ENCEPHALARTOS

JOURNAL OF THE CYCAD SOCIETY OF SOUTH AFRICA

TYDSKRIF VAN DIE BROODBOOM VERENIGING VAN SUID-AFRIKA

NO. 38 JUNE / JUNIE 1994 ISSN 1012-9987

CYCAD SOCIETY OF SOUTH AFRICA

BROODBOOM VERENIGING VAN SUID-AFRIKA

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COVER / VOORBLAD : *Encephalartos manikensis* female cones, the largest 550 mm long.

Photo: Piet Vorster

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FROM THE PRESIDENT

In "*Encephalartos*" No. 36 members were requested to pay their 1994 membership fees before the end of February. Due to the late appearance of this issue, and even though not many members have responded up to now, "*Encephalartos*" No. 37 was sent to all members. I would like to point out that members who have not paid their 1994 membership fees were not supposed to have received "*Encephalartos*" No. 37. This conditional concession was made to give members more time to submit their membership fees, but it must be realized that if this is not done, the Society is going to lose a considerable amount of money. According to a notice in "*Encephalartos*" No. 37, membership fees for 1995 must be paid before the end of December 1994 and members are requested to keep this in mind since we can't repeat this year's concession.

The aim of cycad collectors is to include the maximum number of available species and variations of species in their collections. I am very concerned about the survival of **pure** species in the present set-up where different species, which have been in geographic isolation for millennia, are now growing together and producing offspring in the same garden. Persons responsible for the pollen banks are taking great care to keep pollen pure and to supply pollen of specific species on request. The main idea is to keep species true to type. It was pointed out in different papers published in "*Encephalartos*" and other journals that cycads can indeed be pollinated by insects and it is a known fact that different species do interbreed. If a receptive female cone was not covered to keep out insects, before it is hand-pollinated using "desired" pollen, one can not really accept that insect pollination with "undesired" pollen has not already taken place. In my own garden it happened last year that I was away when a female *Encephalartos villosus* cone became receptive. In spite of the fact that this cone was not hand-pollinated, about 30% of the seeds were indeed fertilized.

I certainly do not want to discourage members to experiment with crossings, but we are working with seriously threatened plants and it is our duty to build up and keep a nucleus of pure species. It might be a good idea if we could reach a stage where only pollen of "registered" male plants will be kept in pollen banks for members providing "registered" seeds and seedlings. In this regard I would welcome comments from our members.

Hannes Robbertse

VAN DIE PRESIDENT

In "*Encephalartos*" nr 36 is daar versoek dat ledegeld vir 1994 voor die einde van Februarie 1994 betaal moes wees. Ongelukkig het hierdie uitgawe laat verskyn en het baie lede nie op die versoek gereageer nie. Tot op datum is daar nog 'n groot aantal lede wat nie hul lidmaatskap vir 1994 hernieu het nie. Ek wil net weer eens daarop wys dat lede wat nie hul lidmaatskap betyds hernieu het nie, streng gesproke, nie daarop geregtig was om "*Encephalartos*" nr 37 te kon ontvang nie. Ons het egter 'n voorwaardelike toegewing gemaak deur hierdie uitgawe van die Tydskrif aan alle lede te stuur, met die gevolg dat die Vereniging skade kan ly indien al die lede nie betaal nie. In "*Encephalartos*" nr 37 is kennis gegee dat lidmaatskap vir 1995 voor die einde van Desember 1994 hernieu moet word. Die vergunning wat vanjaar toegepas is kan nie weer herhaal word nie en lede word versoek om betyds hul lidmaatskap te hernieu.

Broodboomversamelaars streef daarna om eksemplare van al die beskikbare spesies en variasies van spesies in hul versamelings in te sluit. Ek is baie bekommerd oor die voortbestaan van **suiwer** spesies in ons huidige opset, waar verskillende spesies wat vir millenniums geografies van mekaar geskei was, nou in dieselfde tuine bymekaar groei en kan voortplant. Die persone wat die stuifmeelbanke behartig doen baie moeite om die stuifmeel suiwer te hou en die regte stuifmeel op versoek te voorsien, juis met die doel om spesies suiwer te hou. In verskillende artikels wat in "*Encephalartos*" asook in ander tydskrifte verskyn het, is daarop gewys dat insekbestuiwing wel by broodbome plaasvind. Dit is ook bekend dat verskillende spesies vrylik met mekaar kan kruis. Indien 'n ontvanklike vroulike keël dus nie vooraf toegemaak was om insekte uit te hou nie, kan daar nie sondermeer aanvaar word dat insekbestuiwing met "ongewensde" stuifmeel, nie reeds plaasgevind het teen die tyd dat handbestuiwing met die "gewensde" stuifmeel uitgevoer word nie. In my eie tuin het dit verlede jaar gebeur dat ek nie tuis was toe 'n keël van 'n vroulike *Encephalartos villosus*-plant bestuif moes word nie. Ten spyte van die feit dat die keël toe nie handbestuif is nie, was ongeveer 30% van die sade wel bevrug.

Ek wil nie lede ontmoedig om kruisings te maak nie, maar waar ons met ernstig bedreigde plante werk, is dit ons plig om 'n kern van suiwer spesies op te bou en te handhaaf. Dit sal daarom ook goed wees indien 'n stadium bereik kan word waar stuifmeelbanke slegs stuifmeel van "geregistreerde" manlike plante sal aanhou vir diegene wat "geregistreerde" saad of saailinge wil voorsien. In hierdie verband sal ek graag kommentaar van lede wil ontvang.

Hannes Robbertse

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 broodboomsoort, in die vorm van 'n in-diepte-artikel in leketaal. In hierdie uitgawe val die kollig op:

ENCEPHALARTOS MANIKENSIS (Gilliland) Gilliland

Roy Osborne
Department of Chemistry, University of Natal, 4001 Durban.

INTRODUCTION

It was in July 1937 that Witwatersrand University botany lecturer Hamish Boyd Gilliland (Figure 1) lead a party of his students on a plant exploring safari to the eastern highlands in the Manica District in Zimbabwe (then Rhodesia). When two students from the group were dispatched to scout out the Numkwarara Valley near Mount Gorongowe, they were surprised to find a flourishing stand of cycads. On examining specimens and later, photographs, Gilliland recognised the plant as not unlike *Encephalartos gratus*, described by Prain from Malawi in 1916. Furthermore, Gilliland noted that the Manica plants were almost identical to cycads he had seen earlier on Mount Garuso in Mozambique (then Portuguese East Africa). Bearing in mind that, at that time, only six cycad species were known from outside South Africa (*E. barteri, E. hildebrandtii, E. gratus, E. laurentianus, E. poggei and E. septentrionalis*), it is easy to see why Gilliland at first believed that the Manicaland plant (and presumably also the Mozambican plant) was a variant of the Malawian cycad; he hence named it as *Encephalartos gratus* var. *manikensis* in 1938. However, a little further comparative study and the inspection of new material revealed significant differences between the plants from Manicaland and *E. gratus*; thus in 1939 Gilliland renamed his plant as *E. manikensis*. The change in status from variety to species explains why the plant is correctly referred to with the authorship (Gilliland) Gilliland.

As time progressed, an increasing number of cycad populations were found in both Zimbabwe and Mozambique. It was largely through the extensive field work of Raymond Münch and H. Basil Christian that the need for a proper botanical study of the Zimbabwean and Mozambican cycads in the so-called "*E. manikensis* complex" was called for. In 1966 Münch invited a South

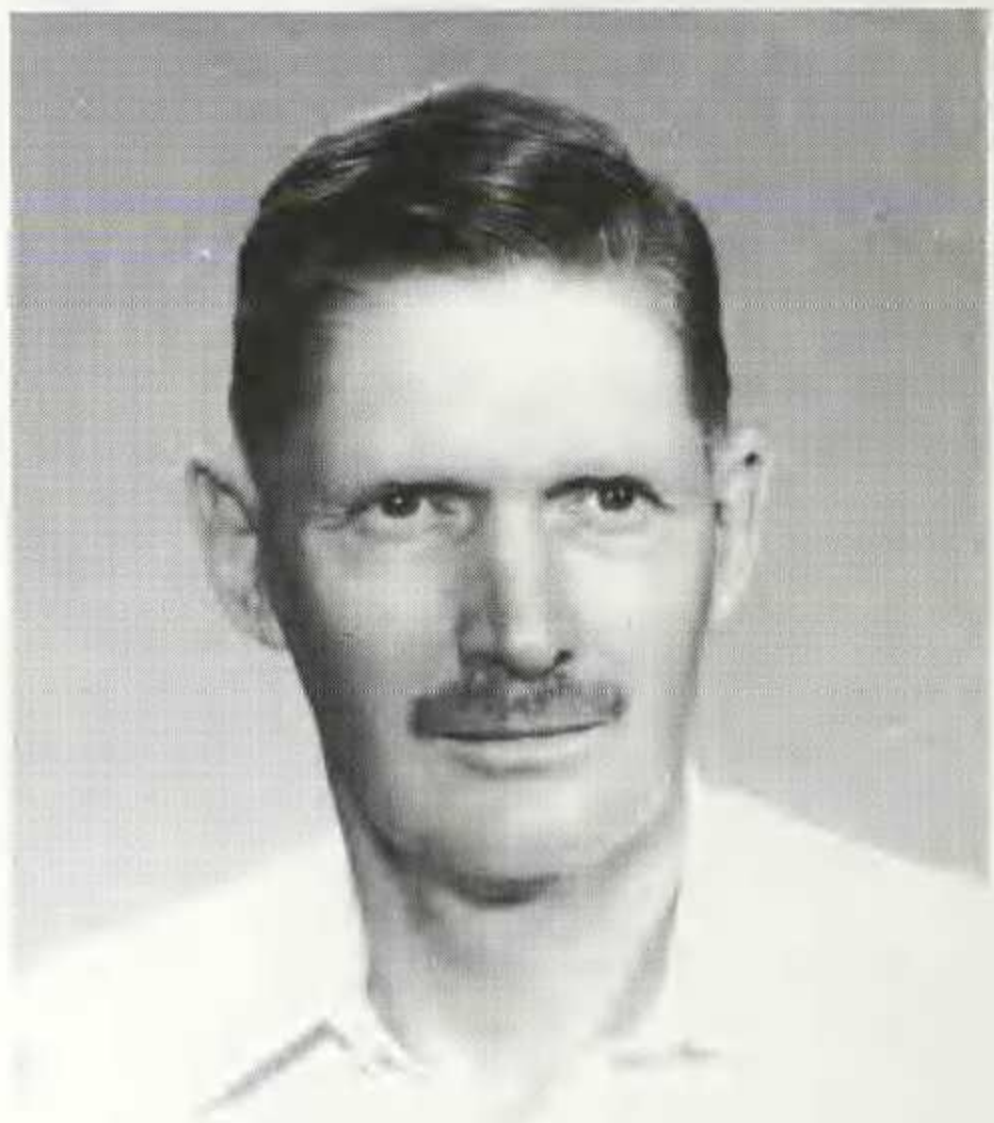

Figure 1 Professor H.B. Gilliland, the Witwatersrand University botanist who named *Encephalartos manikensis*. Photo kindly loaned by Mrs Rita Gilliland.

Africa group comprising Drs Dyer and Verdoorn and Mr J.A. Smit to inspect the plants in his living collection at Rusape, after which it was possible for the botanists to

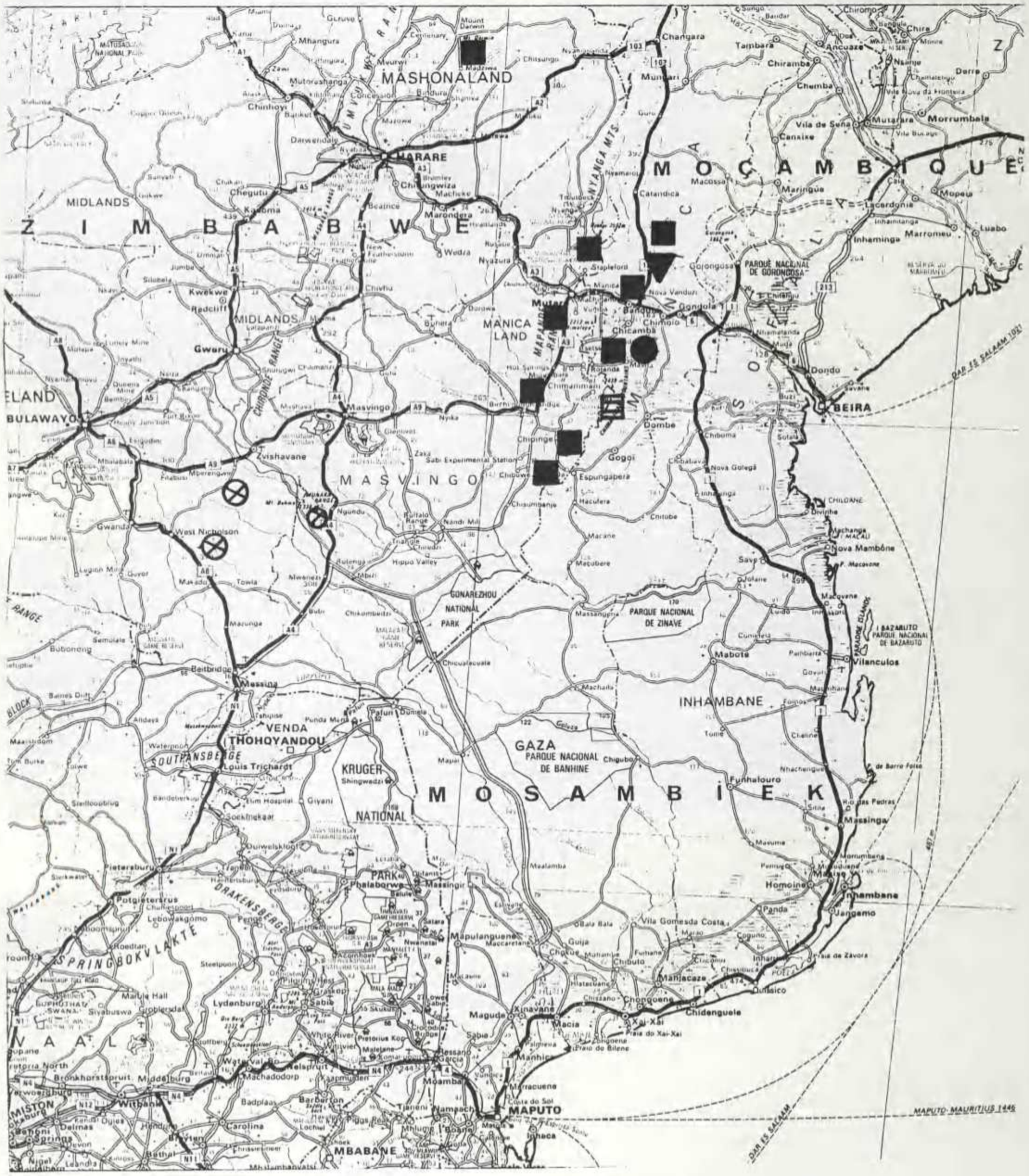

Figure 2 Distribution of *Encephalartos manikensis* and its allies in Zimbabwe and Mozambique. The approximate localities are indicated as follows:

■ *E. manikensis*

⊟ *E. chimanimaniensis*

⊗ *E. concinnus*

● *E. munchii*

▼ *E. pterogonus*

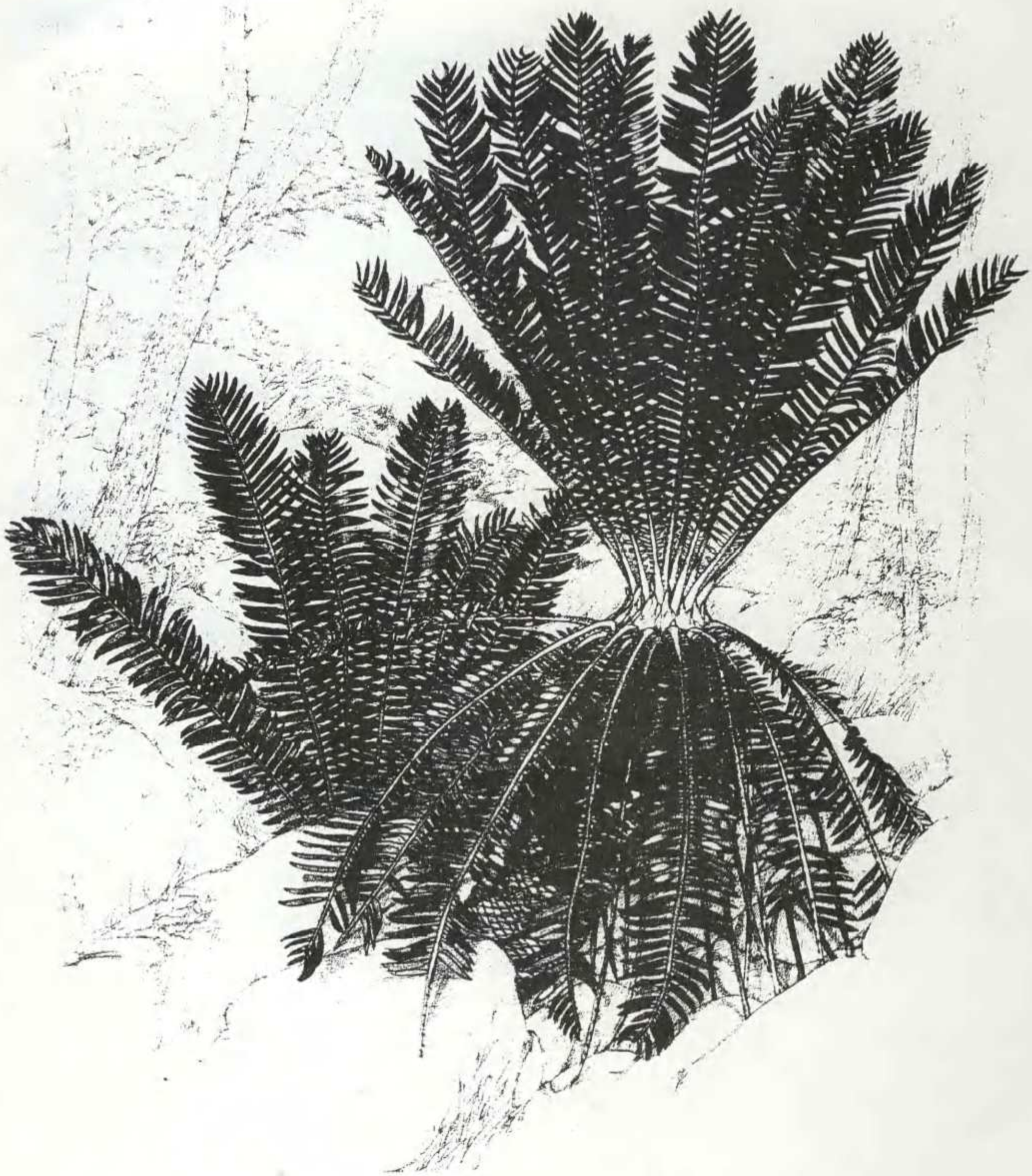

Figure 3 *Encephalartos manikensis* on the *Brachystegia* (Msasa)-wooded slopes of Mount Gorongowe in eastern Zimbabwe. Reproduced by permission from Douglas Goode's "Cycads of Africa".

distinguish five separate species, largely on the basis on male cone morphology. Thus in 1969, despite not having seen the plants in the wild, Dyer and Verdoorn separated *E. chimanimaniensis, E. concinnus, E. munchii* and *E. pterogonus* from *E. manikensis*, but recognized even then that the work was incomplete. The unfortunate series of civil wars over the last two decades has prohibited further botanical studies in Mozambique and only now does it seem likely that access to the areas of interest may become less risky.

The following comments on *E. manikensis* refer to the broad species concept after the 1969 treatment of Dyer and Verdoorn.

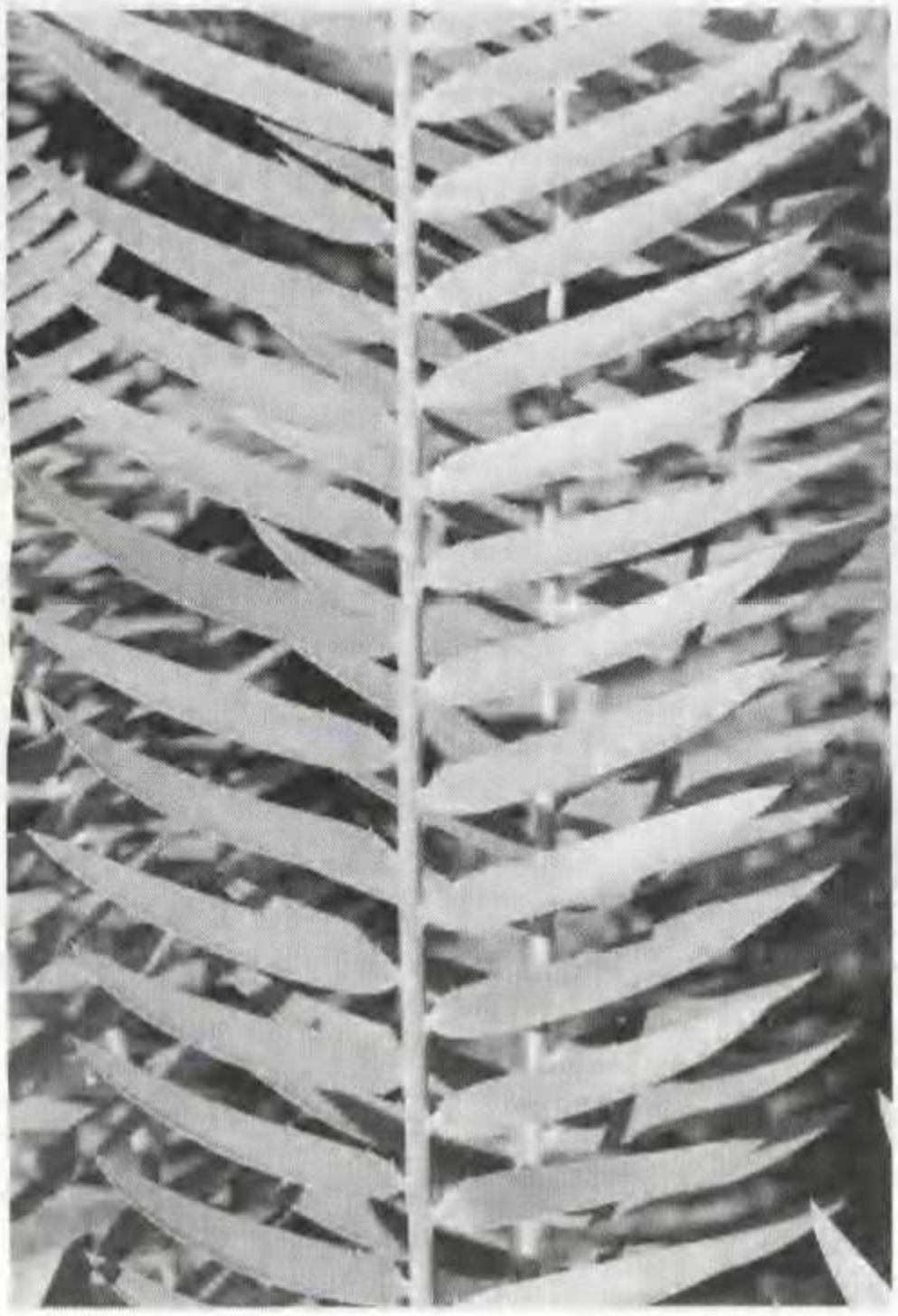

Figure 4 Leaf detail: *E. manikensis* "Elizabethvillensis".

