# ENCEPHALARTOS

JOURNAL OF THE CYCAD SOCIETY OF SOUTH AFRICA

TYDSKRIF VAN DIE BROODBOOM VERENIGING VAN SUID-AFRIKA

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**COVER / VOORBLAD : Many of the understorey *Zamia*, like this *Zamia splendens* from Mexico have pinkish red emergent leaves. / Baie van die Zamias wat in woude groei, soos hierdie *Z. splendens*, se blare het 'n pienkerige rooi kleur wanneer hulle verskyn.**

**Photo / Foto: Willie Tang**

## CONTENTS / INHOUD

## CONTENTS / INHOUD (continued / vervolg)

# FROM THE PRESIDENT

# VAN DIE PRESIDENT

Our Society stands for different things, as is shown by our constitution. Nevertheless, our most important aim is to promote the growing of cycads, and all our other aims really are subject to this.

One of the nicest things must be to collect. Once one has aquired your first seedling, it is a great adventure to get more species and to watch how they react to your treatment. There comes, however, a time when one possesses all the readily available species, and then a shift in priorities is needed so that one doesn't lose interest.

Collections usually start when one sees a garden with beautiful cycads, and promptly desires to possess the same. For the newcomer it is often a problem to obtain his first plant, but soon he finds out about nurseries, and before long is the proud owner of ten plants. Thereafter the collection g rows rapidly, money changes at a disquieting rate, and marriages become turbulent. However, there comes a time when the addition of new plants and new species start to slow down. Now one no longer yearns for your garden to look like your role model's. The problem is, though, how to give a unique character to your collection? There are three possibilities. The first is to acquire cycads of other genera. For this, availability is a problem which is going to become bigger. Recent alleged irregularities in international trade of cycads will result almost certainly in new legislation which is going to make it almost impossible for us to exchange seed or seedlings with collectors in other countries. The second possibility is to create hybrids. Many natural and artificial hybrids are beautiful, and certainly this technology makes it possible to possess plants which will make your neighbour jealous. It is a mistaken belief that each of us must duplicate the work of the National Botanical Institute by restricting ourselves to wild species, and to try and keep every species and variant. We are talking of a garden situation, where beauty is the aim. Thirdly, it is a commendable endeavour to care well for those plants which you chose to possess so that they don't become eyesores. Are all your plants as good-looking as they can be? Don't be shy to write to us to boast with your nice plants, and share with us your secret methods. Our gardens tend to be stereotype: send us hints on how you practiced originality with your landscaping.

**Piet Vorster**

Ons Vereniging staan vir verskillende dinge, soos blyk uit ons grondwet. Ten spyte hiervan, is ons belangrikste doelstelling om die kweek van broodbome te bevorder, en al ons ander doelstellings is eintlik maar ondergeskik hieraan.

Een van die lekkerste dinge moet wees om te versamel. Nadat mens jou eerste saailing gekry het, is dit 'n groot avontuur om meer soorte te kry en om te sien hoe hulle op jou behandeling reageer. Daar kom egter ook 'n tyd wanneer mens al die geredelik beskikbare soorte besit, en dan is 'n klemverskuiwing nodig sodat mens nie belangstelling verloor nie.

Versamelings begin gewoonlik as mens iewers 'n tuin met mooi broodbome sien, en dan begeer om dieselfde te besit. Vir die nuweling is dit dikwels 'n probleem om die eerste plant te bekom, maar spoedig vind mens uit van kwekers, en voor lank besit mens tien plante. Daarna groei die versameling vinnig, geld verwissel onrusbarend van eienaar, en huwelike raak stormagtig. Daar kom egter 'n tyd wanneer die toevoeging van nuwe plante en nuwe soorte begin afplat. Mens streef nou nie meer daarna dat jou tuin soos jou model s'n lyk nie. Die probleem is egter, hoe om 'n eiesoortige karakter aan jou versameling te gee? Daar is drie moontlikhede. Die eerste is om broodbome van ander genusse te bekom. Daar is bekombaarheid 'n probleem wat groter gaan word. Onlangse beweerde onreëlmatighede in internasionale handel in broodbome gaan byna sekerlik lei tot nuwe wette wat dit vir ons bykans onmoontlik gaan maak om saad of plantjies met buitelanders uit te ruil. Die tweede moontlikheid is om hibriede te skep. Baie natuurlike en kunsmatige hibriede is pragtige plante, en dit is beslis 'n moontlikheid om so plante te bekom wat jou buurman jaloers sal maak. Dit is 'n foutiewe idee dat ons elkeen die werksaamhede van die Nasionale Botaniese Instituut moet dupliseer deur ons te beperk tot wilde soorte, en om elke soort en variant te probeer aanhou. Ons praat van 'n tuinsituasie, waar aanskoulikheid die einddoel is. Derdens is dit 'n verdienstelike strewe om die plante wat jy uitgekies het, goed te versorg sodat hulle nie 'n oogseer word nie. Is u plante almal so mooi as wat hulle kan wees? Skryf gerus aan ons om te spog met u mooi plante, en deel met ons u wenresepte. Ons tuine is geneig om stereotiep te wees; stuur vir ons wenke oor hoe u oorspronklikheid toegepas het met u landskapuitleg.

**Piet Vorster**

# FOCUS ON ...

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

# FOKUS OP ...

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

## CYCAD FOSSILS

**Roy Osborne**
P.O. Box 244, Burpengary, Queensland, 4505 Australia

**PREFACE**

Our popular "Focus on ..." series has now covered nearly 70 of the living (extant) cycad species, but this represents only a small proportion of the whole cycad group. Many of the cycads are, quite literally, buried in the past. Jeff Wijnants (*Encephalartos* No 65) recently gave some indication of the importance of cycad fossils; this article extends the history to reveal a little more of the fascinating forerunners of today's cycad flora.

**INTRODUCTION**

Many introductory books describe cycads as "ancient plants", "prehistoric flora", "living fossils" and so on. A popular generic label for cycads offered for sale in nurseries describes them in eye-catching graphics as "Dinosaur Food". But more and more research is showing these ideas to be false. Certainly, cycads were an important component of the world's Mesozoic flora - but, with few exceptions, those plants were very different to the cycads we see around us today. It is now becoming accepted, perhaps reluctantly by the romantics, that the present cycad species have evolved comparatively recently, and that they are just as responsive as any other biological organism to the genetic changes and environmental influences which shaped their past and will determine their future.

Chapter 6 of "The Biology of Cycads" (Norstog & Nicholls 1997) deals in depth with the material covered in this overview and is recommended to any readers wanting to study the subject in greater detail. There is also a range of books on palaeobotany which offer a broad perspective of plant evolution.

**TECHNIQUES USED**

Uncovering evidence for the origin of plants is the work of the palaeobotanist, who examines impressions of plant parts usually found in rock strata of known geological ages. The plant parts range from the microscopic, such as pollen grains and stomatal impressions, to very large 3-dimensional macrofossils like entire tree trunks. Even the chemical remains from more recent fossils can contribute valuable data (e.g. Lockheart *et al.* 2000). The work demands a thorough knowledge of plant anatomy and morphology and requires painstaking attention to detail, its progress often leading to more questions than answers. Major difficulties arise from localities which are hard to reach and difficult to "work", incomplete and poorly preserved material, and determining which parts belong together in mixed fossil finds and when vegetative and reproductive parts of the same plant become separated in time and in space.

Leading palaeobotanists who have been responsible for much of the historic work referred to in this article are: Bruno Pettriella (Argentina); Robert Hill (Australia); Tom Harris, Marie Stopes and Wilson Crosfield Worsdell (Britain); Divya Darshan Pant (India); Alfred Gabriel Nathorst and Rudolf Florin (Sweden); Ted Delevoryas, Sergei Mamay and George Wieland (USA).

**THE GEOLOGICAL TIME SCALE** (Figure 8; Table 1)

For us to comprehend aspects of the earth's long history, geologists have determined a time scale with classifications into eras (e.g. the Mesozoic Era) and subdivisions into periods (e.g. the Jurassic Period), time epochs (early, middle or late) and ages consistent with geological strata (e.g. Oxfordian deposits of the late Jurassic). Time boundaries between the major divisions are consistent with major events in the world's history, e.g. the start (or end) of a major ice age, periods of intense volcanic activity and dramatic changes in global sea level.

**WHERE DID IT ALL START? THE LATE PALAEOZOIC ORIGIN** (Figure 8)

The earliest of the three main geological eras is the Palaeozoic, a time span of nearly 300 million years that includes the start of terrestrial plant life. Of particular interest to us are the two final periods, the Carboniferous "Coal Age" (360–286 million years ago) and the subsequent Permian (286–245 million years ago). The

Carboniferous, described as "a paradise for plant life", was when a diversity of primitive seed-bearing plants, known as the pteridosperms (also called Cycadofilicales or seed ferns) were abundant. Some of these bore seeds on small branched stalks while others had seeds at the ends of leafy fronds. In many cases the seeds were large and similar in structure to those of modern cycads. Some fronds comprised large simple leaves but others were serrated, lobed, divided or pinnate. Conditions changed during the ensuing Permian; intense upheavals caused seas and swamps to be become new and often mountainous land masses. Many primitive plants vanished and were replaced by novel smaller and hardier plants.

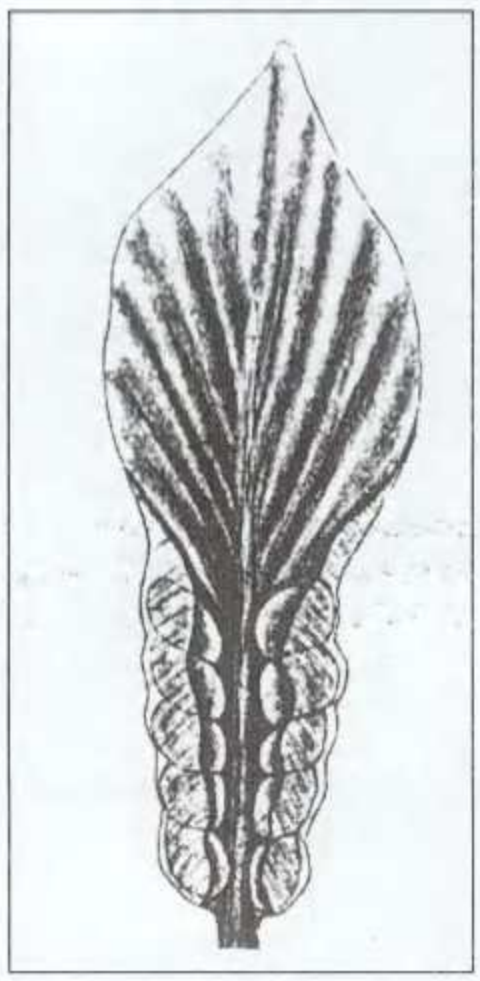


**Figure 1 Hypothetical representation of *Archaeocycas whitei*, a seed-bearing leaf from the North American Permian and possible precursor of a cycad sporophyll (Norstog & Nichols 1997 ex Mamay 1976).**

**Figure 2 *Crossozamia* megasporophyll from the Chinese early Permian strata (Norstog & Nicholls 1997 ex Goa & Thomas 1989) showing remarkable similarity with modern *Cycas*.**

The name "seed ferns" is somewhat unfortunate as these plants are only distantly related to the true ferns; equally misleading is reference to the late Palaeozoic as the "Age of Ferns".

Amongst the Carboniferous and Permian fossils there is a scattering of stems, leaves and reproductive parts which show some cycad-like qualities of morphology and anatomy. There is evidence that the first true cycads arose during these times from pteridosperms of the order Medullosales (Worsdell 1906) or possibly from other seed ferns (Arnold 1953). Significantly, recent work from early Permian deposits in China has revealed the presence of cycads that are almost identical to the *Cycas panzihuaensis* plants growing there today. In this context the general statement, seen in many texts, that *the cycad group* originated "some 250 million years ago", is entirely reasonable.

It should be borne in mind that different pteridosperms also gave rise to other early gymnosperms (with the common property of having "naked" seeds). These included *Ginkgo*, members of the order Gnetales (*Ephedra, Gnetum* and *Welwitschia*), the first conifers and the superficially cycad-like group known as the cycadeoids (Bennettitales). Because of these multiple origins, the gymnosperms cannot be regarded as a natural group and are said to be paraphyletic in origin (K.D. Hill 1998).

## SOME IMPORTANT PALAEOZOIC CYCADS

Fossil cycads from the Palaeozoic pose major questions of identity; many are of doubtful origin and many seem to be intermediates in evolutionary stages. Inevitably, there is a certain amount of guesswork in trying to find evolutionary lines extending back 250 million years. Although it is not surprising to see different hypotheses of which-fossil-fits-where amongst various possibilities, it is clear that these ancestral cycad forms were very different from the plants of today.

Various parts of cycads are considered separately in attempting to trace this long ancestry. An example of a stem from which cycad trunks may have developed is that of *Cycadoxylon fermyi* from the Lower Permian in France. Some workers maintain that ancestral cycad leaves were entire but there is more support for the view that cycads originated from plants with pinnately compound leaves, suitable candidates being *Tianboalinia* and *Yuania* from the Lower Permian in China (Delevoryas 1993).

Opinions vary more on the origin of cycad reproductive structures. Presumed sporophylls given the name *Cycadospadix* were previously thought to be early forms of cycad sporophylls but the genus is now considered to be Bennettitalean rather than cycadean. Seed-bearing sporophylls such as *Archaeocycas whitei* (Figure 1) and *Phasmatocycas* species from the North American Permian strata are stronger candidates as early forms of true cycad material. Similarly, *Crossozamia* (Figure 2) and *Primocycas*, from Chinese Lower Permian deposits, bear

ovules on short stems leading to expanded and dissected blades - homologous to the female sporophylls of many present Asian *Cycas* species (Delevoryas 1993). The fossil *Lasiostrobus polysacchi* from the Carboniferous of North America has some similarities with cycad male cones.

Consensus of fossil evidence, comparative morphological studies, biogeography and genetic analyses, overwhelmingly points to *Cycas* as the oldest cycad genus. No other cycad genera can be unequivocally related to Palaeozoic ancestors; their origins lie in the next era, the Mesozoic.

## THE BALMY DAYS OF THE MESOZOIC ERA
(Figure 8)

A major extinction event at the end of the Palaeozoic Era was followed by a long period during which the earth's climate was relatively warm and moist, and plants were uniformly abundant across the earth's surface. This, the Mesozoic Era, comprised three periods: the Triassic (245–208 million years ago) the Jurassic (208–144 million years ago) and the Cretaceous (144–66.4 million years ago).

The pteridosperms continued as an important component of the world's flora until they died out during the middle Mesozoic. By contrast, the cycads rose to dominance during this time. The Jurassic Period is often described as the "Age of Dinosaurs" or as the "Age of Cycads", for both reached their heights of abundance and diversity at this time. However, the "cycads" in that context is used very broadly also to include the cycadeoids, a group which later became extinct. Despite the similarities in their names, the cycadeoids differed in many ways, both vegetatively and reproductively, from the true cycads. The impressive and well-preserved "cycad" stems from the Black Hills of North Dakota, U.S.A. (highly sought after by collectors) are not true cycads but mostly trunks of the genus *Cycadeoidea* (Wieland 1906).

The final period of the Mesozoic, the Cretaceous, was the time when angiosperms made their appearance. It is thought that the angiosperms originated, through a process involving enclosure of ovules, from a line which can again be traced back to the pteridosperms, i.e. monophyletically. The flowering plants became increasing successful due to their vigorous and efficient reproduction processes. In particular, their shorter generation times allowed for more frequent genetic recombinations and hence greater diversity (Norstog 1987). As a result, the angiosperms were able to outcompete the gymnosperms which, with a few notable exceptions, generally declined in significance. The present 1000-odd gymnosperm species represent just less than 0.5% of all the flowering plants (K.D. Hill 1998), although some, like the conifers of the temperate forests of the northern hemisphere, are major contributors to the world's biomass.

## SOME IMPORTANT MESOZOIC CYCADS

Mesozoic cycads are well represented in all continents as fossilised stems, leaves and male and female reproductive parts. The general impression one gets from the various reconstructions is as follows: plants had somewhat slender stems, occasionally branched, and without any distinctive armour of persistent leaf bases. The stem apex supported a crown of leaves that were sometimes broadly simple and sometimes pinnately divided; leaves were mostly deciduous. Leaflets sometimes had a distinctive midrib but were more often without a midrib of any kind. Male cones generally comprised a packed structure of pollen-bearing scales while the seed-bearing megasporophylls were loosely organised in a manner conducive to wind pollination.

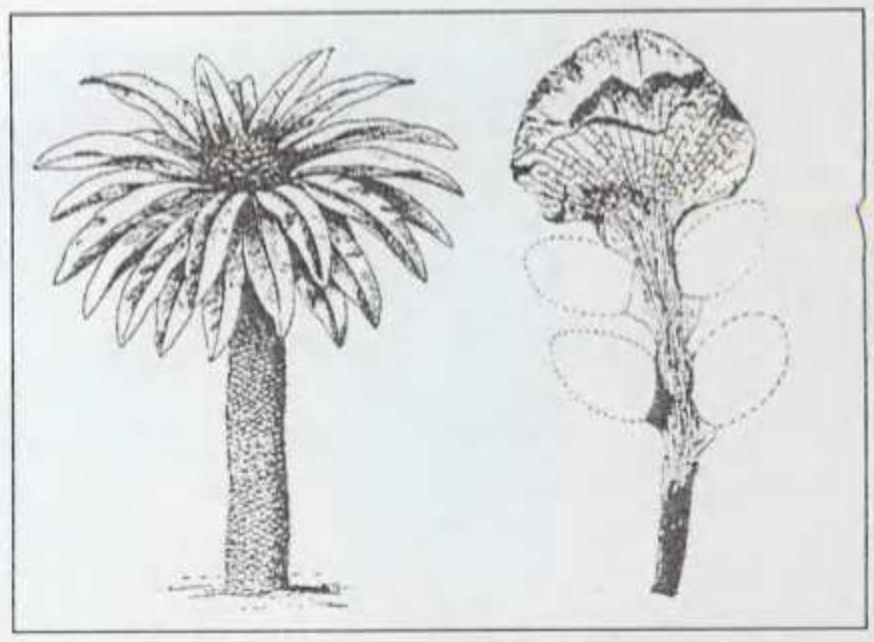


**Figure 3 The reconstruction of *Bjuvia simplex* with *Palaeocycas integer* from fossils across the Triassic/Jurassic boundary in Sweden (Norstog & Nicholls 1997 ex Florin 1933).**

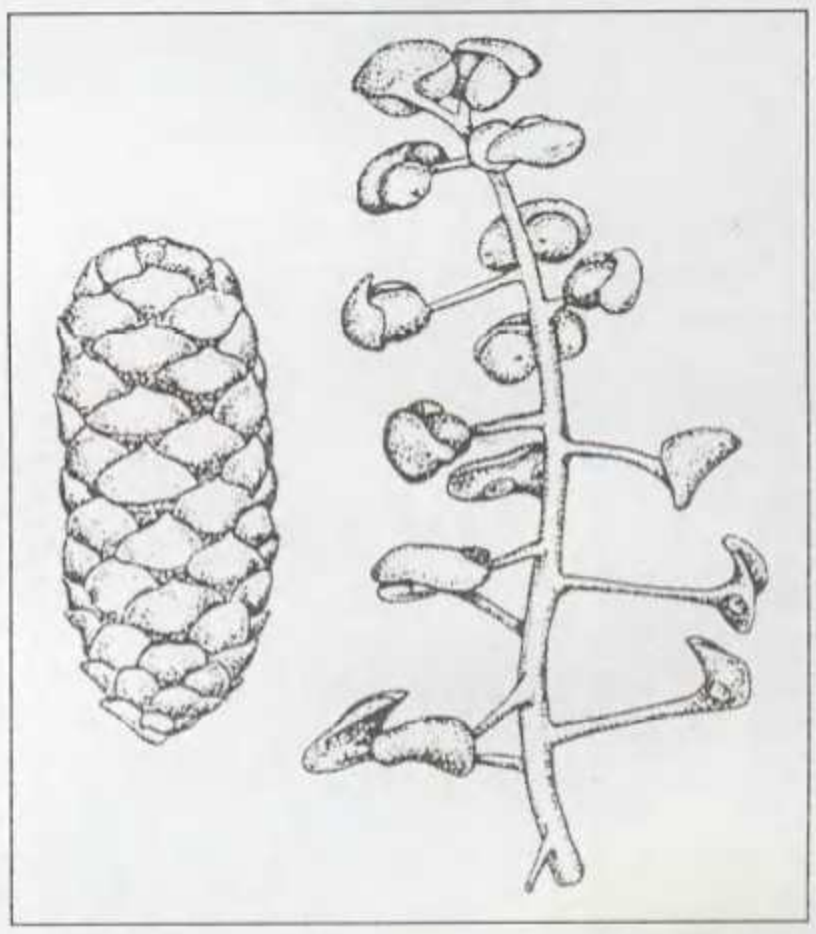


**Figure 4 The compact male cone *Androstrobus manis* and the associated much looser female "cone" *Beania gracilis* from Jurassic deposits in Yorkshire (Norstog & Nicholls 1997 ex Harris 1964).**

A well-known cycad fossil reconstruction is that by Rudolf Florin (1933) using Swedish *Bjuvia simplex* (Figure 3) foliage in association with the sporophylls of *Palaeocycas integer*. Another commonly-cited "compound" reconstruction is that of *Beania gracilis*. This species was named

from a megasporophyll found in Jurassic deposits of Yorkshire but is now thought to be the same plant as male cones called *Androstrobus manis* (Figure 4), large pinnate leaves known as *Nilssonia compta* and scale leaves named *Deltolepis crepidota* (Harris 1941). Similarly, *Beania mamayi* female material is associated with *Androstrobus wonnacotti* male cones and the leaves of *Nilssonia tenuinervis*. These fossil species are collectively grouped in their own cycad family, the Nilssoniaceae, equal in rank to the Cycadaceae, Stangeriaceae and Zamiaceae (Norstog and Nichols 1997).

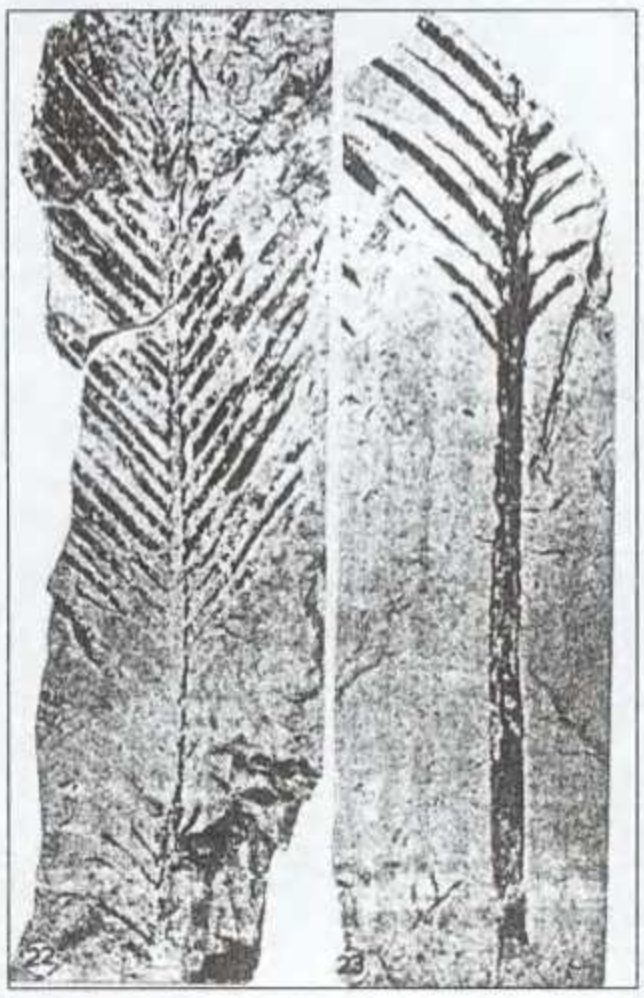


**Figure 5 Portion of the leaf of *Leptocycas gracilis* from the late Triassic of North Carolina (Pant 1973 ex Delevoryas & Hope 1971).**

Another often-cited cycad fossil is the slender-trunked *Leptocycas gracilis* (Figure 5), discovered as a series of leaves, stems and male cones by Ted Delevoryas and colleagues from Upper Triassic strata in North Carolina. This plant appears to have some similarities with the modern *Zamia*. *Dioonitocarpidium* (Figure 6) is a more bizarre Triassic reconstruction which has all the appearances of a flamboyant ladies' hat at some fashionable social occasion.

