsoord naby Uitenhage bygewoon. Besonder welkom was 'n besoekende lid van=af Tzaneen, Mark Dando, wat sy wittebrood op Kaap St. Francis onderbreek het om die byeenkoms by te woon. Na die jaarverga=dering het almal gesellig saam vleis ge=braai en oor broodbome gesels.

Tydens die jaarvergadering is die volgende komitee vir 1987 verkies: Frank Marx (Voorsitter), Grey Greyling (Ondervoor=sitter), Pieter Stroebel (Sekretaris/Te=sourier), Vernon Rathbone (Port Elizabeth-verteenwoordiger), John Boshoff (Despatch-verteenwoordiger), Jan Brümmer (Uitenhage-verteenwoordiger), Andries Jonker, Roy Clemence en Maans Kemp. Frank Marx is aangewys om die Oos-Kaap op die Nasionale Uitvoerende Komitee te verteenwoordig.

MEMBERS OF 1987 EASTERN CAPE COMMITTEE
From left to right, front: Pieter Stroe=bel, Frank Marx, Grey Greyling.
Back: Maans Kemp, John Boshoff, Andries Jonker, Vernon Rathbone, Jan Brümmer.
Absent: Roy Clemence.

Visiting member, Mark Dando (second from left), chatting to Eastern Cape members.

Natal

SLIDE SHOW

Danie Nel reports:

A pleasant surprise awaited members and visitors on 26 September 1986 when Mr Harry Gerber showed us a selection of slides of local cycads. One does not always realise that all these lovely cycads occur right on our doorstep, ready for our appreciation.

After refreshments, our President, Roy Osborne, told us about his tour abroad and showed us slides of a variety of cycads in America, including those in the botanic gardens he had visited. While showing us slides of Zamia speci=mens, he introduced us to some of our American members who appeared on the photographs. We can now at least relate names to faces.

All of us enjoyed the evening and lear=ned a lot at the same time.

VISIT TO PARK

The next Natal excursion is a visit to the Queen Elizabeth Park in Pietermaritz=burg on 30 November 1986. This will be followed by a "bring and braai" at Cynthia Giddy's home at Umlaas Road.

Noordoos-Transvaal / North-Eastern Transvaal

BESOEK AAN VERSAMELING

Loren Bronkhorst doen verslag:

Op Saterdag 27 Oktober het lede en ander belangstellendes die broodboomversameling van mnr. Kobus Smit en mev. Smit van Pietersburg besoek.

Behalwe dat hulle 'n volledige versameling van Suid-Afrikaanse spesies het, is hulle ook die trotse eienaars van spesies afkomstig van onder andere Zimbabwe, Uganda en Kenia, byvoorbeeld Encephalartos hildebrandtii, E.laurentianus, E. manikensis, E.poggei, E. septentrionalus, E. gratus, E.tegulaneus, E. bubalinus, E. barteri.

Die meeste van die plante word beskerm teen wind en weer deur skadudoek. Daar blyk 'n sigbare verskil te wees tussen die plante wat beskerm word deur die skadudoek en dié wat in oop beddings staan. Die drie meter-plus blaarlengte van die E.laurentianus het die besoekers besonder beïndruk.

Vir die meeste lede was dit 'n belewenis om die versameling van 130 plante te kon besigtig. Reëlings word getref vir verdere uitstappies van hierdie aard.

CYCADS FROM SEED

The photograph shows a twelve year-old specimen of Encephalartos transvenosus. It was grown from a seed and bought as a five year-old seedling in a plastic bag in June 1979. It was kept in the bag until February 1983 and then planted in the garden. It now has a stem diameter of 30 cm, with leaves 1,3 m long.

(Members are invited to send in similar photographs and particulars of plants grown from seed, which have reached a reasonable size.)