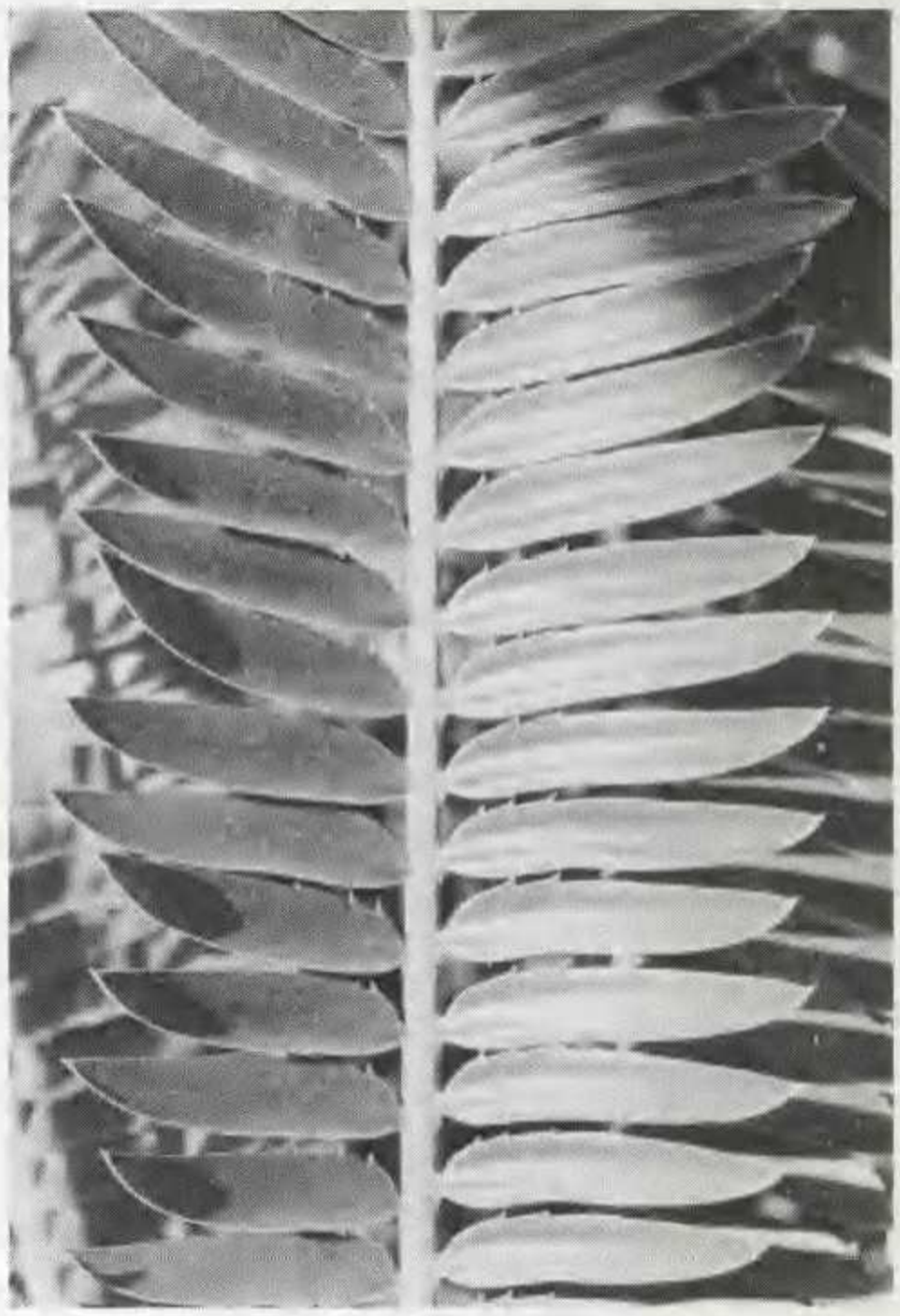

Figure 5 Leaf detail: *E. manikensis* from Garuso.

DISTRIBUTION (Figure 2)

The type material, as mentioned above, comes from the Numkwarara Valley near Mount Gorongowe in eastern Zimbabwe (Figure 3). Here it occurs in relative abundance in the grassland, around forest margins and near granite koppies at an altitude of about 1400 m. Much smaller populations are reported from Zimbabwe in several widely-distant localities but generally in the vicinity of granite outcrops: near Mount Darwin in the north and southwards near Chipinge (the "Chipinga" form), near Mount Selinda (the "Elizabethvillensis" form) (Figure 4), near Mount Nyarurwe (Nyanyadzi?) ("Bob's Cycad", after Bob Contat), along the Odzi River (the "South Odzi" form) and the Garezi River south of Birchenough. In Mozambique there are even more scattered, small populations, again usually in the vicinity of granite outcrops or whaleback mountains. These plants are known under locality names: from Garuso (Figure 5) and the nearby Mount Nhaungue (Nhaungwe) (plants also known as "Nyoka" or *E.* "Torrei") and Mount Bandula (*E.* "Bandulanus") (Figure 6), from Mount Chicamba (Chigamba) (Figure 7) slightly to the south, from areas slightly northwards at Vanduzi and somewhat further to the north from Mount Chinyayadze (Chinyazange?) (Figure 8) near the Pungoe (Pungwe) River. Several private collectors have plants alluded to as "from Chimoio" but it seems this may have been more of a distribution centre than a plant locality.

Plants from the Ribáuè Mountain and near Nampula, in the northern parts of Mozambique, as referred to by Douglas Goode, are more likely to be *E. turneri*. In addition, the cycad populations mentioned by various authors from the Zambesi Valley are almost certain to be *E. gratus* which is now known to be widely distributed in the Zambesia Province of Mozambique

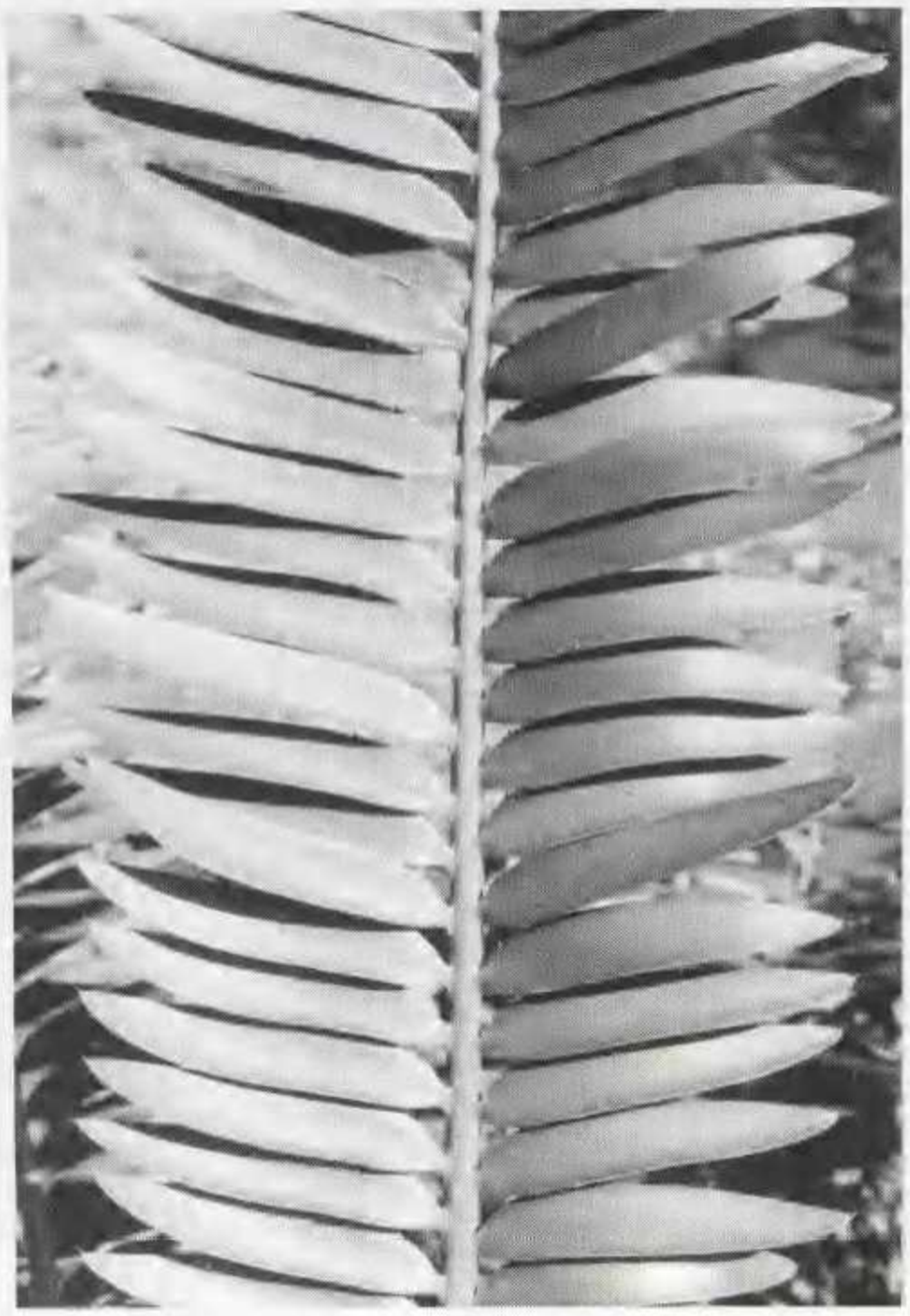

Figure 6 Leaf detail: *E. manikensis* from Bandula.

Figure 7 Leaf detail: *E. manikensis* from Chicamba.

(Johan Hurter, *pers. comm.*). The identity of a small cycad population in the extreme south, near Pafuri, is unknown at the present time and the writer would welcome any input from readers who have first-hand experience of this plant.

A fairly large number of *E. manikensis* specimens (Figure 9) are in public and private gardens. The largest *ex-situ* representation is that at Ewanrigg Garden outside Harare, with 186 specimens, many of which have been directed to the garden after confiscation from illegal traders. A group of 31 plants, at Hillside Dam Gardens near Bulawayo, was also planted after the arrest of a trucker who was shuttling cargoes of cycads and tree ferns from Mutare to Bulawayo. The species is fairly well distributed in international botanic gardens and a large number of plants are in private gardens around the world.

DESCRIPTION

1. STEM

E. manikensis has stems 1.0-1.5 m tall and up to 300 mm in diameter with suckering and occasionally branching at the base. The stem apex has soft white bracts (cataphylls) which become more prominent when new leaf flushes or cones emerge.

2. LEAVES AND LEAFLETS

Leaves are very variable with locality, typically a glossy light to dark green (which easily distinguishes the plant from *E. munchii* with its bluish foliage) and 1-2 m long. New leaves are covered with a fine layer of white hairs which is gradually lost as the leaves mature. Leaflets often show a distinct yellow band at the point of attachment to the rachis. Leaflets are inserted in a flat plane (viewed in longitudinal section to the rachis) and more-or-less at right angles to the rachis (in the planar view). Median leaflets are 120-150 mm long and 20-25 mm wide, sometime curving slightly forwards at the tip. They usually have 2 or 3 spines on their margins. Leaflets reduce in size progressively towards the leaf base, ending in a series of prickles and simple spines so that there is very little bare petiole to the leaf. The leaflets may be quite closely spaced and overlapping, or relatively far apart, this varying both with locality and the degree of sunlight to which the plant is exposed.

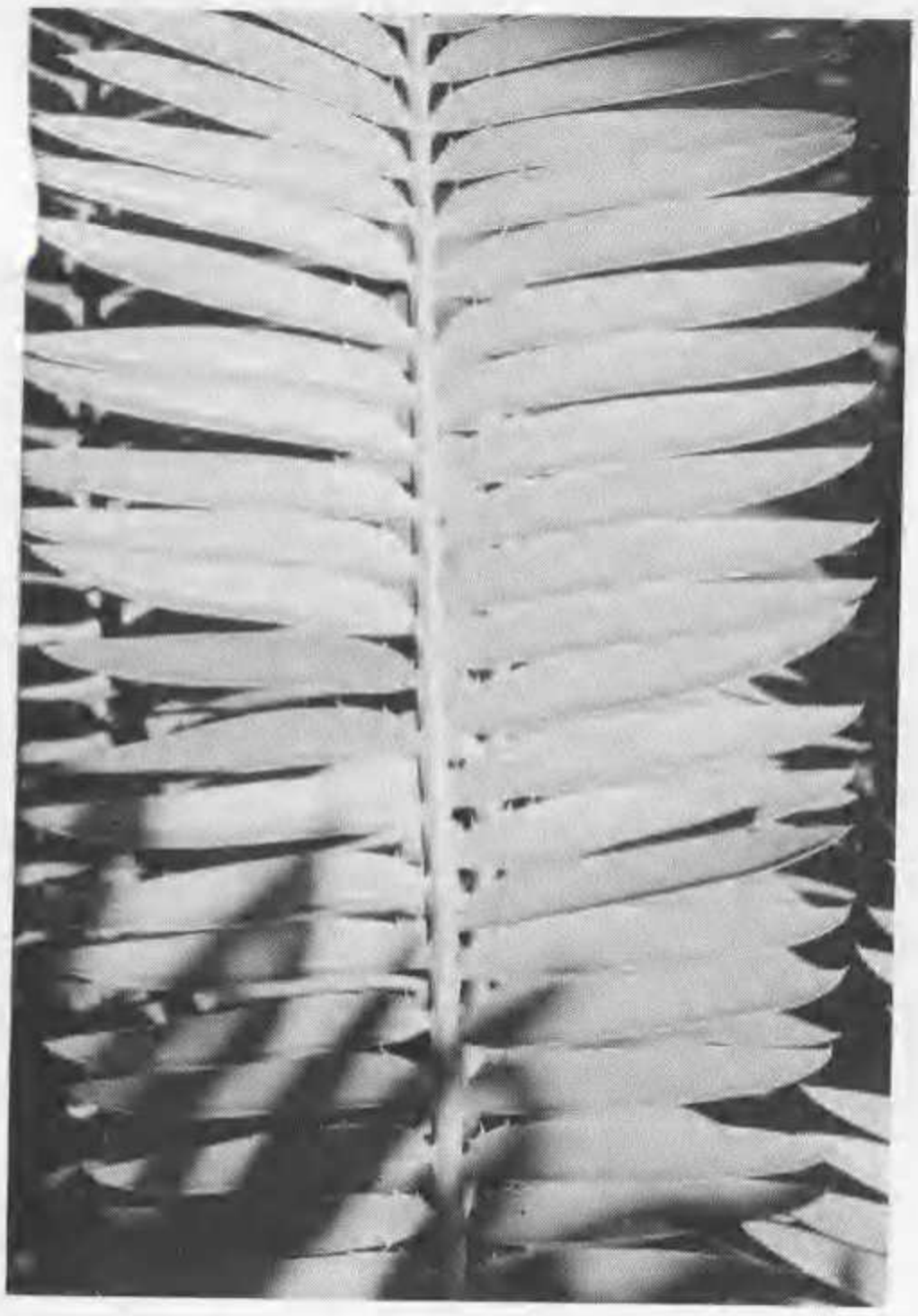

Figure 8 Leaf detail: *E. manikensis* from Chinyayadze.

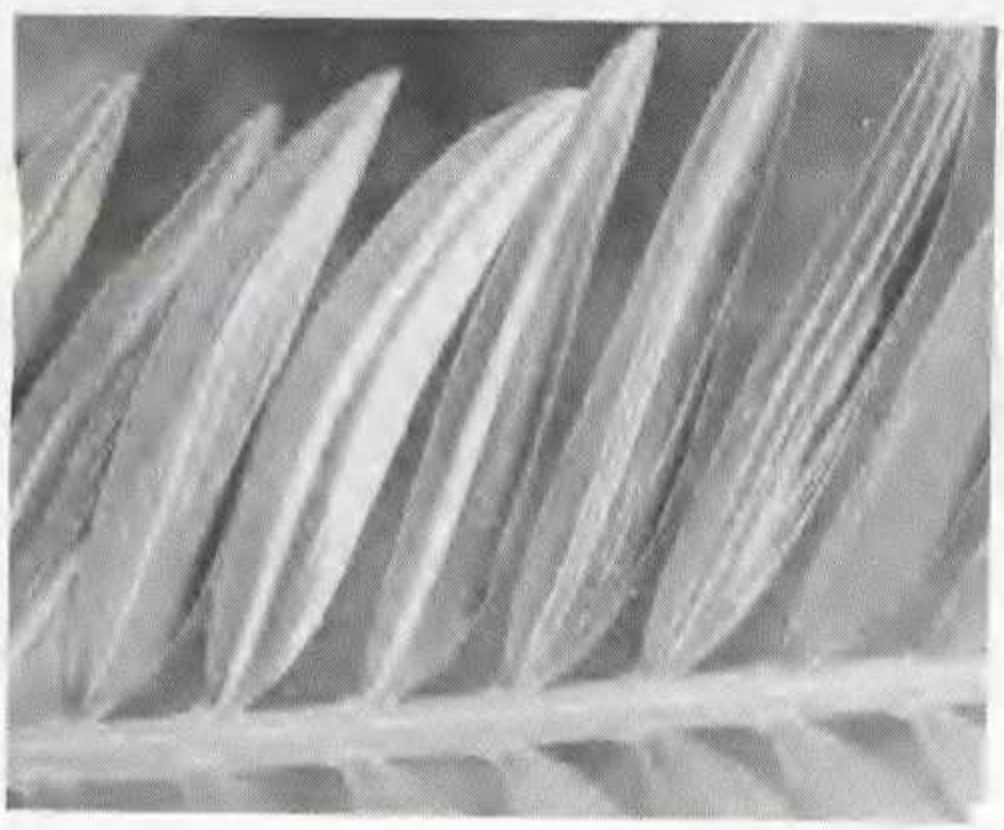

Figure 9 An unusual example of leaf variegation was found on a plant grown by Ita van der Walt in Pretoria.

3. CONES

Both the male and the female plants produce 1-4 cones.

Figure 10 Male cones of *E. manikensis* are often mistaken for female cones by growers. The cone at the rear was at the pollen-shedding stage. Photo: M.I. Claassen.

Male cones (Figures 10, 11) have peduncles up to 150 mm long and vary in length from 250-600 mm and in diameter from 80-150 mm. They vary in colour from a bluish-green to yellow-green and resemble the female cones, especially at the time of first emergence. The male cone scales of *E. manikensis* are thicker than those of *E. concinnus*, not curved like those of *E. chimanimaniensis* and without the "wings" that are characteristic of *E. pterogonus.*

Female cones (Figures 12, 13) are impressively large, 300-450 mm long and 200-250 mm in diameter with short peduncles. They vary in colour from blue-green to dark green, becoming lighter in colour on maturity. Cone scales are thick, ridged and with a prominent flattish terminal facet which may be slightly hairy. Large female cones often show vegetative outgrowths at their apex (Figure 14).

4. SEEDS

The seeds are deep red, 25-35 mm long and 15-20 mm in diameter.

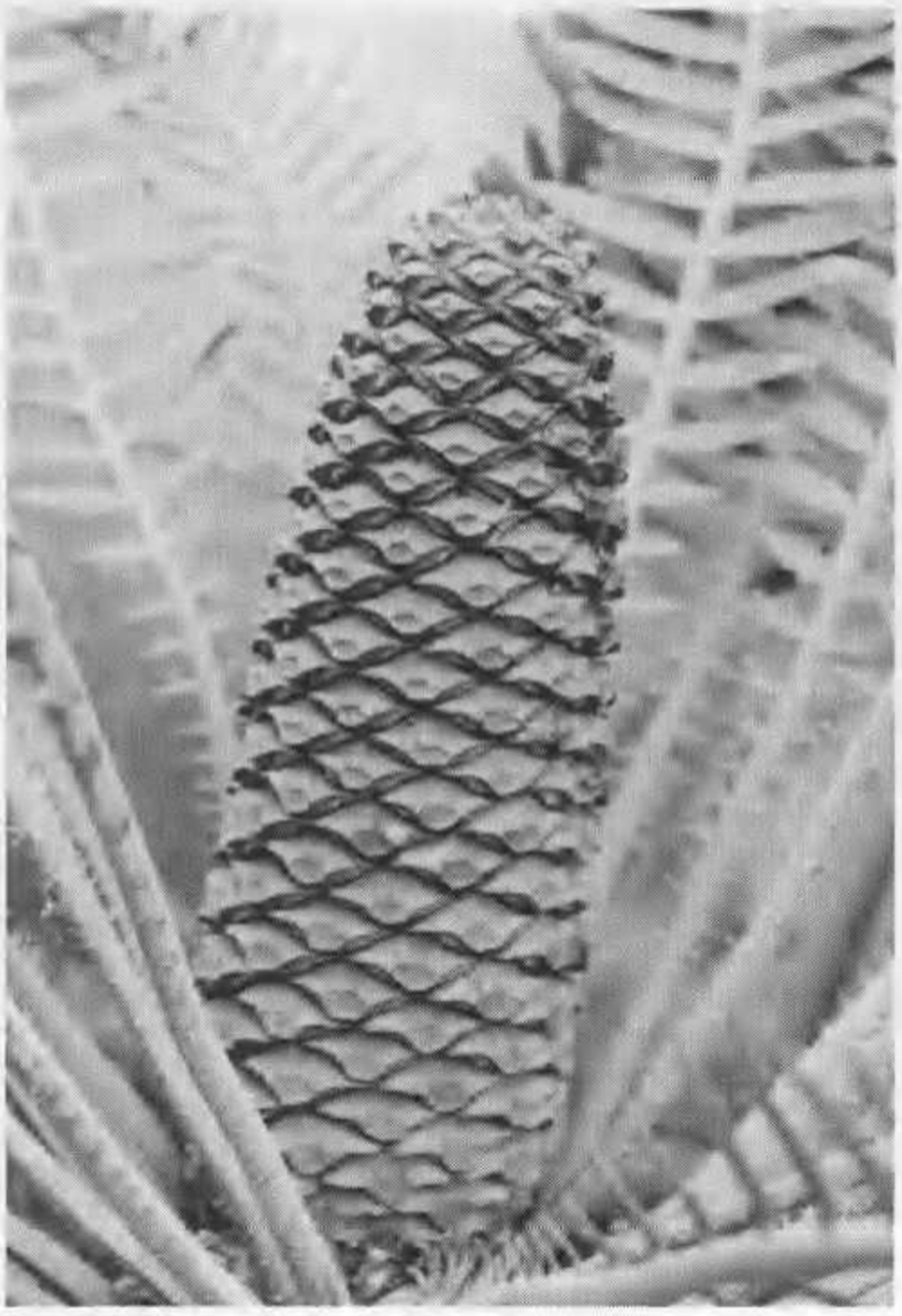

Figure 11 The male cone on this garden specimen of *E. manikensis* was 460 mm long and 140 mm in diameter. Note also the pubescence on the leaf rachises.

Figure 12 The large, pale-green, barrel-shaped female cone typical of *E. manikensis*.