Other Mesozoic fossils show close analogies to *Cycas*, e.g. leaf material of *Aricycas paulae* (Figure 7) from the Late Triassic in Arizona and a well-preserved leaf, mega-sporophyll and seed composite named *Cycas steenstrupi* from the Upper Cretaceous in Greenland (Wieland 1906). But this era also reveals plants which may be ancestral to *Dioon, Encephalartos* and *Stangeria*. Forms relating to *Dioon* are found from South America, Asia and Europe, indicating an early and widespread occurrence for this genus; e.g. a well-preserved stem called *Lyssoxylon grigsbyi* from the Upper Triassic in New Mexico is remarkably similar to that of the present-day *Dioon spinulosum*. The renowned South African geologist, Alec du Toit, described 12 species of Jurassic fossil cycads in 9

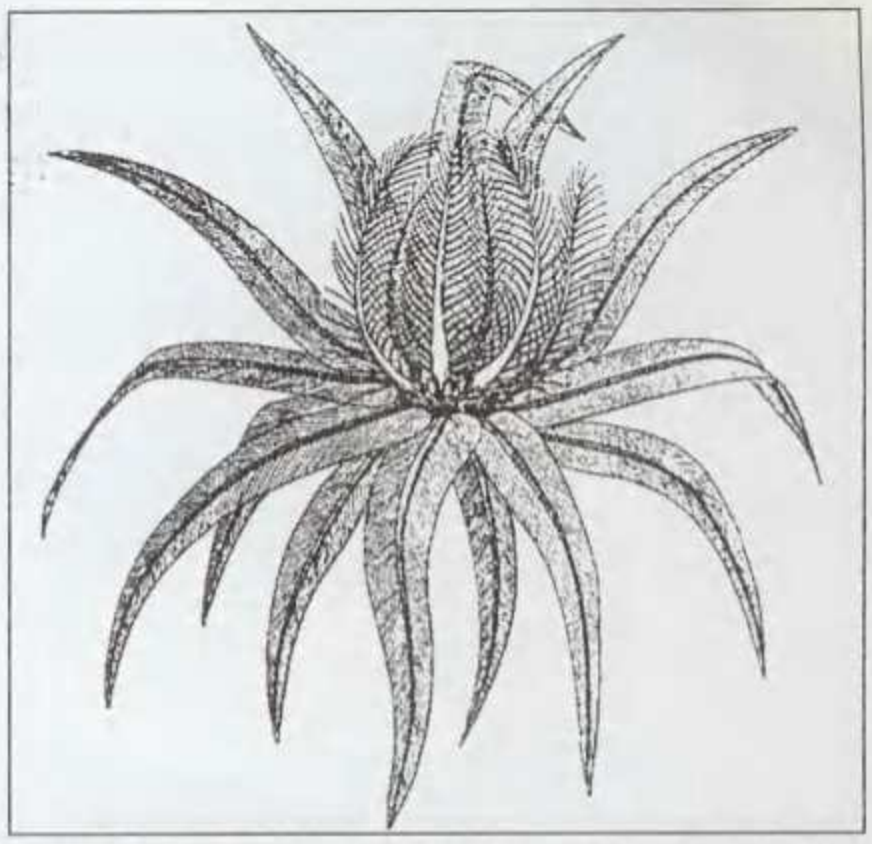


**Figure 6 Reconstruction of *Dioonitocarpidium* from the late Triassic of Bavaria (Norstog & Nicholls 1997 ex Mamay 1976).**

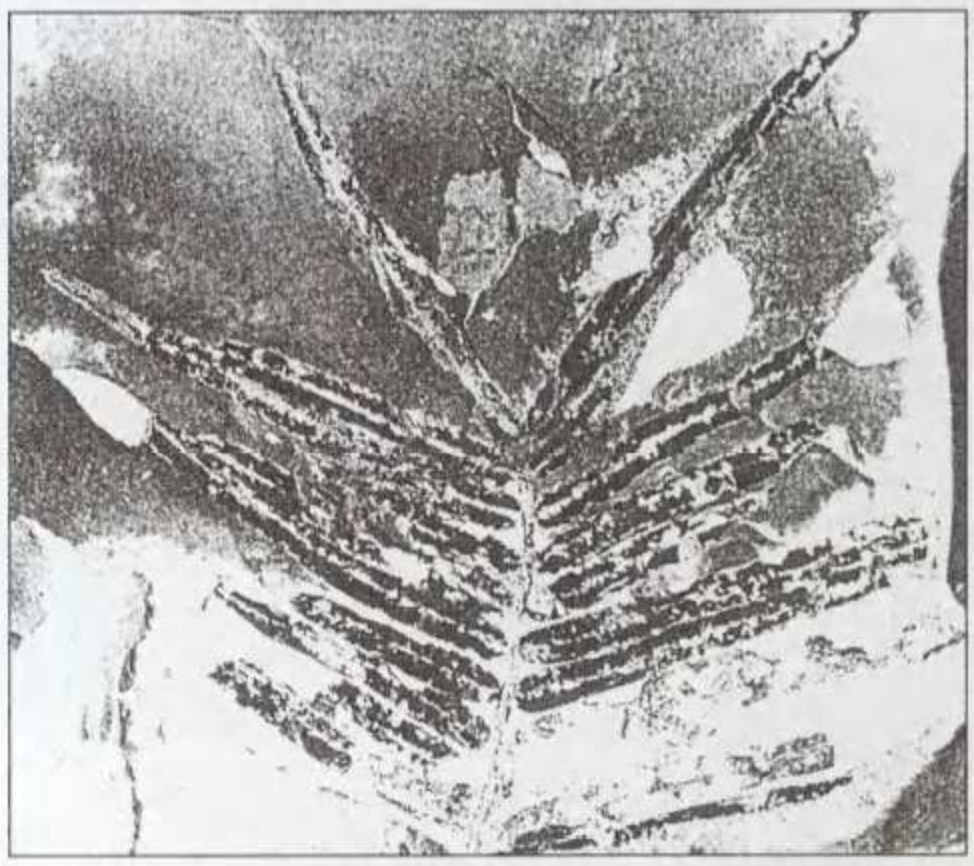


**Figure 7 Leaf of *Aricycas paulae* from the late Triassic of Arizona, showing a prominent midrib in each of the leaflets (Norstog & Nicholls 1997 ex Ash 1991).**

genera in the Eastern Cape area of South Africa. In particular, his specimen of *Zamites recta* from the Sundays River Valley is comparable with the extant *Encephalartos longifolius* (Dyer 1965). *Stangeria* was almost certainly of fairly early Mesozoic origin with fossil precursors found from the Jurassic strata of Argentina (e.g. *Mesodescolea* leaves) and England (e.g. male cones of *Androstrobus zamioides*). *Bowenia* too appears to go back to the Triassic in an affinity with *Antarcticycas schopfii* from the Middle Triassic of Antarctica.

## THE CENOZOIC ERA MODERN TIMES (Figure 8)

Our present Cenozoic Era, extending over the past 65 million years, comprises two main periods. Mass extinctions of the older floras resulted from major changes in sea level and climate with episodes of intense volcanic

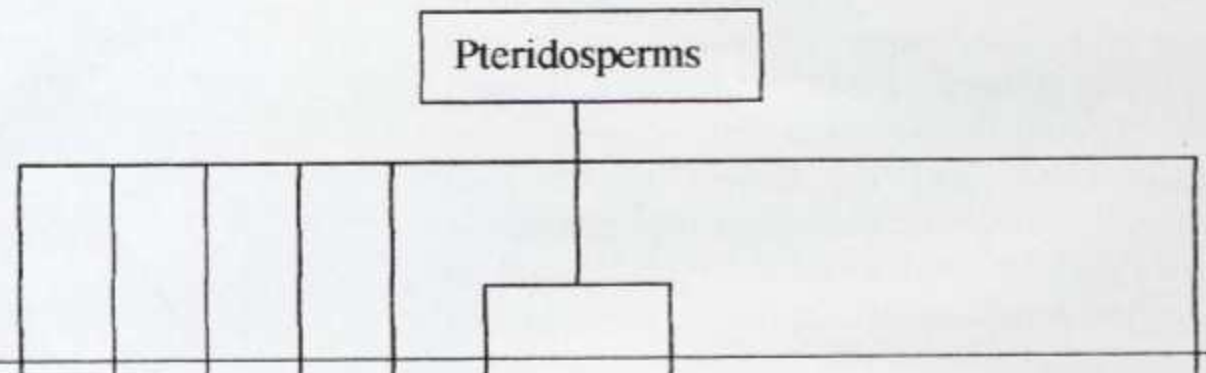
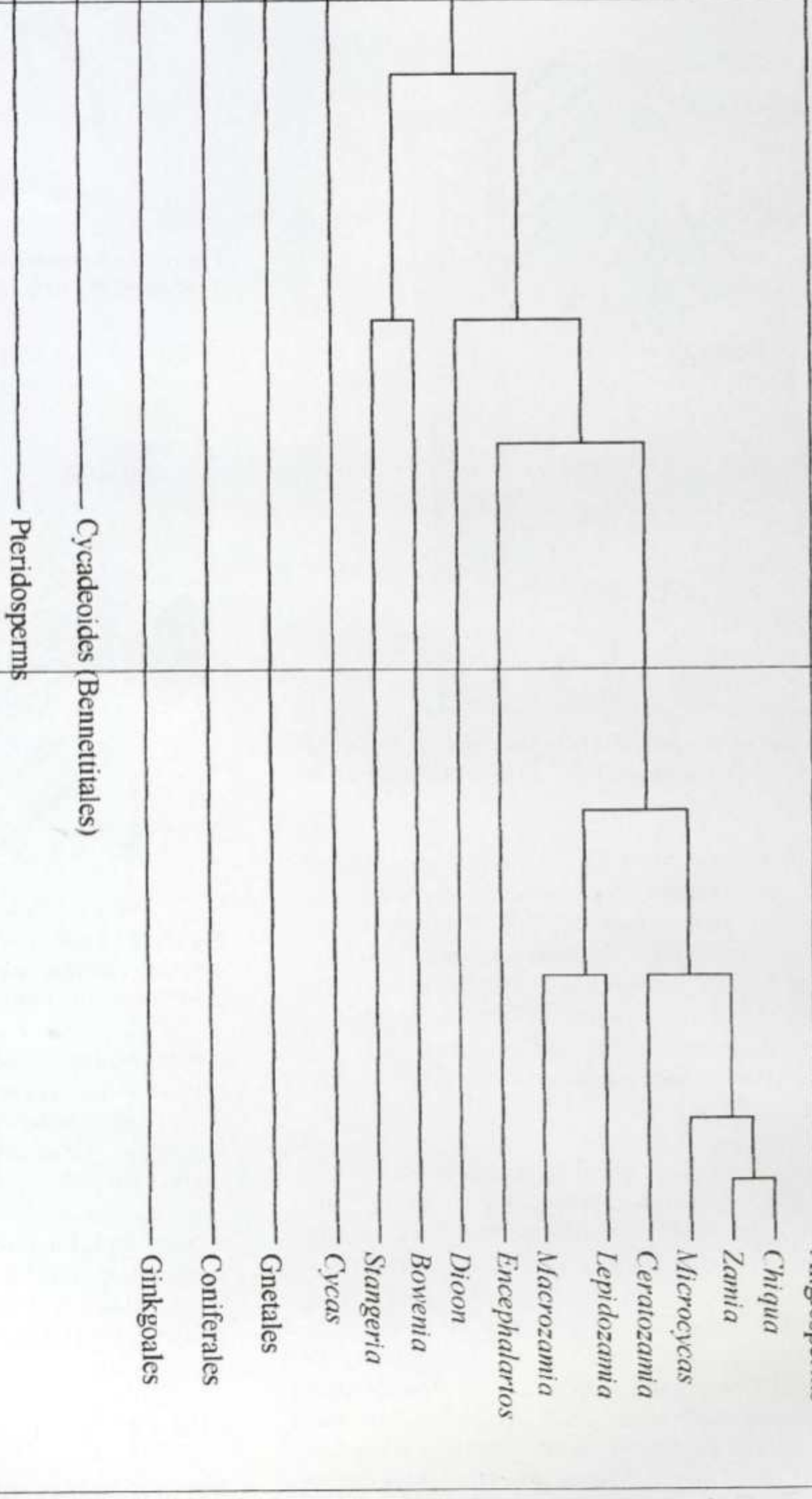
| Geological Time | Evolutionary trace |
|---|---|
| Palaeozoic Era<br>Carboniferous Period<br><br>Permian Period |  |
| Mesozoic Era<br>Triassic Period<br><br>Jurassic Period<br><br>Cretaceous Period |  |
| Cenozoic Era<br>Tertiary Period<br>Palaeocene<br>Eocene<br>Oligocene<br>Miocene<br>Pliocene<br><br>Quarternary Period<br>Pleistocene<br><br>Holocene | |



**Fig 8: A possible evolutionary route for the extant cycads, based on evidence from the fossil records and on current cladistic interpretations (e.g. Loconte & Stevenson 1990, Stevenson 1990).**

activity which signalled the start of the Tertiary (Palaeocene>Eocene>Oligocene>Miocene>Pliocene). This was followed by a huge glaciation which heralded the Quaternary (Pleistocene>Holocene). Only during this era do we see the appearance of a wide range of the present cycad genera. It is significant that many of our extant cycads are in fact *younger* than the early angiosperms.

## SOME IMPORTANT CENOZOIC CYCADS

Once again, *Cycas* is evident in this era. A fossil named *Cycas fujiana* from Japan is so similar to the present *C. revoluta* as to be almost indistinguisable (Pant 1987). Significantly, the complete absence of *Cycas* fossils in Australia, coupled with the fact that only one subsection of one section of *Cycas* occurs there, must mean that the genus migrated southwards long after its Asian origin, probably in the Tertiary Period (K.D. Hill 1998). Thus, although some of the extant *Cycas* species are almost unchanged from very early origins, the Australian *Cycas* representatives must be considered relatively modern.

But also very significant is the number of Cenozoic fossils which are clearly assignable to modern cycad genera. The list includes: *Bowenia eocenica, B. papillosa, Lepidozamia foveolata, L. hopeites* and *Macrozamia australis* from Australia, *Ceratozamia wrightii, Dioon inopinum* and *D. praespinulosum* from Alaska, *Ceratozamia hoffmannii* from Switzerland, *Encephalartos gorceixianus* from Greece, *Encephalartos cretaceus, Zamia coloradoensis, Z. tennesseeana, Z. mississippiensis, Z. wilcoxiensis* and *Z. wyomingensis* from the USA, *Zamia australis* and *Z. tertiaria* from South America and *Zamia collazoensis* and *Z. noblei* from the Caribbean.

It is also important to note that many fairly recent cycads are already extinct. By way of example, Robert Hill (1998) describes the Cenozoic genus *Pterostoma* which is widespread in Eocene and Oligocene strata of Australia and New Zealand. This genus appears to have affinities with *Dioon* but is now wholly extinct.

## CONTINENTAL DRIFT

A major influence on evolution of plants and animals was that of continental drift. At the start of the Mesozoic, the terrestrial world was a single landmass known as Pangaea. In the mid-Jurassic, about 180 million years ago, Pangaea separated into two supercontinents, the northern landmass of Laurasia and the southern landmass of Gondwana. For the first time, effective gene-flow in cycads was stopped and the plants became progressively more different as the landmasses drifted apart. These separation and speciation processes became more pronounced as Laurasia took shape into the present Asia and North America, while Gondwana slowly fragmented into Australia, Africa, South America, India, Antarctica, New Guinea and New Zealand. Each of these new landmasses had their own topography and climate, and each ultimately developed their unique floras.

Further speciation occurred in local niches such as coastal sand masses, wet and dry forests, grasslands, semi-deserts and volcanic islands. Although the final separation of the continents occurred only 45 million years ago, the underlying processes continue even today. In this context, *Dioonopsis* is interesting because this fossil, known from Japan, Yorkshire, Alaska and California, is clearly related to the extant genus *Dioon*, found only from Mexico and Honduras.

## RELATIONSHIPS WITH INSECTS

Recent advances in our knowledge of cycad-insect relationships have a major impact on evolutionary theory: these developments are summarised in a four-part review by Osborne and Oberprieler (in preparation for future "*Encephalartos*" issues). We maintain in that review that primitive cycads were wind-pollinated and only the relatively small number of species, which adopted strategies such as symbiotic associations with insects, were able to survive in the long term. The controversial aspect of our theory is that we propose that the extant cycads "copied" (more correctly, they independently developed) these techniques from the angiosperms - quite the opposite of the more conventional assumptions.

## CONCLUSION

The fossil evidence presented above allows for the following general conclusions: (a) the oldest genus, *Cycas*, originated in the Palaeozoic, (b) the genera *Stangeria, Bowenia, Dioon* and *Encephalartos* were established during the Mesozoic, (c) the remaining genera in the Zamiaceae came into their own during the Cenozoic. While it is entirely reasonable to say that the cycads *as a group* have an origin dating back 250 million years, this is not true for the individual extant species. The current *species*, with few exceptions, are probably of fairly Cenozoic origin.

Any hypotheses about the origin of and relationships in cycads must be assessed in terms of the "snapshot" we have in the world's flora at present. Furthermore, these relationships must be continuously revised as new evidence comes to light. These endeavours provide a remarkable opportunity for the interaction of scientists from many different disciplines and "progress through controversy" seems to be the order of the day. Perhaps the most exciting prospects lie in the realm of DNA technology. It is now possible to take a tiny fragment of material from any sort of biological original and, fairly rapidly, find out its entire pedigree. These techniques are revealing the presence of a built-in but somewhat erratic biological clock that allows one to estimate the rate of random genetic changes. The more "different" organisms of a single lineage are from one another, the further back in time one must go to find their common ancestor. This is a powerful tool in drawing up evolutionary trees based on solid evidence and there is optimism that we are now getting close to the truth.

**TABLE 1: SOME CYCAD OR CYCAD-LIKE FOSSILS**

**(A) PALAEOZOIC**

| Fossil genus | Locality | Geological time | Plant Part |
|---|---|---|---|
| Archaeocycas whitei | South-western USA | Lower Permian | Megasporophylls |
| *Crossozamia chinensis* | Taiyuan, China | Lower Permian | Megasporophylls |
| *Crossozamia cucullata* | Taiyuan, China | Lower Permian | Megasporophylls |
| *Crossozamia minor* | Taiyuan, China | Lower Permian | Megasporophylls |
| *Crossozamia spadicea* | Taiyuan, China | Lower Permian | Megasporophylls |
| *Cycadoxylon fermyi* | France | Lower Permian | Stem |
| *Dioonites densinervis* | China | Permian | Leaf |
| *Lasiostrobus polysacchi* | North America | Upper Carboniferous | Male cone |
| *Lesleya* | | Carboniferous | Leaf/megasporophyll |
| *Phasmatocycas kansana* | Kansas, USA | Permian | Megasporophyll |
| *Phasmatocycas spectabilis* | Texas, USA | Permian | Megasporophyll |
| *Plagiozamites plauchardii* | | Carboniferous | Leaf |
| *Primocycas chinensis* | Eastern China | Lower Permian | Megasporophylls |
| *Ptychoxylon* | | | Stem |
| *Sobernheimia jonkeri* | Germany | Lower Permian | Fructification |
| *Taeniopteris* | USA | Permian | Leaves |
| *Tianbaolinia circinalis* | Taiyuan, China | Lower Permian | Leaf and leaflet fragments |
| *Yuania chinensis* | Taiyuan, China | Lower Permian | Leaf fragments |
| *Yuania striata* | Taiyuan, China | Lower Permian | Leaf fragments |