LETTERS BRIEWE LETTERS BRIEWE

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

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

Dear Sir

Thank you for the copy of ENCEPHALARTOS No.7 which was forwarded to me. I am most gratified to know that the article on cycads was appreciated by your Society and wish to thank you for praising "The Flying Springbok" in your journal.

The editor of "The Flying Springbok", Miss Rosenbrock, printed the article in good faith and any inaccuracies are regretted. However, it would be an impossible task to check the facts of every article. I suggest that you take the matter up with the author, Beryl Bowie.

N.J.L. VENTER
DIRECTOR (PUBLIC RELATIONS)
SOUTH AFRICAN AIRWAYS

We have also received a letter from the author, Beryl Bowie. She points out that she wrote the article in 1983 and that it was only published in 1986. During that period the situation regarding officially declared endangered cycad species changed. The height of the avenue of Encephalartos altensteinii in Lukin Road, East London was intended to be 8 ft and not 8 m. Mrs Bowie tells us that she has become very interested in cycads and that she has a number of specimens in her garden.

EDITOR

Sir

On reading the articles in ENCEPHALARTOS No. 2 and following discussions with your President, Roy Osborne, in Minneapolis this year, I am concerned that too much is being inferred from casual reports on alleged sex reversals in cycads.

I cite three dependable published references in respect of sex-determining chromosomes in dioecious gymnosperms, one of which refers to a cycad:

Abraham, A. and Mathew, P.M. 1962. Cytological studies in Cycads: Sex chromosomes in Cycas. Ann. Bot. 26: 261-266;

Mehra, P.N. and Khitha Subhash, C. 1981. Karyotype and mechanism of sex determination in Ephedra foliata Boiss - a dioecious gymnosperm. Cytologia 46: 173-181;

Pollock, E.G. 1957. The sex chromosome of the Maidenhair tree. J. Heredity 48: 290-293.

From these papers it is clear that sex chromosomes have been observed in Cycas pectinata, Ephedra foliata en Ginkgo biloba. In the second paper a brief mention is also made of sex determination by sex chromosomes in lower as well as higher plants. I have also personally observed and published definite sex chromosomes in a number of strictly dioecious hepatics (Liverworts).

Coming now to the case of Encephalartos: on the basis of the occurrence of sex chromosomes in Cycas pectinata and some other gymnosperms, I suspect the occurrence of sex chromosomes in other cycads too, including Encephalartos. However, I do not want to be absolutely dogmatic, but would like to go strictly by the authentic data. Have any of your members personally observed the reversal of sex in any Encephalartos? You have an opportunity to examine this point. If it does turn out to be correct, then emphasis on sex determining chromosomes will have to be ruled out in this genus.

Noordoos-Transvaal / North-Eastern Transvaal

BESOEK AAN VERSAMELING

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Op Saterdag 27 Oktober het lede en ander belangstellendes die broodboomversameling van mnr. Kobus Smit en mev. Smit van Pietersburg besoek.

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The photograph shows a twelve year-old specimen of Encephalartos transvenosus. It was grown from a seed and bought as a five year-old seedling in a plastic bag in June 1979. It was kept in the bag until February 1983 and then planted in the garden. It now has a stem diameter of 30 cm, with leaves 1,3 m long.

(Members are invited to send in similar photographs and particulars of plants grown from seed, which have reached a reasonable size.)

Let me also bring to your notice that in some of the other gymnosperms like Cedrus deodora and Biota orientalis, there is no strict sex dimorphism. In both of these species I have observed individuals which are predominantly male or predominantly female. In these cases obviously no sex determining chromosomes are involved and the determination of sex is quantitative (perhaps dependent on reshuffling of genes during sexuality and their accentuation or otherwise in specific individuals).