AFFINITIES AND HYBRIDS

E. manikensis shares several characters, especially in the leaf and leaflet appearance, with *E. concinnus, E. chimanimaniensis, E. pterogonus, E. munchii* and the other as yet undescribed cycads from Mozambique, all of which are broadly within "the *E. manikensis* complex". To assist those who would like to attempt to distinguish amongst the named species, we reproduced the two keys, one based on male cones and the other on leaf characters, from the Dyer & Verdoorn (1969) publication in the article on *E. concinnus* ("*Encephalartos*" 34). In using the keys, it must be noted that the male cone details are based on dried material.

The variability within *E. manikensis*, as presently defined, is, to some extent, a matter of botanical nicety. What constitutes a separate species, subspecies or variety depends somewhat on personal points of view. I believe the degree of variability in *E. manikensis* is parallel to that within the *E. altensteinii/E. natalensis* combination and that naming of new taxa at the species level may be unjustified. Extensive field work needs to be done to resolve *E. manikensis* fully, i.e., to complete the work

Figure 13 Four female cones were born simultaneously on this specimen of *E. manikensis* in a Durban North garden.

started by Drs Dyer and Verdoorn. It will be a tough assignment to ascertain the status of each of these populations - conditions are hostile, the area is vast, local resources are minimal, the plants are limited in number and coning is infrequent. The most useful tools in this respect may well prove to be those of the molecular biologist: protein electrophoresis and cpDNA

Figure 14 Mr T. Radack, German farmer in Mozambique's Chimoio district, shows the vegetative growth at the apex of one of two female cones on a plant he obtained north of Vanduzi. Photo: Bob Contat.

studies which are only just beginning to be used in the analysis of *Encephalartos* as a genus.

At present, there is no information on either natural or artificial hybrids relating to *E. manikensis*.

CONSERVATION AND CULTIVATION

Both Zimbabwean and Mozambican cycads were extensively plundered by plant traders in the 1970's, most of the specimens finding their way into South African collections. Unfortunately, the original localities were by-and-large kept secret and hence so many of the plant specimens, presently in private gardens, have little real botanical value. The trading activities were much reduced in Zimbabwe when the Control of Goods (purchase and sale of cycads) Regulations were promulgated in 1974 and with the subsequent Parks and Wildlife Act in 1975, which listed all species of *Encephalartos* in Zimbabwe as specially protected indigenous plants. The unfortunate civil war in Mozambique has had the advantage of halting cycad exploitation altogether over the past 20 years, but plant populations may be re-exposed to this threat as peace is restored.

As suggested previously ("*Encephalartos*" 34), I believe that the Harare and Ewanrigg Gardens' staff should take a lead in establishing and managing a gene pool for both the Zimbabwean and Mozambican cycad populations, with a programme for re-establishment of propagated plants into depauperate populations, even if in the first instance it means removing additional seed and/or plant material from the wild for this purpose.

E. manikensis is a fast-growing cycad that responds well to good soil and regular watering. It prefers semi-shade conditions and needs protection from strong winds and cold. It is not frost tolerant.

ACKNOWLEDGEMENTS

I am grateful to Mike Kimberley, Ian Turner and Piet Vorster for their comments on the first draft of this text.

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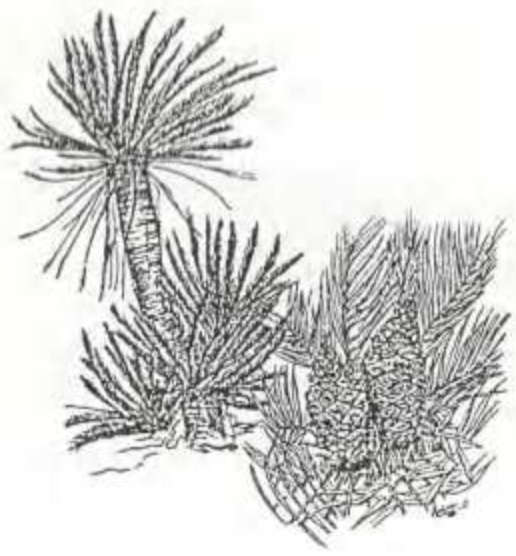
[Unless otherwise stated, all photographs were taken by the author.]



ARTICLES / ARTIKELS

ENCEPHALARTOS SPECIES GROWING IN KENYA AND TANZANIA

Ian S. Turner
Springs Farm, P.O. Box 2162, Harare, Zimbabwe

Received 1 February 1994

In January 1993, I made a trip with three friends to Kenya and Tanzania to look at the *Encephalartos* species growing there and try to collect some seeds.

We arrived in Nairobi and hired transport, then headed north the same day. By evening we had reached Nanyuki and stayed for the night in the hotel in the village. We were up early the next morning and carried on to the habitat of *Encephalartos tegulaneus*. The village there had a rest-house so we hired some rooms and organized some guides to take us the next day to where the cycads are growing. To begin with the walking was easy, then we had to enter an area of very thick thorny bushes and also some quite big trees growing on a mountain side. There were no paths to follow so we went along wild pig trails. This was very hard going because it was like a tunnel through the bushes and it was not possible to stand up. My shirt was torn to shreds by all the thorn bushes. Some of the cycads growing there were really big plants and by climbing a tree they could be seen growing above some of the bushes.

Figure 1 Mature *E. tegulaneus* female cones.

At this locality we were lucky to find lots of seeds, the cones had just broken up and under some plants were hundreds of seeds: all good and fertile. It would be interesting to know when seeds were last produced because very few small plants or seedlings were seen. We could only conclude that maybe something like wild pigs eat the seeds because I personally only saw one seedling and another plant that must have been about 6-7 years old. All the other plants were really old specimens, so regeneration there is very slow indeed. *E. tegulaneus* (Figure 1) is a very impressive cycad with its stiff dark green leaves and massive trunk.

The next locality we visited was that of *E. kisambo*. To me this is the most beautiful of all the *Encephalartos* species. It grows on the top and one side of a small mountain in a quite wet place. Ferns and other plants were found growing on the trunks of that species. There were lots of big yellow to orange coloured cones and they looked very colourful among the big spiny leaves. *E. kisambo* is a very robust species and even quite young plants can produce some large long leaves. The place where these plants grow must be about ideal for any of the *Encephalartos* species with green leaves. The soil was rich and fertile. There was some light shade from big trees and plenty of moisture to supply the plants' needs. We saw quite a lot of young plants and seedlings, so regeneration in the colony is good.

We took the Mombasa road and turned off a few miles outside Mombasa and after travelling for 10-15 miles we came across *E. hildebrandtii* (Figure 2). This plant grows in the lowlands and the soil is very sandy. Some really big plants were to be seen with trunks up to 2 metres tall. No cones were seen but a few seedlings were found under some of the female plants. It seems like this plant as with *E. tegulaneus* is very slow to regenerate. This is a complete contrast to *E. kisambo* and *E. bubalinus* where lots of young plants were growing. To see *E. bubalinus* we crossed the border into Tanzania. This cycad grows in a very isolated area and to get there we drove through the Serengeti Game Reserve. It was very interesting seeing the thousands upon thousands of wildebeest, zebra, Thompson's and Grant's gazelle. I had never thought it possible to see so many animals. The game was in every direction as far as the eye could see.

We drove for miles and miles and then took a turn-off which was no more than wheel tracks across the Serengeti. In January the rains have not finished in Tanzania and we soon came to some very wet places and

Figure 2 *E. hildebrandtii* near Mombasa.

to make things worse it became dark. We got completely bogged down three times and had it not been for the help of a missionary who happened to be passing that way in his four-wheel drive vehicle, we would have had to spend the night on the road. We eventually arrived at our destination and found a rest-house where we stayed the night.

We were up early the next morning and decided to hire a vehicle which would be better for the rough road which leads to where the cycads grow. It was an old van and had to be push started, but it was four-wheel drive and had good clearance. So off we went with the rain pouring down (Figure 3). The vehicle cut out a couple of times so we all had to get out and push. This was pretty hard work because it is not easy to get up any speed on a muddy road. So we had to get the van up a bit of a rise so as to be able to pick up a bit of momentum on the way down. We went as far as the van could go then started to walk.

We could see cycads on a hillside across a valley from where we were. With the rain falling, we all became soaking wet and cold and our boots were full of water, but seeing as we were intrepid cycad enthusiasts, we carried on regardless and it was very nice to see *E. bubalinus* growing in the wild. There were some nice large plants all over the hillside. A few small plants were seen but not a single cone, male or female, and no seeds from the previous year were seen. It seems as if

Figure 3 A sudden torrential downpour.

there is something, be it climatic or fires, which triggers off the coning of a cycad colony. Maybe some 3 to 4 or even more years pass before cones are again produced.

Figure 4 *E. bubalinus* at the edge of the Serengeti.

We had a good look at the plants there then headed back to the car. The rain had become so heavy that a small river we had crossed in the car in the morning was now in flood and it was impossible to get the car

through, so we all had to wade through the very cold water waist deep. It did not much matter because we could not have got any wetter than we already were from the rain. It was good to get back to the rest-house and get on dry clothes and have some hot tea. Chicken and rice was for dinner that night. I think when they choose which chicken to slaughter they must work out which one is about to die of old age and that is the one which goes in the pot. But maybe it is my teeth that are not as good as they used to be.

We got directions from the rest-house owners of another road to return on which would be a short-cut, so we thought it was a good idea to take it because we would then miss the place where we had got stuck on the way in. We had travelled for about two hours when we came upon a beautiful colony of *E. bubalinus* (Figure 4) right on the side of the road and some plants were even falling on the road where the soil had been washed out of the bank they were growing on. These plants were in a valley, the soil was better there and the weather warmer so the plants were much better specimens than the ones on the mountain. Here again no cones were to be found but some seedlings from the previous year were seen. Only a very few seeds from a cone ever get to grow into a mature plant. Quite a lot of seeds germinate on top of the ground and are unable to get their roots into the soil and so perish. Most of the plants growing at this locality were so big and lush they almost looked a different species to the ones first seen.

It would have been nice to have been able to spent more time there looking at the plants but we had far to go, so we carried on until we came to a part of the road that was completely flooded. There was another track leading off towards Ngorongoro so we had no alternative but to take it. I don't think many cars pass that way because we came to a small village where we found a man wanting a lift. He said he had been waiting for six days for any vehicle to pass through, so we could not disappoint him. In fact it was good to have a local to show us the way and he came in handy to help push the car at a river crossing where we got stuck in the mud which had been washed down by the rain. We wanted to go into the bush to cut branches to put under the wheels but returned to the car without them when we heard lions roaring nearby. The mud was so deep I did not think we would ever get the car out but the driver was a stubborn fellow who would not give up easily and eventually we got the car onto a hard surface.

It was now getting late and darkness soon fell. It was very hard to see the track in the dark and we left the road and drove straight into a bog. I felt sure we were there for the night but with pushing for all we were worth, we again got the car onto hard ground. The road ahead was very wet but the driver went flat out and got the car through. Luck or someone else was truly with us that day. We eventually got to the Ngorongoro Crater hotel at 21h50 all pretty tired and very dirty, and very, very relieved.

The last cycad we were to see was *E. sclavoi* and it was one and a half days' drive to get to its locality. On the way there we stayed at a very nice old hotel built by some Germans many years ago. There were still some big pictures of old German ships hanging on the walls.

Encephalartos sclavoi grows at a very beautiful place called World's View. It grows right near the top of a very steep mountain and along one side for a short distance. Because there are people living all over the area, there is a road right up the mountain which was quite fortunate. The local population grows many acres of potatoes and tomatoes. The altitude being quite high the weather was cool so potatoes grow very well indeed. There were also some good plum trees with very nice fruit that was being sold on the roadside. It was strange to see these crops being grown there but it was obviously something left from the colonial days and the farmers there seemed to be making good money with their crops.

Encephalartos sclavoi is very different from the other cycads we had seen. Its leaves are shorter, have no spines and have a thick hard texture. It seems to be quite slow growing. It grows right out in the full sun. Some trunks were hanging down over the rocks they were growing between. Unfortunately again we were not to see a single cone. We did find a few seeds which some rodents had carried to hide under small rock ledges. Some had started to germinate so maybe cones had been produced the previous year. The terrain was so steep where the plants were growing we had to be very careful not to trip because it was a very long way to roll to the bottom of the mountain.

Figure 5 Yet another frustrating puncture, hours from any assistance.

We stayed a while to enjoy the wonderful view and just look at the cycads then left (Figure 5) with the intention of checking another cycad which could be a new species. We booked into a rest-house and during the night the

rain poured down. The next morning the owners of the rest-house told us that we would never get to the area we wanted to visit because the road would be very muddy. So still with the memory of the road to *E. bubalinus* in our minds we decided to return to Kenya because we only had two days left before our return to Zimbabwe. It was a very interesting expedition and I look forward to returning one day to find the unknown cycad.

CYCADS AT THE KAROO BOTANIC GARDEN

Roy Osborne
Department of Chemistry, University of Natal, 4001 Durban

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The National Botanic Gardens of South Africa, with Kirstenbosch as its head office and showpiece, includes 7 regional gardens and 2 reserves. The Karoo Botanic Garden at Worcester, described by curator Ian Oliver as "the showpiece of the Breë River Valley", is one of the world's foremost succulent gardens. The approximately 6 000 species represented in the garden comprise a fascinating mixture of Karoo plants including leaf, stem and root succulents, ephemerals, geophytes and highly adapted shrubs and bushes.

Figure 1 Staff horticulturist James Townsend examining *Encephalartos altensteinii* at the seed-shedding stage.

Figure 2 *Encephalartos horridus* is particularly well-adapted to the climate of the Karoo garden.

History of the garden

The Karoo Botanic Garden was initially developed in 1921 on a 15-ha site near Matjiesfontein under the curatorship of ex-stationmaster Mr J. Archer, and known then as the Logan Memorial Garden. With water shortages, staff difficulties, and road development, this site was not entirely suitable and in 1946 the garden was relocated to 154 ha of land just outside Worcester. The plant collection was extended and the gardens developed under a succession of curators each with their own

Figure 3 *Encephalartos lehmannii* at the Karoo National Botanic Garden, with *Euphorbia tetragona* behind and the Brandwacht Mountains in the background.

speciality interest and particular vision.

Curators: Karoo Botanic Garden

1925-1939	Mr J. Archer
1945-1959	Mr J. Thudichum
1959-1973	Mr Frank Stayner
1973-1987	Mr Bruce Bayer
1987-1991	Mr Ben Engelbrecht
1991-present	Mr Ian Oliver

Figure 4 A splendid feature planting of *Encephalartos princeps* at the Karoo garden.

Climate, topography and vegetation

The garden is situated on Malmesbury shale and at an altitude of 300 m to 525 m. The rainfall is low (130-200 mm per year) mostly falling in winter. Temperatures vary in the range from 0°C to 42°C. This harsh environment, typical of much of the Karoo, results in a vegetation characterized by special structural and physiological adaptations. Succulents are the most widespread groups of Karoo plants, but a wide range of short-lived annuals, bulbous plants and spiny shrubs adds to the botanical diversity. It is this diversity that the Karoo Botanic Garden strives to represent.

Figure 5 The Karoo garden is also one of the very few botanic gardens to grow *Welwitschia mirabilis* successfully in an open-ground planting.

Cycads in the Karoo Botanic Garden

During its history, the garden has acquired a fairly comprehensive collection of Eastern Cape cycads, presently comprising 82 mature specimens in 8 species [*Encephalartos altensteinii* (Figure 1), *E. arenarius*, *E. caffer*, *E. horridus* (Figure 2), *E. lehmannii* (Figure 3), *E. longifolius*, *E. princeps* (Figure 4) and *E. trispinosus*]. Of these, the largest single component is a collection of 44 specimens of *Encephalartos lehmannii* (Figure 3), probably representing the most significant *ex situ* gene pool for this species. At present there is no set programme for pollen collection/storage, artificial pollination and seed harvest, but we hope that this will follow from the recognition of the Karoo Botanic Garden's cycad collection as being a vital link in a series of living cycad collections. One hope too that the gardens will be able to add the remaining "non-tropical" Eastern Cape species (*Encephalartos cycadifolius, E. friderici-guilielmi, E. latifrons*) to its collection. In this way the Kirstenbosch, Karoo, Pretoria/Witwatersrand, Lowveld and Natal Botanic Gardens could become a vital cohesive unit in the common aim of *ex situ* cycad conservation.

Other plants of particular interest

Apart from its cycads, readers of this journal would find many plants of interest on a visit to the Karoo Botanic Gardens (Figure 5). At the risk of errors of omission, I would suggest the following: The spring-flowering annuals and the mesembryanthemums (September-

Figure 6 Apart from its cycads, a striking feature of the Karoo gardens is its impressive collection of caudiciform plants like this specimen of *Cyphostemma jutae*.

November), the aloes (June-August), the amaryllids (March-April) and other bulbous plants, the fascinating collection of leaf succulents and caudiciform (Figure 6) plants and the specialized collections of smaller and rarer karroid plants in their geographically-arranged display beds.

Notes for visitors

The Karoo Botanic Garden (Figure 7) is situated near

Figure 7 The entrance gate to the Karoo National Botanic Gardens at Worcester.

Worcester on the opposite side of the N1 to the town. The turnoff is clearly marked: turn left at the second robot on the N1 if travelling north or turn right at the second robot on the N1 if travelling south. The garden is open daily from 07h30 to 18h00. The entrance fee is R3.00 for adults and R1.00 for pensioners, children and students, charged only during the period August to mid-November. Plant material is offered for sale to the public during normal weekday business hours.

References

OLIVER, I. The Karoo National Botanic Garden. *Veld & Flora*, June 1993, pp. 46-48.

Karoo Botanic Garden, Worcester. Publication of the National Botanic Gardens of South Africa, Kirstenbosch.

Address for correspondence: *The Curator (Ian Oliver), Karoo NBG, P.O. Box 152, 6850 Worcester; telephone 0231-70785, fax 0231-28719.*

ON *CYCAS PECTINATA* HAMILTON FROM NORTH-EAST INDIA

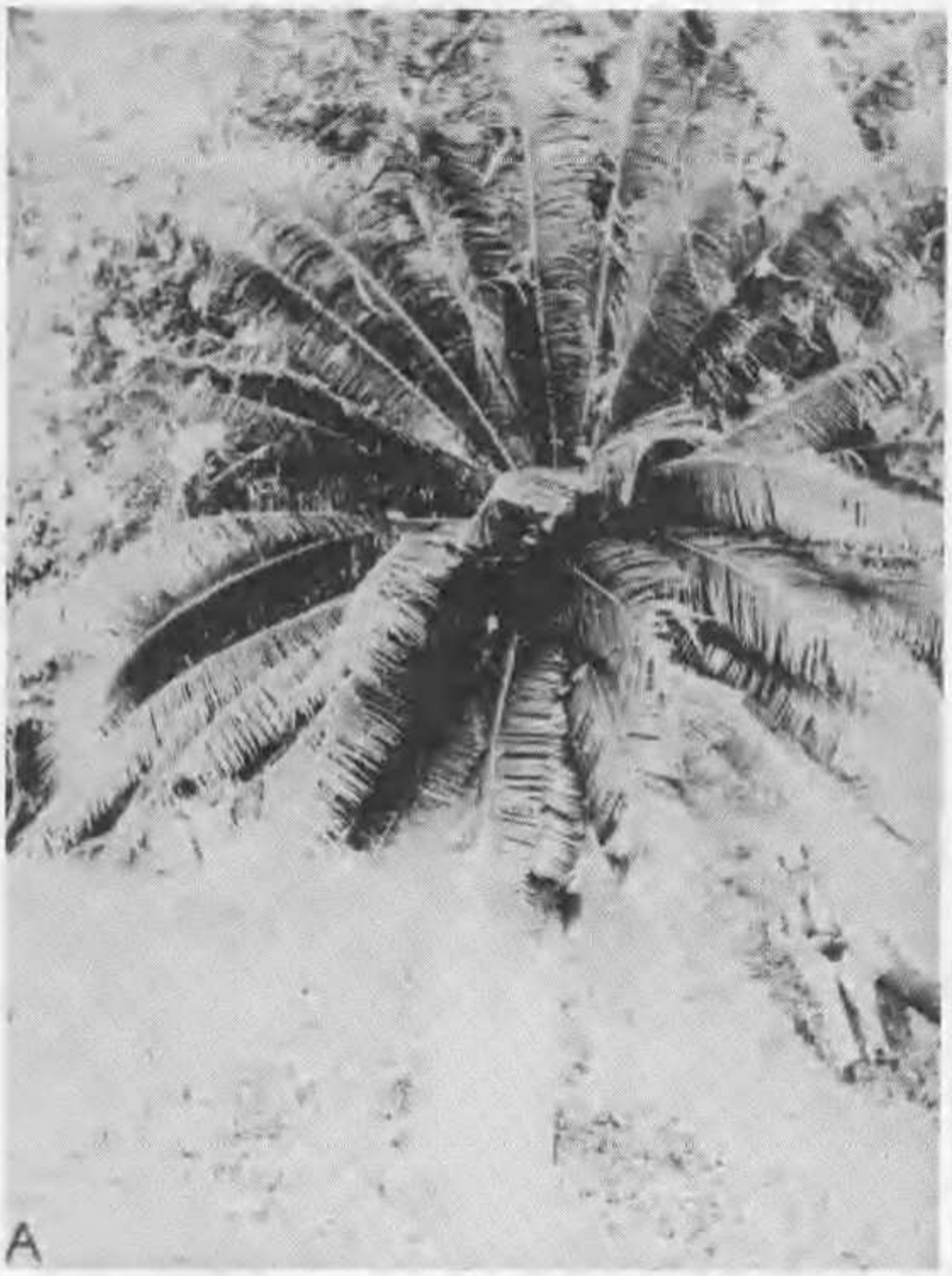
Divya Darshan Pant, Rita Singh and Devendra Kumar Chauhan

Department of Botany, University of Allahabad, Allahabad 211002, India

Received 21 March 1994

ABSTRACT

The authors find that the name *Cycas pectinata* was erroneously attributed to Griffith (1854) by Kurz (1877) and Thiselton-Dyer (1890) although the priority for the specific name goes to Hamilton (1823). A selected



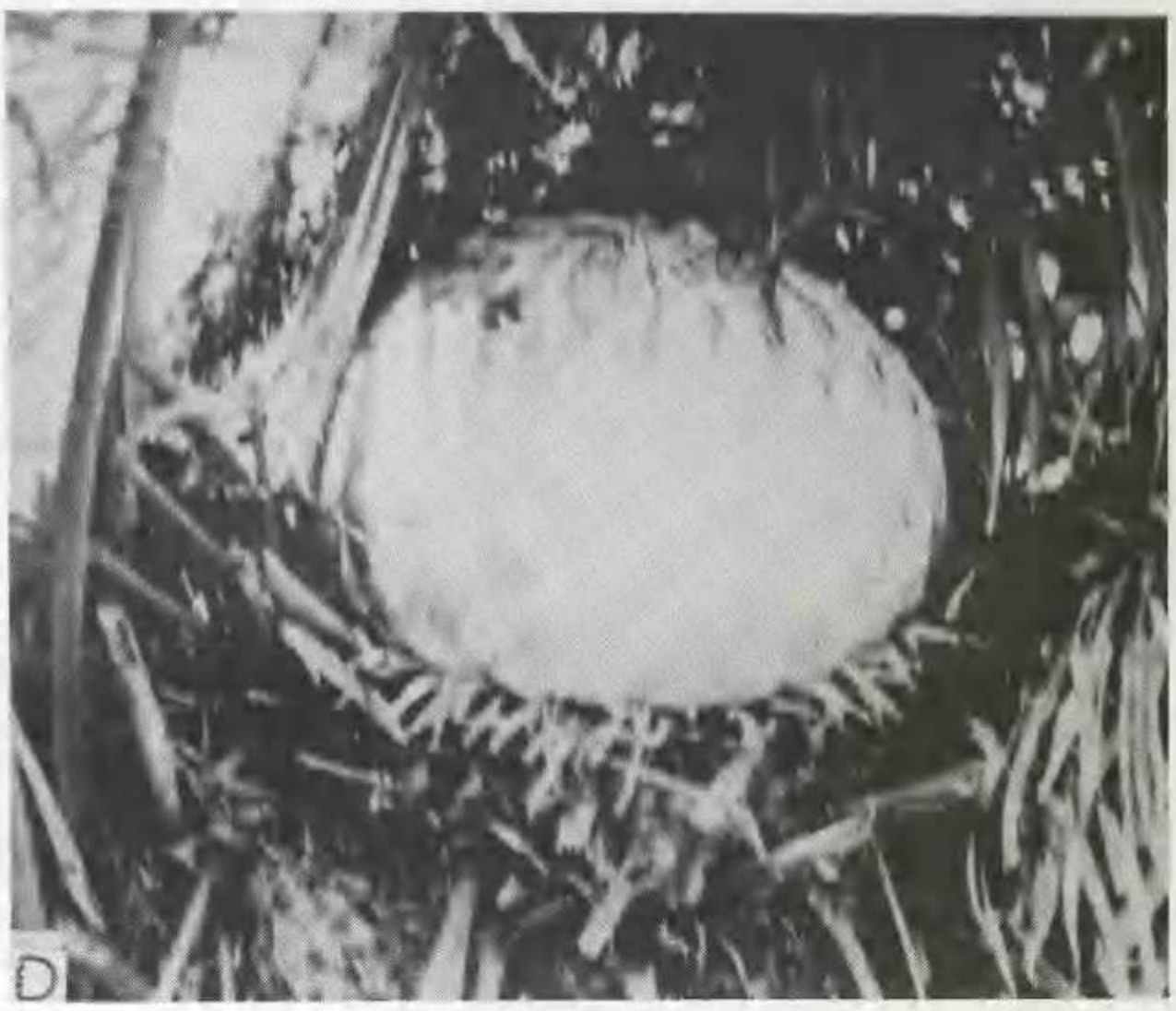


Figure 1 *Cycas pectinata* Hamilton. **A.** Palm-like male tree with an apical crown of large pinnate leaves. **B.** Apical portion of a leaf showing pinnae and a terminal subulate spine. **C.** A fully developed but unopened apical male cone. **D.** A massive cluster of megasporophylls at the apex of a female tree. Photos A, B and D: courtesy Dr. Y.S. Chauhan.

synonymy of the species is given and it is pointed out that *C. pectinata* Hamilton is a distinct species and that it is neither a form of *C. circinalis* L. as claimed by Schuster (1932) nor a variety of *C. siamensis* Miq. as suggested by Thiselton-Dyer (1890) and Burkhill (1933).