**(B) MESOZOIC**

| Fossil genus | Locality | Geological time | Plant part |
|---|---|---|---|
| *Almargemia dentata* | Portugal | Cretaceous | Leaves |
| *Almargemia incrassata* | Santa Cruz, Argentina | Lower Cretaceous | Leaf fragments |
| *Androstrobus balmei* | Yorkshire | Jurassic | Male cone fragments and pollen grains |
| *Androstrobus manis* | Yorkshire | Jurassic | Male cone fragments and pollen grains |
| *Androstrobus prisma* | Yorkshire | Jurassic | Male cones |
| *Androstrobus triassicus* | | Triassic/Jurassic | Male cones |
| *Androstrobus wonnacotti* | Yorkshire | Jurassic | Male cone and pollen grains |
| *Androstrobus zamioides* | Yorkshire | Jurassic | Male cone and pollen grains |
| *Antarcticycas schopfii* | Antartica | Middle Triassic | Stem fragments |
| *Aricycas paulae* | Arizona, USA | Late Triassic | Leaf and leaflets |
| *Beania carruthersii* | Scotland | Jurassic | Female cone fragments and seeds |
| *Beania gracilis* | Yorkshire | Jurassic | Megasporophylls and seeds |
| *Beania kochi* | Greenland | Jurassic | Megasporophylls and seeds |
| *Beania mamayi* | | | Megasporophylls |
| *Bjuvea simplex* | Sweden | Triassic/Jurassic | Leaves |
| *Ctenis biloba* | | | Leaf |
| *Ctenis japonica* | Rio Negro, Argentina | Triassic | Leaf |
| *Ctenis kaneharai* | Yorkshire and Manchuria | Jurassic | Leaves |
| *Ctenis patagonica* | Chubut, Argentina | Jurassic | Leaf |
| *Ctenis pontica* | Transcaucasia | Middel Jurassic | Leaves |
| *Ctenis reedii* | Yorkshire | Jurassic | Leaves |
| *Ctenis sulicaulis* | Yorkshire | Jurassic | Leaves |
| *Ctenis takamaiana* | Mendoza, Argentina | Upper Triassic | Leaf |
| *Ctenozamites* | | | Leaves |
| *Cycadites jabalpurensis* | India | Cretaceous | Leaves |
| *Cycadites rectangularis* | Transcaucasia | Jurassic | Leaves |
| *Cycadospadix hannoqcuei* | Various regions | Jurassic | Megasporophylls |
| *Cycadospadix pasinianus* | | Jurassic | Megasporophylls |
| *Cycas steenstrupi* | Greenland | Upper Cretaceous | Megasporophyll, leaf and seeds |
| *Danaeopsis angustifolia* | Germany | Triassic | Leaves |

| | | | |
|---|---|---|---|
| *Deltolepis crepidota* | Yorkshire | Jurassic | Cataphylls |
| *Dioonites borealis* | N.W. Canada | Cretaceous | Leaves |
| *Diooniticarpidium pennaeforme* | Germany | Triassic | Megasporophyll |
| *Doratophyllum astarensis* | Greenland | Triassic/Jurassic | Leaves |
| *Encephalartos cretaceous* | Dakota, USA | Cretaceous | Leaves |
| *Fascivarioxylon mehtae* | India | Jurassic | Stem |
| *Glandulataenia glandulatus* | Nidhpuri, India | Triassic | Leaflet fragments |
| *Glandulataenia triassicus* | Nidhpuri, India | Triassic | Leaflet fragments |
| *Kurtziana branmayri* | Argentina | Triassic & Jurassic | Leaves |
| *Kurtziana cacheutensis* | Argentina | Triassic & Jurassic | Leaves |
| *Lepacyclotes triphyllus* | | Triassic | Megasporophylls |
| *Leptocycas gracilis* | North Carolina, USA | Upper Triassic | Whole plant |
| *Lyssoxylon grigsbyi* | Arizona & New Mexico, USA | Upper Triassic | Stem |
| *Mesodescolea plicata* | Santa Cruz, Argentina | Lower Cretaceous | Leaves |
| *Michelilloa waltonii* | San Juan Province, Argentina | Triassic | Stem fragments |
| *Moltenia dentata* | South Africa | Triassic | Leaves |
| *Nilssonia clarky* | Santa Cruz, Argentina | Lower Cretaceous | |
| *Nilssonia compta* | Yorkshire | Juarssic | Leaves |
| *Nilssonia grandiflora* | Transcaucasia | Middle Jurassic | Leaves |
| *Nilssonia kendallii* | Yorkshire | Juarassic | Leaves |
| *Nilssonia princeps* | India & Argentina | Triassic & Jurassic | Leaves |
| *Nilssonia taeniopteroides* | Argentina & Anatarctica | Triassic, Jurassic & Cretaceous | Leaves |
| *Nilssonia tenuinervis* | | | Leaves |
| *Nilssonia variabilis* | Transcaucasia | Middle Jurassic | Leaves |
| *Nilssonia vittaeformis* | Transcaucasia | Middle Jurassic | Leaves |
| *Nilssoniocladus nipponense* | Japan | Lower Cretaceous | Stems and leaves |
| *Otozámites hespera* | Oaxaca, Mexico | Jurassic | Leaves |
| *Palaeocycas integer* | Sweden | Triassic/Jurassic | Megasporophylls |
| *Paracycas blomquistii* | | | Leaves |
| *Paracycas brevipinnata* | Transcaucasia | | Leaves |
| *Paracycas cteis* | Yorkshire | Mesozoic | Leaves |
| *Paracycas harissii* | Russia | | Leaves |
| *Paracycas intermedia* | Russia | | Leaves |
| *Paracycas raripinnata* | Russia | | Leaves |
| *Pseudoctenis anomozamoides* | San Juan, Argentina | Triassic | Leaves |
| *Pseudoctenis barrealensis* | Argentina | Triassic & Jurassic | Leaves |
| *Pseudoctenis capensis* | Rio Negro, Argentina | Triassic | Leaves |
| *Pseudoctenis carteriana* | Argentina | Upper Triassic | Leaves |
| *Pseudoctenis crassa* | Santa Cruz, Argentina | Cretaceous | Leaves |
| *Pseudoctenis ctenophylloides* | San Juan, Argentina | Triassic | Leaves |
| *Pseudoctenis dentata* | Santa Cruz, Argentina | Lower Cretaceous | Leaves |
| *Pseudoctenis eathiensis* | Santa Cruz, Argentina | Jurassic | Leaves |
| *Pseudoctenis ensiformis* | Antarctica | Upper Jurassic – Lower Cretaceous | Leaves |
| *Pseudoctenis falconeriana* | Argentina | Triassic | Leaves |
| *Pseudoctenis fissa* | San Juan, Argentina | Middle Triassic | Leaves |
| *Pseudoctenis giganteus* | Santa Cruz, Argentina | Lower Cretaceous | Leaves |
| *Pseudoctenis grandifolia* | Rio Negro, Argentina | Triassic | Leaves |
| *Pseudoctenis groeberiana* | San Juan, Argentina | Middle Triassic | Leaves |
| *Pseudoctenis harriesi* | Yorkshire | | Leaves |
| *Pseudoctenis harringthoniana* | San Juan, Argentina | Middle Triassic | Leaves |
| *Pseudoctenis lanei* | Yorkshire | Jurassic | Leaves |
| *Pseudoctenis locusta* | Yorkshire | | Leaves |
| *Pseudoctenis spathulata* | Rio Negro, Argentina | Triassic | Leaves |
| *Pseudoctenis spectabilis* | Rio Negro, Argentina | Triassic | Leaves |
| *Pseudoctenis wardii* | Rio Negro, Argentina | Triassic | Leaves |
| *Pseudopterophyllum cteniforme* | Sweden | | Leaves |
| *Sanchucycas gigantea* | Japan | Cretaceous | Stem |

| | | | |
|---|---|---|---|
| *Sueria rectinervis* | Santa Cruz, Argentina | Lower Cretaceous | |
| *Tetoria endoi* | Japan | Lower Cretaceous | Leaves |
| *Ticoa harrissi* | Santa Cruz, Argentina | Lower Cretaceous | |
| *Ticoa jeffersoni* | Antarctica | Jurassic & Cretaceous | |
| *Ticoa magallanica* | Chile | Cretaceous | |
| *Ticoa lamellata* | Santa Cruz, Argentina | Lower Cretaceous | |
| *Ticoa magnipinnulata* | Santa Cruz, Argentina | Lower Cretaceous | |
| *Walkomia feistmantelii* | Tasmania | Triassic | Leaves |
| *Zamioidea keuperiana* | | Triassic | Megasporophylls |
| *Zamia macrozamiodes* | | Triassic | Megasporophylls |
| *Zamites lucerensis* | Oaxaca, Mexico | Jurassic | Leaves |
| *Zamites recta* | South Africa | Upper Jurassic | Leaves |
| *Zamiostrobus stenorachis* | | Jurassic | Female cone |

**(C) CENOZOIC**

| **Fossil genus** | **Locality** | **Geological time** | **Plant part** |
|---|---|---|---|
| *Anomozamites muelleri* | New South Wales, Australia | Eocene | Leaves |
| *Bororea andreisii* | Chubut, Argentina | Lower Tertiary | Stem |
| *Bororea anzulvichii* | Chubut, Argentina | Lower Tertiary | Stem |
| *Bowenia eocenica* | Victoria, Australia | Middle Eocene | Leaflet fragments |
| *Bowenia papillosa* | New South Wales, Australia | Middle Eocene | Leaflet fragment |
| *Ceratozamia hoffmannii* | Austria | Miocene | Leaves |
| *Ceratozamia wrightii* | Alaska | Eocene | Leaf fragments |
| *Ceratozamites vicetinus* | Italy | Oligocene | Leaves |
| *Cycadites escheri* | Switzerland | Miocene | Leaf |
| *Cycas fujiana* | Kyushu, Japan | Eocene | Leaf fragment |
| *Dioon inopinum* | Alaskia | Eocene | Leaf fragments |
| *Dioon praespinulosum* | Alaska | Eocene | Leaf fragments |
| *Dioonopsis nipponica* | North-eastern Japan | Palaeocene | Leaves and leaflets |
| *Encephalartos cretaceous* | South Dakota & Kansas, USA | | |
| *Encephalartos gorceixianus* | Greece | Miocene | Leaves |
| *Eostangeria saxonica* | Germany | Middle Eocene | Leaves |
| *Lepidozamia foveolata* | New South Wales, Australia | Middle Eocene | Leaflet fragment |
| *Lepidozamia hopeites* | Victoria, Australia | Oligocene | Leaf fragments |
| *Macrozamia australis* | Tasmania, Australia | Lower Oligocene | Leaf fragment |
| *Manucoa cazaui* | Rio Negro, Argentina | Lower Tertiary | Stem |
| *Pterostoma anastomosans* | New South Wales, Australia | Middle Eocene | Leaf fragment |
| *Pterostoma hirsutus* | Tasmania, Australia | Lower Eocene | Leaves |
| *Pterostoma zamioides* | Victoria, Australia | Middle Eocene | Leaves |
| *Zamia australis* | Argentina | Oligocene/Lower Miocene | Leaf portion |
| *Zamia collazoensis* | Puerto Rico and Virgin Islands | Upper Eocene/Oligocene | Leaves |
| *Zamia coloradoensis* | Colorado, USA | Palaeocene | Leaves |
| *Zamia mississipiensis* | Mississipi, USA | Lower Eocene | Leaf and leaflet fragments |
| *Zamia noblei* | Puerto Rico and Virgin Islands | Upper Eocene/Oligocene | Leaves |
| *Zamia tennesseeana* | Tennessee, USA | Lower Eocene | Leaflet |
| *Zamia tertiaria* | Argentina & Chile | Lower Miocene | Leaflet fragments |
| *Zamia wilcoxensis* | Louisiana, USA | Lower Eocene | Leaflet |
| *Zamia wyomingensis* | Wyoming, USA | Palaeocene | Leaves |
| *Zamiostrobus saportanus* | France | Miocene | Cone |
| *Zamiphyllum sambiense* | Germany | Miocene | Leaves |
| *Zamites epibius* | France | Miocene | Leaves |

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# ARTICLES / ARTIKELS

## BUCKAWAYO: CYCAD HAVEN (OR IS THAT HEAVEN?)

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*Received 19 October 2001*

Buckawayo is the name of my farm at Letsitele in the far Northern Province of South Africa. Buckawayo is very central to many of the exceptionally rare species of *Encephalartos* found in this area. The climate is wonderfully hot in summer, on a good day the mercury will touch 40°C. The converse to this is that on the coldest night in July the temperature will not drop below 5°C.

When I bought the farm in November 1997 it was an abandoned mango farm. The reason for this was very simple, almost no water during the last severe drought in 1991.

With good rains over the last eight years the water table has risen significantly but water is a very precious resource on the farm and with this uppermost in my mind I reckoned that cycads would be well suited to cultivating at Buckawayo.

Only 30 kms to the east is the habitat of *Encephalartos dyerianus* fairly safe in its mountain eyrie, access to this habitat is very difficult, only 4-wheel drive vehicles can get there. It is almost impossible for private visitors to get to these cycads.

About 200 kms to the north is the very vulnerable habitat of *E. hirsutus*. Back at Buckawayo you can see the very impressive range of mountains known as the northern Drakensberg (Dragon Mountain). It is here within sight of Buckawayo that three critically endangered species grow, namely *E. nubimontanus*, *E. dolomiticus* and *E. brevifoliolatus*. I fear that *E. dolomiticus* is probably represented by less than fifty plants in habitat. The population of *E. nubimontanus* is supposedly a little more stable but still critically endangered. The status of *E. brevifoliolatus* is also very unstable. According to what one reads there are "only five widely separated specimens" that were located, all male plants.

To the east of the habitat of these three species also on top

of this mountain range one finds a peak known as Mariepskop, the site of a military radar station, installed in the 1960's to watch over the sub-continent. In a very deep ravine at the bottom of the Klaserie River waterfall you will find a handful of the critically rare green form of *E. laevifolius*, also known as the "Mariepskop laevifolius".

Back at Buckawayo if you were to travel northwest for 30 kms you would arrive at the magnificent Modjadji forest - home of the giant *E. transvenosus*. Status of this cycad is given as safe. The feeling one gets when you first set eyes on these behemoths is impossible to describe, one has to experience the sight to understand eternity. Some plants are fifteen metres tall.

**Figure 1 This *Encephalartos inopinus* was planted on the 14 th February 2001 at Buckawayo and on the 1st October 2001 it started pushing a cone. Plants in the background are *E. laevifolius*.**

The second last species you will encounter in fairly close proximity to Buckawayo is *E. inopinus* (Figure 1) growing on the same range of mountains near Penge, the site of an old asbestos mine. I am afraid to say that this species is on the verge of extinction. Earlier this year a local farmer was charged with having 56 of these plants in his possession. These plants had all been poached from the wild. This very unique and beautiful cycad will probably only be represented in cultivation in the future.

The last cycad species close to Buckawayo is the miniature *E. cupidus*. This plant occurs in the Blyde River Canyon where it has been poached to virtual extinction. At the Cycad Conference in Miami in 1999 we were told that a local muti man (medicine man) had chopped out 45 plants for use in traditional healing.

Within 150–200 km to the south and southwest another seven species grow, namely *E. eugene-maraisii, E. middelburgensis, E. lanatus, E. humilis, E. paucidentatus, E. laevifolius* and *E. heenanii*.

Sorry, I had almost forgotten I should be writing about the cycads growing at Buckawayo. Having an idea is easy, having an ideal requires a little more thought but combining the idea and the ideal requires a vision. A vision associated with cycads requires a lot of money. This was the hard part.

A few options were available to me to try and contact cycad growers and cycad enthusiasts. I used three books as a reference source, Dyer's book in *Bothalia*, Goode's book "Cycads of Africa" and, lastly, Cynthia Giddy's book "Cycads of South Africa". In the acknowledgement section of all three books names were given of people who had helped to gather information for the books. Unfortunately about 90% of the people mentioned had already passed away, but I was able to find about five people whom I contacted and and who were able to give me the names of people they knew who collected cycads. From these people whom I contacted I was able to acquire some of my very earliest plants. As time passed and I became more discerning as to whom I could buy from I also found very reliable sources of seed and seedlings.

In order for me to afford more plants I started trading in cycads. I soon found out that this was not an easy game. Plants were very expensive, especially the very rare ones. The other major problem I encountered was the ease with which a plant would die. I am very pleased to say that in the six years I have learnt what not to do with cycads.

My collection of seedlings was growing fairly well, both in numbers and in size, but I still had no permanent place for them. This very important factor was enough motivation for me to aquire Buckawayo.

In August 1998 I planted my very first cycad in the ground at Buckawayo. With this very first planting I had assumed a very major responsibility towards the conservation of cycads. My aim with this venture was fourfold, firstly the totally hedonistic experience, cycads give me lots of pleasure. Secondly, the very important job of trying to become involved with conservation. Thirdly, this facility would be available for the training of University and Technikon students in the conservation and cultivation of cycads.

Lastly, the venture would not succeed if the commercial aspects were not part of the entire conservation ethic. I had to be very aware of the accuracy of seed and seedling sources. This was achieved by careful and thorough purchases. I was able to ascertain in our local journal,

"*Encephalartos*", that seed collecting trips had been done to certain African states. I contacted the person who led the expedition and from him I was able to buy many species of local and African cycads. Over the next year I was able to buy about 1000 African cycads. As fate would have it I received a call from this person one day saying that he had decided to emigrate and would I be interested in buying his cycads. Wow!! What a question? Of course I would and somehow I did.

The plants were all duly loaded and transported over a period of one month to our farm in Brits near Pretoria. From here I started transferring some of these plants to Buckawayo where they were replanted into new containers and marked. In the meantime lots of seed had germinated and had been planted into containers where they were growing into healthy young plants (Figure 2, .Colour Figure 18 on p. 32).

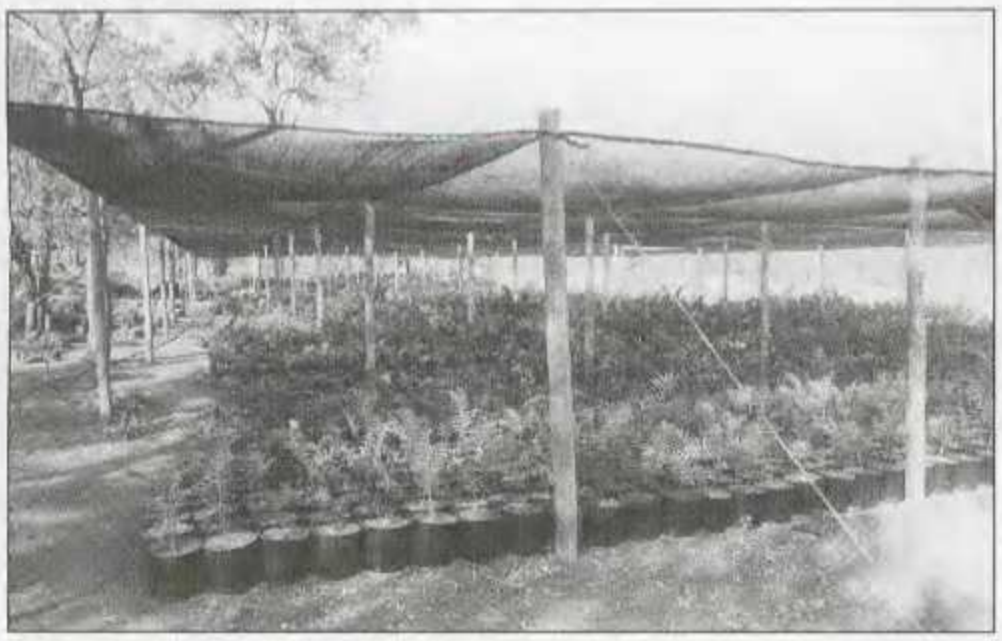

**Figure 2 Shadehouse No. 3. This is where the "African" species are being cultivated. Species being grown include *E. tegulaneus, E. manikensis, E. sclavoi, E. ferox, E. septentrionalis, E. concinnus, E. gratus, E. kisambo, E. laurentianus, E. hildebrandtii, E. umbeluziensis, E. turneri*, and lastly *E. chimanimaniensis*.**

**Figure 3 Some staff members preparing the planting holes. Plants in the background are *E. eugene-maraisii*.**

By January 1999 I had planted over 600 cycads in the ground (Figures 3, 4, 5), most of these 600 plants were *E. dyerianus, E. eugene-maraisii, E. middelburgensis, E. nubimontanus*, and *E. laevifolius*. *E. laevifolius* from four separate localities are growing at Buckawayo: (a) Kaapsche Hoop form, (b) Mariepskop form, (c) Tugela form, and (d) Downs form. A year after planting I measured and documented all the plants in the garden. The cycads were planted in a very informal setting, there were no straight line in the two-hectare garden. I used palm trees planted in the ground as initial shade protection for the young plants.

**Figure 4 About 200 plants of the *E. eugene-maraisii* complex have been planted. Several of thse plants are already coning, including the very endangered *E. dolomiticus*.**

**Figure 5 This area of the farm is being prepared for plantings of *E. cupidus*.**

One year after doing the measuring and documenting I repeated the procedure. My initial response was disap-

pointment but as I analyzed growth that had taken place I came to the conclusion that it is not possible for all the plants to grow at the same rate. The *E. middelburgensis* outperformed all four other species, second was the *E. laevifolius*, and third was *E. nubimontanus* with a moderate growth, fourth was *E. eugene-maraisii* and a very poor fifth was *E. dyerianus* which only grew by about 5% that year (diameter of caudex). The average growth was recorded for that year (minimum 20 plants):

| | |
|---|---|
| *E. middelburgensis* | 20% |
| *E. laevifolius* | 16% |
| *E. nubimontanus* | 15% |
| *E. eugene-maraisii* | 12% |
| *E. dyerianus* | 5% |

This trial has not been conducted scientifically but the data has been accurately recorded and documented.

In January of this year I decided that it was time to attempt a more accurate scientific experiment. What I needed was a very large shade house. After deciding which species and how many of each I wanted to plant I designed and built a shade house of 2400m$^2$.

The design is a structure of 100 metres long and 24 metres wide. Lengthwise the treated gum poles (125/150 mm) were planted at intervals of 5 metres, that is 21 poles. In the width the poles were planted at a distance of 6 metres apart. This gave me grid sections of 5m x 6m, a very workable 30m$^2$ per grid. This means that there are eighty grids of 30m$^2$ in the total area of 2400m$^2$. In the length I have lines A–D and in the width I have lines 1–20. Each one of the grids can be easily identified, A1–D20.

Depending on the size and species of the seedling I decided that I would allocate 30 plants per grid section, that is 1m$^2$ per plant. I intended planting 3 to 5 year old seedlings that had been container grown. In the case of some of the seedlings being older and larger, I would then allocate either 16 or 20 plants per grid section, 1.6–2.0m$^2$ per plant.

The structure was covered with a 40% black shade netting; the poles were secured using a plastic coated 6mm steel cable. The sides of this structure were left open allowing free wind flow as well as unrestricted access for working at any point in the shade house.

The soil is a sandy loam, very deep, red in colour, with exceptionally good drainage capabilities. The entire area was ploughed to a depth of 400mm; this was done to relieve soil compaction at an upper level. The entire area was then fertilized using organic phosphate (bone meal). Dolomitic lime was also applied at the rate of 100grms per square metre to raise the pH of the soil. The pH of the soil was analyzed at 5.2, and I will monitor the soil pH on an annual basis.

After completion of the structure and the ploughing of the soil nothing was done for a period of 30 days. This was to allow weeds to show, the weeds were removed and the area levelled to allow for the marking of the planting holes.

Each hole, measuring 400mm x 400mm across and 400mm deep, was dug and the soil removed to the exterior of the shade house. Once thirty holes had been dug and the soil removed we set about preparing the correct soil medium that would be used in the planting holes. The combination of mediums I decided to use is as follows. I screened the existing soil that had been removed from the holes, using a 15mm screen. I still needed fairly large particles as well as the smaller stones that the soil had contained. I used this soil at a rate of 1/3 mixed with a very clean coarse river sand also at a ratio of 1/3. To this I added, again at a ratio of 1/3, a very well composted and screened pine bark medium. This medium was measured to have and AFP (air filled porosity) of 30% that is very well drained yet still able to hold adequate moisture. For the actual planting I used an organic fertilizer again, bird guano from the platforms off our west coast. This fertilizer contains good N:P:K trace elements as well as a growth hormone. We decided to dig, prepare and plant 30 holes at a time. Once the cycad had been planted we recorded the diameter of its caudex, number of leaves, as well as overall condition of the plant.

a) Minimum of 25mm caudex diameter and 4 or better strong leaves (rating = 1)
b) Minimum of 20–25mm caudex diameter and 2–3 good strong leaves (rating = 2)
c) Less than 20mm caudex diameter and 1 leaf only (rating = 3).

The initial planning was to plant 23 species of cycads. Certain of these species would be planted in multiples of thirty. For example *E. tegulaneus* was available in fairly large quantities so I decided to plant 5 blocks of 30 plants per block, but as *E. munchii* and *E. septentrionalis* were not being easy to obtain I was only able to plant one block of each, that is 30 plants each of these two species. The seed of *E. tegulaneus* was collected from habitat. The seedlings of *E. munchii* I received from the curator of the Durban Botanical Gardens, while the seed of the *E. septentrionalis* was also habitat collected.

Using four people per grid block (30m$^2$), that is two labourers and two students, it took a full day to complete the entire exercise from digging the holes to mixing the medium to finally planting the relevant cycads.

The following cycads have already been planted in their appropriate blocks:

1) *E. lehmannii* - 4 blocks of 30 (=120 plants). A1, B1, C1, D1
2) *E. tegulaneus* – 5 blocks of 30 (=150 plants). A2–A6.
3) *E. middelburgensis* – 4 blocks of 30 (=120 plants). B2–B5.
4) *E. eugene-maraisii* – 5 blocks of 30 (=150 plants). B6, B7, B8, C2, C3.
5) *E. sclavoi* – 2 blocks of 30 (=60 plants). C4, C5.
6) *E. princeps* – 4 blocks of 30 (=120 plants). D2, D3, D4, D5.
7) *E. msinganus* – 2 blocks of 30 (=60 plants). A7, A8.
8) *E. cerinus* – 2 blocks of 30 (=60 plants). B9, B10.