P.N. MEHRA
EMERITUS PROFESSOR
DEPT.OF BOTANY
PANJAB UNIVERSITY
CHANDIGARH
INDIA

CYCADS ARE TOUGH

In ENCEPHALARTOS no. 6 (page 22) we reported on how "tough" some cycads are. The photograph above further illustrates this point. The specimen of Encephalartos longifolius shown must have been approximately 2,5 m tall when its stem was severely damaged on one side by a veld fire, causing it to bend over until its crown touched the ground. The wound healed and the plant continued growing, once again turning its head up to the sky.

Readers are invited to send in similar stories on how tough cycads are, with or without photographs.

CYCADS OF AUSTRALIA

by Len Butt

Macrozamia communis

"Burrawang", the aboriginal name, seems synonymous in Australia with all of our cycads, and I have seen many Macrozamia and even one Lepidozamia labelled "Burrawang Palm" in nurseries.

Macrozamia communis forms subterranean caudices in deep sandy soils, but in shallow soils may occasionally form a trunk to two metres tall with diameter of up to 60 cm. Depending on size of mature plants and suitability of growth conditions, fronds can number from fifty to one hundred on a plant. Initially, the fronds grow erect from the trunk apex, spreading outwards eventually up to 200 cm in length. Cones form in the leaf axils among the fronds.

The male cones can be any number up to ten, and the female to about six. It is found in coastal and range areas, from Bega in the south up the New South Wales coast to almost Queensland. Particularly fine specimens can be seen in the Haw= kesbury Sandstone areas around Sydney such as Ku-ring-gai Chase right up into the cliff country. Although it grows in communities on the deep sandy loam of our coast soils, it does equally well in hilly country and seems to grow well among eucalypts such as the spotted gum.

Seed has proved to have a high viability and germinates well. M. communis does well as a potted plant and lives long in cultivation, the fronds having high or= namental value. Landscaping potential of this cycad is very high, and along with other species such as M. miquelii it should adapt well in any well-drained situation. The palm-like appearance of the dense circle of fronds lends itself well to garden situations, and the plant's longevity and hardiness is notable. The

M. communis in habitat, with new leaves.

fleshy casing of the seed is sought after by marsupials and fruit-eating bats and possums have been known to dig up and carry off seed planted with the flesh intact. The poisonous kernel of the seed is always left uneaten by our native fauna.

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

GIVE AND TAKE GEE EN NEEM

The exchange of plants is illegal in terms of the Plant Improvement Act. This act has however no bearing on the exchange of pollen and seeds and the unconditional donation of plants. Members are invited to use this column for offer's and requests in this con=nection.

The Nature Conservation Ordinances of the various provinces may how=ever control the exchange and donation of seeds and plants and members are advised to contact their local provincial nature con=servation office for information, permits, etc.

Persons who want to arrange over=seas exchanges should consult the Department of Agriculture, Divi=sion of Plant and Seed Control. In this case import and export permits are usually required and a phytosanitary certificate is gene=rally necessary.

The 'Give and Take' column is also available for requests concerning any other items of interest to members, e.g. books, photographs, etc.

Die ruil van plante is onwettig in terme van die Plantverbeteringswet.. Hierdie wet het egter geen betrek=king op die ruil van stuifmeel en saad en die onvoorwaardelike sken=king van plante nie. Lede word genooi om hierdie kolom te gebruik vir aanbiedings en versoeke in hierdie verband.

Die Natuurbewarings-ordonnansies van die verskillende provinsies mag egter die ruil en skenking van saad en plante beheer en lede word aangeraai om met hulle plaaslike provinsiale natuurbewaringskantoor in verbinding te tree t.o.v. inlig=ting, permitte, ens.

Persone wat oorsese ruilings wil reël moet met die Departement van Landbou, Afdeling Plant- en Saad=beheer in verbinding tree. In hierdie geval is invoer- en uitvoer=permitte gewoonlik nodig en 'n phyto=sanitêre sertifikaat word algemeen vereis.

Die 'Gee en Neem'-kolom is ook beskikbaar vir versoeke t.o.v. enige ander items wat vir lede van belang mag wees, bv. boeke, foto's, ens.