INTRODUCTION

Hamilton (1823) described plants of *Cycas* from north-east India under the name *E. pectinata*. Later Blume (1848) mentioned the species, and in a poshumous publication Griffith (1854) briefly described *Cycas pectinata* without appending the name of the author of the species or his own name and also without even referring to the earlier publication of Hamilton. Griffith also gave short accounts of two new species of the genus and called them *C. Jenkinsiana* Griff. and *C. macrocarpa* Griff. and thus claimed them for himself. He gave illustrations of the megasporophylls of the three species but did not specifically mention any distinctions between them. Later Thiselton-Dyer (1890) recognized *C. pectinata* as the valid species and merged *C. Jenkinsiana* Griff. with it and made it a synonym. Thiselton-Dyer's account makes no mention of *C. macrocarpa* Griff. and its status remains undecided. Although Kurz (1877) and Thiselton-Dyer (1890) attributed the name *C. pectinata* to Griffith, as pointed out above, Griffith himself had not claimed the authorship of the specific name. This would be clear from the fact that he duly appended his name to the two new species, *C. Jenkinsiana* Griff. and *C. macrocarpa* Griff. but did not do so for the two previously named species, *C. circinalis* and *C. pectinata*. Accordingly, and also under the rules of priority, the specific name *C. pectinata* should be attributed to Hamilton (1823) and the subsequent use of the specific epithet by Griffith (1854) should come under the synonymy since both the authors have employed the name for plants of the same kind growing in the same region. A fuller synonymy of this interesting species is given below:

***Cycas pectinata* Hamilton** (Figures 1A-D; 2; 3A-D; 4A, C-I; 5A-D; 6A-E; 7A-H; 8A-H)

Selected Synonymy

1823 *C. pectinata* Hamilton, pp. 322, 323
1848 *C. pectinata* Hamilton. Blume, p. 15
1854a *C. pectinata*. Griffith, pp. 10, 11
1854b *C. pectinata*. Griffith, Pl. CCCLX, fig. 3
1854a *C. Jenkinsiana* Griff. Griffith, pp. 9, 10
1854b *C. Jenkinsiana* Griff. Griffith, Pl. CCCLX, figs. 1, 2 and Pl. CCCLXII fig. I

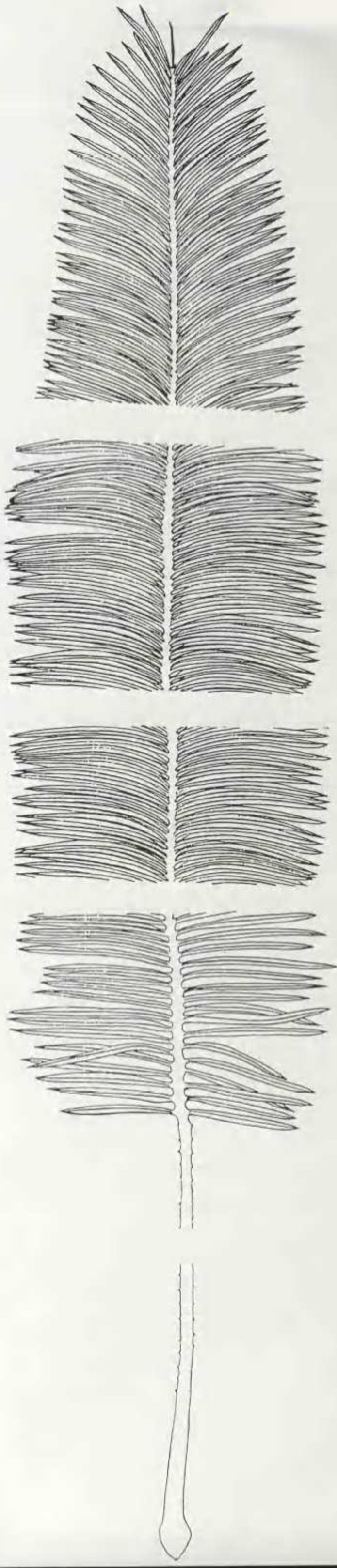


Figure 2 *Cycas pectinata*; apical, middle and basal portions of a leaf.

1854a ? *C. macrocarpa* Griff. Griffith, pp. 11-14
1854b ? *C. macrocarpa* Griff. Griffith, Pl CCCLXII, fig. II
1877 *C. pectinata* Griff. Kurz, pp. 501-503
1890 *C. pectinata* Griff. Thiselton-Dyer, p. 657
1903 *C. pectinata* Griff. Prain, pp. 745, 746
1921 *C. pectinata* Griff. Brandis, pp. 697, 698
1922 *C. pectinata* Griff. Gamble, p. 721
1926 *C. pectinata* Griff. Pilger, p. 14
1932 *C. circinalis* L. subsp. *vera* var. *pectinata* (Griff.) Schuster, pp. 66-68
1935 *C. pectinata*. Burkhill, pp. 718, 719
1940 *C. pectinata* Griff. Kanjilal *et al.*, p. 347
1960 *C. pectinata* Griff. Raizada & Sahni, pp. 96, 97, Pl. II, fig. 1
1962 *C. pectinata* Griff. Pant & Mehra, pp. 29, 30
1962 *C. pectinata*. Abraham & Mathew, pp. 261-266, figs. 1-8 and Pl. 1, figs. 1-4
1963 *C. pectinata* Griff. Pant & Nautiyal, pp. 267-275, figs. 6F, G; 7C; Pl. 29, fig. 71
1971 *C. pectinata* Griff. Smitinand, pp. 163-175, p. 110 fig. 46
1972 *C. pectinata* Griff. Smitinand, pp. 185-192
1973 *C. pectinata* Griff. Pant, pp. 37-39, fig. 12, pp. 118 50A
1990 *C. pectinata* Griffith non Hamilton. Zhou Lin *et al.*, p. 149
1990 *C. pectinata*. Turner, pp. 12-14 and fig. on p. 14
1991 *C. pectinata*. Pant, pp. 8, 11, 13, figs. 2, 3
1993 *C. pectinata*. Pant & Singh, pp. 4-9, Plate 1, fig. D
1993 *C. pectinata* Griff. Jones, pp. 151, 152

DISTRIBUTION

The species is wild in the foot-hills of eastern Nepal; *Shorea robusta* (Sal) forests of the Sikkim Terai and outer valleys; Someshwer Hills in Bihar; the plains and hills of Assam; Khasi Hills and adjoining regions up to 610 m above sea level in north-east India. It extends eastwards into Bangladesh (Chittagong), Myanmar (Burma) up to Shan States, Martaban, Tennaserim in the forests of *Dipterocarpus obtusifolius* and *Pinus insularis* (*P. khasya*) and beyond into Siam, Indochina, Malaya and in Yunnan and Guizhou Provinces of China.
Local names: Nepal - Thakal, Thaljimura; Myanmar - Mondaing.

EXTERNAL FEATURES

The plants of *C. pectinata* are robust, evergreen, palm-like trees, usually 4-6 m tall but sometimes recorded to reach a height of 6.7 m (Kanjilal *et al.* 1940). The trunk is often branched, reaching a diameter of 600 mm or more, glabrous and sometimes annulated below but towards apex covered with an armour of large and small leaf bases in alternating bands. All parts of the plant except the adult trunk are covered with a dense hairy brown tomentum.

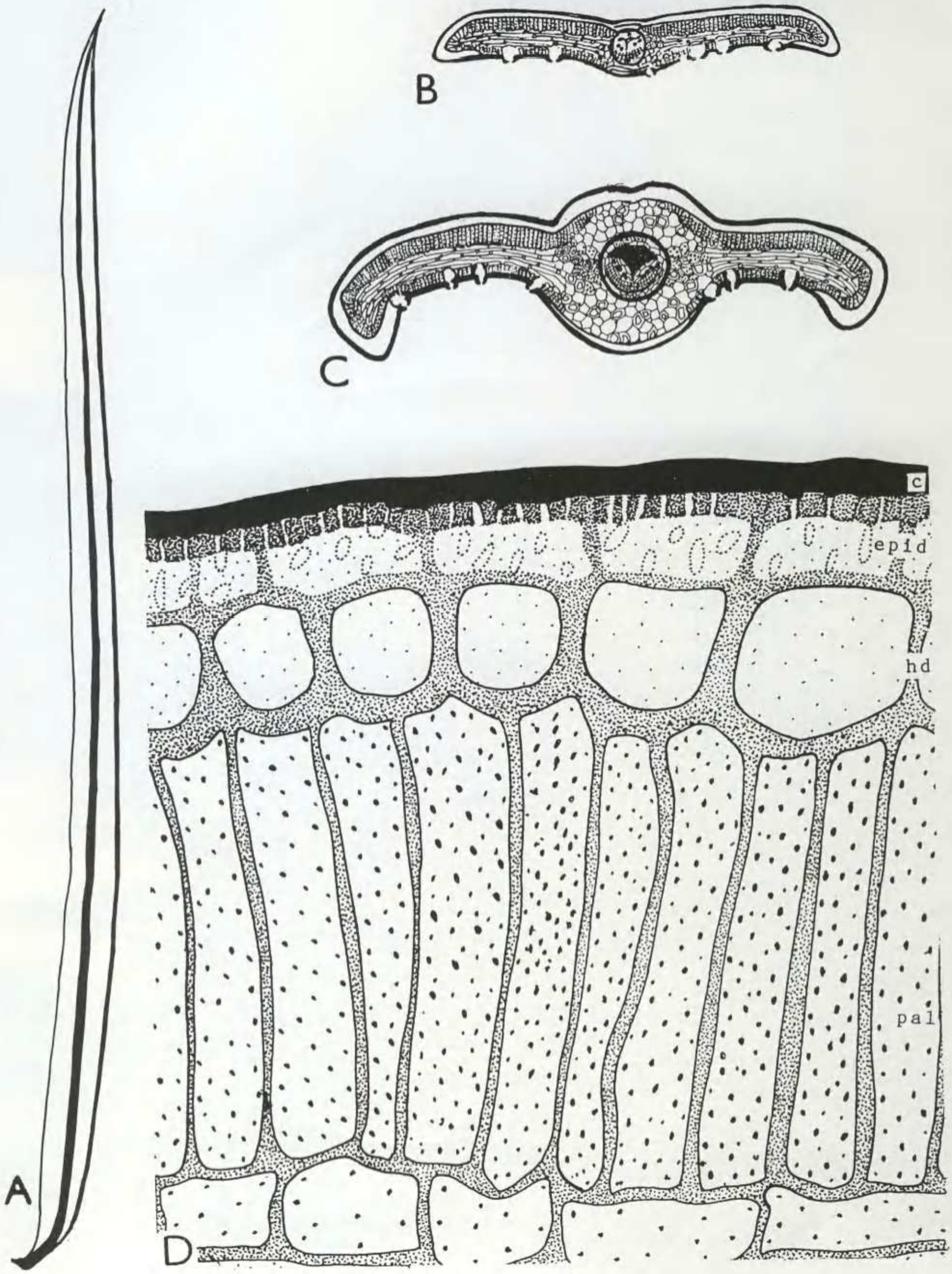
The foliage leaves are 1.5-2 m long with their apices bent downwards. The petiole is about 450 mm long, 4-12 mm thick, subquadrangular, showing two rows of a few small and distant pinnacanths. The pinnae, forming about 160 pairs in a leaf, are narrow, 4-12 mm (usually about 7 mm) wide, 140-250 mm long and sub-falcate. They are sub-opposite and crowded in the upper part of the rachis but become more or less distant towards the petiole. The apical and basal pinnae become gradually smaller in size. The rachis usually ends in a subulate spine with a pointed end (Figures 1B, 2). The acroscopic margin of a pinna ends straight in the rachis but the basiscopic margin is decurrent. The apices of the pinna taper gradually and end in a minute spine, their lamina is flat but the edges of the margins are slightly recurved (Figure 4A). The midrib is raised to form shallow ridges on both sides but on the upper side a shallow groove runs along its mid-ventral line from base to apex. Unusually the lamina of a pinna is discontinuous showing only the midrib in the interrupted part.

The cataphylls are dimorphic. Some of them are ordinary and deltoid like those of most other species of *Cycas* (Figure 7B). These have a wide dorsiventrally flattened base and a tapering, terete short or long apex. Other cataphylls are larger and appear like abortive foliage leaves having a similar but a shorter rachis and numerous circinately coiled hairy rudimentary pinnae which fail to grow and open out (Figure 7A). All cataphylls are brown in colour due to their being covered with a dense ramentum of brown hairs.

Male cones are cylindric ovoid, usually up to 800 mm long, 150-200 mm in diameter and shortly peduncled (Figure 1C). The microsporophylls are deltoid, clavate, 35-50 mm long, 10-21 mm wide and their apices are much thickened and abruptly acuminate. The acumen is about 40 mm long, subulate and ascending. Mature male cones are yellowish brown in colour and we find that in the Roxburgh Botanical Garden of Allahabad University they do not emit any noticeable odour like that of the male cones of *C. circinalis*.

The pollen grains are about 26 x 17 μm, elliptic, shaped like a cowrie mollusc shell with a convex proximal side and a flatter distal face having a median longitudinal sulcus (Figures 6D, E) and the furrow of the sulcus has wider rounded ends. The proximal side of the grain

Figure 3 *Cycas pectinata*. **A.** A single leaflet (x 1). **B, C.** Transections of apical and basal portions of pinnae (x 50). **D.** Ventral side of a portion of a transection of a pinna showing thick cuticle and cutinized epidermis above thick-walled transversely cut hypodermal cells which are longitudinally elongated and palisade cells (x 750). (c = cuticle, epid = epidermis, hd = hypodermis, pal = palisade)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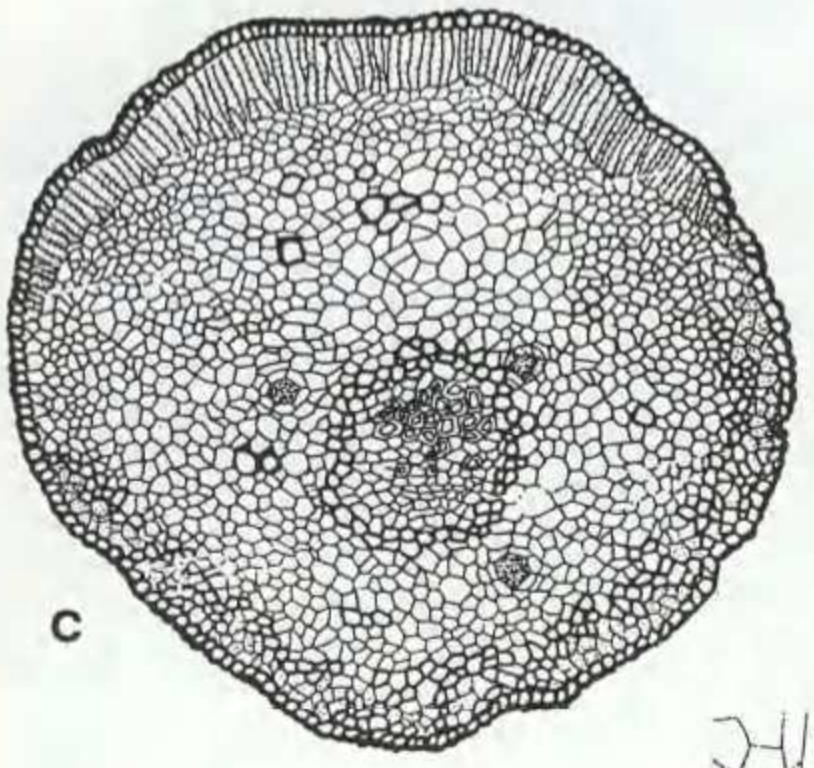