9) *E. horridus* – 1 block of 30 (=30 plants). D8.
10) *E. umbeluziensis* – 1 block of 30 (=30 plants). D8.
11) *E. altensteinii* – 1 block of 30 (=30 plants). D10.
12) *E. hildebrandtii* – 1 block of 30 (=30 plants). A11.
13) *E. inopinus* – incomplete block – 13 plants.
14) *E. nubimontanus* – large seedlings, 12 years old, - incomplete block – 8 plants.
15) *E. paucidendatus* – 1 block of 30 (=30 plants). B12.
16) *E. caffer* – incomplete block – 15 plants. C12.
17) *E. lebomboensis* – 1 block of 30 (=30 plants). D12.
18) *E. natalensis* x *E. woodii* – 1 block of 30 (=30 plants). C13.
19) *E. concinnus* – incomplete block – 10 plants.
20) *E. septentrionalis* – 1 block of 30 (=30 plants). B15.
21) *E. munchii* – 1 block of 30 (=30 plants). B16.
22) *E. longifolius* 2 blocks of 30 (=60 plants). A9, A10.
23) *E. laevifolius* – incomplete block – 11 plants. C14.

Already a total of 1227 cycads have been planted since the 2nd of April 2001. I anticipate that the balance of the cycads will be planted end of December 2001. On three separate occasions students of horticulture have participated in this project (Figure 6), that is a total of thirteen students who had until then never had any exposure to cycads whatsoever. With this project I hope to achieve many objectives, primary objective being able to create awareness of the plight of our cycads to the next generations of potential cycad enthusiasts.

**Figure 6 The new shadehouse - students from Pretoria University planting seedlings of *E. longifolius*.**

I intend running practical workshops for students twice a year. The workshops will last for about ten days, the only restrictions I have are that they be bona-fide students enrolled at either a University or Technikon studying horticulture.

The farm has facilities to accommodate five students at a time; this training will be open to local as well as foreign students. Training is done free of charge, the students are fed, accomodated and paid a nominal salary. Transport from Pretoria to Letsitele is available if needed.

In closing, the system that I have devised where the cycads are planted in grid blocks of 30 is very easy to manage. Cycads are allocated an individual number where monitoring will be possible. In grid block A the first cycad planted will be no 1 A1 and the last one 1 A30. The next grid block will be 1 B1–1 B30, this will facilitate the personal monitoring of each cycad. If an individual either grows very well or whether another dies this system will be easily monitored. The measuring of the caudex growth and leaf production will be done once a year, this date will be kept on computer. Growth patterns and tempo will be analyzed. This information will be available on request. Fertilizing regimes will be accurately recorded: quantity and frequency of fertilization. For top dressing I will use 3:1:5 (45) and seabird guano four times a year. The entire area has been mulched with a 19mm pine bark (Figure 7), the reason for this again is twofold: water conservation and weed control. Finally the cycads will all be on a drip irrigation system allowing the accurate dispensing of water to plants. Amount of water will probably be restricted to about 5 to 8 litre per plant per week.

**Figure 7 Mulching with pine bark to prevent excessive moisture loss. Mulching also helps control weed growth. Plants being mulched are 5 year old seedlings of *E. lehmannii*. September 2001.**

What do I personally hope to achieve from this? Firstly as owner of this operation I will make the decisions as to what I do with the plants. I am hoping that many of these plants will mature and eventually become seed producers, but primarily this will remain a commercial venture. If plants become too congested they will be lifted and containerized for resale. Hopefully many botanic gardens will want to buy plants from Buckawayo for planting in their gardens.

Secondly it is vital to gain credibility from all persons involved in conservation, whether it be from academics, enthusiasts, commercial growers or generally just the private person who wants one cycad in a pot. I hope to work with Nature Conservation Authorities on this project, I would be more than willing to arrange workshops for Nature Conservation officials who need to be trained in cycad ID or any other aspects related to cycad conservation.

Unfortunately I don't know of any project that has succeeded where local people have become involved with cycad propagation. Neither the Edendale project in Natal nor the Mananga project in the far eastern Mpumalanga has succeeded as a commercial venture.

Plans for the future are well underway at Buckawayo, a

second shade house of 3000m$^2$ has been completed, work on construction of the third shade house has commenced.

I have been very fortunate to acquire a very large collection of very rare cycads. The cycads that I have bought will be transported to Buckawayo only 40 kms away. Approximately 300 of the 700 plants are suckers from the adult plants, these suckers have all been established in containers for a few years. These rare plants, which include *E. dolomiticus, E. heenanii and E. cupidus*, as well as all the other rare category plants will be planted in the new shade houses. The mature cycads, which include *E. inopinus, E. dolomiticus, E. nubimontanus* and *E. laevifolius* will be carefully removed and replaced in colonies at Buckawayo for future seed production.

I would like to thank my wife Lelanie for her support in this endeavour as well as for her unwavering support despite what at times felt like insurmountable obstacles. I love cycads.

# CYCADS OF THE WORLD FOR THE LAYMAN

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***Bowenia***

1. *B. serrulata* [Queensland, Australia]
2. *B. spectabilis* [Queensland, Australia]

***Ceratozamia***

1. *C. alvarezii* [Chiapas, Mexico]
2. *C. euryphyllidia* [Oaxaca and Veracruz, Mexico]
3. *C. hildae* [San Luis Potosi and Queretaro, Mexico]
4. *C. kuesteriana* [Tamaulipas, Mexico]
5. *C. latifolia* [San Luis Potosi, Queretaro and Hidalgo, Mexico]
6. *C. matudae* [Chiapas, Mexico]
7. *C. mexicana* [Hidalgo, Puebla, San Luis Potosi and Veracruz, Mexico]
8. *C. microstrobila* [San Luis Potosi, Mexico]
9. *C. miqueliana* [Chiapas and Veracruz, Mexico]
10. *C. mixeorum* [Oaxaca, Mexico]
11. *C. morettii* [Veracruz, Mexico]
12. *C. norstogii* [Chiapas, Mexico]
13. *C. robusta* [Oaxaca and Veracruz, Mexico; Belize and Guatemala]
14. *C. sabatoi* [Hidalgo and Queretaro, Mexico]
15. *C. whitelockiana* [Oaxaca, Mexico]
16. *C. zaragozae* [San Luis Potosi, Mexico]

***Chigua***

1. *C. bernalii* [Colombia]
2. *C. restrepoi* [Colombia]

***Cycas***

1. *C. aculeata* [Vietnam]
2. *C. angulata* [Northern Territory, Australia]
3. *C. apoa* [New Guinea; Indonesia]
4. *C. arenicola* [Northern Territory, Australia]
5. *C. armstrongii* [Northern Territory, Australia]
6. *C. arnhemica* subsp. *arnhemica* [Northern Territory, Australia]
7. *C. arnhemica* subsp. *muninga* [Northern Territory, Australia]
8. *C. arnhemica* subsp. *natja* [Northern Territory, Australia
9. *C. badensis* [Queensland, Australia]
10. *C. balansae* [Vietnam]
11. *C. basaltica* [Western Australia]
12. *C. beddomei* [India]
13. *C. bifida* [China and Vietnam]
14. *C. bougainvilleana* [New Britain; Solomon Islands]
15. *C. brachycantha* [Vietnam; Laos; Thailand and China]
16. *C. brunnea* [Northern Territory and Queensland, Australia]
17. *C. cairnsiana* [Queensland, Australia]
18. *C. calcicola* [Northern Territory, Australia]
19. *C. campestris* [Papua New Guinea]
20. *C. canalis* subsp. *canalis* [Northern Territory, Australia]
21. *C. canalis* subsp. *carinata* [Northern Territory, Australia]
22. *C. chamaoensis* [Thailand]
23. *C. chamberlainii* [Philippines]
24. *C. changjiangensis* [China and Vietnam]
25. *C. chevalieri* [Vietnam]
26. *C. circinalis* var. *circinalis* [South India]
27. *C. circinalis* var. *swamyii* [India, Hassan district of Karnataka]
28. *C. clivicola* subsp. *clivicola* [Thailand]
29. *C. clivicola* subsp. *lutea* [Tailand]
30. *C. collina* [Vietnam]
31. *C. condaoensis* [Con Dao Islands]
32. *C. conferta* [Northern Territory, Australia]
33. *C. couttsiana* [Queensland, Australia]
34. *C. curranii* [Philippines]
35. *C. debaoensis* [China]
36. *C. desolata* [Queensland, Australia]
37. *C. diannenensis* [China]
38. *C. dolichophylla* [China and Vietnam]
39. *C. edentata* [Philippines]

40. *C. elephantipes* [Thailand]
41. *C. elongata* [Vietnam]
42. *C. falcata* [Sulawesi and Kabaena Island]
43. *C. ferriginea* [China]
44. C. *fugax* [Vietnam]
45. *C. furfuracea* [Western Australia]
46. *C. guizhouensis* [China]
47. *C. hainanensis* [Hainan Island, China]
48. *C. hoabinhensis* [Vietnam]
49. *C. hongheensis* [China]
50. *C. inermis* [China]
51. *C. javana* [Java; Indonesia]
52. *C. lane-poolei* [Western Australia]
53. *C. lindstromii* [Vietnam]
54. *C. litoralis* [Myanmar; Thailand; Malaysia; Sumatra and Vietnam]
55. *C. maconochiei* subsp. *maconochiei* [Northern Territory, Australia]
56. *C. maconochiei* subsp. *lanata* [Northern Territory, Australia]
57. *C. maconochiei* subsp. *viridis* [Northern Territory, Australia]
58. *C. macrocarpa* [Malaysia; Thailand]
59. *C. media* subsp. *media* [Queensland, Australia]
60. *C. media* subsp. *banksii* [Queensland, Australia]
61. *C. media* subsp. *ensata* [Queensland, Australia]
62. *C. megacarpa* [Queensland, Australia]
63. *C. micholitzii* [Vietnam; China]
64. *C. micronesia* [Mariana Island; Guam]
65. *C. multipinnata* [China]
66. *C. nathorstii* [Sri Lanka]
67. *C. nongnoochiae* [Thailand]
68. *C. ophiolitica* [Queensland, Australia]
69. *C. orientis* [Northern Territory, Australia]
70. *C. pachypoda* [Vietnam]
71. *C. panzhihuaensis* [China]
72. *C. papuana* [Papua New Guinea]
73. *C. parvulus* [China]
74. *C. pectinata* [S.E. Asia; N.E. India; China]
75. *C. petraea* [Thailand]
76. *C. platyphylla* [Queensland, Australia]
77. *C. pranburiensis* [Thailand]
78. *C. pruinosa* [Western Australia & Northern Territory]
79. *C. revoluta* [China; Japan]
80. *C. riuminiana* [Philippines]
81. *C. rumphii* [S.E. Asia; Pacific Island]
82. *C. scratchleyana* [New Guinea]
83. *C. schumanniana* [Papua New Guinea]
84. *C. seemannii* [Fiji; Tonga; Vanuata & New Caledonia]
85. *C. segmentifida* [China]
86. *C. semota* [Australia]
87. *C. sexseminifera* [China; Northern Vietnam]
88. *C. siamensis* [S.E. Asia; China]
89. *C. silvestris* [Queensland, Australia]
90. *C. simplicipinna* [S.E. Asia]
91. *C. spherica* [North-eastern India]
92. *C. taitungensis* [Taiwan; China]
93. *C. taiwaniana* [China]
94. *C. tanqingii* [China]
95. *C. tansachana* [Thailand]
96. *C. thouarsii* [Madagascar; Africa]
97. *C. tropophylla* [Vietnam]
98. *C. tuckeri* [Queensland, Australia]
99. *C. wadei* [Philippines]
100. *C. xipholepis* [Queensland, Australia]
101. *C. yorkiana* [Queensland, Australia]
102. *C. yunnanensis* [China]
103. *C. zeylanica* [Sri Lanka; Andaman Islands; Nicobar]

***Dioon***

1. *D. califanoi* [Oaxaca, Mexico]
2. *D. capitoi* [Puebla, Mexico]
3. *D. edule* var. *edule* [Mexico]
4. *D. edule* var. *angustifolium* [Nuevo Leon and Tamaulipas, Mexico]
5. *D. holmgrenii* [Oaxaca, Mexico]
6. *D. mejiae* [Honduras]
7. *D. merolae* [Chiapas, Mexico]
8. *D. purpusii* [Oaxaca, Mexico]
9. *D. rzedowskii* [Oaxaca, Mexico]
10. *D. sonorense* [N.W. Coast, Mexico]
11. *D. spinulosum* [Vera Cruz and Oaxaca, Mexico]
12. *D. tomasellii* [S.W. Coast, Mexico]

***Encephalartos***

1. *E. aemulans* [KwaZulu-Natal, South Africa]
2. *E. altensteinii* [E. Cape, South Africa]
3. *E. aplanatus* [Swaziland]
4. *E. arenarius* [E. Cape, South Africa]
5. *E. barteri* subsp. *barteri* [Benin; Ghana; Nigeria; Sudan; Togo]
6. *E. barteri* subsp. *allochrous* [Nigeria]
7. *E. brevifoliolatus* [Northern Province, South Africa]
8. *E. bubalinus* [Tanzania; Kenya]
9. *E. caffer* [E. Cape, South Africa]
10. *E. cerinus* [KwaZulu-Natal, South Africa]
11. *E. chimanimaniensis* [Mozambique; Zimbabwe]
12. *E. concinnus* [Zimbabwe]
13. *E. cupidus* [Northern Province, South Africa]
14. *E.* cycadifolius [E. Cape, South Africa]
15. *E. delucanus* [Tanzania]
16. *E. dolomiticus* [Northern Province, South Africa]
17. *E. dyerianus* [Northern Province, South Africa]
18. *E. equatorialis* [Uganda]
19. *E. eugene-maraisii* [Northern Province, South Africa]
20. *E. ferox* [KwaZulu-Natal, South Africa; Mozambique]
21. *E. friderici-guilielmi* [E. Cape, South Africa]
22. *E. ghellinckii* [KwaZulu-Natal, South Africa]
23. *E. gratus* [Malawi; Mozambique]
24. *E. heenanii* [Swaziland; Mpumalanga, South Africa]
25. *E. hildebrandtii* [Kenya; Tanzania]
26. *E. hirsutus* [Northern Province, South Africa]
27. *E. horridus* [E. Cape, South Africa]
28. *E. humilis* [Mpumalanga, South Africa]
29. *E. inopinus* [Northern Province, South Africa]
30. *E. ituriensis* [Dem. Rep. Congo (the former Zaire)]
31. *E. kisambo* [Kenya]
32. *E. laevifolius* [Mpumalanga, South Africa; Swaziland]
33. *E. lanatus* [Mpumalanga, South Africa]
34. *E. latifrons* [E. Cape, South Africa]
35. *E. laurentianus* [Angola; Dem. Rep. Congo]
36. *E. lebomboensis* [KwaZulu-Natal & Mpumalanga,

South Africa; Swaziland; Mozambique]
37. *E. lehmannii* [E. Cape, South Africa]
38. *E. longifolius* [E. Cape, South Africa]
39. *E. macrostrobilus* [Uganda]
40. *E. manikensis* [Mozambique; Zimbabwe]
41. *E. marunguensis* [Dem. Rep. Congo; Tanzania]
42. *E. middelburgensis* [Mpumalanga, South Africa]
43. *E. msinganus* [KwaZulu-Natal, South Africa]
44. *E. munchii* [Mozambique]
45. *E. natalensis* [KwaZulu-Natal, South Africa]
46. *E. ngoyanus* [KwaZulu-Natal & Mpumalanga, South Africa; Swaziland]
47. *E. nubimontanus* [Northern Province, South Africa]
48. *E. paucidendatus* [Mpumalanga, South Africa; Swaziland]
49. *E. poggei* [Angola; Dem. Rep. Congo]
50. *E. powysii* [Kenya]
51. *E. princeps* [E. Cape, South Africa]
52. *E. pterogonus* [Mozambique]
53. *E. relictus* [Swaziland]
54. *E. schaijesii* [Dem. Rep. Congo]
55. *E. schmitzii* [Dem. Rep. Congo; Zambia]
56. *E. sclavoi* [Tanzania]
57. *E. senticosus* [Mpumalanga & KwaZulu-Natal, South Africa]
58. *E. septentrionalis* [Sudan]
59. *E. tegulaneus* [Kenya]
60. *E. transvenosus* [Northern Province, South Africa]
61. *E. trispinosus* [E. Cape, South Africa]
62. *E. turneri* [Mozambique]
63. *E. umbeluziensis* [Swaziland; Mozambique]
64. *E. villosus* [E. Cape, KwaZulu-Natal & Mpumalanga, South Africa]
65. *E. whitelockii* [Western Uganda]
66. *E. woodii* [KwaZulu-Natal]

***Lepidozamia***

1. *L. hopei* [Queensland, Australia]
2. *L. peroffskyana* [N.S.W. & Queensland, Australia]

***Macrozamia***

1. *M. cardiacensis* [Queensland, Australia]
2. *M. communis* [N.S.W., Australia]
3. *M. concinna* [N.S.W., Australia]
4. *M. conferta* [Queensland, Australia]
5. *M. cranei* [Queensland, Australia]
6. *M. crassifolia* [Queensland, Australia]
7. *M. diplomera* [N.S.W., Australia]
8. *M. douglasii* [Queensland, Australia]
9. *M. dyeri* [Western Australia]
10. *M. elegans* [N.S.W., Australia]
11. *M. fawcettii* [N.S.W., Australia]
12. *M. fearnsidei* [Queensland, Australia]
13. *M. flexuosa* [N.S.W., Australia]
14. *M. fraseri* [Western Australia]
15. *M. glaucophylla* [N.S.W., Australia]
16. *M. heteromera* [N.S.W., Australia]
17. *M. humilis* [N.S.W., Australia]
18. *M. johnsonii* [N.S.W., Australia]
19. *M. lomandroides* [Queensland, Australia]
20. *M. longispina* [Queensland, Australia]
21. *M. lucida* [Queensland, Australia]
22. *M. macdonnellii* [Northern Territory, Australia]
23. *M. machinii* [Queensland, Australia]
24. *M. macleayi* [Australia]
25. *M. miquelii* [N.S.W. & Queensland, Australia]
26. *M. montana* [N.S.W., Australia]
27. *M. moorei* [Queensland, Australia]
28. *M. mountperriensis* [Queensland, Australia]
29. *M. occidua* [Queensland, Australia]
30. *M. parcifolia* [Queensland, Australia]
31. *M. pauli-guilielmi* [Queensland, Australia]
32. *M. platyrachis* [Queensland, Australia]
33. *M. plurinervia* [N.S.W. & Queensland, Australia]
34. *M. polymorpha* [N.S.W., Australia]
35. *M. reducta* [N.S.W., Australia]
36. *M. riedlei* [Western Australia]
37. *M. secunda* [N.S.W., Australia]
38. *M. spiralis* [N.S.W., Australia]
39. *M. stenomera* [N.S.W., Australia]
40. *M. viridis* [Queensland, Australia]

***Microcycas***

1. *M. calocoma* [W. Cuba]

***Stangeria***

1. *S. eriopus* [E. Cape & KwaZulu-Natal, South Africa]

***Zamia***

1. *Z. acuminata* [Nicaragua; Panama]
2. *Z. amazonia* [Brazil; Colombia; Venezuela]
3. *Z. amazonum* [Brazil; Colombia; Peru; Venezuela]
4. *Z. amblyphyllidia* [Cuba; Jamaica; Puerto Rico]
5. *Z. amplifolia* [Colombia]
6. *Z. angustifolia* [Bahamas; Cuba]
7. *Z. boliviana* [Bolivia]
8. *Z. chiqua* [Colombia; Panama]
9. *Z. cremnophila* [Mexico]
10. *Z. cunaria* [Panama]
11. *Z. disodon* [Northern Colombia]
12. *Z. dressleri* [Panama]
13. *Z. encephalaroides* [Colombia]
14. *Z. fairchildiana* [Costa Rica; Panama]
15. *Z.* fischeri [Mexico]
16. *Z. furfuracea* [Mexico]
17. *Z. gentryi* [Ecuador]
18. *Z. herrerae* [Mexico; Guatemala]
19. *Z. hymenophyllidia* [South-eastern Amazonian Colombia]
20. *Z. inermis* [Mexico]
21. *Z. integrifolia* [Florida, Georgia (U.S.A.); Bahamas Cuba; Caiman Islands]
22. *Z. ipetiensis* [Panama]
23. *Z. lacandona* [Eastern Chiapas, Mexico]
24. *Z. lacondonis* [Mexico]
25. *Z. lecointei* [Brazil].
26. *Z. lindleyi* [Panama]
27. *Z. loddigesii* [Mexico]
28. *Z. lucayana* [Bahamas]

29. *Z. manicata* [N. Colombia; S. Panama]
30. *Z. melanorrhachis* [North-central Colombia to Amazonian Colombia]
31. *Z. montana* [Colombia; Venezuela]
32. *Z. muricata* [Venezuela]
33. *Z. neurophyllidia* [Panama]
34. *Z. obliqua* [Colombia; S. Panama]
35. *Z. paucijuga* [W. Mexico]
36. *Z. poeppigiana* [Peru; Ecuador]
37. *Z. polymorpha* [Mexico; Belize]
38. *Z. portoricensis* [Puerto Rico]
39. *Z. pseudomonticola* [Costa Rica]
40. *Z. pseudoparasitica* [Panama; Costa Rica]
41. *Z. prasina* [Soutern Belize]
42. *Z. pumila* [Dominican Rep.; Florida (U.S.A.); Cuba]
43. *Z. purpurea* [Mexico]
44. *Z. pygmaea* [Cuba]
45. *Z. roezlii* [Colombia]
46. *Z. skinneri* [Panama]
47. *Z. soconuscensis* [Mexico]
48. *Z. spartea* [Mexico]
49. *Z. splendens* [Mexico]
50. *Z. standleyi* [Honduras]
51. *Z. tuerckheimia* [Guatemala]
52. *Z. ulei* [Brazil]
53. *Z. urep* [Peru]
54. *Z. variegata* [Guatemala; Belize; Mexico]
55. *Z. vazquesii* [Mexico]
56. *Z. wallisii* [Colombia]

The compilers wish to thank **Ken Hill** for his assistance.

The following species are excluded from the list due to the following reasons:

***Cycas miquelii*** - The type specimen in fact matches so closely *Cycas revoluta* that it can only be regarded as an aberrant individual lacking spines on the petiole. The name *C. miquelii* must therefore fall into the synonymy of *C. revoluta* (Ken D. Hill, *Encephalartos* No. 65).

***Cycas szechuanensis*** - Now regarded as conspecific with *C. taiwaniana* according to Ken D. Hill.

# LETTERS TO THE EDITOR / BRIEWE AAN DIE REDAKTEUR

E-mail received

**CYCAD SITES**

Spent half nite (*sic*) on your site. Spectacular, breathtaking, GREAT. Nature lover.

***Imtiaz Mahomed,*** *Pretoria.*
**<imahomed@oldmutualpfa.com>**

*Received 11 December 2001*

Dear Editor

***"ENCEPHALARTOS" No 68***

May I congratulate the editorial and production team on the December 2001 issue of "*Encephalartos*"? The articles by Willie Tang on leaf succulence in *Cycas tansachana*, and his wonderfully illustrated report on *Cycas revoluta*, are fascinating and important contributions to the ever-increasing pool of knowledge which has been documented in your magazine. "*Encephalartos*" can continue to stand proudly as the world's leading cycad journal.