-Roy Osborne (20 Maryvale Road, West=ville, 3630; tel. no. 031-866953) would be very grateful for a few seeds of Encephalartos munchii, if anyone has any to spare.

-Mr N.J. Kachelhoffer (PO Box 3107, Pretoria, 0001; tel. no. 012-219375) would like to buy 100 to 200 seeds of any cycad species.

-Erwin Schroeder (PO Box 3, Hermannsburg, 3508; tel. no. 03345-930) would appre=ciate any information on Encephalartos hybrids, for research purposes. Photo=graphs showing cone and leaf detail, as well as a description of the plant, would be especially appreciated. If it is a natural hybrid, information on its area of origin would also be im=portant. Should it be impossible to send photographs, portions of a leaf (top, middle, etc.) as well as cone scales would be welcome.

EX PRESS

Cycads

'THE Natal Parks Board is clamping down on illegal cycad trading,' Dr George Hughes, assistant director conservation of the Natal Parks Board, said in a statement to the Press.

'It is not our intention to make criminals out of well meaning citizens who may already have cycads in their gardens, but we need to ensure that the ruthless exploitation of Natal's cycads is effectively stopped.'

In August, 36 cycads were illegally taken from the veld in the Transkei and smuggled into Natal across the Umtamvuna River. Natal Parks Board officials apprehended the smuggler who was charged and fined. The Natal Parks Board informed the Transkei Nature Conservation Department of this case and the cycads were returned to Transkei, thus further cementing the excellent working relationship between the two conservation authorities.

All cycads are specially protected indigenous plants and a Natal Parks Board permit is required whenever they are gathered, collected, imported or exported.

'We appeal to the public to help us by contacting the Natal Parks Board should they be in any doubt about what to do where cycads are concerned,' Dr Hughes said.

Highway Mail,
12 September 1986.

Tougher clamp on cycad trade

THE Natal Parks Board is to clamp down more tightly on illegal trading in valuable cycad plants, says Dr George Hughes, Assistant Director (Conservation) of the board.

It was not the board's intention to make criminals out of well-meaning people who had cycads in their gardens, but the exploitation of Natal cycads had to be stopped.

Thousands of cycads were available commercially from nurseries at Umlaas Road and in the Transvaal. He appealed to gardeners to plant them, rather than illegally buy one of the larger plants.

Some of the bigger plants might be more than 100 years old.

All cycads are specially protected indigenous plants and a Parks Board permit is required whenever they are gathered, collected, imported or exported. Even a gift of a cycad from one person to another should be covered by a letter of donation.

Dr Hughes appealed to the public to get in touch with the board should they be in any doubt about what to do.

In August a man was fined after smuggling 36 Transkei cycads into Natal across the Umtamvuna River. The cycads were then returned to the Transkei.—Pietermaritzburg bureau

The Natal Mercury,
20 November 1986.

Thieves get plants

Mercury Reporter

A DURBAN man is offering a reward for information leading to the recovery of R600 worth of plants stolen from his property, including some 'irreplaceable' imported varieties.

Mr Bryan Young of Sarnia Road went away leaving instructions for his neighbour to check on the plants.

'They were there on Saturday but gone on Sunday,' he said. Cycads were among the plants stolen.

He had previously lost some of his plants to thieves five months ago.

'I have reported it to the police. But I am appealing to anybody who saw anything to come forward,' said Mr Young.

The Natal Mercury,
15 October 1986.

The Daily News, 1 October 1986.

Cycad theft charge

Court Reporter

TWO young men appeared briefly before Mr C J van der Schyff in the Durban Magistrates Court yesterday in connection with allegations of stealing cycads and other plants from Mitchell Park.

Before the Court were Barry Muller, 21, and Anthony Pape, 21. No charge was put to them.

They were remanded on bail of R150 each until December 12.

Mrs T A Woker appeared for the State.