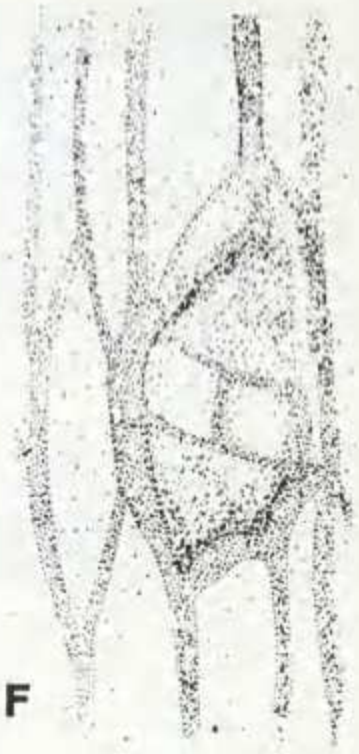

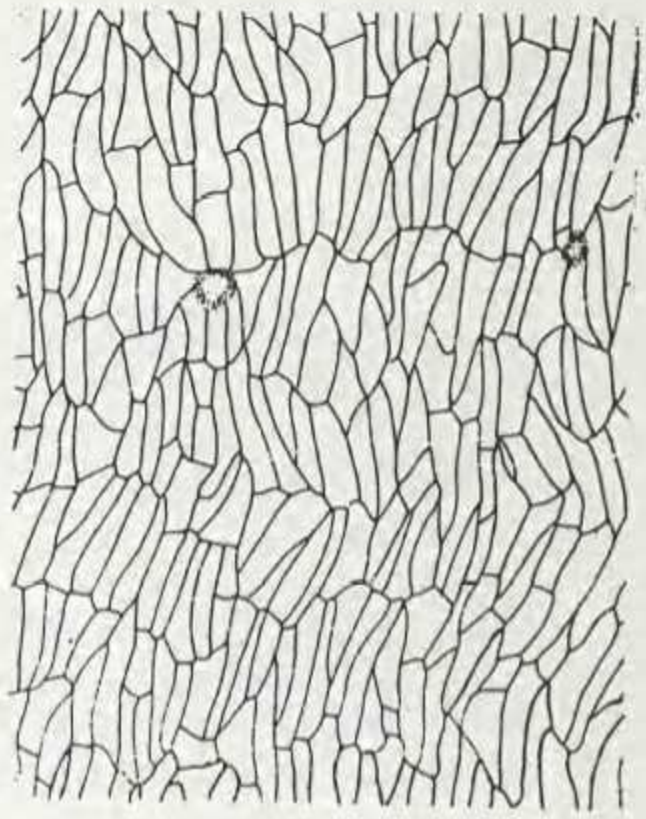

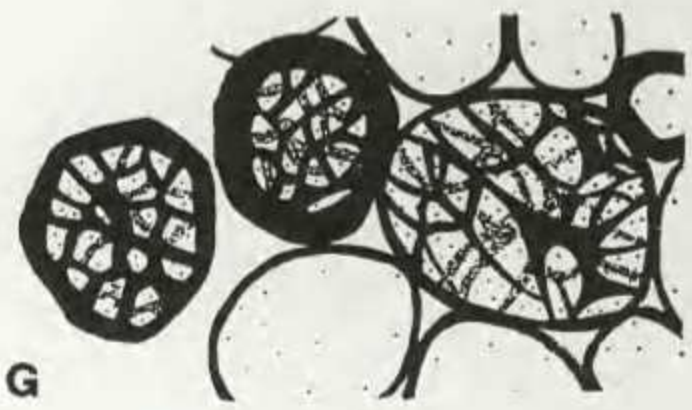

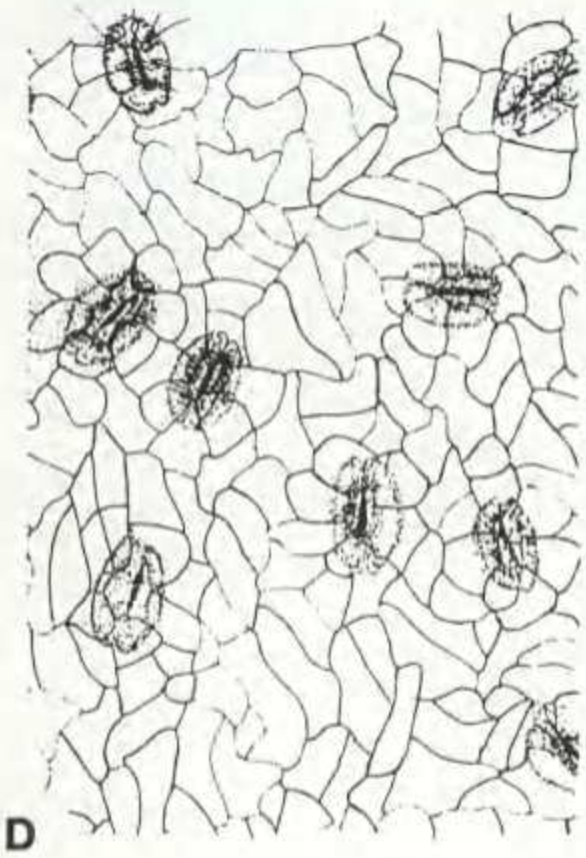

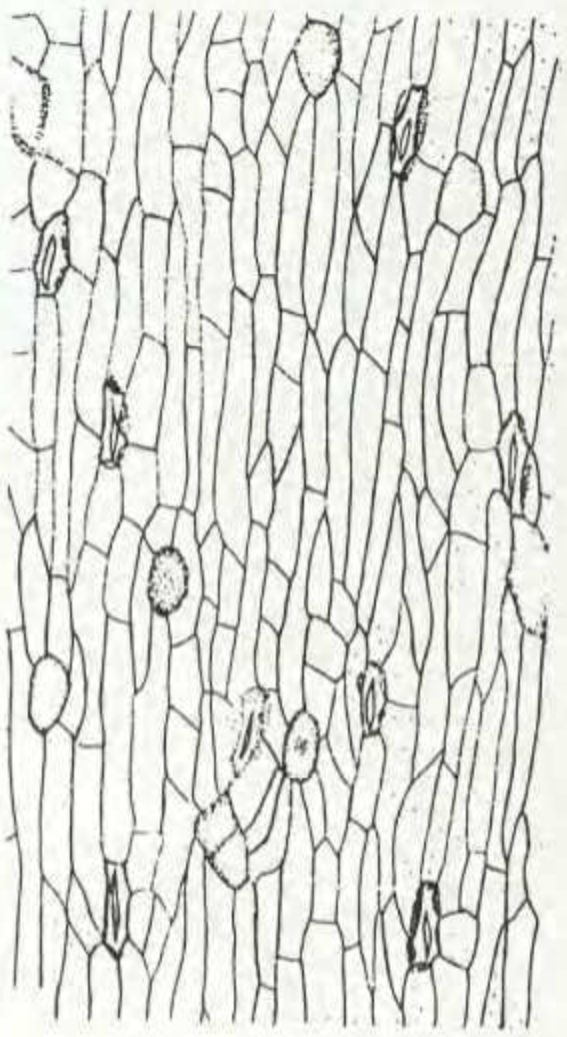

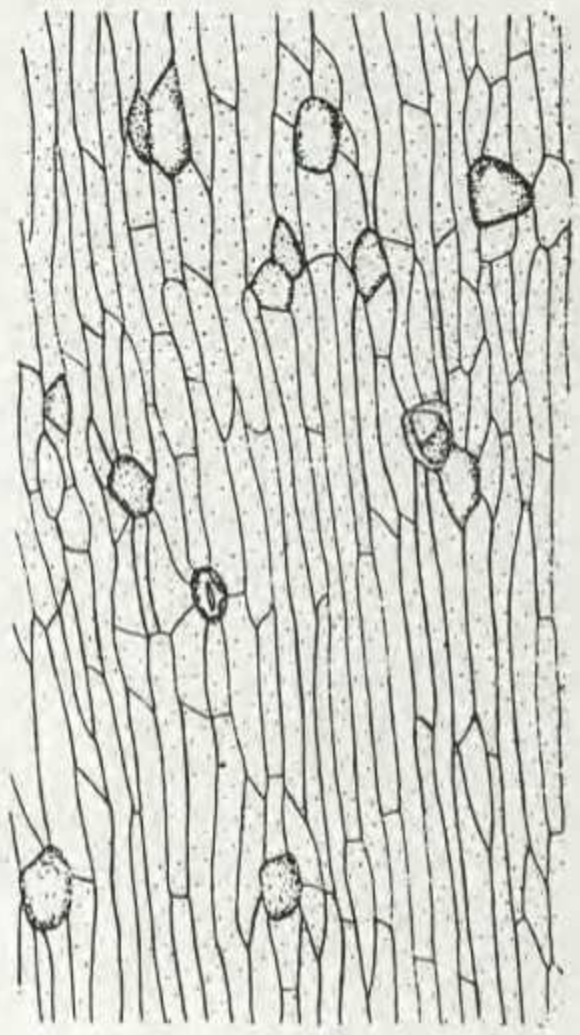

Figure 4 A and C-I. *Cycas pectinata*, **B.** *C. siamensis*. **A, B.** Transections of pinnae (both x 25). **C.** Transection of a subulate spine at apex of a leaf (x 45). **D, E.** Stomatiferous lower and non-stomatiferous upper epidermis, respectively, of a pinna showing slightly undulate anticlinal walls of cells (both x 150). **F.** A multicelled hair base enlarged (x 400). **G.** Slightly thicker-walled parenchymatous cell in ground tissue of subulate spine at the end of a leaf showing reticulate wall thickenings (x 300). **H, I.** Lower and upper epidermal layers, respectively, of a spine (x100).

shows a foveolate sculpture under SEM where the large areoles between the muri verge on the reticulate pattern and the pits tend to form concentric twists around the distal pole (see Figure 6D).

The numerous megasporophylls (Figures 1D, 7C-G) are 150-200 mm long, densely tawny-silky throughout. Their stalk is as long as the blade or shorter. They usually bear 4-6 glabrous ovules in upper part. Their apical blade is broadly orbicular, 75 mm in diameter. The margin of the blade is deeply subulate-pectinate having 12-20 mm long spiny subulate lobes. The blade terminates in a strong subulate acumen, about 30 mm long, the acumen tapers from a flat base and ends in one or two spinous teeth. The seeds are compressed ovoid and glabrous when mature. They are 40-60 mm long, 30-45 mm in diameter and their micropyle opens over a raised mamilla. They are deep yellow or yellowish red in colour.

We have repeatedly observed at Allahabad that in our *C. pectinata* male, originally collected from Assam, the cones are produced in September-October, but Raizada and Sahni (1960) report that in Assam the plants "flower" in May.

ANATOMY

Since the structure of the roots and stems is more or less similar in the various species of *Cycas*, the present article deals only with the generally diagnostic anatomy of the pinnae. The thick cuticle and epidermis of *C. pectinata* was briefly described by Pant and Nautiyal (1963). Although they found that the pinna epidermis of *C. pectinata* was somewhat similar to that of *C. siamensis* a closer re-examination of the epidermal peels of the two species by us shows that the anticlinal walls of epidermal cells of *C. pectinata* are more or less undulate (Figures 4D, E, 5A-D, 6A-C) while those of *C. siamensis* are straight. As described by Pant and Nautiyal (1963) the surface walls of the epidermal cells show numerous oval or rounded simple pits at the periphery of each cell on either side of the anticlinal walls. Pant and Nautiyal (1963) also observed that these periclinal wall pits were generally in the range of 4-5 x 1-2 μm in the upper and 2-3 x 1-2 μm in the lower epidermal cells. These authors found that the surface wall pits were more crowded in the cells around subsidiary cells of *C. pectinata* and we find that they appear prominent in such cells and at the periphery of hair base cells. The walls of these cells may appear reticulately thickened due to the enlargement of the simple pits. Cutinized ramental hairs made up of two or more cells are scattered all over the leaf surface. The hair base cell is attached asymmetrically to the crossed apical arm which forms a very asymmetrically topped "T". The hairs are just like those described by Pant and Nautiyal (1963) for *C. revoluta* and *C. rumphii*. Often the crossed top arm of the hair is so precariously perched over the basal cell that it is hardly projecting beyond it on one side but its longer arm on the opposite side forms almost its entire length (Figure 7H).

The upper epidermis is non-stomatiferous but shows frequent hair bases scattered among the usually irregularly disposed polygonal epidermal cells (Figures 4E, 5A-C). The hair bases may be single-celled or multicelled often having two to four cells usually with almost parallel partitions in a circular or elongated oval outline (Figures 4F, H, I, 5C). Occasional hair bases may have biseriate cells. Among the irregularly disposed upper epidermal cells are frequently seen regularly arranged filament-like groups of cells with two thinner parallel walls inside usually thicker walled polygonal outlines (Figures 4E, 5A, B). It is likely that during an earlier stage of leaf development, such cells were produced by repeated parallel divisions in polygonal protoderm cells. Such filamentous formations are more frequently seen around hair bases. Similar formations of upper epidermal cells were described by Pant and Das (1993) in the upper epidermis of nine other species of *Cycas* and we have seen them in *C. siamensis* as well. Earlier, Harris (1932, Figure 21A) described similar groups of cells in the cuticle of a fossil cycadean leaf, *Doratophyllum astartensis* from Greenland, and he too thought that they could have been produced by parallel sub-divisions of single mother cells. It would thus appear that such formations were an ancient trait of the Cycadales which go back to the Jurassic times. The upper epidermis over the midrib and towards the apex of the pinna shows longitudinal files of longitudinally elongated cells.

The lower epidermis shows irregularly oriented haplocheilic stomata scattered on either side of the midrib (Figures 4D, 5D, 6A-C). The stomata tend to be longitudinally oriented on either side of the midrib (Figure 6A). They are absent below the midrib except in its extreme basal part (Pant & Nautiyal 1963) where again they tend to be longitudinally oriented. The lower epidermis of the midrib is just like its upper epidermis.

The guard cells in the stomatal apparatus are surrounded and partly overlapped by a more or less regular ring of subsidiary cells and some of them have overlapping encircling cells in addition, as already described by Pant and Nautiyal (1963). The stomatal pits are shallow and they have a surrounding canopy of short papillae of their encircling or subsidiary cells. The guard cells are just like those of other cycads (Figures 4D, 5D, 6B).

A transverse section of the pinna shows that its two lateral edges are slightly curved downwards only at the margin (Figures 3B, C, 4A). A hypodermis of longitudinally elongated thick-walled cells lies below the upper epidermis of the lamina (Figure 3D) but it

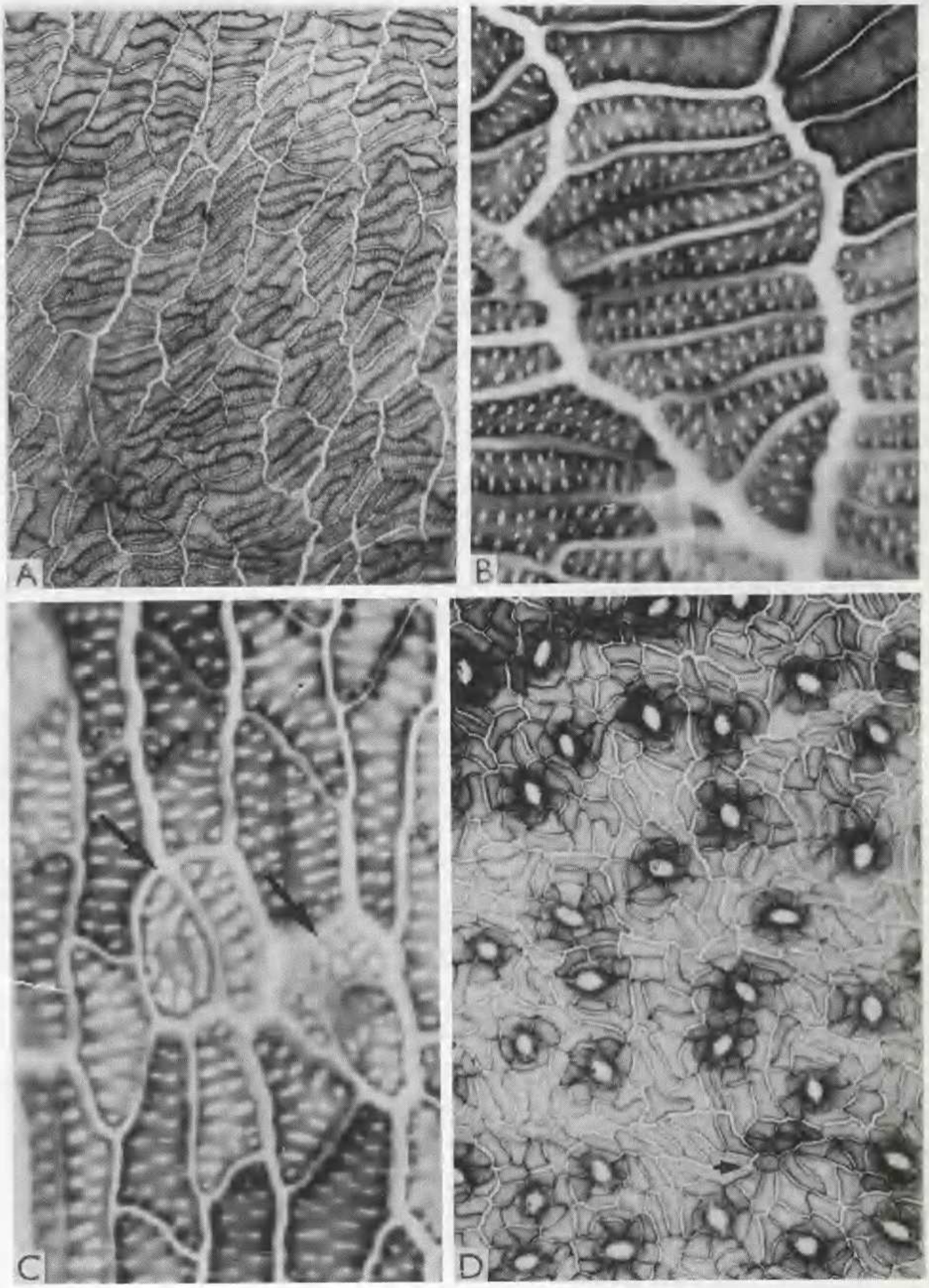

Figure 5 *Cycas pectinata*. **A.** Undulate-walled upper epidermal cells of a pinna showing parallel thin-walled partitions inside thicker walls of polygonal cells and surface wall pits (x 450). **B.** A portion of the same epidermis more magnified to show details of surface wall pits and parallel thinner partitions inside thicker-walled polygonal outlines (x 750). **C.** Two hair bases (arrows) in upper epidermis more magnified to show undulate walls of epidermal cells. **D.** Scattered stomata in lower (dorsal) pinna epidermis. A hair base (arrow) is also seen (x 450).

becomes three or more layers thick at the margin and extends on the lower side of its curved extremity. The palisade layer is interrupted only along the mid-ventral line of the raised portion of the midrib and extends right up to the margins on either side. Inside the lower epidermis of the pinna is the mesophyll whose cells are vertically elongated and more regularly arranged like those of a palisade but they are shorter.

The parenchymatous cells around the vascular strand of the midrib show numerous slightly thicker-walled cells whose walls have reticulate thickenings all around the cell as described by Pant and Nautiyal (1963) in mesophyll cells of *Macrozamia riedlei*. Such cells also occur in the parenchyma of the rachis and in the subulate spine at the end of the rachis (Figure 4G). The diploxylic midrib bundle, the transfusion tissue and the accessory transfusion tissue are ordinary (see Pant 1973).

The anatomy of the subulate spine forming the tip of the leaf rachis is interesting in combining features of a pinna and a rachis (Figure 4C). Its adaxial (ventral) side is slightly flattened and on this face it shows a band of palisade-like cells below the epidermis. Elsewhere, below the epidermis of the rest of its more rounded outline on the abaxial (dorsal) side, is present a hypodermis like that of the rachis and here it shows mixed chlorophyllose and thick-walled sclerenchymatous cells like those of the hypodermis in the rachis. The parenchymatous tissue in the interior of the spine is traversed by two or more, usually up to four, diploxylic vascular bundles. The multiple bundles in the basal part of the spine lie in an arc and in this part there are almost the same number of mucilage canals, usually on the phloem side of the bundles although sometimes the canals may even lie on the inner side of the arc (on the xylem side) or between the bundles. All except one each of the vascular bundles and mucilage canals gradually end in the lower regions of the spine. Usually the extreme apex of the spine shows a single vascular bundle and one or more mucilage canals (Figure 4C).

The only other mentionable anatomical character of *Cycas pectinata* is the presence of stomata in the nucellus of its seeds (Pant & Nautiyal 1963).

KARYOTYPE

The karyotype of plants belonging to both sexes of this species was worked out by Abraham and Mathew (1962). The investigated plants were growing in the botanical garden of the College of Science in Kerala University (their source was not mentioned). Mitoses in root tips of female and male plants and meioses in pollen mother cells were studied. Root tip mitoses in plants of both sexes showed 2n=22 chromosomes (Figures 8A-H), with almost similar sets of chromosomes. The only noticeable difference between the diploid sets of male and female plants was the presence of a heteromorphic pair of chromosomes in the males where one chromosome was satellited and the other non-satellited (Figures 8B, F) whereas in the females, this pair was homomorphic and both members of the pair were satellited (see Figures 8A, E). Abraham and Mathew (1962) believed that the chromosomes of this pair in males were XY where X was satellited and Y was non-satellited and they thought that the tow satellited chromosomes in the females were XX. They suggested that their ideas of chromosomal inheritance of sex were confirmed by a study of the haploid sets of chromosomes formed during meioses in pollen mother cells since they observed two types of haploid sets, one kind showed a single satellited chromosome (Figures 8D, H) while the other had no such chromosome (Figures 8C, G). It was thus in essence concluded that the union of a spermatozoid having a satellited haploid set with the invariably satellited haploid set of the egg nucleus would result in the formation of a zygote with a satellited homomorphic pair of chromosomes (XX) and this would produce a female plant. On the contrary if a spermatozoid with a non-satellited haploid set fused with the egg nucleus it would give rise to a zygote having a heteromorphic pair (XY) and the plant produced by it would be male. These authors, therefore, concluded that the dioecism in *Cycas pectinata* is determined by sex chromosomes. However, the chromosomal inheritance of sex in cycads needs to be confirmed by critical studies of the karyotypes in *C. pectinata* as well as in other species of diverse cycads.

DISCUSSION AND COMPARISON

As pointed out earlier, *Cycas pectinata* Hamilton is the legitimate name of the species which has been wrongly attributed to Griffith by most later authors. It is also true that Griffith (1854) had himself never claimed authorship of the species which he described under that name. Accordingly, the name *Cycas pectinata* Griffith non Hamilton, as used by Zhou *et al.* (1990), is a superfluous epithet since the only valid name for the species is *Cycas pectinata* Hamilton. Indeed all authors who have used the name *Cycas pectinata* Griffith have actually dealt with plants which should go under the name *Cycas pectinata* Hamilton.

Further the present study of the vegetative and reproductive parts of plants of *Cycas pectinata* Hamilton growing in Assam and adjacent areas shows that the plants of this species are quite distinct from those of *C. circinalis* L. which grows in the adjoining areas of the hills of Orissa and further towards south-west of these north eastern Indian habitats right up to Kerala. The plants of *C. pectinata* are, at the same time, distinct from those of *C. siamensis* which grow in areas overlapping the habitats of *C. pectinata* towards the east in Manipur, Bangladesh, Myanmar and further to the

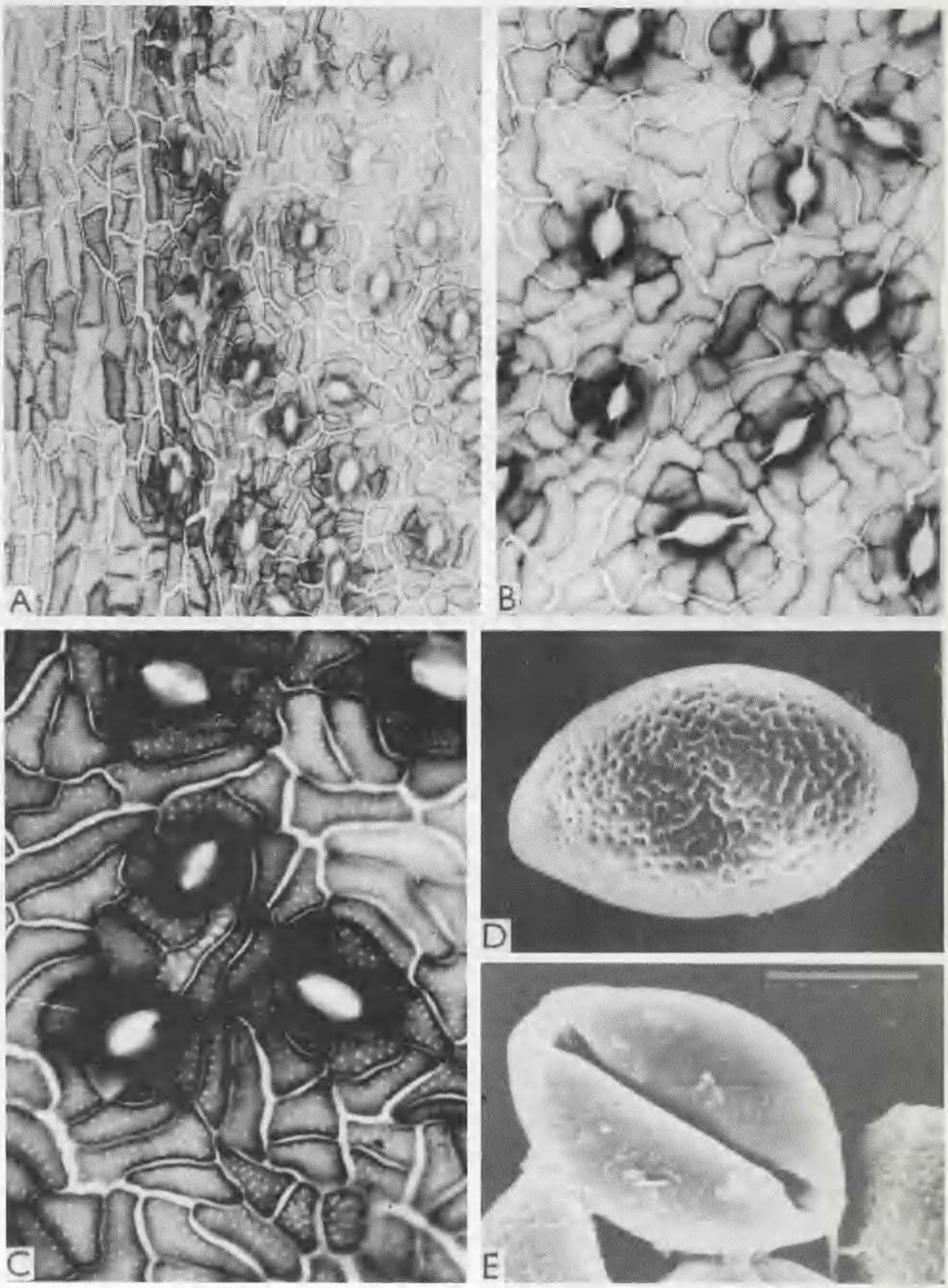

Figure 6 *Cycas pectinata*. **A-C.** Lower epidermis of pinna showing scattered stomata. **D, E.** Scanning electron micrographs of pollen grains. **A.** Shows a patch of epidermis of lamina and adjacent midrib. Stomata by the side of midrib (on the left) tend to be longitudinally oriented (x 450). **B.** A portion of epidermis over lamina more magnified to show scattered stomata. The guard cell outlines and lignin lamellae arealso seen (x 700). **C.** A portion further enlarged to show surface wall pits in epidermal cells (x 1000). **D.** Convex proximal face showing reticulate pattern of foveolate sculpture. The pits (areoles) and muri tend to be in concentric twists around the proximal pole. **E.** Distal face showing sulcus with rounded ends.