***Roy Osborne,*** *P.O. Box 244, Burpengary, Queensland, 4505 Australia.*

*Received 28 December 2001*

Geagte Redaktrise

**KLEUR-AFDELING**

Na aanleiding van die President se versoek om te laat weet wat ons dink van die kleur-afdeling van "*Encephalartos*" No. 68, die volgende:

1. Die redaksionele komitee kan gerus die kuns van binneversiering *cum* argiktektoniese *cum* ontwerp slagspreuk "Less is more" tydig en ontydig in gedagte roep met bladuitleg.
2. Kleur moet net toegewys word aan kleur-relevante en kleurwaardige foto's
3. Die vier uitgawes van 2001 se "*Encephalartos*" het 98 kleurfoto's ('n gemiddeld van 6 per pagina) geplaas waarvan 'n goeie persentasie nie net swak was nie, maar suiwer onsinnig. In No. 65 was daar maksimaal vier kleurwaardige foto's; in No. 66 kan net pagina 11 regverdig word; No. 67 moontlik twee van p. 11 & 12 terwyl p. 17 uitstekende foto's bevat van wie (*sic.*) ek graag figure 16 & 17 bykans volblaaie sou wou sien; en p. 18 se figuur 23 is belangrik vir kleur. No. 68 bevat twee van die allerbeste foto's van die jaar (Figuur 13 & 14) en kon met gemak 'n volblad verdien. Om die waar-heid te sê, Figuur 14 kon 'n dubbel middelblad (centre fold) gewees het.
4. Sal dit ook nie 'n aangenamer uitleg wees om tipografie in die middel (tussen die kleurblaaie, soos in No. 67) te plaas nie?
5. Inheemse broodbome word deesdae (*vis à vis*

uitheemse) afgeskeep en ek glo die groter persentasie intekenare sal hiermee saamstem.

6. Soos "Fokus op ..." n gereelde rubriek word, kan daar gerus aan gedink word om met elke uitgawe 'n puik kleurfoto van 'n inheemse broodboom te plaas (volblad) as 'n vorm van galery vir versamelaars. Selfs dalk 'n los blad wat geborg word. Daar moet talle belangstellendes wees wat top kwaliteit foto's kan lewer (soos bv. Alice de Beer en Derik Minnaar).
7. Dalk moet u voorstelle aanvra hoe die getal intekenare vermeerder kan word.

***Zandberg Jansen,*** *Roosweg 8, Dawnview, 1401 Germiston. R.S.A..*

*Ontvang 6 Januarie 2002*

[Graag ontvang ons kleurwaardige foto's van broodbome wat deur mnr Jansen geneem is, asook artikels oor inheemse broodbome wat deur hom geskryf is. Of dalk kan hy sy invloed gebruik om iemand te oorreed om sulke artikels te skryf, veral "Fokus op ..."-artikels oor die Suid-Afrikaanse spesies wat nog nie gedoen is nie.– **Redaktrise.**]

## Translation

Dear Editor

**COLOUR SECTION**

With reference to the President's request to readers to express their opinions on the colour section in "*Encephalartos*" no. 68, the following:

1. The editorial committee should really bear in mind at any time the slogan "Less is more" with regard to the art of interior decoration *cum* architectural *cum* planning of page lay-out.
2. Colour should only be awarded to colour relevant and colour-worthy photographs.
3. The four issues of "*Encephalartos*" in 2001 contained 98 colour photos (an average of 6 per page) of which a large percentage was not only of poor quality but downright absurd. No. 65 contains a maximum of four colour-worthy photos; in No. 66 only page 11 can be justified; No. 67 perhaps two on p. 11 & 12 whilst p. 17 contains excellent photographs of which I would have liked to see figures 16 & 17 as nearly full-page, figure 23 on p. 18 is an important colour figure. No. 68 contains two of the very best photographs of the year (figures 13 & 14) which deserve full-page printing. As a matter of fact figure 14 could have been a centre fold.
4. Shouldn't a better lay-out be to place typography in the middle of the magazine (between the colour pages as in No. 67)?
5. Indigenous cycads (*vis à vis* exotic) are nowadays being treated shabbily and I believe that most of our readers would agree with this,
6. Just as "Focus on ..." is a regular column, it should be considered to print in each issue an excellent colour photo (full-page) of an indigenous cycad as a form of gallery for collectors. It could even be a loose page that has been sponsored. Surely there are many of those interested who can supply top quality photographs (for instance Alice de Beer and Derik Minnaar).
7. Perhaps you should ask for proposals how to increase the number of subscribers.

[We are looking forward to receiving colour-worthy photographs of cycads taken by Mr. Jansen, as well as articles written by him on indigenous cycads. Or perhaps he can use his influence to persuade someone to write such articles, especially "Focus on ..." articles on the South African species still to be done. **– Editor.**]

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Dear Editor

**REMARKS ON "*ENCEPHALARTOS*"**

I have always considered "*Encephalartos*" to be the best cycad publication for international news and information. Issue No. 68 was one of the best ever. It had a splendid mixture of articles about cycads from all around the world by people from all around the world. I was particularly impressed by the "Focus on " article on *Macrozamia communis*" by Paul Kennedy, Craig Thompson, and Roy Osborne. It is one of the best ever done. I especially liked the information on this cycad's ecology and pollination. It is very interesting indeed that the cones of this species produces heat in two peaks each day. I conducted a survey of cycad cone heating patterns when I was a graduate student over 15 years ago. Out of some 50 species that I examined growing at Fairchild Tropical Garden, I found only one that had two heating periods in one day. This was the male cone of *Bowenia spectabilis* (heating pattern published in "Proceedings of CYCAD 90"). In *B. spectabilis* the first period of cone heating occurs shortly after midnight and the second in the late afternoon near dusk. I suspected that if an adventurous person camps by wild *Bowenia spectabilis* during the pollination season at these times of day he or she will be able to observe the natural pollinators of this species at work.

Keep up the excellent work Isabella. We appreciate your hard work!

***Willie Tang,*** *Fairchild Tropical Garden, 11935 Old Cutler Road, Miami, Florida 33156, U.S.A.*

*Received 14 January 2002.*

[Thank you, Willie, for your kind words. However, I have to remind you that I am only the compiler-typist of the magazine and without the valuable contributions by authors I can do nothing. I also wish to thank those authors on whom I can rely to help me out when I do not receive enough contributions, especially "Focus on ..." articles, to compile a specific issue. Some of our members have complained that we do not print enough articles on indigenous South African cycads. However, none of the

complainants has volunteered to write such articles. I came to the conclusion that in their opinion our few regular contributors have an inexhaustible source of information on indigenous cycads at their disposal and can go on writing such articles indefinitely. **– Editor.**]

# SHORT COMMUNICATIONS / KORT MEDEDELINGE

## BLUE AND RED LEAVES IN CYCADS

**William Tang**
Fairchild Tropical Garden, 11935 Old Cutler Rd., Miami, Florida 33156

*Received December 2001*

Like most plants, cycad leaves are usually green. This green colour is the result of chlorophyll, the pigment which allows the leaves to absorb sunlight and convert it into usable food for the plant. Chlorophyll absorbs most wavelengths of visable light, except for green, which is reflected back. We see the reflected green wavelengths and this is what gives plant leaves their typical colour. In many cycad species newly emerged leaves have a blue or red colour. Why is this so and what is the function of these colours in cycad leaves?

When we are in our garden or observing cycad plants in the wild it is easy to be carried away by the beauty of cycad foliage and think only of their ornamental value. From the plant's point of view, however, leaves have only one primary purpose - they are solar collectors. Much like the satellites sent into orbit equipped with solar panels, cycad leaves are outstretched by the plant for one overriding purpose, to gather sunlight. From sunlight the leaves generate virtually all the power and much of the nutrition the cycad requires to survive, grow, and reproduce. Cycad leaves are often modified with spines. These serve to protect the valuable leaves and the delicate growing point of the stem. The spines on the leaves keep leaf-feeding animals and large vertebrates, that may damage the stem, away from the plant (see Tang 1991 for further discussion of spines). So, this line of reasoning allows us to safely conclude that blue and red leaf colours function either to: 1) assist the leaf's ability to gather sunlight or 2) protect the leaf from damage.

The blue colour of some cycad leaves is caused by a layer of wax on the surface (see Osborne *et al.* 1987 for a discussion of cycad leaf waxes) and is most prominent in some *Encephalartos* species of the desert regions (Colour Figures. 1, 2 on p. 25) such as *E. horridus* and *E. lehmanii*. Although not as striking as in these *Encephalartos*, it is also found throughout the genus *Dioon*, including both the desert and forest species. In *Macrozamia*, the desert species *M. macdonelli*, has the most prominent blue leaves. Lastly, a bluish cast is found in some cliff and desert dwelling species of *Cycas* including the Thai *C. nongnoochii* and Australian *C. couttsiana*. All cycad species have a layer of wax on the surface of the leaves which is highly impermeable to water loss. It protects the leaves from drying out during periods of heat and drought. A layer of leaf waxes may also protect the leaf from insect damage (Eigenbrode and Espelie 1995). Not all wax surfaces are blue and there are cycads with fairly thick waxy leaves that are not blue. The blue colour results from a particular type of wax and/or its microscopic arrangement on the leaf surface. Scientists have recently suggested that blue waxes may protect leaves by reflecting harmful UV rays. Just as UV light causes sunburn in human beings, it will burn cycad leaves, breaking down chlorophyll, DNA, and other vital chemicals. You can test the UV reflectance of your blue cycad leaves with the type of UV light used by insect collectors. Shine such a lamp at night and you will notice that its light reflects bright and white off the blue cycad leaves. This is most prominent on the under surface of leaves where the blue wax is least likely to have been washed off by rain. I have confirmed this with leaves of *E. lehmannii, E. arenarius* (blue form), and *D. mejiae*. With time, as the leaf ages, the blue UV-reflecting wax is rubbed or washed off the leaves of these species.

In many cycads, emerging leaves are often red or shades thereof ranging from orange to red-brown. The red colour of leaves is a mystery that has been commented on since the ancient Greek philosopher Aristotle. Until recently, there was no clear explanation of the function of red leaves. Red colour in leaves is caused by pigments known as anthocyanins. Anthocycanins absorb most wavelengths of visable light except red. They reflect red wavelengths and thus give the leaf its red colour. When red colour appears, such as in autumn leaves, anthocyanins are produced and when red colour disappears, as when a developing red leaf becomes fully mature, anthocyanins are broken down and eliminated by the plant. This pigment appears to have a particular function and is not the byproduct of some other metabolic process in the plant.

In cycads, the New World forest genera *Ceratozamia* and *Zamia* most frequently exhibit red emergent leaves (Colour

Figures. 3-6 on p. 25, and Front Cover). Besides these I have only seen a few *Dioon* and *Encephalartos* display red leaves (Colour Figure 7 on p. 26). Why are shade-adapted forest cycads most likely to have red leaves? Ideas about the function of anthocyanins in plant leaves have included: 1) Protecting the leaf from UV damage, 2) Allowing the leaf to absorb more light to raise temperature and thus improving leaf metabolism, and 3) Bouncing light in the far red part of the spectrum (the most common form of light in dim shade), like a mirror back toward the chlorophyll layer of leaves to increase photosynthesis. Each of these ideas have been discredited: 1) Anthocycanins are typically concentrated in the center of leaves below the main chlorophyll layer (see Figure 1), so the location is not right for UV protection, 2) In species tested no temperature differences were found between red and green leaves, so this idea has been discarded, 3) No mechanism has yet been discovered by which anthocycanins can reflect light effectively to photo-synthetic sections of the leaf to significantly increase photo-synthesis so the idea has lost favour.

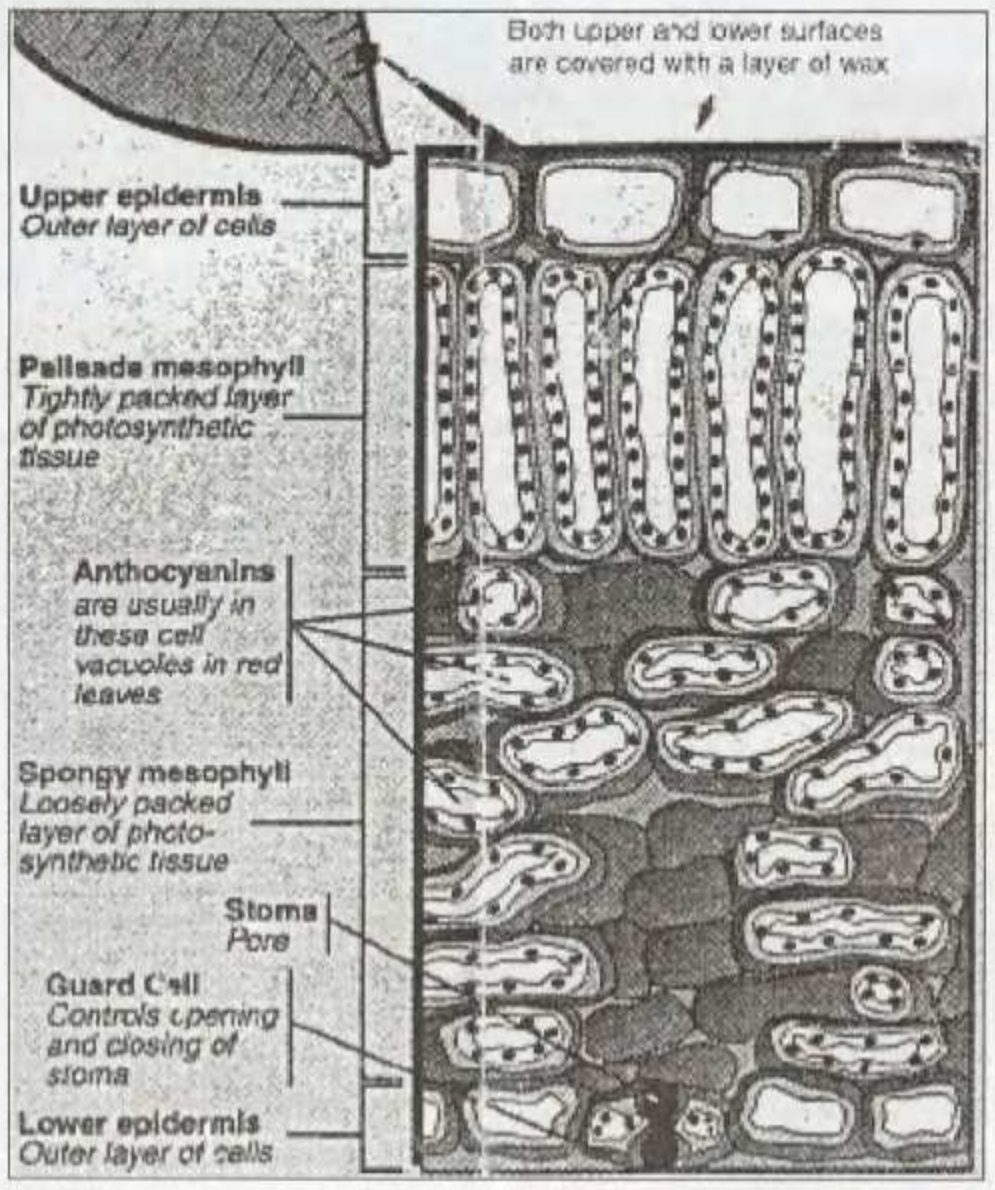


**Figure 1 This cross-section diagram of a typical plant leaf shows the positions of wax layers and areas where chlorophyll and anthocyanins are concentrated. Modified from Tasker (1995).**

Recently a new explanation for red pigments in leaves was presented that appears to provide a conclusive explanation (Gould *et al.* 1995, Tasker 1995). The explanation is a protective one. Plants actually use two forms of chlorophyll molecule to capture sunlight. These are called chlorophyll a & b, and each captures light in slightly different wavelengths. Each type of chlorophyll has an associated chemical system which assists in the capture of light. For chlorophyll b this is called Photosystem II. Photosystem II is susceptible to damage from too much light. In prolonged periods of bright light the chemicals responsible for running Photosystem II may become physically damaged, reducing photosynthesis (Powles 1984, Tasker 1995). If anthocyanins are manufactured in the leaves during times of stress, including stages of leaf emergence and aging, they can capture excess light that would otherwise damage Photosystem II, thus extending the ability of the leaf to function. To test this idea, scientists measured the uptake of CO2, an indirect way to measure of photosynthesis, in 2 species of plants that had either red or green emergent leaves. In repeated tests they detected greater uptake of CO2 and reduced damage to Photosystem II in red leaves.

This theory begins to explain why red-emergent leaves seem to be mostly found in shade species of *Ceratozamia* and *Zamia*. Leaves of shade species are adapted to function most efficiently in dim light. If they are exposed to full sun, they can be readily damaged. Most gardeners know that if you place a shade grown plant into the full sun their leaves will burn. In the forest understorey, light is not uniform. The forest canopy has many small openings and spotlights of full sun will reach the forest floor. As the sun moves across the sky these small spotlights also move across the forest floor. A shade plant on the forest floor, such as a *Ceratozamia* or *Zamia*, will be exposed at one moment to dim light less than 1% of sun and the next moment to a beam of full blazing sun. An emerging leaf full of anthocyanins could shield Photosystem II from much of the damaging light, allowing the leaf to tolerate this sudden burst of light and harvest the energy without damage, better than a green emergent leaf. Not all plants in a given population will have red leaves. In fact, you will often see both red and green forms in a given population of cycads. The production of anthocyanins is costly to the plant in energy and nutrients, which can be used otherwise in general growth or reproduction. In such a cycad population a strategy or game, if you will, is being played out between green and red leaves. Those plants with red leaves will out compete green-leafed ones in a sunnier habitat, for instance if a storm topples many of the trees in a forest and opens numerous holes in the canopy. On the other hand, in a mature forest that has not been damaged in a long time, the number of openings in the canopy and thus sun flecks on the forest floor will be much fewer and the green-leafed forms may grow and reproduce better. During the life of a tropical forest, through its stages of destruction, recovery, and maturation of the canopy the cycad populations inhabiting its interior will also change and shift the frequency of its leaf colour traits over many generations. Thus the cycad species evolves with environmental change over the seasons and also over immense geological time as the shifting continents completely change the climate of the land and forests that the cycads occupy.

Red pigments in cycads are probably an ancient adaptation that allowed ancient cycads to deal with shifting sun and shade conditions in Mesozoic forests. Since their original appearance as protective pigments, anthocyanins have been utilized by cycads for secondary functions. The brightly coloured cones of some cycads, such as *Encephalartos hildebrandtii* (Colour Figure 11 on p. 26) as well as the

**Colour Figure 1** A waxy blue bloom is apparent in the leaves of this *Encephalartos horridus* in cultivation in Hawaii. Photo: L. Miyano.

**Colour Figure 2** This *Encephalartos dolomiticus* in cultivation in Florida exhibits the blue coloured leaves of many cycads inhabiting arid regions. Photo: M. Perry.

**Colour Figure 3** An emerging leaf flush of *Ceratozamia kuesteriana* displaying the usual red colour of the species. All *Ceratozamia* are dwellers of the forest understorey. Photo: W. Tang.

**Colour Figure 4** A close-up of expanding leaflets of *Ceratozamia* sp. *robusta* complex from the Cayo district of Belize shows the brown-red colour typical of many members of the genus. Photo: W. Tang.

**Colour Figure 5** This *Ceratozamia* sp. *robusta* complex from the Presa Aleman area of Oaxaca, Mexico has orange emergent leaves which slowly turn green after hardening, giving a brilliant display for many weeks or months. Photo: W. Tang.

**Colour Figure 6** In most cycads with red-emergent leaves, the leaves rapidly become green after hardening. The underside of the leaf of *Ceratozamia* in the *robusta* complex from near Molongo in San Luis Potosi, Mexico still retains its brownish colour half a year after hardening. Photo: W. Tang.

**Colour Figure 7** *Encephalartos hildebrandtii* **with brown emergent leaves, in cultivation in Florida. Photo: M. Perry.**

**Colour Figure 8 Leaf of** *Zamia splendens* **with an infection of** *Mycoleptodiscus indicus*. **Note the dark brown necrotic spot surrounded by yellow. Photo: W. Tang.**

**Colour Figure 9 Adult of** *Eubulus trigonalis*. **The elongated snout of this weevil is tucked under the head in this pinned specimen. Scale lines in the background are mm. Photo: W. Tang.**

**Colour Figure 10 Leaflets of** *Zamia lindenii* **(Ecuador) with large brown spots surrounded by yellow indicating infection by** *Mycoleptodiscus indicus*. **Photo: W. Tang.**

**Colour Figure 11 This ripe female cone of** *Encephalartos hildebrandtii* **in cultivation in Florida demonstrates a secondary use of anthocyanin pig-**

**Colour Figure 12** *Zamia amblyphyllidia* **(Vega Alta, NW Puerto Rico) stem heavily infested with** *Eubulus trigonalis*. **Note the grubs with tunnels and frass in the stems and leaf base. Photo: W. Tang.**

**Colour Figure 13 The starchy main root of** *Zamia amblyphyllidia* **hollowed out by a grub of** *Eubulus trigonalis*. **This plant recovered after treatment with insecticides. Photo: W. Tang.**

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**ments in cycads, as an attractant to seed dispersers, mostly birds and primates, animals with good colour vision. Photo: W. Tang.**

yellow, orange, and red colour found in seeds of most cycad species are also due to anthocyanins. These colours appear to display cycad seeds to animals that help disperse them (Tang 1988).


## ACKNOWLEDGEMENTS

I thank Michael Perry and Leland Miyano for contributing photographs for this article.


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# TWO NEW PESTS OF *ZAMIA* IN FLORIDA


**William Tang**

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*Received December 2001*


Cycads contain a number of potent toxins, including MAM glycosides and BMAA (Seawright *et al.* 1993). These are found in cycad leaves, stems, cones, and roots in varying concentrations. Over millions of years cycads have evolved these poisons and now produce them in their tissues as protection against animals, fungi and other organisms that may want to eat them. Overall these toxins are very effective, and most potential pests avoid cycads. In every region where cycads are native,however, certain insects, and other kinds of pests have broken this toxic defense barrier. Some of these are notorious in the damage they can inflict on both wild and cultivated plants. In South Africa the larvae of the leopard moth, *Zerenopsis leopardina* (Geometridae) can defoliate a large *Encephalartos* plant in a few days (Staude 1994). In Australia, the notorious tranes weevil, *Melanotranes* sp. (Curculionidae), burrows into the starch-rich stems of *Macrozamia*, often killing the plant (Oberprieler 1993). Most recently, the cycas scale, *Aulacaspis yasumatsui* (Diaspididae) has spread out from its native range in southern Asia and devastated *Cycas* in parts of the U.S. (Tang 1997). Below I discuss two little known pests that have become a serious problem to *Zamia* growing in Florida.