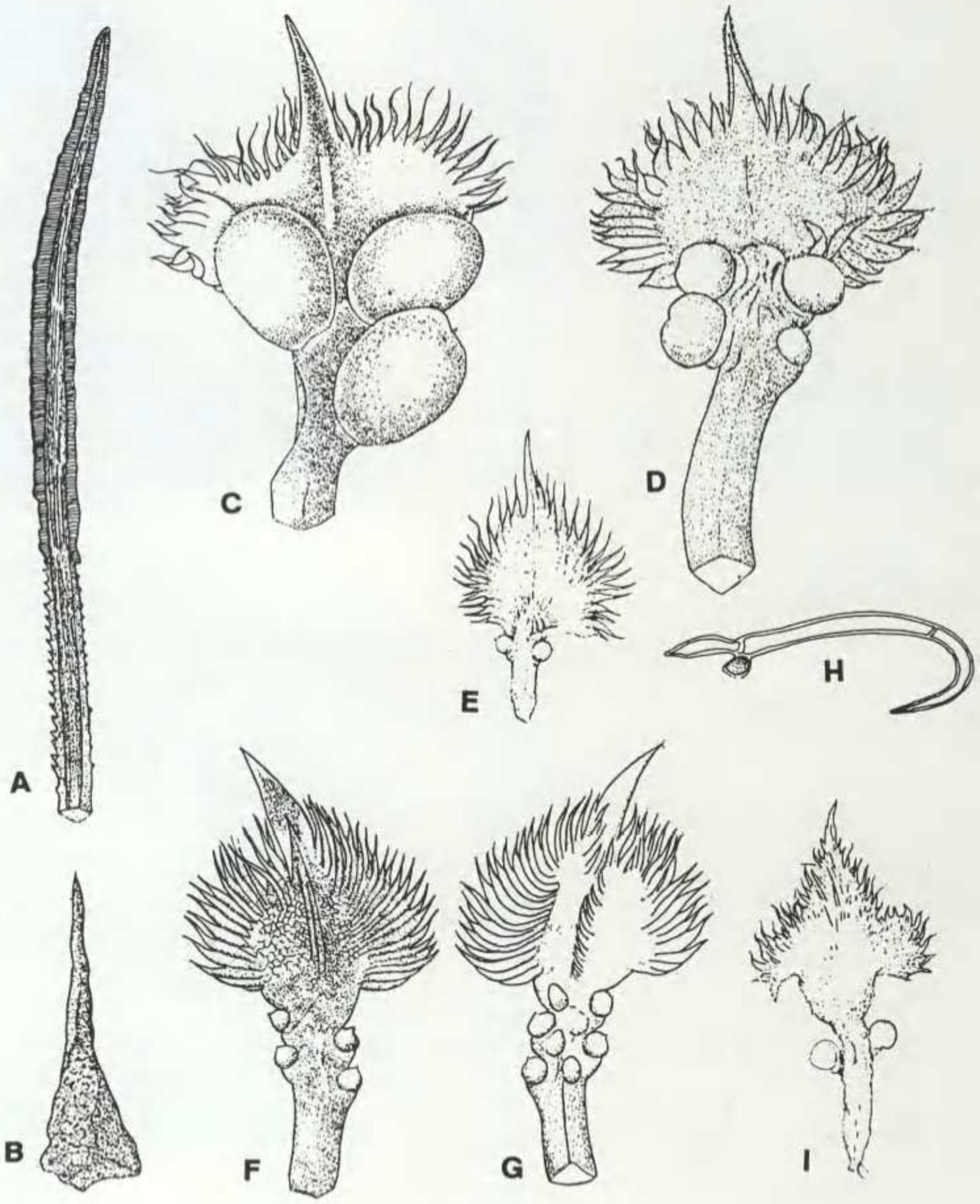

Figure 7 A-H. *Cycas pectinata*, **I.** *C. siamensis*. **A.** Leaf-like cataphyll showing circinately coiled pinnae which never open out (x 0.5). **B.** Deltoid cataphyll (x 0.5). **C-G.** Megasporophylls showing broadly orbiculate blades with deeply subulate pectinate margins and a strong subulate acumen at the apex. **H.** A three-celled epidermal hair. **I.** Megasporophyll showing the usual two seeds and a deeply pectinate blade and an apical acumen. (C, D, F, G: after Griffith 1854b; E, I: after Smitinand 1971.)

south and east in adjoining countries. Not only are the size and form of the plants and reproductive parts of *C. pectinata* clearly different from those of *C. circinalis* and *C. siamensis* but this is also true for their male cones, pollen grains and the anatomy of their pinnae (see Table 1).

On the basis of this comparative study it can be safely concluded that *C. pectinata* Hamilton is a distinct species which is neither a form of *C. circinalis*, as claimed by Schuster (1932), nor a variety of *C. siamensis* Miq., as suggested by Thiselton-Dyer (1890) and Burkill (1933). Undoubtedly the three species show some points of resemblance with each other but such similarities can be found even between many other species, particularly when they inhabit adjacent areas. The important differences which the three species show with each other clearly suggest that they should be recognized as three distinct species, where *C. pectinata* Hamilton stands equal in rank with *C. circinalis* L. and *C. siamensis* Miquel.

Table 1 Distinctive characters of *Cycas circinalis, C. pectinata* and *C. siamensis*

	C. circinalis Linnaeus	*C. pectinata* Hamilton	*C. siamensis* Miquel
Stem or trunk	Columnar, usually 4-6 m high or taller but shorter in Karnataka plants, diameter at base of fully grown trees about 300 mm or more	Columnar, usually 6 m high or more in fully grown trees, diameter at base 600 mm or more	Columnar, trunk up to 2 m high with a basal tuberous part 600 mm or more in diameter
Armour of leaf bases	Usually present all over the trunk except in the extreme basal part	Usually present only towards the apex but most of the trunk glabrous	Usually present over the entire columnar part but tuberous base glabrous
Foliage leaves	1.5-3 m long with one or a pair of pinnae terminating the rachis, leaves shorter in Karnataka plants	1-2 m long with a subulate spine ending the rachis	0.6-1.2 m long with one or a pair of pinnae terminating the rachis
Pinnae	200-300 mm long and 6-12 mm wide (but sometimes up to 500 mm long and 18 mm wide), lamina flat but edges of margins very slightly curved downwards	140-250 mm long and 4-9 mm wide, lamina flat but edges of margins slightly recurved (Text Figure 4A)	40-250 mm long and 6-7 mm wide, margins slightly recurved and abruptly narrowed to appear mucronate or beak-like in a transverse section (Text Figure 4B)
Cataphylls	Usually monomorphic, deltoid	Usually dimorphic, some deltoid others with a longer rachis and abortive, circinate pinnae	Usually monomorphic, deltoid
Hairs on leaves	Only a few hairs present in young leaves	Young leaves and all parts except old trunks covered with a hairy tomentum	Young leaves and all parts except trunk copiously hairy and usually appearing rusty villous
Anticlinal walls of epidermal cells	Straight	Slightly wavy	Straight
Palisade in pinnae	Absent over midrib	Extends over midrib on its two sides but absent along the mid-ventral line	Extends over midrib on its two sides but absent along the mid-ventral line
Megasporophyll	150-300 mm long, stalk longer than blade with 6-12 ovules, blade rhomboid, about 70 mm long, 25-35 mm wide, margins dentate with short narrow teeth right up to apex	150-200 mm long, stalk as long as blade or shorter with 4-6 ovules in upper part, blade broadly orbiculate, 75 mm wide, margin deeply subulate-pectinate, terminating in a strong subulate acumen, about 25 mm long (Text Figures 7C-G)	Usually smaller than those of *C. pectinata* but similar, stalk usually with one ovule on either side in its upper part at base of ovoid rhomboid blade, margin of blade deeply pectinate with a long acumen, about 50 mm long at apex (Text Figure 7I)
Seed	Ovoid, glabrous, about 40 x 20 mm, pale reddish yellow, nucellar stomata not reported	Compressed ovoid, glabrous, 40-60 x 30 mm, brownish yellow or deep yellow, nucellar stomata present	Ovoid oblong, glabrous, about 37 mm long, orange red or yellow, nucellar stomata not reported
Male cone	Usually conical, up to 1 m long x 300 mm in diameter, reddish orange, mature cones emit a strong odour	Ovoid, up to 800 mm long x 200 mm in diameter, yellowish brown, mature cones noticeably odourless	Ovoid oblong, 300 mm long x 70-100 mm in diameter, no observations on odour available
Pollen grains	26.8 x 18.8 μm, 28.1 x 19.6 μm, SE Micrographs showing foveolate proximal face with large discrete pits (Dehgan & Dehgan 1988, Marshall *et al.* 1989)	c. 26 x 17 μm, SE Micrographs showing foveolate proximal face verging on reticulate pattern with pits tending to be in concentric twists around proximal pole	Undescribed
Karyotype	2n=22 (n=11) (Sax & Beal 1934, Rao 1964)	2n=22, sex chromosomes reported (Abraham & Mathew 1962)	Undetermined

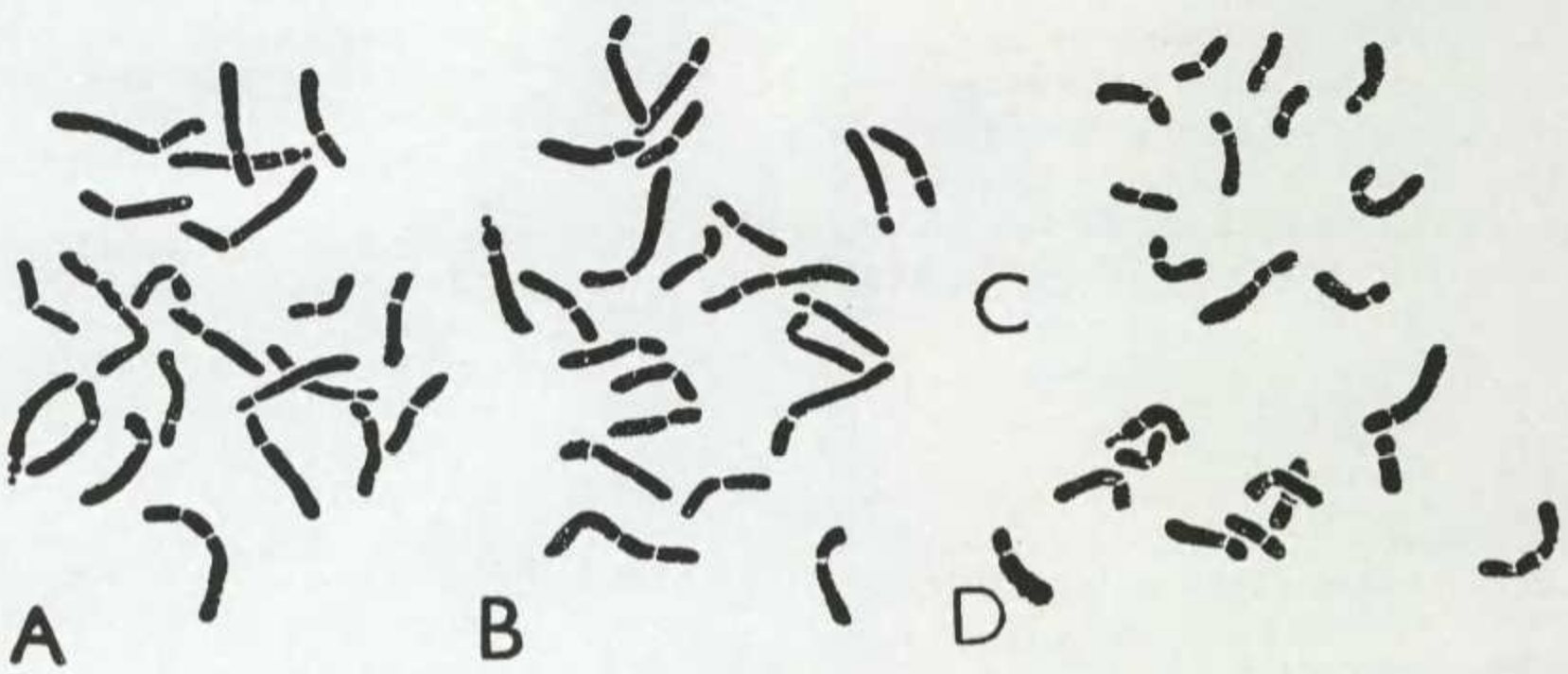

Figure 8 *C. pectinata*. **A.** A diploid set of 22 chromosomes in a female plant. One of the chromosomes lying at the 12 o'clock and another at the 8 o'clock position are satellited. **B.** A diploid set of 22 chromosomes in a male plant where only one chromosome (at 9 o'clock position) is satellited. **C.** A haploid set of 11 chromosomes at pollen meiosis having no satellited chromosome. **D.** Another haploid set of 11 chromosomes in pollen meiosis having one satellited chromosome. **E.** Diploid set of chromosomes from a female plant where both the members in third pair are satellited. **F.** Diploid complement of chromosomes in the male plant where the third pair is heteromorphic (one of them being satellited and the other non-satellited). **G.** A haploid complement of the male plant showing all chromosomes non-satellited. **H.** Another haploid complement of the male plant showing the third chromosome satellited. (All after Abraham & Mathew 1962.)

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SHORT COMMUNICATIONS / KORT MEDEDELINGS

DISTRIBUTION OF "*ENCEPHALARTOS*"

Piet Vorster
Botany Department, University, Private Bag X5018, 7599 Stellenbosch

Received 8 March 1994

"*ENCEPHALARTOS*" No. 36 (December 1993) was mailed to members on the 7th February this year. A number of members phoned either the distribution officer, the president or the editor to enquire why they had not yet received their copies. We find this gratifying, as it shows that members really look forward to each issue. Most of those who phoned in understood our explanation of why that number was late, but a few people were outright rude, and for this reason I wish to explain how it works.

"*ENCEPHALARTOS*" is very expensive to produce. For instance, the December 1993 issue cost about R7 000-00, of which half was printing costs and the other half postage. In order to keep membership fees as low as possible, we are continuously exploring ways to save

At present "*ENCEPHALARTOS*" is printed by the printshop of the University of Stellenbosch, at cost price. This means an enormous saving for our members. However, the printshop's primary function is to handle the University's printing, and we, as outsiders, cannot expect preferential treatment. Although we stand in the back of the line, we have a working agreement with the management so that we get "*ENCEPHALARTOS*" delivered at dates of our choice, provided that we hand in the manuscript before certain deadlines. This is especially important with the December issues, because at the end of each year and the beginning of the next the printshop is really very busy. For the last December issue we handed in the manuscript after the deadline, because the President wished to announce the outcome of the voting concerning changes to the constitution in that issue. The result was that the printing of "*ENCEPHALARTOS*" could not be handled before the end of the year, and when the printshop re-opened after the Christmas vacation, we had to take second place to the immediate needs of the University.

I also wish to point out that your board consists of people who unselfishly devote many hours every year to the affairs of the Society, without any personal compensation. A particularly onerous task is that of Editor, and it is really very awkward if the deadline for submission of the manuscript to the printer approaches and one still has nearly no contributions from our members. It hurts when members then thoughtlessly hurl unfriendly words at board members.

To be a member of a society does not mean that one can ask "**what do I get?**", but rather "**what can I do?**". It is unfortunately true that many of our members provide no input at all, apart from jumping on board members when "*ENCEPHALARTOS*" is late. For instance, only 46 (i.e., 6.5%) of our 707 members last year cast their votes on the proposed change of our constitution, yet this matter affects members in no small way. So please, do your bit, and write in to "*ENCEPHALARTOS*" to share your experiences and problems with other members, for that is what the Society is all about.

COMMENTS ON ARTICLES WHICH APPEARED IN "*ENCEPHALARTOS*" 36

Piet Vorster
Botany Department, University, Private Bag X5018, 7599 Stellenbosch

Received 8 March 1994

VARIATION IN *ENCEPHALARTOS LONGIFOLIUS* (pp. 17-21)

I cannot accept the sort of variation described by Dr. Strydom as part of the natural range of variation of *E. longifolius*. I am convinced that it indicates hybridization, and the most likely partner is *E. horridus*. The distribution of *E. horridus* overlaps in places with *E. longifolius*, and they are known to hybridize in nature. The claim that *E. horridus* does not at present occur at the places where these spiny plants were collected, need not be taken too seriously, as the distribution areas of many species have been changed beyond recognition in recent years through the enthusiastic efforts of collectors. On the other hand, distribution patterns are dynamic, changing with long term climatic changes, and it is not inconceivable that some species which today are geographically well separated, were in contact in the past. If sufficiently common, hybridizing which took place a thousand years ago may still be manifested in their progeny today.

One of the more interesting aspects of Dr. Strydom's photographs, is the marked overlap of leaflets. I enclose a photo (Figure 1) of a leaf of a field-collected hybrid between *E. horridus* and *E. longifolius*, from a site where the two species grew together. As can be seen, the leaflets are spaced conspicuously more laxly than in Dr. Strydom's photographs. Factors which may affect characteristics like degree of overlap of the leaflets,

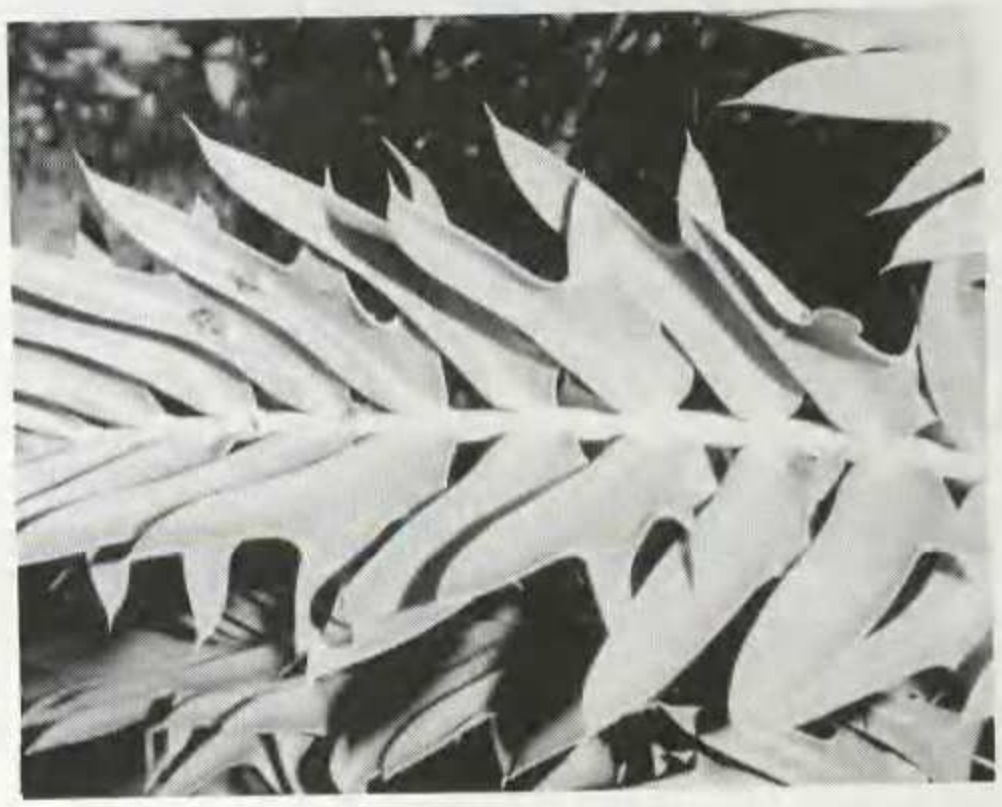

Figure 1 *Encephalartos horridus* x *E. longifolius*: portion of a frond of a plant found in nature, growing amongst both parent species.

leaflet width, and leaflet colour, may include which species was the female parent, and also the characteristics of the parent specimens. To illustrate this, I include three photographs (Figures 2-4) of leaves of different field-collected *E. longifolius* to show the difference in degree of overlap of the leaflets. It is also only fair to point out that in *E. longifolius* the foliage may vary in colour from dark green to completely glaucous.

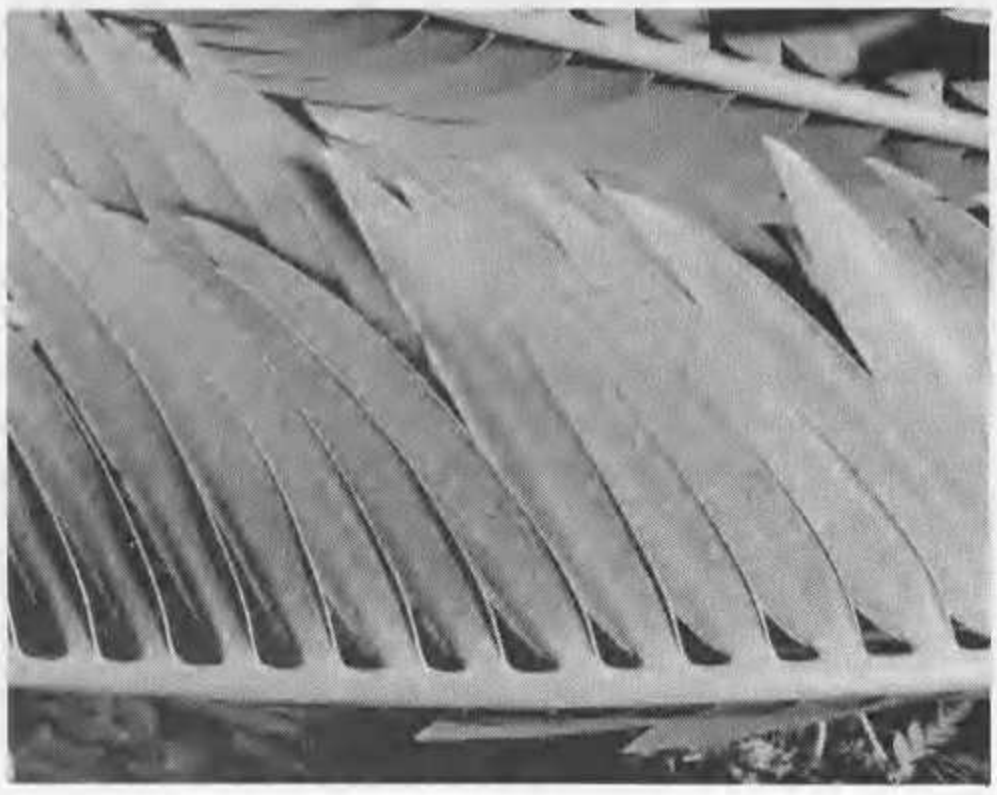

Figure 2 *Encephalartos longifolius*: portion of a frond of a plant from near Sidbury, showing strongly overlapping leaflets.