Sometime in the late 1980's or early 1990's a weevil appeared at Fairchild Tropical Garden which burrows into the stems of *Zamia*, causing their decline and, without treatment, eventually kills them. The larvae or grub of this weevil feeds in the starch-rich stem, tuberous section of the root and leaf bases (see Colour Figures 12 and 13 on p. 26). Larvae will grow to nearly a centimetre long and then pupate in the *Zamia* tissues that they fed on. The adult (Colour Figure 9 on p. 26), which is about 6 mm long emerges from the infected *Zamia* and disperses to other plants and begins the infection cycle anew. This weevil has been identified as *Eubulus trigonalis* Champion (family Curculionidae, subfamily Cryptorhynchinae). It is known from Mexico and Guatemala (O'Brien and Wibner 1982) and may occur naturally in other countries of Central America. This particular genus of weevil occurs throughout Central and South America and at least two species occur naturally in the U.S. United States Dept. of Agriculture records indicate this genus of pest have been detected entering the U.S. in certain agricultural products including tuber shipments of dasheen [taro] (*Colocasia esculenta*) and Yuca [cassava] (*Manihot esculenta*) and on occasion in fruits such as banana and pineapple and in ornamental plants such as *Dracaena* cane. This pest may have entered Fairchild garden on another plant and become a pest in *Zamia*. In the past, Fairchild Garden has been a rescue centre for cycads seized by the U.S. Fish & Wildlife Service and this pest may have been introduced through this route. This pest has been particularly destructive to the *Zamia* native to the northeast coast of Florida, often recognized as a distinct species *Z. umbrosa*, that is cultivated in large numbers at Fairchild Garden. It attacks *Z. amblyphyllidia* (N.W. Puerto Rico) and possibly *Chigua restrepoi*. It has not benn detected in the *Zamia* native to Miami, variously known as *Z. floridana, Z. integrifolia*, and *Z. pumila*, cultivated ajacent to infeted plants. It has not been detected in wild populations of this *Zamia* near the garden, however, no systematic survey has been conducted.

A control measure for infected plants would be a systematic insecticide - one that would be absorbed and penetrate the inner tissue of the plant. One application should be sufficient in potted plants, however, repeated applications or the use of s time-release systemic pesticide may be most effective for plants in the ground. Stems of plants that have succumbed to this pests and all their roots and leaves should either be buried in a deep pit, burned, or tightly sealed in a plastic bag for disposal. The most effective method for avoiding this pest is prevention. Don't bring any suspect plants into your garden, especially large, wild-

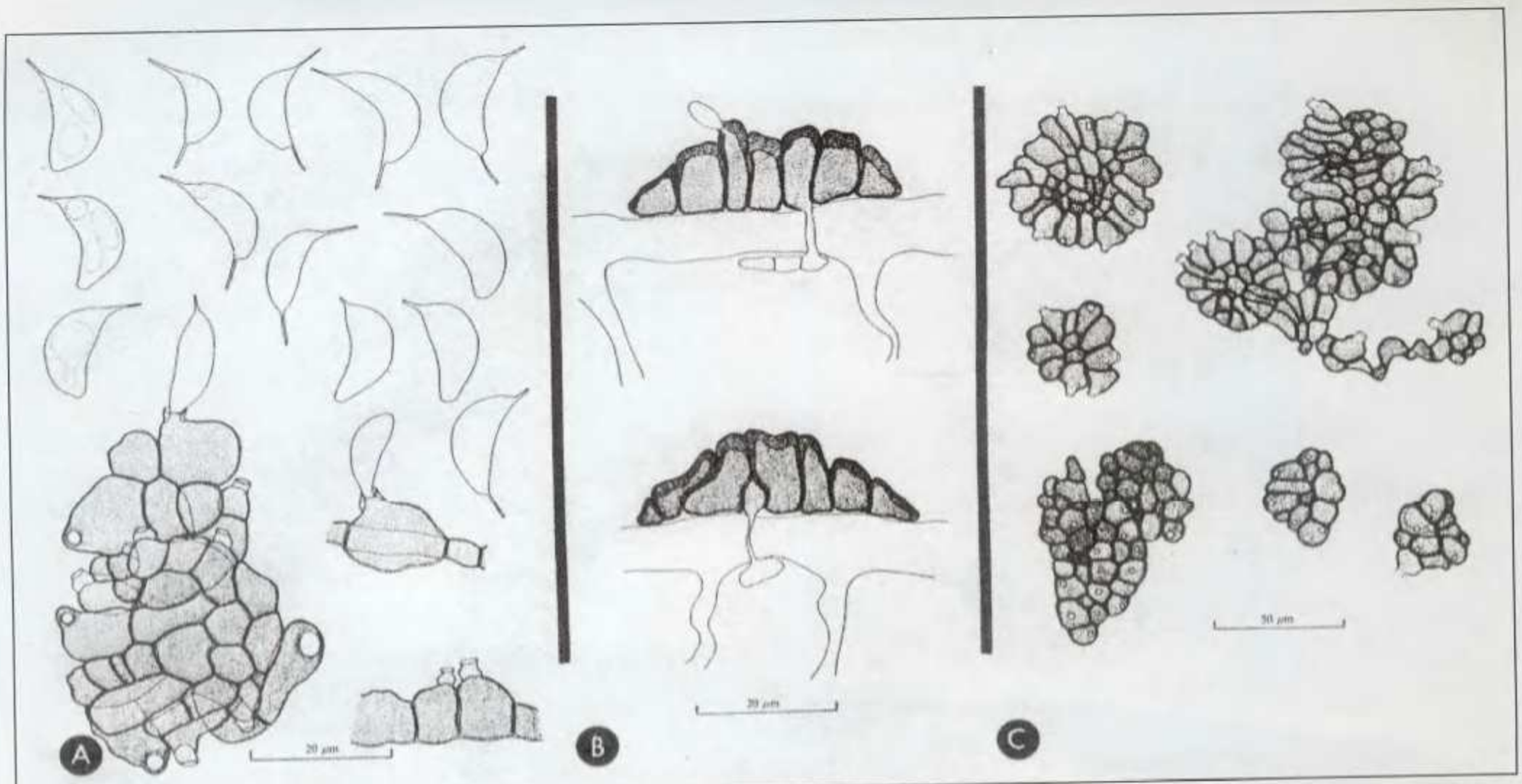


**Figure 1 Drawings of *Mycoleptodiscus indicus*: A) Masses of reproductive and non-reproductive cells and conidia (fruiting bodies), B) Infection process showing the fungal cells sending haustoria into the cells of the hoste, and tight spore-bearing masses of cells (sporodochia) on a leaf surface. From El-Gholl and Alfieri (1991).**

collected plants. Treating all new plants with a systemic insecticide as a precaution would be an effective measure. If detected early, an infestation can be wiped out before it spreads to other plants and becomes difficult or impossible to stop.

In the early 1990's a fungal disease was identified in Florida that attacks the leaves of *Zamia*. The organism responsible has been identified as *Mycoleptodiscus indicus* (Sahni) Sutton (El-Gholl and Alfieri 1991). This organism has been reported in South America, the West Indies, Africa, Southeast Asia, New Zealand and other South Pacific islands. It appears widespread throughout the tropics and subtropics. In Florida this fungal disease of *Zamia* begins its attacks as small yellow spots on the leaflets (Colour Figure 8 on p. 26). As the infected spot expands the center becomes necrotic and brown with the edges of the infected zone remaining yellow (Colour Figure 10 on p. 26). Leaves with a serious infection will shed their leaflets and the plant may go into decline. Usually the plant recovers, but may undergo another round of the leaf infection and decline again. The rainforest *Zamia*, such as *Z. splendens*, *Z. lindenii* and *Z. cunario*, as well as *Chigua restrepoi*, are particularly vulnerable. Those species native to drier habitats, such as the Caribbean *Zamia* (*Z. pumila, Z. integrifolia*, etc.), *Z. furfuracea*, and *Z. fischeri* are less prone to infection.

An infection of *Mycoleptodiscus indicus* may start as a single cell on the surface of a *Zamia* leaf. The fungal cell will grow a process, called a haustorium, that will penetrate a cell in the leaf (Figure 1B) and begin feeding and growing. When the fungal mass becomes large enough it will form fruiting bodies called conidia (Figure 1A). Rain and wind will spread these fruiting bodies. Droplets of water striking an infected area will scatter fruiting bodies to new leaves and plants and water sitting on leaves for long periods will promote the establishment and new growth of the fungus.

Control measures for this disease would include limiting irrigation to the early morning hours, so that droplets of water that accumulate on leaves would quickly dry off. Irrigation should be done at soil level; overhead watering should be avoided. Infected leaflets should not be left to fall to the ground, but should be bagged and discarded, since they may continue to be a source of infection for months or even years. Chemical fungicides may be temporarily effective.

## ACKNOWLEDGEMENTS

I thank Rolf Oberprieler, Michael Perry, and the Florida Department of Agriculture for identifications and/or assistance in the production of this article.

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TANG, W. 1997. New pest threatens *Cycas*. *Encephalartos* 49: 14-17.

# DRAFT POLICY FOR REGULATING THE EXPORT OF INDIGENOUS PLANT SPECIES FROM THE PROVINCE OF GAUTENG TO INTERNATIONAL DESTINATIONS

**Nat Grobbelaar**
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*Received 21 December 2001*

On the 29th September 2001, a meeting was convened by the Department of Agriculture, Conservation, Environment and Land Affairs of the Gauteng Provincial Government to discuss a document bearing the title above. The proposals that was put to the meeting included the following recommendations:

**(a) That an application for the export of plants indigenous to South Africa only be considered for:**

*(i) Research purposes if, amongst other things, South Africans are included in the research teams.*

*(ii) Commercial purposes if the material was artificially propagated and are at least of the F2 generation - in the case of seed, the seed must have been produced by F2 adult plants. The mother plant material must have been legally acquired and the material must have been propagated in a controlled nursery of the exporter. The nursery must be registered with the Gauteng Directorate of Nature Conservation and also as a business.*

**It was further proposed that permission not be granted to export plants for the augmentation of private collections or as personal effects. Where individuals emigrate, personal collections must therefore be forfeited to the state - all material can be donated to the National Botanical Institute.**

Although a considerable amount of cycad trade occurs legally between South Africa and other countries, the Cycad Society of South Africa was not invited to participate in the discussion referred to above.

# WILDLANDS TRUST LAUNCHES CYCAD RESCUE PLAN (November 14, 2001): MEDIA RELEASE

From the desk of Niki Moore, Zululand News Agency, Seventh Avenue Communications, P.O. Box 223, 3936 St Lucia Estuary, R.S.A. (sent to Isabella Stoltz at "*Landbouweekblad*", Pretoria).

*Received 16 January 2002*

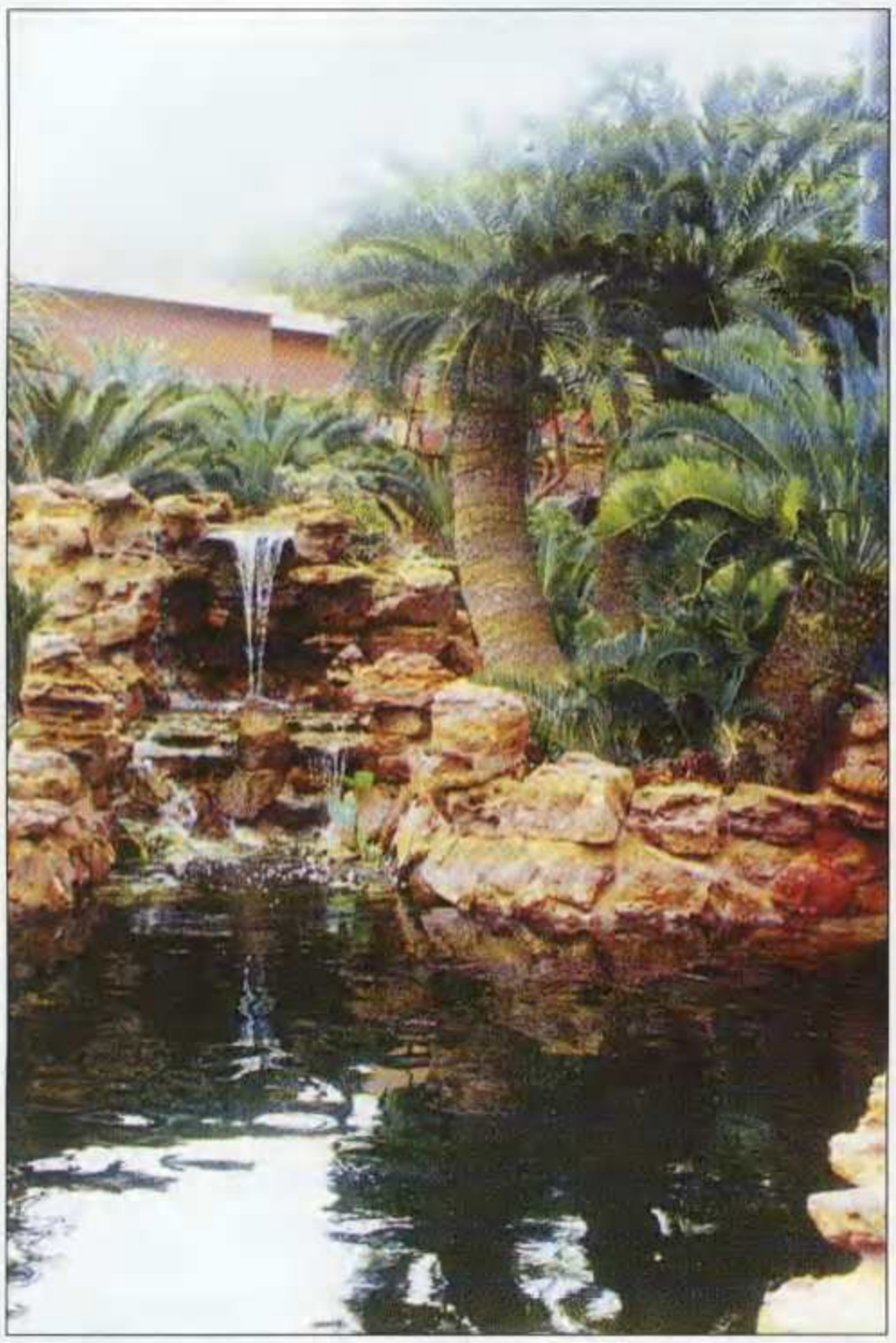
The Wildlands Trust has announced an R80 000 grant to launch a cycad research project with the eventual aim of ensuring the survival of these endangered plants. The research project will be carried out under the auspices of KZN Wildlife's Threatened Plant Conservation Unit.

The cycad (*Encephalartos* spp.) is a living fossil, an extremely primitive plant that is in great demand as a collector's item. This demand has, ironically, increased its value as a black-market commodity and a thriving underground trade exists in these plants that has led to its becoming even rarer.

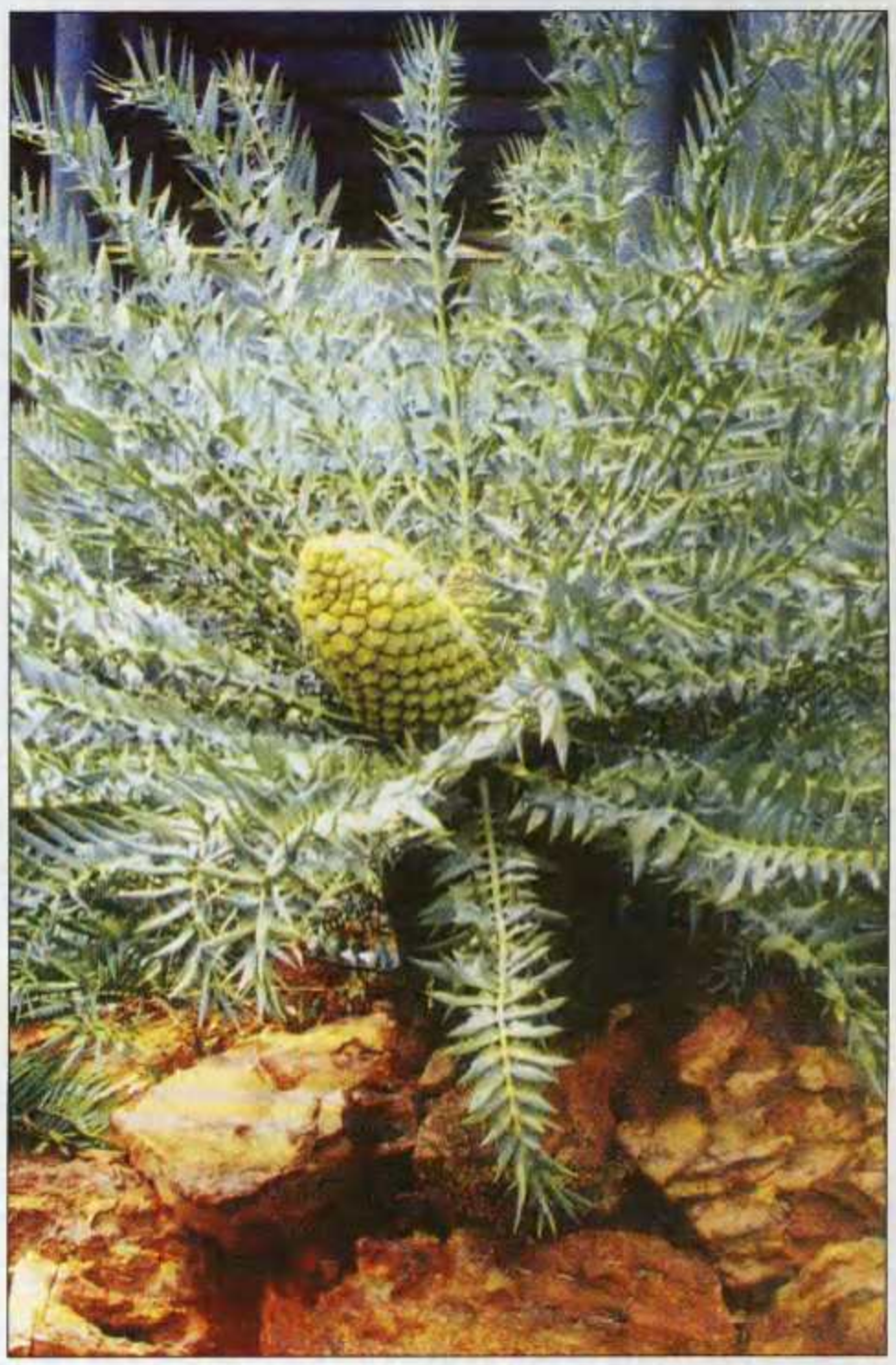
"The first step towards any kind of conservation is knowledge," said Wildlands Trust CEO Andrew Venter. "So the first step in conserving the cycad in KZN is to gather all the knowledge we have about these plants."

The research project, therefore, will begin by collating all the existing data on cycads, including numbers of plants ofthe different species, their location and habitat. This will also include an inventory of existing legislation and conservation measures. Field work will gather data about the ongoing threats to cycad populations in the province.

**Kleurfigure / Colour Figures 14 (bo / above) 'n Groep / A group of *Encephalartos middelburgensis*, en / and 15 (onder / below) *E. heenanii* in die tuin van / in the garden of Martin Bruwer, Pretoria. Foto's / Photos: Derik Minnaar.**



**Kleurfiguur / Colour Figure 16** Volwasse eksemplare van / Mature specimens of *Encephalartos longifolius* in die tuin van / in the garden of Martin Bruwer, Pretoria. Foto / Photo: Derik Minnaar.



**Kleurfiguur / Colour Figure 17** Vroulike / Female *Encephalartos horridus* met keëls in die tuin van / in cone in the garden of Martin Bruwer, Pretoria. Foto / Photo: Derik Minnaar.

**Colour Figure 18** A row of three year old seedlings (on the left) of *Encephalartos eugene-maraisii, E. dyerianus* and *E. middelburgensis* planted in the ground at Buckawayo. Plants in bags (400 in total) are mostly five year old *E. transvenosus*. August 1998. Photo: Steve Trollip.

<u>Onder regs / Below to the right</u>: **Kleurfiguur / Colour Figure 19** *Encephalartos horridus*; steriele vroulike keëlskubbe wat wortels gevorm het / sterile female cone scales that formed roots. Photo: Nat Grobbelaar.

Nursery near Brits in the Northwest Province. The day started with visitor registration, followed by the sale of hundreds of cycads (Figures 1–4), most of them being rare (Figure 4) and mature (Figures 1, 2). Numerous seedlings (Figure 3) were also offered at reasonable prices. The event was very well organised, with computerised permit issuance. Tea and sandwiches, as well as lunch were also available.

**Figure 1 Grey-leafed *Encephalartos* species at Steve's cycad sale.**

**Figure 2 Some of the mature cycads put out for sale.**

**Figure 3 Some of the cycad seedlings displayed at Steve's sale.**

**Figure 4 An *Encephalartos latifrons* specimen at Steve's sale.**

**Figure 5 Steve Trollip at the venue of the mini conference.**

A workshop started at 10h00 in the form of a mini conference. The venue was beautifully decorated with potted plants. Notes were handed out and slide shows conducted, covering very actual and interesting cycad topics. The conference ended with a question session, of which the winner was awarded a beautiful *Encephalartos longifolius* from Grass Roots Nursery.

We wish to thank Steve (Figure 5) for the hard work to blow fresh air into cycad education and promotion. Considering the feedback from many enthusiasts, it appears that a great need for such an event exists. Due to the

success of the event, **another similar workshop is in process of being organised for 20 April 2002**, before winter kicks in. For any ideas, feedback and more info, please contact Steve or Derik.

## STERIELE MEGASPOROFILLE VORM WORTELS / STERILE MEGASPOROPHYLLS FORM ROOTS

**Isabella Claassen**
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Einde November 2000 het die eerste keël van 'n vroulike *Encephalartos horridus*-plant in my tuin verskyn. Toe die keël teen die einde van Oktober 2001 spontaan begin disintegreer het, het ek wit wurmagtige strukture bo-in die keël waargeneem. By nadere ondersoek is vasgestel dat 20 skubbe van die onderste rye apikale steriele skubbe elk twee wortels (tot 20 mm lank) gevorm het (Kleurfiguur 19 op p. 32). Die betrokke skubbe was al relatief uitgedroog en alhoewel hulle geplant is, het die wortels almal gevrot.

A female *Encephalartos horridus* plant in my garden produced its first cone at the end of November 2000. When the cone began to disintegrate spontaneously at the end of October 2001, I observed white worm-like structures at the top of the cone. On closer investigation it was found that 20 scales of the lowermost apical rows of sterile scales each formed two roots (up to 20 mm in length) (Colour Figure 19 on p.32). These, already somewhat dessicated, scales were planted but al the roots rotted.

# BOOK REVIEWS / BOEKBESPREKINGS

**HILL, K. & OSBORNE, R.** ***CYCADS OF AUSTRALIA***
x + 116 pp on glossy paper. Kangaroo Press, Australia. 2001. A$65-00. Available from Cycad Centre in South Africa, PACSOA in Australia and from Bruce Ironmonger in the U.S.A.

Of all the countries that can boast to have indigenous cycads, Australia has the largest number of genera (4) and species (69 with an additional 7 subspecies, giving a total of 76 extant taxa. Forty four of these taxa were described after 1990 - the year in which one of the International Conferences on Cycad Biology was held in Australia. One is therefore tempted to deduce that this conference greatly stimulated the taxonomic investigation of the Australian cycad flora. In this Ken Hill, the senior author of the book under review, played a leading role. He was involved in the description of no less than 29 of the 44 new taxa.

After 8 brief but informative chapters on *Relationships and distribution patterns, Morphology and anatomy, Reproduction and dispersal, Hybridism, Economic botany, Toxicity, Conservation and Cultivation*, the bulk of the book (pages 17–112) is devoted to a discussion of the Australian cycad taxa. The species are dealt with in an evolutionary rather than alphabetical order but an *Index to species* at the end of the book makes it easy for the layman to locate a particular taxon.

The species are **not** described in detail. Instead, a general description of the characters of each genus and its sections are provided. This is followed by a listing of the distinguishing features and notes about each species. This together with the large number of excellent colour photographs, taken almost exclusively in the wild, should fully compensate for the lack of a detailed description of the individual species as far as most cycad enthusiasts are concerned. It will probably also act as a suitable substitute for the lack of a taxonomic key for the identification of a specimen.