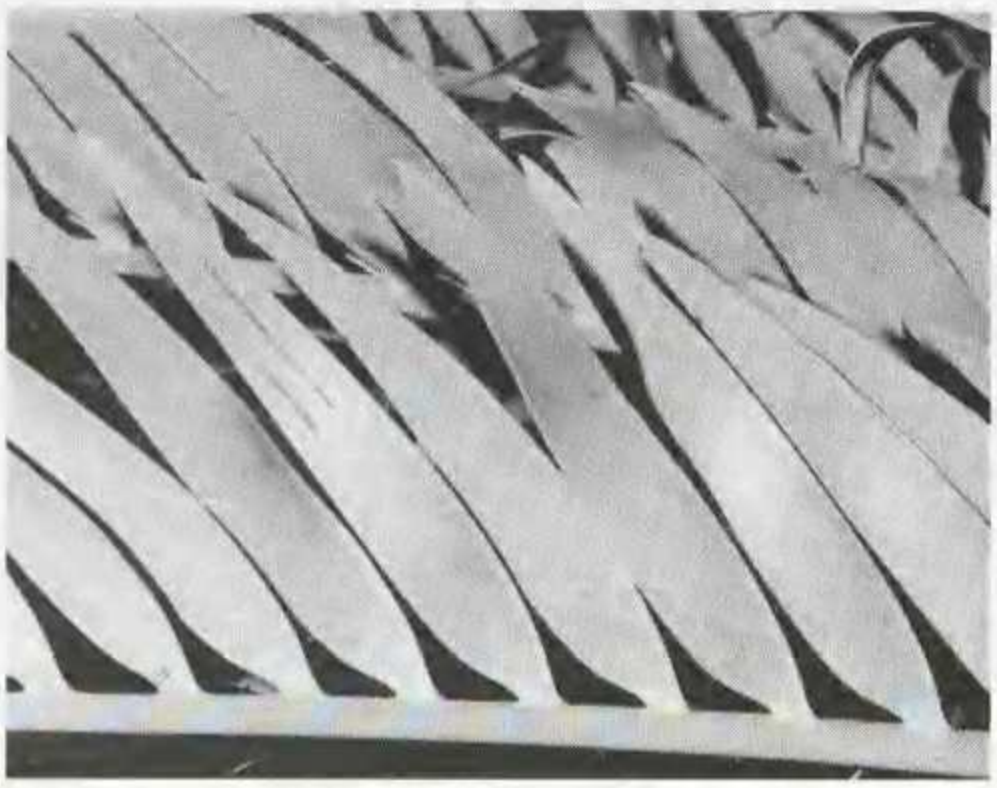

Figure 3 *Encephalartos longifolius*: portion of a frond of a plant from near Loerie, showing laxly spaced leaflets.

As for Dr. Claassen's communication, I believe that the small spines or protuberances on the margins of leaflets in *E. longifolius* are indicative of hybridization, probably with *E. horridus*, and many generations in the past. I was instrumental in obtaining the seeds from the school garden, and I am afraid that the information at our disposal is insufficient to form conclusions. In gardens anything is possible. As for leaf colour, the way colour

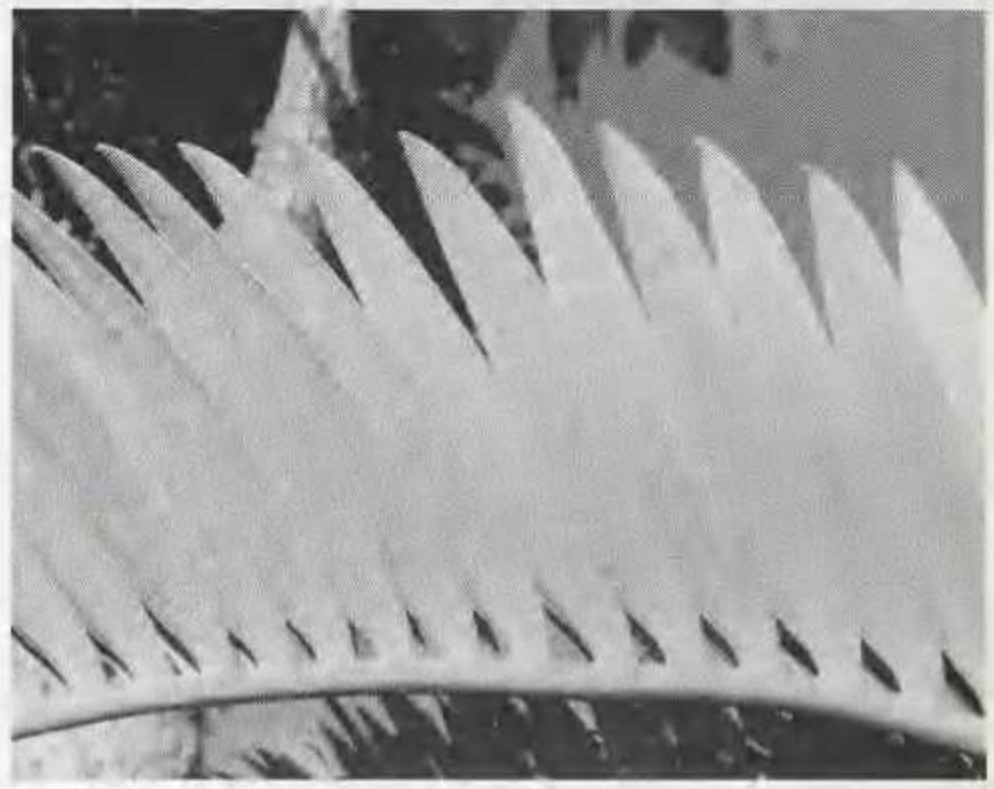

Figure 4 *Encephalartos longifolius*: portion of a frond of a plant from near Joubertina, showing overlapping leaflets. These fronds are completely glaucous ("blue").

is inherited is still not clear. For instance, Dr. Claassen herself produced hybrids between *E. trispinosus* and *E. villosus* which are blue-green rather than blue. On the other hand, member Maans Kemp produced hybrids between *E. horridus* and *E. villosus* which are as blue as *E. horridus*. I have hybridized *E. transvenosus* with *E. horridus* using both species as female parents. The progeny are all green, albeit like in *E. ferox* rather than the bright green of *E. transvenosus*, but by no stretch of imagination can the colour be described as blue. All the *E. altensteinii* x *E. trispinosus* hybrids, natural or artificial, which I have seen, were green like *E. altensteinii*.

"FISHTAIL" *ENCEPHALARTOS TRANSVENOSUS* (p. 22)

If this feature is permanent, I cannot help feeling that a virus infection may be involved.

BURNING OF *ENCEPHALARTOS LANATUS* TO INDUCE LEAF FORMATION (pp. 24, 25)

I believe that the evidence is inconclusive in proving the stimulating effect of fire. I believe carefully controlled experiments will show that pruning off the old fronds will have exactly the same effect. The explanation is that the plant cannot photosynthetize once its fronds have been removed by either pruning or burning, so it is forced to produce leaves or starve.

I may mention, with trepidation, that frond production can also be stimulated through a liberal dose of the deadly nematode poison, Nemacure. However, here the result is very dramatic, with new fronds often produced within a week.

ENCEPHALARTOS SCLAVOI: CORRECT AUTHOR CITATION AND PLACE OF PUBLICATION (p 9)

I have checked the original literature, and found that the name *Encephalartos sclavoi* was validly published in *Delpinoa* 29/30: 3-5 (31st March 1989) and the describing authors were cited as *De Luca, D. Stevenson & Moretti*.

The re-publication of the name, without reference to the previous publication, was in *Memoirs of the New York Botanical Garden* 57: 156-157 (7th March 1990) with the describing authors cited as *Moretti, D. Stevenson & De Luca*.

There is no justification for the re-publication of the name, as the 1989 publication was perfectly valid. It is difficult to understand why the authors allowed such unnecessary nomenclatural confusion to take place, especially as Stevenson himself edited the special volume of *Memoirs of the New York Botanical Garden* in which the second publication took place, and he must have known that it was unnecessary.

According to Article 11.2 of the latest (1988) edition of the *International Code of Botanical Nomenclature*, the correct name is the earliest legitimate one in the same rank, in this case being *Encephalartos sclavoi* De Luca, D. Stevenson & Moretti in *Delpinoa* 29/30: 3-5 (31st March 1989).

References

GREUTER, W. *et al.* 1988. International Code of Botanical Nomenclature adopted by the Fourteenth International Botanical Congress, Berlin, July-August 1987. Konigstein, Koeltz.

STEVENSON, D.W., MORETTI, A. & DE LUCA, P. 1989. *Encephalartos sclavoi* De Luca, D. Stevenson and Moretti (Zamiaceae), a new species from Tanzania. *Delpinoa* 29/30: 3-5.

STEVENSON, D.W., MORETTI, A. & DE LUCA, P. 1990. A new species of *Encephalartos* (Zamiaceae) from Tanzania. *Memoirs of the New York Botanical Garden* 57: 156-161.

PROFESSOR MORETTI: PROMOTION

Roy Osborne
Department of Chemistry, University of Natal,
4001 Durban

Received 16 March 1994

Aldo Moretti (45) (Figure 1), internationally well-known for his cycad-oriented research work, has been appointed as full Professor of Botany at the University of Naples, Italy. The promotion is in recognition of his teaching, research and administrative abilities. His work has included such diverse topics as investigations into nitrogen-fixation by *Azolla* and blue-green bacteria, the cytotaxonomy, phytochemistry, karyology and molecular biology of cycads, design of the palaeobotanical exhibits in a new ethnobotanical museum in Naples, in addition to which he has been vigorously involved in the living collections at "Orto Botanico". He has collaborated with other research workers widely and internationally, attending and presenting work at many important conferences and having an impressive list of publications. At present Professor Moretti is working jointly with Roy Osborne on a DNA-analysis project for the genus *Encephalartos* and plans to visit South Africa later this year to further this collaboration.

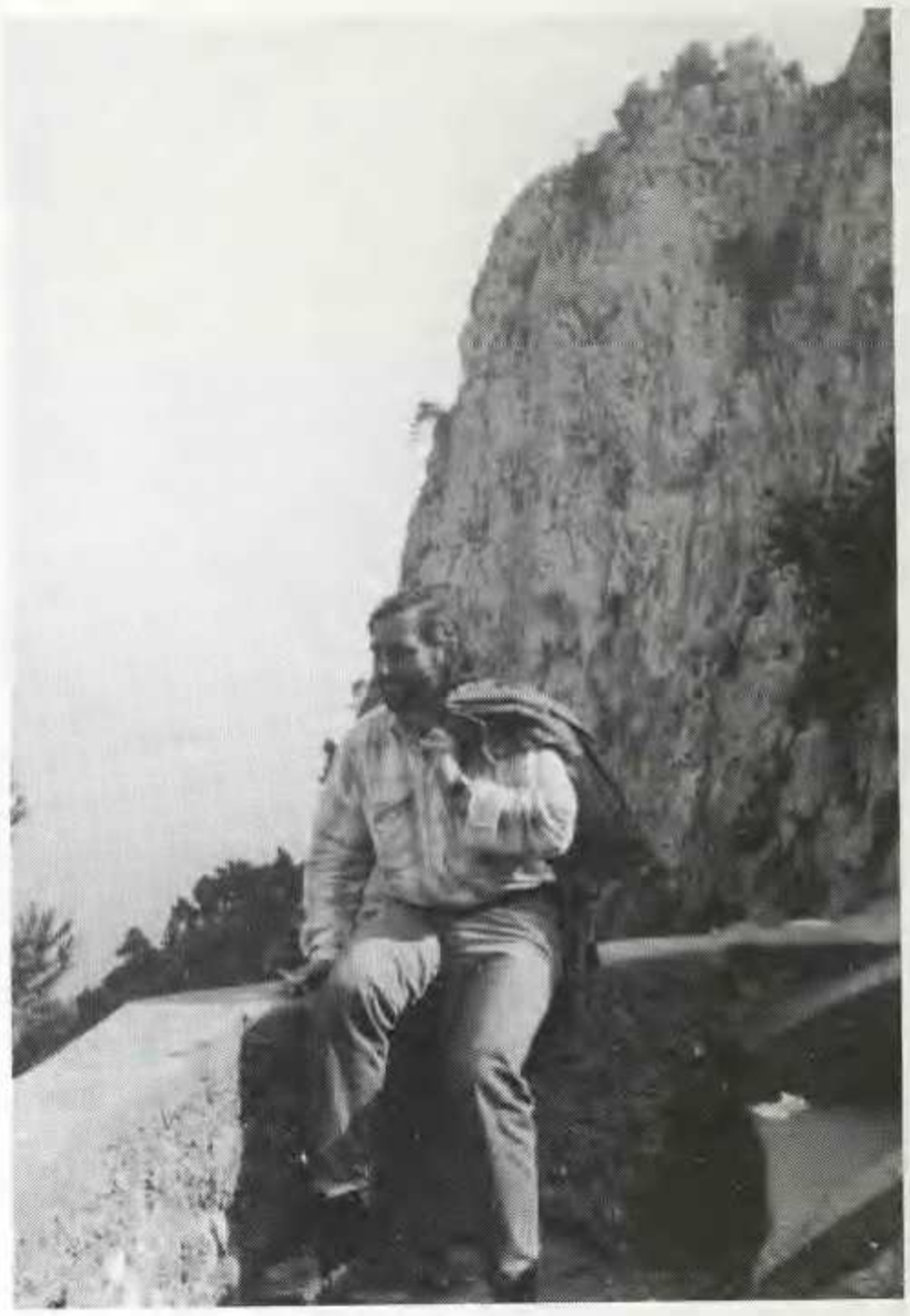

Figure 1 Aldo Moretti relaxing on the Isle of Capri. Photo: Roy Osborne.

INDEX TO THE "FOCUS ON ...." SERIES

Roy Osborne
Department of Chemistry, University of Natal, 4001 Durban

For those readers who particularly wish to refer to the features on particular species, we list below the issues, dates and authors for the various "Focus on ...." articles which have been published in the first 38 issues of ENCEPHALARTOS.

ISSUE	DATE	SPECIES	AUTHOR
Encephalartos #1	March 1985	*Encephalartos longifolius*	Maans Kemp
Encephalartos #2	June 1985	*Stangeria eriopus*	Piet Vorster
Encephalartos #3	September 1985	*Encephalartos caffer*	Maans Kemp
Encephalartos #4	December 1985	*Encephalartos lehmannii*	Maans Kemp
Encephalartos #5	March 1986	*Encephalartos woodii*	Roy Osborne
Encephalartos #6	June 1986	*Cycas thouarsii*	Piet Vorster
Encephalartos #7	September 1986	*Encephalartos horridus*	Maans Kemp
Encephalartos #8	December 1986	*Encephalartos latifrons*	Maans Kemp
Encephalartos #9	March 1987	*Encephalartos ferox*	Roy Osborne
Encephalartos #10	June 1987	*Encephalartos villosus*	Roy Osborne
Encephalartos #11	September 1987	*Encephalartos arenarius*	Maans Kemp
Encephalartos #12	December 1987	*Encephalartos ghellinckii*	Roy Osborne
Encephalartos #13	March 1988	*Encephalartos altensteinii*	Maans Kemp
Encephalartos #14	June 1988	*Encephalartos barteri*	Roy Osborne
Encephalartos #15	September 1988	*Encephalartos lebomboensis*	Roy Osborne
Encephalartos #16	December 1988	*Encephalartos lanatus*	Roy Osborne
Encephalartos #17	March 1989	*Encephalartos eugene-maraisii* (incl. *E. middelburgensis*)	Roy Osborne
Encephalartos #18	June 1989	*Encephalartos friderici-guilielmi*	Maans Kemp
Encephalartos #19	September 1989	*Encephalartos laevifolius*	Roy Osborne
Encephalartos #20	December 1989	*Encephalartos transvenosus*	Roy Osborne
Encephalartos #21	March 1990	*Encephalartos umbeluziensis*	Roy Osborne
Encephalartos #22	June 1990	*Encephalartos hildebrandtii*	Roy Osborne
Encephalartos #23	September 1990	*Encephalartos ngoyanus*	Cynthia Giddy
Encephalartos #24	December 1990	*Encephalartos princeps*	Maans Kemp
Encephalartos #25	March 1991	*Encephalartos gratus*	Roy Osborne
Encephalartos #26	June 1991	*Encephalartos cycadifolius*	Maans Kemp
Encephalartos #27	September 1991	*Encephalartos paucidentatus*	Roy Osborne
Encephalartos #28	December 1991	*Encephalartos aemulans*	Piet Vorster
Encephalartos #29	March 1992	*Encephalartos dyerianus*	Piet Vorster
Encephalartos #30	June 1992	*Encephalartos dolomiticus*	Piet Vorster
Encephalartos #31	September 1992	*Encephalartos inopinus*	Roy Osborne
Encephalartos #32	December 1992	*Encephalartos cerinus*	Cynthia Giddy
Encephalartos #33	March 1993	*Encephalartos trispinosus*	Maans Kemp
Encephalartos #34	June 1993	*Encephalartos concinnus*	Roy Osborne
Encephalartos #35	September 1993	*Encephalartos munchii*	Roy Osborne
Encephalartos #36	December 1993	*Encephalartos cupidus*	Riekie Slabbert & Johan Hurter
Encephalartos #37	March 1994	*Encephalartos sclavoi*	Riekie Slabbert & Johan Hurter
Encephalartos #38	June 1994	*Encephalartos manikensis*	Roy Osborne

FINANCIAL STATEMENT / FINANSIËLE STAAT

THE CYCAD SOCIETY OF SOUTH AFRICA

CONSOLIDATED INCOME AND EXPENDITURE STATEMENT FOR THE YEAR ENDING 1993-12-31

	1993 Rand	1992 Rand
INCOME	41569	33957
Subscriptions	27377	25780
Donations	3354	2304
Interest received	2546	2759
Donations - Seedbank	---	150
Encephalartos - Back copies - Sales	2804	1939
Sundry income	5288	1025
EXPENDITURE	41654	25461
Bank Charges	564	475
Encephalartos - Printing & postage	32204	17020
General expenses	3843	5261
Postage and Stationery	4726	2425
Telephone	317	265
Seedbank Expenses	---	15
NET SURPLUS (+), LOSS (–) FOR THE YEAR	– 85	+8496
Unappropriated surplus - Beginning of year	38091	29595
Unappropriated surplus - End of year	38006	38091

CONSOLIDATED BALANCE SHEET AS AT 1993-12-31

CAPITAL EMPLOYED		
Capital fund account	37873	38091
EMPLOYMENT OF CAPITAL		
Fixed assets	1	1
Educational equipment		
Net current assets	37872	38090
Current assets	39971	38571
Bank	14484	19512
Bank deposit	21500	15000
Petty cash	---	5
Debtors	81	812
Stock	3906	3242

	1993 Rand	1992 Rand
Current liabilities	2099	481
Prepaid subscriptions	1162	141
Creditors	937	340

HEAD OFFICE: INCOME AND EXPENDITURE STATEMENT FOR THE YEAR ENDING 1993-12-31

INCOME	41288	32690
Subscriptions	27377	25780
Donations	3511	2215
Interest received	2546	2756
Sundry income	5050	---
Encephalartos - Back copies - Sales	2804	1939
EXPENDITURE	41374	*24999*
Bank charges	564	450
Encephalartos - Printing & postage	32204	17020
General expenses	3820	5097
Postage	2591	1933
Stationery	1878	234
Telephone	317	265
NET SURPLUS (+), LOSS (–) FOR THE YEAR	– 86	+7691
Unappropriated surplus - Beginning of year	37286	29595
Unappropriated surplus - End of year	37200	37286

HEAD OFFICE: BALANCE SHEET AS AT 1993-12-31

CAPITAL EMPLOYED	37873	37286
EMPLOYMENT OF CAPITAL		
Fixed assets	1	1
Educational Equipment		
Net current assets	37872	37285
Current assets	39971	37766
Bank	14484	18707
Bank deposit	21500	15000
Petty cash	---	5
Debtors	81	812
Stock	3906	3242

	1993 Rand	1992 Rand
Current liabilities	2099	481
Prepaid subscriptions	1162	141
Creditors	937	340

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

I therefore certify that the attached Income and Expenditure Statements and the Balance Sheets are in accordance with the information provided and reflect a true and fair representation of the income and expenditure and the financial position of the Society as at 31st December 1992.

Pretoria, 2nd March, 1993.

Signed: L.M.D. Vorster.

NATAL NATURE CONSERVATION ORDINANCE

CHANGES TO THE NATAL CONSERVATION ORDINANCE

Cynthia Giddy
P.O. Box 45, 3730 Umlaas Road

Several amendments to the Nature Conservation Ordinance 15 of 1974 were proclaimed by the Administrator of Natal on the 29th of November 1993 and published in the Official Gazette of the Province of Natal on the 23rd of December 1993.

These affect the purchase, donation, importation and exportation of Specially Protected plants in and out of Natal as well as the fines applicable to transgressions of the Ordinance. The schedules of Specially Protected plants have also been added to. All the plants on CITES Appendix I and Appendix II are now protected under the Natal Ordinance. This is already the case in the Transvaal and the Cape Province.

The following amendments should be read in conjunction with the existing ordinance. Under definitions the following changes and additions have been made:

"cycad" means the genera *Encephalartos* and any hybrid, and *Stangeria*;

"gather" means to pick, pluck, uproot, cut, accumulate, collect, cultivate, amass, chop off, saw off, break or damage or destroy, whether wholly or partially;

"indigenous plant" means any plant or part thereof including cycads and any cycad hybrid indigenous to the Republic or Namibia or any territory which formed part of the Republic and in terms of an act of Parliament became an independent state, but does not include any plant which is a noxious weed by virtue of any law;

"microchip transponder" means an electronic microchip inserted in the body of a specially protected indigenous plant and used for identification purposes;

"purchase" means to buy, procure, acquire, barter or exchange as valuable consideration.

Purchase of specially protected indigenous plants

194 (1) No person shall purchase any specially

protected indigenous plant except from a person lawfully entitled to sell it under the provisions of this Chapter.

(2) Any purchaser of a specially protected indigenous plant shall obtain from the seller a document wherin the following particulars are contained:

(a) the name and residential address of the seller and purchaser;
(b) the date of sale;
(c) the species of the plant and the diameter or length (whichever is the greater) of its stem;
(d) the number of the current licence or permit which authorizes the seller to conduct the sale;
(e) the signature of the seller or his agent.

Licence to sell specially protected indigenous plants

196 (1) A specially protected indigenous plant may be sold only under the authority of and in accordance with a licence issued in terms of this section.

Donation or exchange of specially protected indigenous plants

197 (2) No person shall donate or exchange any specially protected indigenous plant without a permit first having been obtained from the Board, which permit shall be retained by the donor or person who exchanges such plant.

(3) Any person who donates or exchanges with any other person any specially protected indigenous plant, shall, at the time of delivery of such plant to such other person, hand to him a document containing the following particulars:

(a) the names and residential addresses of the persons participating in such donation or exchange;
(b) the date and place of delivery;
(c) the number and species of such plant and its size, either in diameter or in stem heights, whichever measurement may be the greater;
(d) the manner in which the donor or those participating in the exchange came into possession of such plant so donated or exchanged;
(e) the signatures of the persons concerned.

(4) The document referred to in subsection (3) shall be retained by the owner of such specially protected indigenous plant for the natural lifespan of such plant or while such plant is in the possession of the owner.

(5) A person required to hold a permit referred to in subsection (2) or a document referred to in subsection (3) shall produce it to an officer, honorary officer or employee of the Board within 24 hours of being requested to do so by such officer, honorary officer or employee and upon failure to do so shall be guilty of an offence.

Exportation of specially protected indigenous plants

198 (1) No person shall export from the Province any indigenous plant save under the authority of and in accordance with a permit issued to him in terms of this chapter.

(2) No cycad with a diameter in excess of 15 cm may be exported from the Province unless it has been fitted with a microchip transponder by an officer or employee of the Board.