In addition to a note about the derivation of its name, information about the habitat, distribution and conservation status of each species are also provided.

A novel inclusion near the end of the book are two lists. The one cites the e-mail addresses of 7 cycad-oriented web-sites whilst the other lists 6 cycad-oriented societies. A reference is provided in the text to the original description of each taxon. Under the heading "Other Reading" towards the end of the book, 27 additional publications are cited. The text is concise and to the point yet easy to follow.

The authors must be congratulated on the production of a splendid and lovely-illustrated work. This book fills a long and growing need. Its acquisition is a must for all that are interested in the cycads of Australia.

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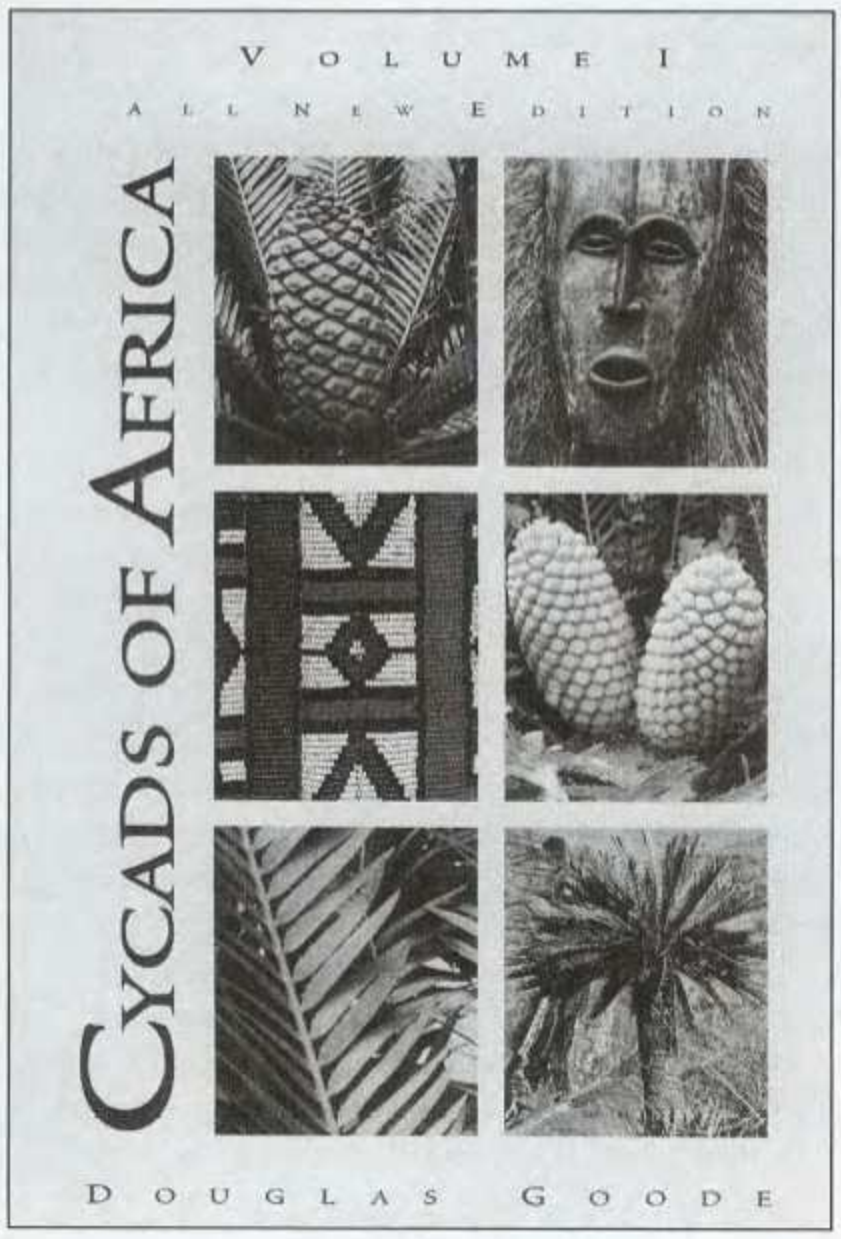
**GOODE, DOUGLAS.** ***CYCADS OF AFRICA*****, vol. 1.** GALLOMANOR: Cycads of Africa Publishers, Private Bag X23, 2052 Gallomanor, South Africa, 2001. 353 Pages, numerous colour photographs, drawings, and maps. Price: R500 (excluding VAT), R655 (including VAT).




Any book on all the *Encephalartos* species is welcome. Currently there is no other book available which treats all the species, and until recently pictures of tropical species were scarce.

The tropical species were treated by Heibloem (1999, reviewed in *ENCEPHALARTOS* 60), but he included neither the South African species nor all the tropical species. This new book treats all the known species of *Encephalartos* and also *Cycas thouarsii* and *Stangeria eriopus*, but excludes *E. macrostrobilis* without providing any reasons, as well as the subsequently described *E. relictus*.

The book commences with an account of the author's experiences while hunting cycads, country by country, taking up 20 pages. This makes absorbing reading for us more sedentary types, but does not tell much about the conditions under which the plants grow. Readers, especially those living outside Africa, probably don't realise how difficult and dangerous it is to travel in tropical Africa, and how immensely difficult it is to reach the remote sites where cycads tend to grow.

The main part of the book consists of treatments of individual species. There is no key to the species, and the species are arranged according to geographical region as well as morphological similarities. Individual species treatments consist of a few paragraphs on geographical distribution and the author's tribulations in getting to see the plants. I found it not to be very informative with regard to habitat descriptions, and for information on habitat one has to peer at the postage stamp sized photograph which heads every treatment, or the background of habitat photographs. The descriptions are rather informal, which should appeal to the non-technical reader. For every species there is a paragraph on conservation status.

The main glory of this book is the illustrations. Unlike Goode's previous *Cycads of Africa* (1989), this one is not illustrated by water colour paintings (except for detailed drawings of the cone scales, many of which are from the previous book), but by mostly excellent colour photographs. These depict plants in habitat, as well as the cones. The former are very informative, but sadly not all the cones are illustrated and some photos show very immature cones. If only Goode had made known his needs, many of the missing photographs could have been supplied from our members' archives. There are also two small outline distribution maps for each species, one showing the distribution in Africa, and one in the country or countries where the particular species occurs. The photographs of plants in habitat are very informative. On the whole they are of excellent quality, although a few are rather unclear such as those showing the male cones of *E. woodii* (page 122), *E. msinganus* (page 132), *E. lebomboensis* (page 134 and top of page 141), E. senticosus (page 142), and *E. umbeluziensis* (page 175) - surely it must have been possible to get better photographs of these relatively common species.

For every species the naming authors and date of publication are given, incorrectly for *E. manikensis, E. horridus, E. villosus,* and *E. poggei*; but no literature references. Towards the end of the book there is a short and not quite adequate bibliography.

There is an article on the relationship between African cycads and moths by Hermann Staude who has made a comprehensive study of the subject.

The book ends with a photo gallery of 34 pages, containing full page photographs which are mostly informative, but including some irrelevant photos (pages 319, 331, 332, 335, 339, 345, and 338 which is similar to that on page 14). Surely these would have been more effective if included with the text of the relevant species. Not all photographs by outside contributors credited, for instance the female cones of *E. dolomiticus* at the top of p. 63.

The index is quaint: the names appear in the same order as in the body of the text, rather than alphabetical, so that one has to read through the whole index to find a page reference.

As reviewer I am obliged to point out a number of drawbacks. The book contains too many unnecessary photographs, showing the same thing, for instance habit of *E. caffer* on pages 36 and 37. There are also too many irrelevant photographs, such as on pages 8, 10, 12 to 27,

203 (lower right), 216 (top and lower right), 244 (lower right), and 245 (centre left), which merely add to the cost of the book. It is a pity that no close-ups were provided of the variants of *E. natalensis* (pages. 128 to 129), but wisely the continuous variation within *E. manikensis* is ignored.

The inclusion of both geographical forms of *E. lebomboensis*, treated as separate entities, is not explained. My impression is that Goode does not understand the issue perfectly. For instance, on page 135 he states that the foliage of the two forms are similar but that their cones differ, whereas the reverse is true. To add to the confusion, on the same page he refers to "a cycad with incurving leaves ... in the catchment area of the Pongola River". The plants found there have ramrod-straight leaves, as evidenced by the photographs on page 140.

The photo of *E. aplanatus* on page 168 does not show the diagnostic characteristics of that species, and is probably *E. villosus*.

On p. 175 a perceived hybrid between *E. umbeluziensis* and *E. villosus* is shown. One would presume that this is an artificial hybrid, as the distributions of the two species do not overlap in nature.

The map of *E. caffer* (page 185) is inaccurate, as it has also been reported from Oribi Gorge in Natal and probably occurs sporadically between there and Humansdorp.

The plants depicted on pages 192 and 194 (upper) are almost certainly not *E. chimanimaniensis*, but those on page 195 (lower) are.

*E. powysii* (page 259) and *E. allochrous* (page 291) are not validly published names. The correct names are *E. tegulaneus* subsp. *powysii* and *E. barteri* subsp. *allochrous* respectively, though it is my personal opinion that both deserve specific rank.

On page 263 rumours of a cycad from Tanga which possibly differs from *E. hildebrandtii*, are perpetuated without explaining the differences. The photographs are not helpful. Neither is a "form of *E. tegulaneus*" (page 336) further explained.

I presume that the "bracts" of *Cycas thouarsii* referred to on page 305, are in fact megasporophylls.

However, the above points are minor compared to the wealth of illustrative material. We can be thankful that there are people like Douglas Goode who not only are willing to meet the enormous cost, personal discomfort, and outright life-threatening danger to visit these plants in habitat, but also to document the plants for the benefit of all of us.

This book is volume 1. The author told me that it will be some years before volume 2 can be expected, and that it will contain a number of as yet undescribed species of which he knows.

On the technical side, the production of the book is excellent. I like the large size of the photographs and the non-repetitive layout. The paper is non-transparent and not too glossy, the binding is good, and the quality of printing beyond reproach.

The main impression of this book is lavishness. It will certainly look good on any coffee table, but I guess most copies will be found in studies or on bedside tables, where the evocative photographs will provide a source of wonder, enjoyment, and information for years to come.

**Piet Vorster**
Botany Department, University of Stellenbosch, Private Bag X1, 7602 Matieland.

# NEW CYCAD PUBLICATIONS

CHEMNICK, J. 2001. **The Ceratozamias of Chiapas, Mexico.** *The Cycad Newsletter* 24(3): 3–8.

[The paper deals mainly with the distribution, habitats and vulnerability of the various *Ceratozamia* speciesof the Chiapas, Mexico and contains several black and white as well as colour photographs of the plants concerned.]

*Author's address: 114 Conejo Road, Santa Barbara, CA 93103, U.S.A.*

GORELICK, R. 2001. **Cycad Prepollen: Description and Possible Revolutionary Consequences of Zoidogamy.** *The Cycad Newsletter* 24(3): 12–14.

[The differences between prepollen, as produced by cycads, and true pollen as is produced by flowering plants are explained. Both prepollen and true pollen develop a pollen tube through the distal end of the grain. The pollen tube of cycads grows into and parasitizes the nucellus. The sperm cells are released through a proximal aperture in the prepollen wall and swims through the pollen chamber to the egg cell - they do not enter the pollen tube. Plants with prepollen and flagellated sperm cells are termed zoidogamous. In the case of true pollen, the sperm cells (or the generative cell from which they will develop) migrates into the pollen tube and remains near its growing tip. The sperm cells are released from the pollen tube at the egg cell

after the pollen tube had grown through the micropylar endof the ovule. Plants with true pollen and with pollen tubes that deposit nonflagellated sperm directly on the egg cell are termed siphonogamous.]

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LEITCH, I.J., HANSON, L. WINFIELD, M., PARKER, J. & BENNETT, M.D. 2001. **Nuclear DNA C-values complete familial representation in gymnosperms.** *Annals of Botany* 88(5): 843–849.

[The gymnosperms are a monophyletic yet diverse group of woody trees with approximately 730 extant species in 17 families. A recent survey showed that DNA C-values were available for approximately 16% of species, but for only 12 of the 17 families. This paper completes familial representation reporting first C-values for the five remaining families Boweniaceae, Stangeriaceae, Welwitschiaceae, Cephalotaxaceae and Sciadopityaceae, C-values for nine *Ephedra* and two *Gnetum* species are also reported. C-values are now available for 152 (21%) species. Analysis confirms that gymnosperms are characterised by larger C-values than angiosperms (model IC of gymnosperms = 15.8 pg compared with 0.6 pg in angiosperms) although the range (IC = 2.25–32.20 pg) is smaller than that in angiosperms (IC = 0.05–127.4 pg). Given complete familial coverage for C-values and increasing consensus in gymnosperm phylogeny, the phylogenetic component of C-value variation was also investigated by comparing the two datasets. This analysis revealed that ancestral gymnosperms (represented by cycads and/or *Ginkgo*; mean genome size = 14.71 pg) probably had larger genomes than ancestral angiosperms.]

*Authors' adresses unknown.*

TERRY, I. 2001. **Thrips and weeveils as dual, specialist pollinators of the Australian cycad *Macrozamia communis* (Zamiaceae).** *International Journal of Plant Sciences* 162(6): 1293–1305.

[Specialist beetles (Insecta, Coleoptera) have generally been considered to be the sole pollinators of cycads that have been studied. The possible pollination role of members of the thrips genus *Cycadothrips* (Thysanoptera, Aeolothripidae) found on male and female cones of some species of the Australian cycad genus *Macrozamia* (Zamiaceae), however, has never been experimentally investigated. This study, which included behavioral observations, visitation rates, pollen loads and exclusion experiments of insect visitors to *Macrozamia communis* cones in New South Wales, indicated that both *Cycadothrips chadwicki* Mound and *Tranes lyterioides* Pascoe (Coleoptera, Curculionidae) affect pollination. This is the first demonstration that specialist pollinators of two different insect orders pollinate a cycad. *Cycadothrips* adults and larvae fed on pollen, and *Tranes* weevil adults fed mainly on male sporophyll tissue and some pollen. Larvae of both insects developed in male cones; thrips larvae fed on pollen and weevil larvae fed on cone rachis tissue. *Tranes* adults moved from male cones mainly during the early evening to other cones, including female cones; sometimes this occurred as a mass, synchronized movement of all adults from male cones. Thrips moved out of male cones to other cones, including to female cones, only during the daylight hours, primarily between 1200 and 1700 hours. The behaviours of other insect visitors to male and female cones suggest that they are not pollinators. The implications of *Cycadothrips* species as pollinators of cycads are discussed.]

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WALTERS, T. & CUESTAS, S. 2001. **Montgomery Botanical Center's Collection: A 2001 Update on the Collection.** *The Cycad Newsletter* 24(3): 9–11.

[A total of 332 cycads were planted into the Grounds Collection during 2001, the majority of which came from past expeditions to Australia, Thailand, Japan and Vietnam. In 2001, wild collected speciems of *Cycas revoluta* were also incorporated in the Grounds Collection. As of August 2001, the Montgomery Botanical Center has approximately 2,500 cycads planted in the Grounds Collection and more than 2,000 cycad seeds, seedlings and juvenile cycad plants in its Nursery Collection, making it one of the world's largest cycad research collections. As of January 1, 2001, 72% of the accessions and 74% of the plants in the Ground Cycad Collection and 90% of the Nursery Cycad Collection are documented as being wild-collected.]

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*Compiled by* ***Nat Grobbelaar,*** *P.O. Box 15357, 0039 Lynn East, South Africa.*

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| 2370 | BERRY, Dr Edward H | Posbus 11736, UNIVERSITAS, Bloemfontein, 9321 |
| 0776 | BESSELING, Mnr J | Kerrystraat 9, Rembrandt Park X5, JOHANNESBURG, 2090 |
| 2624 | BESTER, Mnr S F | Delta Valley Farms, Posbus 138, GROOT DRAKENSTEIN, 7680 |
| 2345 | BEZUIDENHOUT, Frikkie | Posbus 6686, FLAMWOOD, 2572 |
| 1541 | BEZUIDENHOUT, Mnr L | Saffierstraat 10, Wilkoppies, KLERKSDORP, 2570 |
| 0399 | BISCHOFBERGER, Mr K | P O Box 108, WAPADRANT, 0050 |
| 9007 | BLOEMFONTEINSE OPENBARE BIBLIOTEEK | Die Bibliotekaris, (Afd Pligeksemplare), Posbus 3704, BLOEMFONTEIN, 9300 |
| 1559 | BOHI, Mr K | P O Box 782651, SANDTON, 2146 |
| 0947 | BOOYSEN, J J | Posbus 912-1157, SILVERTON, 0127 |
| 2723 | BOOYSEN, Louis C | Posbus 12177, QUEENSWOOD, 0121 |
| 2701 | BOOYSEN, Pieter & Lorraine | Posbus 12177, QUEENSWOOD, 0121 |
| 2657 | BOSCH, Dr Willem A | Posbus 27978, DANHOF, 9310 |
| 1130 | BOSHOFF, Mnr A J J | Posbus 30163, WONDERBOOMPOORT, 0033 |
| 2577 | BOSSY, Mr M C Eric | P O Box 897, MAGALIESSIG, 2067 |
| 2655 | BOTES, Riaan | Litlestraat 20, PAARL, 7620 |
| 2278 | BOTHA, Mnr C J | Posbus 65, DUIWELSKLOOF, 0835 |
| 2651 | BOTHA, Ds Daan | Posbus 1288, TZANEEN, 0850 |
| 2143 | BOTHA, Mev R | Posbus 20549, PROTEA PARK, RUSTENBURG, 0305 |
| 0276 | BOTHA, Prof T J R | Clairlaan 80, Manor Gardens, DURBAN, 4001 |
| 2042 | BOTHMA, Miss C S M | P O Box 11620, RYNFIELD, 1514 |
| 0848 | BOTHMA, Mev J W | Xavierstraat 2, Robertsham, JOHANNESBURG, 2091 |
| 1857 | BOUCHER, Mnr Ruan | Posbus 1610, POTCHEFSTROOM, 2520 |
| 2548 | BOUWER, Mnr Gerhard | Grysduikerweg 101, FLORAUNA, 0182 |
| 0822 | BOY, Mnr Ralph B | Posbus 17273, PRETORIA-NOORD, 0116 |
| 2354 | BRAND, Mnr J C | Posbus 33119, GLENSTANTIA, 0010 |
| 1142 | BRITS, Mev M C | Naudestraat 451, WONDERBOOM SUID, 0084 |
| 2265 | BROOKS, F A | P O Box 63, MONDEOR, 2110 |
| 1807 | BRUMME, Mnr D | Jakarandastraat 7, PAROWVALLEI, 7500 |
| 1191 | BRUWER, Mnr P C | Posbus 58093, KARENPARK, 0118 |
| 1016 | BRYTENBACH, Mnr A S | Posbus 748, WARMBAD, 0480 |
| 2190 | BUCHHOLTZ, Mrs D E T | P O Box 358, KWELERA, 5259 |
| 0616 | BUHR, Mr E W | P O Box 2, PORT SHEPSTONE, 4240 |
| 1776 | BURDEN, I & S | P O Box 787, LINKHILLS, 3652 |
| 0595 | BURSEY Mrs J | Lowlands Nursery, P O Box 9, KEI ROAD, 4920 |
| 2576 | BYLEVELDT, Mr G | P O Box 7274, PETIT, 1512 |
| 2369 | Die CALITZ Gesin | Posbus 29565, Danhof, BLOEMFONTEIN, 9310 |
| 9014 | CAPE NATURE COSERVATION: Scientific Services | The Librarian, Private Bag X5014, STELLENBOSCH, 7599 |
| 2595 | CAPE TECHNIKON LIBRARY | The Librarian, P O Box 652, CAPE TOWN, 8000 |
| 2690 | CARDOSO, Mr E G | P O Box 40330, CLEVELAND, 2022 |
| 2509 | CARRICK, Mr A H | Postnet Suite 214, Private Bag X7, TYGERVALLEY, 7536 |
| 2087 | CAVANAGH, Mr K R | Indigeflora, P O Box 1258, EDENVALE, 1610 |
| 2414 | CAWOOD, Mnr Richard | Posbus 97642, WESPARK, Pretoria, 0146 |
| 2497 | CHERRYWOOD NURSERY | P O Box 345, KENTON ON SEA, 6191 |
| 0949 | CHRISTIE, Mr A N R | 36 Murray Street, Waverley, JOHANNESBURG, 2090 |
| 0228 | CHRISTOPULO, Mr G | P O Box 168, MTUNZINI, 3867 |
| 0488 | CIAN, Mr G | 7 Chelsea Road, Athlone Park, AMANZIMTOTI, 4126 |
| 2200 | CILLIERS, André | P O Box 351, POTCHEFSTROOM, 2520 |
| 2679 | CLAASSEN, Mnr L J | Posbus 135, VREDENDAL, 8160 |
| 0156 | CLAASSEN, Dr M I | Posbus 25688, MONUMENTPARK, 0105 |
| 2478 | CLARKSON, Dr Keith | Posbus 34281, GLENSTANTIA, 0010 |
| 1436 | CLARKSON, Mr S P | P O Box 29231, Melville, JOHANNESBURG, 2109 |
| 2312 | COETZEE, Dr Derrick F | Posbus 1271, BALLITO, 4420 |
| 2038 | COETZEE, Mnr K N | Posbus 435, RANDFONTEIN, 1760 |
| 2477 | COETZEE, Mnr R J | Posbus 6610, RUSTENBURG, 0300 |
| 1206 | COETZEE, Mnr S D | Windmeulstraat 21, BRACKENFELL, 7560 |
| 2182 | COETZER, A P S | Posbus 20285, PROTEAPARK, 0305 |
| 2389 | COETZER, Ed & Jossie | Sussexlaan 413, LYNNWOOD, 0081 |
| 1579 | COMBRINCK, Mnr J J | Posbus 30, MOOINOOI, 0325 |
| 1681 | COOPER, Mr Simon G | P O Box 38892, GARSFONTEIN, Pretoria, 0042 |
| 1302 | CORBETT, Mrs F J | P O Box 6310, ANSFRERE, 1711 |
| 2449 | CORNELIUS, Mnr A H P D | Wilsostraat 67, Hazelpark, GERMISTON, 1401 |
| 1910 | COWLEY, Mr V W (Cape Flora) | P O Box 10556, LINTON GRANGE, 6015, Port Elizabeth |
| 2023 | CROFT WILD BULB NURSERY, THE | Cameron & Rhoda McMaster,The Croft Enterprises, P O Box 1053, STUTTERHEIM, 4930 |
| 1546 | CURACH Mr S | P O Box 286, LINK HILLS, 3652 |