Importation of specially protected indigenous plants

199 (1) No person shall import into the Province any specially protected indigenous plant save under the authority of and in accordance with a permit issued to him in terms of this chapter.

Gathering of specially protected indigenous plants

200 This section remains substantially the same in that a permit is required for the gathering of any specially protected indigenous plant by the owner of the land or by any persons with the prior written permission of such owner and that such permit will be subject to such conditions as the Board may determine.

Permit for the relocation of specially protected indigenous plants

201A The Board may on application by the landowner wishing to develop his land in such a manner that such development may cause damage or destruction to specially protected indigenous plants, grant a permit for the relocation of such plants.

Offences and penalties

208 Any person who contravenes or fails to comply with the provisions of this Chapter or of any licence or permit issued in terms thereof or of the regulations in force thereunder, shall be guilty of an offence and liable on conviction to a fine or imprisonment for a maximum period of ten (10) years or to both such fine or imprisonment.

Loss of documents procedure

209 (1) Any person who loses any document or permit referred to in sections 194, 197, 199 and 200 shall report such loss immediately to the Board by means of an affidavit.

(2) Upon receipt of the affidavit referred to in subsection (1) the Board may have the matter investigated and may issue a duplicate document or permit to such person.

Exportation and importation of fauna and flora prohibited, save under permit

213C (1) No person shall export from or import into the Province any species of fauna and flora referred to in Schedule 12A except in accordance with a permit granted in terms of this section.

(2) Application for a permit referred to under subsection (1) shall be made to the Director in writing and the Director, or other officer appointed by the Board for this purpose, shall have the discretion to grant any such application, whether in whole or in part, or to refuse the same.

(3) Every permit shall be personal to the holder and subject to such conditions as stipulated by the Board.

In addition to the existing Schedule 12 of Specially Protected plants, an additional Schedule 12A has been approved and this refers to all plants on CITES Appendix I and Appendix II.

Of interest to the members of the Cycad Society are the following families:

Agavaceae	*A. arizonica, A. parviflora* and *A. victoria-regina*
Apocynaceae	All non-South African *Pachypodium* spp.
Asclepiadaceae	All non-South African *Ceropegia* spp.
Cactaceae	All cactaceae
Cephalotaceae	*Cephalotus follicularis* (pitcher plants)
Cyatheaceae	All non-South African tree ferns
Cycadaceae	All non-South African *Cycas* spp.
Didiereaceae	Tasmanian tree ferns
Dicksoniaceae	All *Dicksonia* spp. (tree ferns)
Orchidaceae	All non-South African Orchidaceae spp. (note this includes all hybrids)
Palmae	*Areca ipot, Chrysalidocarpus decipiens, Neodypsis decaryi*
Zamiaceae	All non-South African Zamiaceae spp.

It should be noted that the Ordinance makes no distinction between wild plants and garden plants and that the sections dealing with donations and the export and import of plants therefor apply equally to any cycad whether grown from seed under cultivation or gathered from the wild. It should also be noted that the definition of an indigenous plant means " any plant or part thereof as well as any hybrid of a cycad". This means that cycad seed by definition is included in all the sections.

The addition of Schedule 12A (CITES Appendix I and II) to the ordinance, extends the same protection to all the other genera of cycads in the families of Cycadaceae and Zamiaceae (*Cycas, Ceratozamia, Chigua, Dioon, Encephalartos, Macrozamia, Microcycas, Lepidozamia, Zamia*, and *Bowenia*).

Note that section 213C only regulates the import and export in and out of the Province of Schedule 12A plants, this means that plants or seeds of non-South African cycad species may be donated or exchanged within the Province without the permit referred to in section 197 but that imports or exports in and out of the Province of non-South African cycad species require import and export documents under Section 213C(1).

The onus to obtain a valid invoice from a seller rests on the purchaser, which invoice must contain all the information required under section 194 (purchase date, names and residential addresses, species and size of the plant, the seller's Natal Parks Board nursery licence number and the signature of the seller or his agent). Members of the Cycad Society should in the interests of conservation, report those who refuse to issue such an invoice to the conservation authorities.

The donation of plants or seeds require a prior permit from the Natal Parks Board and a letter of donation as detailed in section 197. The latter document must be retained for the natural lifespan of the plant or while that plant is in the possession of the owner and both

documents (permit and donation letter) must be produced within 24 hours after being requested to do so.

Although these amendments might appear irksome to members of the Cycad Society who in good faith would like to exchange seed and seedlings with fellow collectors with the minimum of paperwork, the main purpose of the conservation legislation is to protect our natural heritage from commercial exploitation.

Sadly those involved in the plunder of our cycad habitats have in the past used exactly these same mechanisms, namely donation letters and the exemption given to plants and seeds of garden origin, to cover their illegal operations. Only by eliminating these loopholes in the legislation can the courts deal effectively with those, who for personal gain, have reduced our cycads to the brink of extinction.

All requests for permits should be made in writing to: The Permit Officer, Natal Parks Board, P.O. Box 662, 3200 Pietermaritzburg; Tel: 0331-471961, Fax: 0331-472812.

LETTERS TO THE EDITOR / BRIEWE AAN DIE REDAKTEUR

Dear Editor

OCCASIONAL PARTHENOCARPY AS A GENERAL RULE IN CYCADS?

In the cycad literature, it still seems questionable whether unfertilized ovules of all genera may reach full exterior development. As far back as 1917, Le Goc reported on fully developed but unfertilized seeds of *Cycas rumphii* (*Ann. Bot. Gard. Peradeniya* ***1917***, 187-194). Similar experiences with *C. revoluta* and *C. rumphii* were mentioned by Pant in his book on "*Cycas* and the Cycadales" (Allahabad **1973**, pp. 135-137).

In 1983, I experienced two corresponding findings with *C. circinalis* seeds, one from a lone female tree in a little patio at the airport of Sta. Cruz de la Sierra (Bolivia), the other from the Kandy (Sri Lanka) Botanic Garden. This prompted me ever since, to look for an embryo in all non-germinated cycad seeds.

Corresponding findings were obtained with the following genera: *Bowenia* (2 events, 1 species), *Ceratozamia* (3 events, 2 species), *Cycas* (30 events, 11 species), *Dioon* (1 event), *Encephalartos* (19 events, 5 species), *Lepidozamia* (1 event), *Macrozamia* (8 events, 5 species), and *Zamia* (2 events, 2 species).

Would it be advisable to start an inquiry among experienced cycad growers?

Yours sincerely

***Dr. med. Helmut Schlegel**, Wilhelm-Haspel Straße 30/2, 71065 Sindelfingen, Germany.*

Received 25 March 1994

COMMENTS ON DR. SCHLEGEL'S LETTER

Dear Editor

For seed plants, parthenocarpy is a phenomenon that results in **fruit** development without fertilization of the egg cell(s) of the ovule(s) in the original ovary. In some species, this requires a stimulus provided by pollination but in other species it can occur without pollination. Because the ovules of cycads are not borne in ovaries, the term **parthenocarpy** in the above letter should be replaced by **embryoless "seed" development**.

In many cycad genera (*Cycas, Ceratozamia, Dioon, Zamia*) the ovules normally enlarge and develop considerably only after pollination and fertilization of an egg cell to result in a mature seed containing an embryo. I do not know what the position is in case of species of *Bowenia, Lepidozamia* and *Macrozamia* but in the case of most *Encephalartos* species, the ovules usually do not enlarge significantly after pollination and fertilization. In other words, it is normal for the "seeds" of most *Encephalartos* species to develop to more or less their maximum size without fertilization. In the letter above, the 19 events with five *Encephalartos* species are therefore not strange. Except in the case of seeds in which the embryo perished very soon after fertilization, embryoless "seeds" should of course strictly speaking not be called "seeds" but "ovules" because it is only after fertilization that an ovule becomes a seed.

***Nat Grobbelaar**, P.O. Box 15357, 0039 Lynn East.*

Received 8 April 1994

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Dear Editor

The question on parthenocarpy in cycads is an old one. In the genera *Encephalartos, Macrozamia* and *Lepidozamia*, female plants almost invariably set seeds whether the cones have been pollinated or not. Externally these seeds, whether fertilized or not, are indistinguishable from each other. In the genera *Stangeria, Bowenia, Zamia, Ceratozamia, Dioon,* and *Cycas* unpollinated ovules do not develop but remain small compared to pollinated seeds. I do not know what the situation is with *Microcycas*.

In the group of genera where the seeds do not develop unless pollinated, the development of seeds can mislead one into thinking that fertilization has occurred, and this has lead to not a few false claims of successful hand-pollination or artificial intergeneric hybridization. What happens, is that the presence of pollen often results in the development of the ovule, exactly as if it had been fertilized. However, for this development to take place, no fertilization is necessary, and the same result can be obtained by pollinating with long-dead pollen. Indeed, it is possible to stimulate growth of the seed of *Ceratozamia* with pollen of *Zamia*, and vice versa, but in spite of Chamberlain's claims no such seeds have ever germinated to my knowledge. Similarly, it has been claimed that *Stangeria* and *Bowenia* have such a stimulating effect on each other, leading to premature claims of successful intergeneric hybridization. Pollen of *Encephalartos* does not stimulate the development of seeds in *Zamia*, but I have not cross-checked other genera for stimulation of seed development by foreign pollen.

I do not know what sets in motion the development of the ovule, but would presume that it is caused by the formation of growth hormones which in turn are produced in response to the presence of proteins in the pollen, almost like an allergic reaction.

I, too, have heard tales of *Cycas* seeds developing in the absence of male plants. In all cases which I have examined, it turned out that the seeds by no means ever attained the size of fertilized or at least pollinated seeds. In cases where unfertilized seeds were bigger than normal, it could probably be ascribed to a somewhat higher than normal level of naturally occurring growth hormones.

Occasionally one hears stories of *Encephalartos* setting fertile seeds in greenhouses, in the total absence of any male plant. In thirty years' experience with plants in cultivation, I have never seen any proof of such claims; and frankly, I don't believe that it occurs.

More plausible are tales of female plants in nature, or in gardens in areas where cycads occur naturally, which set fertile seeds although the nearest males may be several kilometres away. When we still believed that cycads were wind-pollinated, these cases were difficult to explain; but today we know that most, if not all, cycads are pollinated by specialized insects which seem to have an extremely well developed sense of smell and so can detect and find a receptive female cone many kilometres upwind.

***Piet Vorster**, Botany Department, University, Private Bag X5018, 7599 Stellenbosch.*

Received 14 April 1994

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Dear Fellow Members

CHRISTMAS GREETINGS

We received two separate Christmas cards last year with the cutest greetings in them and we would love to share them with you all.

The first one reads: "Wishing you a Gratus Chimanimaniensis and a hopei ngoyanus".

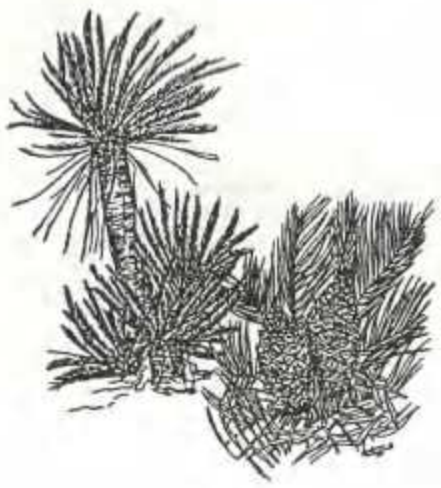
The other reads: "We wish you a microcycas and furfuracea".

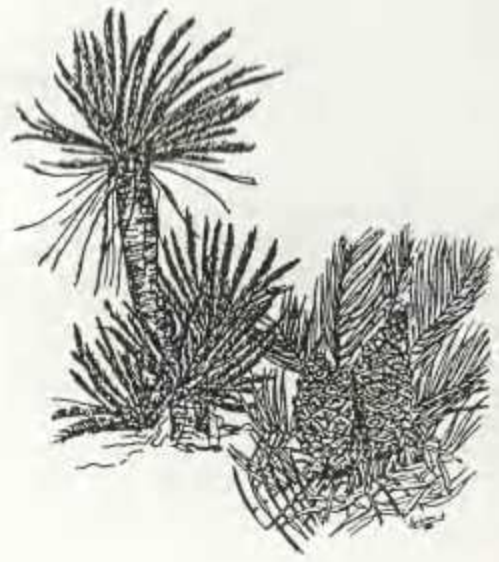
Thank you to the overseas contributors.

Sincerely

***Danie Nel**, Cycad Centre, Box 4726, 4000 Durban.*

Received 30 March 1994





Cycad thieves get best of rare collection

Daily News Reporter

A COLLECTOR of indigenous cycads was shocked this week when thieves stole a "hand-picked" selection of his rarest plants worth R10 000.

Retired Kenville policeman Charles Ramnarain, who has spent the past 30 years collecting cycads, awoke on Monday to find his backyard nursery had been raided and 29 plants taken.

All Mr Ramnarain's plants are registered with the Natal Parks Board, and police have been told.

"They were taken by somebody who knows about cycads. Only the rarest and most valuable species were taken," he said. "They must have used a bakkie to take all these plants at one time."

He said some of the plants were more than 40 years old and worth up to R600 each. He valued the whole collection of 80 plants at more than R25 000.

The distraught collector said he was "shattered".

"I felt like someone had taken my children. I can identify every single one. I only hope whoever has them will take care of them. I don't know if they'll be sold or put in a garden somewhere.

"I spent so much time and money caring for them and even devised my own secret fertiliser so all my plants are very healthy."

Mr Ramnarain moved to Durban from Newcastle with his family and plants four years ago.

He has had plants sent from Cape Town and the Transvaal for his collection.

BEREFT: Cycad collector Charles Ramnarain with one of the more common species of the plant that "choosey" thieves left behind.

Eastern Province Herald
1 February 1994

Council destroys rare old cycad

By BOBBY JORDAN

THE Grahamstown municipality has destroyed a rare, 200-year-old cycad to make way for a primary school playground.

Problems arose when staff members of the Victoria Primary School expressed concern.

Senior nature conservator Mike Reynolds of the Cape Nature Conservation Department described the cycad as "one of the city's most valuable symbolic statues".

He said: "There is no way we would ever have allowed a cycad of that stature to be destroyed." The plant dated back to the 1800s and "probably had a good few hundred years left to go".

The Parks and Forests Department of the Grahamstown municipality were called in to assist with the removal of the cycad, but instead of being replanted the cycad was cut up and disposed of.

The cycad was inspected by members of the parks department who apparently found the valuable plant to be in a state of decay, according to a statement issued by acting Town Clerk Charl Malan.

The plant was "cut up and disposed of" after permission had been granted by the Director of Parks. This sanction to destroy the plant was described as a misunderstanding by Mr Malan.

"The Grahamstown municipality has a large number of cycads in its care and would never wilfully destroy such handsome and valuable plants", Mr Malan said.

"This unfortunate incident is therefore sincerely regretted."

Status of accused irrelevant to cycad case — counsel

Daily Dispatch Reporter

EAST LONDON — The defence attorney for a former city councillor, Mr Phillip Swanepoel, charged with illegally dealing in cycads, argued in the regional court yesterday that an underlying theme in the state's case was that the accused was more of a criminal because of his position.

Mr Swanepoel, 45, was until August last year a city councillor responsible for environmental services.

In his closing argument, Mr W. Opperman said Mr Swanepoel had consistently been in possession of permits to keep cycads. In 1991, after Mr Swanepoel sold his collection, he had been faced with a move to Madagascar.

The move had not subsequently transpired and members of his family had lived on in the house after its sale to a company, Leisure Shipping.

Mr Swanepoel, however, was not always physically present as he worked in Butterworth.

An expert witness, Mrs C. Giddy, had given an overall opinion, Mr Opperman said. She had not made a physical inspection of the cycads.

A coaccused in the case, Mr W. Mbalu, had been confronted by nature conservation officials with the aim of cornering Mr Swanepoel.

Mr Mbalu had denied knowing that selling cycads was illegal.

After the confrontation with the officials, Mr Opperman said, a cycad in Mr Mbalu's possession had been loaded onto Mr Swanepoel's lawn.

In her closing argument, the state prosecutor, Ms D. Neethling, said Mrs Giddy was sure the plants that remained in Mr Swanepoel's garden and those confiscated from his home and replanted in a nature reserve were all plants from the wild.

Mrs Giddy based her opinion on abrasions and the condition of leaves and roots.

When Mr Swanepoel's cycad collection had been sold in 1991, 25 cycads at the most had remained at the house. Ms Neethling said Mr Swanepoel said this equalled the 96 cycads found in the garden by officials.

Mr Swanepoel had built up his collection since 1991, she said.

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He argued the cycads were not his because he no longer owned the house, but he had occupied the house and paid rent.

Ms Neethling asked that the 30 cycads confiscated by nature conservation officials be forfeited to the state.

Mr Swanepoel should be found guilty, she argued, and his position in the community should be taken into account in sentencing.

The case continues today.

The magistrate was Mr W. Bezuidenhout.

Saving the Cycads

Hand pollination may save some of these precious endangered plants from extinction

Text by NANCY GARDINER, Photographs by CYNTHIA GIDDY

CYCADS ARE some of our most ancient and endangered plants but hand pollination by concerned individuals is helping to preserve these precious relics of the past.

Cycads are dioecious, which means that male and female cones are produced on separate plants. So if there is one plant in a garden, there is no chance that fertile seeds will be produced.

In a colony of cycads, which has been left undisturbed, autumn brings the production of pollen in the male cones and a swelling of the seeds on the female cones. At one time it was thought that wind was the only means of bearing the pollen from the male to the female, but now research has shown that beetles also carry out this vital function.

When the female cone disintegrates, some of the fertile seeds fall to the ground to grow while others are carried off by birds and animals to far-off places where new colonies may develop. This is typical of what took place through millions of years.

Then along came man with his thirst for knowledge. The white man came to South Africa and, astounded at the wealth of plant material, proceeded to ruthlessly collect and send back to his home country all manner of plants, including cycads.

Today cycads are fashionable garden subjects and have become status symbols and collectors' pieces. The most rare of cycads in one's garden is a source of great pride and people pay vast sums for them. Often a female plant has been uprooted and taken into a garden with little thought to how it immediately becomes unproductive without any male plants nearby.

So prevalent has this situation become worldwide that concerned people and conservationists are trying to do something about it. Cynthia Giddy, an internationally known expert on cycads, author on the subject, and tireless worker for their survival, serves on the Species Survival Commission of the International Union for the Conservation of Nature.

She says the Cycad Society of South Africa has started a pollen bank where pollen is kept frozen, with little loss of viability, with regional banks in the Eastern Cape, Natal and the Transvaal.

Today data is kept on a computer of the owners of male cycads, their addresses and the name of the species. The owners of female cycads can get in touch with them and so hand pollinate their cones to produce fertile seeds.

Gardeners who want to collect pollen for pollinating their female cones should observe their cycads from autumn through winter (March to June). The male cone will elongate and if it is tapped at regular intervals, there will come a

time when pollen is shed.

At this stage cut off the entire cone. Outdoors and out of the wind, place it on paper. Shake or tap it until all the pollen has been shed. This can now be used to pollinate your female cones of the same species or it can be frozen, after labelling, for future use. It can also be sent by post. (Remember that females do not cone every year.) This pollen can now be kept for up to five years in its frozen state.

When the top sterile scales of the female cone open slightly, remove one or two of these, then introduce the pollen by gently blowing it in. A meat baster is ideal for this. Since the scales are arranged in a spiral, the pollen will find its way down past all the scales and pollination will be complete. It is interesting to know that cycad seeds are mature before they are pollinated, unlike ordinary garden plants whose seeds only swell and mature after pollination.

After six or seven months the seeds will be fully developed and the cone will disintegrate. Don't be tempted to plant these but keep them cool, not deep frozen, for about six months. The embryo will start to emerge from the seed. They can now be planted on top of the soil and kept damp but not too wet. Another six months will see them germinating. With reasonable care, within another five years they should be attractive and garden worthy plants.

All this may sound tedious, but it is well worth the effort since it helps to preserve the species.

It is a sad reflection on humanity that there are those who will not participate in hand pollination, so great is their desire to preserve the rarity, and thus the commercial value, of their plants. But there are also those who think only of the continuing existence of these plants and it is these people who willingly share their knowledge.

For further information on cycads, contact Cynthia Giddy on (0332) 510478.□

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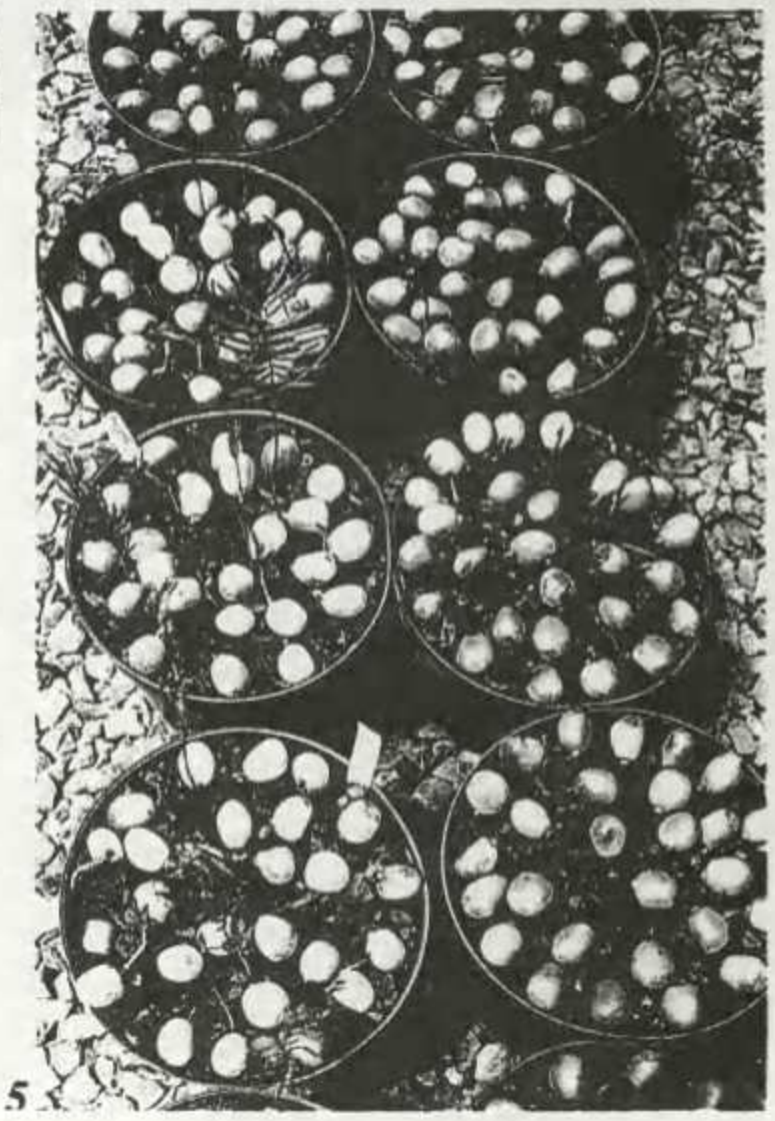

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1. Part of the Giddy Nursery.

2. Pollen shaken from a male cone of* Encephalartos ferox. *It will be frozen or used to pollinate a female cone.

3. A bag is placed over the disintegrating cone to protect it from birds and animals.

4. Stages in the germination of a cycad seed.

5. The start of a new crop of cycad plants. These are about one year old.