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| 2583 | CURLE, A I | P O Box 477, JUKSKEI PARK, 2153 |
| 2429 | CURLING, Mrs C A | P O Box 12422, BENORYN, 1504 |
| 2212 | DALZELL, Mr C G M | Durban Botanical Gardens, P O Box 3740, DURBAN, 4000 |
| 2612 | DANIEL, Ms A N | P O Box 101195, MEER EN SEE, Richards Bay, 3901 |
| 0192 | DAVIDSON, Mr I A | 30 Liza Street, Kilner Park Extention, PRETORIA, 0186 |
| 2247 | DAY, Mnr G L | Posbus 2043, ROODEPOORT, 1725 |
| 2233 | DE ANDRADE, Mr A G | P O Box 1586, ALBERTON, 1450 |
| 2267 | DE BEER, Mr C M | P O Box 1107, WHITE RIVER, 1240 |
| 1956 | DE BEER, Mnr H J | Posbus 32085, Fichardtpark, BLOEMFONTEIN, 9317 |
| 2494 | DE BEER, Wouter & Retha | Franzinastraat 272, ELOFFSDAL, Pretoria, 0084 |
| 2704 | DE BEER, Adv Z H & C | Posbus 68561, BRYANSTON, 2021 |
| 0410 | DE HAAS, Dr G N | Posbus 1897, PIETERSBURG, 0700 |
| 1675 | DE JAGER, Prof F J | Posbus 524, AUCKLANDPARK, 2006 |
| 2241 | DE JAGER, Mnr Lourens | Posbus 52011, DORANDIA, 0188 |
| 1962 | DE JAGER, Mnr S | Posbus 1092, HILTON, 3245 |
| 0080 | DE JONG, J J | P O BOX 934, NORTH RIDING, 2162 |
| 2095 | DE JONGE, Mr H | P O Box 374, MOOINOOI, 0325 |
| 1838 | DEKKER, Ds D J M | Posbus 166, DUNDEE, 3000 |
| 0664 | DE KLERK, Dr J A | Posbus 2234, PIETERSBURG, 0700 |
| 2034 | DE KLERK, Mr J C | P O Box 90458, GARSFONTEIN X4, 0042 |
| 2680 | DE KLERK, Mnr J Danie | Amandastraat 49, Amandaglen, DURBANVILLE, 7550 |
| 0452 | DE KOCK, Mnr C V | Posbus 7222, TZANENG MALL, 0855 |
| 2622 | DE KOCK, Dr G C | Posbus 4677, PIETERSBURG, 0700 |
| 0404 | DE KOCK, Prof G de V | Posbus 5836, WALMER, 6065 |
| 2621 | DE KOCK, Mnr G L | Posbus 74367, LYNNWOODRIF, 0040 |
| 0815 | DE KOCK, Dr J A | Posbus 21, FAUNA PARK, 0787 |
| 2636 | DE KOCK, Mnr Johann H | Posbus 3498, MIDDELBURG, 1050 |
| 2603 | DE LAPELIN DUMONT, S J A L | P O Box 5871, WELTEVREDEN PARK, 1715 |
| 1062 | DE LA REY, Mnr A le R | 27 ste Laan 318, VILLIERIA, Pretoria, 0186 |
| 1186 | DELHOVE, Dr G G C H | P O Box 2078, GEORGE, 2078 |
| 2288 | DELPORT, Mr J L | P O Box 842, DURBANVILLE, 7551 |
| 2355 | DE MUNNIK, Dr A | Posbus 4816, MIDDELBURG, 1050 |
| 2017 | DE RIDDER, Mr Gerard | P O Box 783148, SANDTON, 2146 |
| 1818 | DE SMIDT, Mr D J | P O Box 71329, BRYANSTON, 2021 |
| 2472 | DE VILLIERS, Mnr Tielman | Posbus 73400, LYNNWOODRIF, 0040 |
| 1817 | DEXTER, Peter | 94 Buckingham Road, KLOOF, 3610 |
| 2039 | DIEDERICKS, Mnr W J | Posbus 17081, GROENKLOOF, 0027 |
| 0085 | DIXON, Mr Ian | 20 Varley Road, Hayfields, PIETERMARITZBURG, 3201 |
| 1403 | DODDEMEADE, Mr P W | P O Box 59112, KENGRAY, 2100 |
| 1649 | DOEPEL, Mr W R | P O Box 1127, HONEYDEW, 2040 |
| 1464 | DONALDSON, Dr J S | NBI, Private Bag X7, CLAREMONT, 7735 |
| 2227 | DROTSKY, Mnr S J | Posbus 1202, CARLETONVILLE, 2500 |
| 0806 | DUNCAN, Mrs Lorraine | 10 7th Street, Linden, JOHANNESBURG, 2195 |
| SPES | DU PLESSIS, Mej A | Engelbertusstraat3, Uitbreiding 12, DORANDIA, 0182 |
| 2694 | DU PLESSIS, Antoinette | Posbus, 13980, LERAATSFONTEIN, 1038 |
| 1298 | DU PLESSIS, Mnr André | Essenhoutweg 9, Wilkoppies, KLERKSDORP, 2570 |
| 2619 | DU PLESSIS, Chris H | Roosstraat 16, MONUMENT, Krugersdorp, 1739 |
| 2664 | DU PLESSIS, Dr C J | Departement CACS, Privaatsak X04, ONDERSTEPOORT, 0110 |
| 2290 | DU PLESSIS, Dr G J | Wychwoodlaan 31, Linkside, PORT ELIZABETH, 6001 |
| 2377 | DU PLESSIS, Mnr Johan P | Posbus 3173, PRETORIA, 0001 |
| 2682 | DU PLESSIS, Mnr R F | Posbus 3946, THE REEDS, 0154 |
| 2578 | DU PLESSIS, Mev S C | Rigellaan 337 A, WATERKLOOFRIF, 0181 |
| 6335 | DU PREEZ, Mnr D vdM | Posbus 31, Patensie, 6335 |
| 2218 | DU PREEZ, Mnr H K | Dikbaslaan 59, WONDERBOOM, 0182 |
| 2703 | DU PREEZ, Jaco | Posbus 828, GROBLERSDAL, 0470 |
| 1577 | DU PREEZ, Mnr J C | Posbus 5452, Onverwacht, ELLISRAS, 0557 |
| 1428 | DU RAND, Mr L | P O Box 1254, ROOSEVELT PARK, 2129 |
| 1810 | DU TOIT, Mnr Biem | Posbus 3942, PIETERSBURG, 0700 |
| 2716 | DU TOIT, Mnr Cornelis G | Posbus 3540, KENMARE, 1745 |
| 2358 | DU TOIT, Mnr C L | Terblanchstraat 5, De Zoete Inval, SUIDER PAARL, 7646 |
| 1064 | DU TOIT, Mev H J | Wydgelegen BREDASDORP, 7282 |
| 1271 | DU TOIT, Mnr H X N | Posbus 22, BREDASDORP, 7280 |
| 0971 | DU TOIT, Mnr K P | Posbus 75, BURGERSFORT, 1150 |
| 0082 | DU TOIT, Neethling & Erica | Posbus 3922, NELSPRUIT, 1200 |
| 2040 | DU TOIT, Mnr P J & VAN DER WESTHUIZEN, Mnr P | Posbus 2328, KLERKSDORP, 2570 |
| 2686 | DURRHEIM, Mr Kevin C | 1 George Street, BERLIN, 5660 |
| 2529 | DUVENAGE, Hugo | Posbus 2285, GROBLERSDAL, 0470 |
| 1040 | EALES, Mr L E | 263 Lewisham Road, BLACKHEATH, Johannesburg, 2195 |
| 2671 | EASTERN, Dr A | P O Box 16385, DOWERGLEN, 1612 |
| 2650 | ECONOMAKIS, Mr Ari | Wimpy Shop 5, Alberton Mall, Clinton Road, NEW REDRUTH, 1449 |
| 2571 | EDWARDS, A J | P O Box 10431, MEERENSEE, 3901 |
| 1630 | EKSTEEN, Mnr L J | Posbus 4496, EMPANGENI, 3880 |
| 2148 | ELLIOTT, Mr V | 45 Grenville Avenue, SAVOY ESTATE, 2090 |
| 2011 | ELOFF, Mnr Frits | Posbus 12609, CLUBVIEW, 0014 |
| 2722 | EMERICH, Rian | Posbus 6419, WELTEVREDENPARK, 1715 |
| 2460 | ENGELBRECHT, Mev Antoinette | Posbus 257, GERMISTON, 1400 |

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| 2426 | ENGELBRECHT, Mev A W | Posbus 424, GROBLERSDAL, 0470 |
| 0817 | ERASMUS, Dr C S | 77 Rustenburg Road, EMMARENTIA, Johannesburg, 2195 |
| 2132 | ERASMUS, Mnr H J | Posbus 180, DUIWELSKLOOF, 0835 |
| 1863 | ERASMUS, Mnr P M S J | Posbus 31231, TOTIUSDAL, 0134 |
| 0793 | EVERETT, Mr W A | P O Box 238, CONSTANTIA, 7848 |
| 2638 | EVERT, Mnr John G | Posbus 13170, LERAATSFONTEIN, 1038 |
| 2360 | EXLEY, Mnr Schalk | Posbus 1913, RICHARDSBAAI, 3900 |
| 2504 | FERREIRA, Mnr M P | Weirstraat 413, PRETORIA-TUINE, Pretoria, 0082 |
| 2637 | FEY, Mnr Joggie N | Maskewstraat 21, VANDERBIJLPARK, 1911 |
| 2695 | FLETT, Dr Brad C | 25 Maree Street, POTCHEFSTROOM, 2520 |
| 9015 | FLORA CONSERVATION COMMITTEE | Botanical Society of SA, Kirstenbosch, CLAREMONT, 7735 |
| 1963 | FOKKENS, Mr J F | P O Box 14504, NELSPRUIT, 1200 |
| 0148 | FORRESTER, Mr L A | No 8 Callie Evens Lodge, CATHCART, 5310 |
| 2721 | FOUCHE, Leon | Posbus 102, ROOIHUISKRAAL, 0152 |
| 2662 | FOURIE, Mnr Joop | Posbus 41498, MORELETAPARK, 0044 |
| 2044 | FOURIE, Mnr J J A | Posbus 908541, MONTANA, 0151 |
| 0689 | FOURIE, Mnr M J | Hobsonstraat 9, STILFONTEIN, 2551 |
| 0542 | FRITZ, Mnr G | Posbus 139, HEIDELBERG, 1438 |
| 1632 | FUGLISTER, Mr F J | P O Box 121, HALFWAY HOUSE, 1685 |
| 2238 | GARRATT, Dr P J V | 71 Myro Drive, Glenmore, DURBAN, 4001 |
| 0200 | GERBER, Mr Harry | 45 Anleno Road, Montclair, DURBAN, 4001 |
| 2113 | GIELINK, Mr C C | P O Box 3786, DURBAN, 4000 |
| 1614 | GNEITING, C F H | P O Box 72188, LYNNWOOD RIDGE, 0040 |
| 1466 | GOLDSCHMIDT, Dr R P | P O Box 68332, BRYANSTON, 2021 |
| 0046 | GOODE, Douglas | 10 Hudson Bennett Crescent, GILLITS, 3610 |
| 2665 | GOOSEN, Mnr R N | Posbus 25426, GEZINA, 0031 |
| 2273 | GOSSMANN, J F | Sultanastraat, Uitsig, WELLINGTON, 7655 |
| 1335 | GOULD, Mr & Mrs T | P O Box 132, PENNINGTON, 4184 |
| 1789 | GREYLING, Mnr J J | 21ste Laan 760, RIETFONTEIN, 0084 |
| 1720 | GRIESEL, Mnr C L B | Queens Crescent 427, LYNNWOOD, Pretoria, 0081 |
| 2712 | GROBBELAAR, Francious & Alice | Posbus 1111, LOUIS TRICHARDT, 0920 |
| 1400 | GROBBELAAR, Mev Hanneke | Tarentaalkloof, Posbus 15357, LYNN-OOS, 0039 |
| 0097 | GROBBELAAR, Prof N (Erelid) | Tarentaalkloof, Posbus 15357, LYNN-OOS, 0039 |
| 2633 | GROBLER, J | P O Box 8024, SONPARK, 1211 |
| 2719 | GROBLER, Mnr Johan H | Posbus 892, MOOINOOI, 0325 |
| 2285 | GROBLER, Mnr Phil | Posbus 236, PIETERSBURG, 0700 |
| 2502 | GROENEWALD, Mnr D M | Willsonstraat 161, FAIRLAND, 2195 |
| 2563 | GROENEWALD, Willem L | Posbus 84571, GREENSIDE, 2034 |
| 0420 | HANACZECK, Mr H W | P O Box 44, DUIWELSKLOOF, 0835 |
| 1178 | HARRIS, Mr M V | 64 Robertson Road, WARMBARTHS, 0480 |
| 1600 | HARRIS, Mnr R | Posbus 16514, VERWOERDBURG, 0140 |
| 0510 | HARRISON, E R | P O Box 104, MTUBATUBA, 3935 |
| 0296 | HARRY MOLTENO LLIBRARY | The Librarian, Kirstenbosch, Private Bag X7, CLAREMONT, 7735 |
| 0601 | HART, Mr G B | P O Box 72727, LYNNWOOD RIDGE, 0040 |
| 2271 | HATTINGH, Mev Elza | Posbus 797, HONEYDEW, 2040 |
| 2318 | HATTINGH, Mnr J F | Posbus 13717, SINOVILLE, 0129 |
| 2678 | HECKL, Wolfram | P O Box 1383, HONEYDEW, 2040 |
| 1964 | HEINE Mnr E W P | Groeneweide 10, STELLENBOSCH, 7600 |
| 2326 | HELM, Marius | Posbus 9612, QUEENSTOWN, 5320 |
| 0115 | HENMAN, Mr Enrico | 12 Dhlinza Street, ESHOWE, 3815 |
| 2096 | HENNING, Dr J C | Posbus 1168, ELLISRAS, 0555 |
| 0433 | HENNING, Dr N G C | Cantonmentsweg 80, LYTTELTON MANOR, Centurion, 0157 |
| 2417 | HILLS, Mnr G | Posbus 64, HENNEMAN, 9445 |
| 1711 | HOLLANDER, Prof W J | RAU, Posbus 524, AUCKLANDPARK, 2006 |
| 2582 | HOLT, M G & SAAYMAN, P | P O Box 74312, TURFFONTEIN, 2140 |
| 2556 | HOLZTRÄGER, Dr F A | P O Box 29561, SUNNYSIDE, 0132 |
| 9002 | HOOFDIREKTORAAT NATUURBEWARING | Privaatsak X209, PRETORIA, 0001 |
| 1794 | HOOG, Mr R J L | 22 Douglas Road, KLOOF, 3610 |
| 0086 | HOOLE, Mr James | P O Box 7958, NEWTON PARK, Port Elizabeth, 6055 |
| 0295 | HORNE, Mnr C | Kommandeurstraat 51, WELGEMOED, Belville, 7530 |
| 1983 | HORSTHEMKE, Mr R E | P O Box 365, FERNDALE, 2160 |
| 2236 | HOWES, Cobie & Julie | 55 Homestead Avenue, HILLCREST, 3610 |
| 0498 | HULSHOF, Mr A | P O Box 1526, KLERKSDORP, 2570 |
| 1766 | HUNTER, Dr J J | Nietvoorbij, Privaatsak X5026, STELLENBOSCH, 7599 |
| 2718 | HURLY, Michael | P O Box 11438, MAROELANA, 0161 |
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| 1168 | ISACKS, Mr G R | 44 Windham Avenue, HILLARY, 4094 |
| 2178 | JANSEN, Mnr Zandberg | Roosweg 8, DAWNVIEW, Germiston, 1401 |
| 2593 | JANSE VAN RENSBURG, Mev A E | Posbus 39460, MORELETTAPARK, 0044 |
| 2448 | JANSE VAN RENSBURG, Mr J B | Gen E R Snymanslot 3, WELGELEGEN, 7500 |
| 1002 | JANSE VAN RENSBURG, Mnr J M | Posbus 92, VRYHEID, 3100 |
| 1217 | JANSE VAN RENSBURG, Mnr J P | Jopie Fouriestraat 374, PRETORIA-NOORD, 0182 |
| 0458 | JOHANNES, Mr G | P O Box 215, PIET RETIEF, 2380 |
| 0644 | JOHANNES, Mrs T A | P O Box 276, PAULPIETERSBURG, 3180 |
| 2501 | JOHANNESBURG BOTANIC GARDEN FOUNDATION | P O Box 85481, EMMARENTIA, 2029 |
| 1791 | JOHANNESBURG PUBLIC LIBRARY | Market Square, JOHANNESBURG, 2001 |

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| 2485 | JORDAAN, Mr J A | 22 Paradysvink Street, BIRCH ACRES, Kempton Park, 1619 |
| 2076 | JORDAAN, Dr J B | Posbus 19166, NELSPRUIT, 1200 |
| 0146 | JORDAAN, Sakkie & Anna | Posbus 104, WARRENTON, 6530 |
| 2292 | JOUBERT, J J | Posbus 21991, Helderkruin, ROODEPOORT, 1730 |
| 1355 | JOUBERT, Mnr W | Posbus 376, WARMBAD, 0480 |
| 1462 | KABLE, Mr A J | 12 Orchid Road, TYGERDAL, Goodwood, 7460 |
| 1791 | KADWA, Dr M A | Plastic Surgeon, Parklane Clinic, Private Bag X40500, HOUGHTON, 2041 |
| 2270 | KANONBERG CYCAD FARM | Posbus 2634, DURBANVILLE, 7551 |
| 1482 | KEMP, J J & A | Posbus 1135, PIETERSBURG, 0700 |
| 0010 | KEMP, Mev P | 51 Constance Road, BROADWOOD, Port Elizabeth, 6070 |
| 2151 | KENDALL, L | P O Box 11324, HATFIELD, 0028 |
| 0081 | KENNEDY, Mnr H C | Blok A-E 17, Huis Vergenoegd, Hoofstraat 188, PAARL, 7646 |
| 2596 | KIRSTEN, Mnr André | Privaatsak X5, CLOCOLAN, 9735 |
| 2394 | KLEYNHANS, Mnr P A | Posbus 83419, DOORNPOORT, 0017 |
| 0745 | KLOPPERS, Mnr John S | Posbus 24, GROBLERSDAL, 0470 |
| 1358 | KOFMAN Mnr J H | Posbus 1106, Montana Park, PRETORIA, 0159 |
| 1939 | KORKIE, Mnr E S | Vampirestraat 569, ELARDUSPARK, 0181 |
| 1812 | KRIEL, Mnr W J | Rupertlaan 34, SOMERSET-WES, 7130 |
| 2605 | KRUGER, Mnr A P | Posbus 863, PHALABORWA, 1390 |
| 2286 | KRUGER, H C | P O Box 1061, HERMANUS, 7200 |
| 2469 | KRUGER, H J | Posbus 241, NYLSTROOM, 0510 |
| 2311 | KRUGER, Mnr Johan | Posbus 911343, ROSSLYN, 0200 |
| 2547 | KRUGER, Mnr J C | Posbus 5552, WINKLESPRUIT, 4145 |
| 0853 | KRUGER, Dr P W B | Posbus 3173, PRETORIA, 0001 |
| 1140 | KRUGER, Mnr S R | Monarylaan 10, JORDAANPARK, Heidelberg, 2403 |
| 1672 | KUSCHKE, Mnr M M | Posbus 54, HAZYVIEW, 1242 |
| 1832 | KUUN, Mnr P J C | Posbus 39718, MORELETAPARK, 0044 |
| 2692 | LABUSCHAGNE, Dieter | Posbus 912464, SILVERTON, 0127 |
| 2475 | LABUSCHAGNE, D L | Posbus 174, HEILBRON, 9650 |
| 2420 | LAMBRECHTS, Dr A H D | Amandelweg 51, AMANDA GLEN, Durbanville, 7550 |
| 2343 | LAMBSON, Mr B | P O Box 411521, CRAIGHALL, 2024 |
| 2392 | LEMMENS, Mr D R | P O Box 15285, LAMBTON, 1414 |
| 2627 | LESLIE, Mr Bruce D | P O Box 11124, SILVERLAKES, 0054 |
| 1532 | LESSING, Mnr & Mev J | Oribistraat 30, JEFFREYSBAAI, 6330 |
| 1166 | LIGHTLEY, Mr C G | P O Box 11619, EMPANGENI, 3880 |
| 2666 | LONGMORE, Dr Kevin | 6 Rankin Way, EDGEMEAD, 7441 |
| 0645 | LOTTER, Mnr W J | Posbus 48520, Hercules, PRETORIA, 0030 |
| 0159 | LOUBSER, Prof J D | Posbus 11315, QUEENSWOOD, 0121 |
| 2219 | LOURENS, Mnr A J | Posbus 9455, ELSBURG, 1407 |
| 2620 | LOURENS, D C J | Hansweg 10, VALHALLA, 0185 |
| 2491 | LOURENS, Mev S | Posbus 68, PONGOLA, 3170 |
| 1676 | LOUW, Mr J P | P O Box 21433, VALHALLA, 0137 |
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| 2610 | VAN WYK, Mnr N R | Posbus 522, VRYHEID, 3100 |
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| 2516 | VAN ZIJL, Mnr Eugene | Posbus 11888, HATFIELD, 0028 |
| 2604 | VAN ZYL, Mnr Daan | Posbus 1998, TZANEEN, 0850 |
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| 2673 | VENTER, Mnr Frik P | Posbus 518, BRITS, 0250 |
| 2320 | VENTER, Mev Marlene | Posbus 854, PHALABORWA, 1390 |
| 2466 | VENTER, Mnr M M | Posbus 43245, THERESA PARK, 0155 |
| 2057 | VERMAAK, Mnr E de J | Perskeblomweg 9, Pelissier, BLOEMFONTEIN, 9301 |
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| 2626 | VORSTER, Mev L L | Posbus 48554, ROOSEVELTPARK, 2129 |
| 0016 | VORSTER, Dr Piet | Dept Plantkunde, Universiteit van Stellenbosch, Privaatsak X1, MATIELAND, 7602 |
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| 2609 | PIETERS, Mnr A J | Posbus 1516, WINDHOEK |

## NETHERLANDS, THE

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| 2121 | HORTUS BOTANICUS | Jan M Visser, Plantage Middenlaan 2A, 1018DD AMSTERDAM |
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| 2001 | ROYAL BOTANIC GARDENS | Library, Kew, RICHMOND, Surrey TW9 3AE |
| 9004 | ROYAL BOTANIC GARDENS | Threatened Plant Unit, Kew, RICHMOND, Surrey TW9 3AE |
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| 1051 | HUNTINGTON LIBRARY | Acquisitions Dept/Bot/, 1151 Oxford Road, SAN MARINO, CA 91108 |
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ZIMBABWE

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| 1991 | GILLESPIE, Mr M D | 128 Larmenier Village, 4 Ridgeway North, P.O. CHISIPITE, Harare |
| 1315 | LAPHAM, Mrs E | P O Box H.G. 960, Highlands, HARARE |
| 2295 | McLAUGHLAN, Miss G M | 1 Lloyd Close, Ballantyne Park, HARARE |
| 1218 | MÜLLER, Mrs D | P O Box 246, RUSAPE |
| 2380 | RIVRON, B D | 4 Shiri Road, Greendale, HARARE |
| 2281 | SCHLACHTER, Brian | Box B E 174, Belvedere, HARARE |
| 0096 | TURNER, Mr Ian S | P O Box 2162, HARARE |
| 2068 | WATERS, Mr I R | 29 Ridge Road, Avondale, HARARE |

# DONATIONS RECEIVED / DONASIES ONTVANG

## 9 JANUARY/JANUARIE 2001 TO/TOT 4 JANUARY/JANUARIE 2002

**THE FOLLOWING DONATIONS TO THE CYCAD SOCIETY OF SOUTH AFRICA (AS WELL AS UNLISTED DONATIONS BY FOREIGN MEMBERS) ARE ACKNOWLEDGED WITH THANKS:**

**DIE VOLGENDE DONASIES AAN DIE BROODBOOM VERENIGING VAN SUID-AFRIKA (ASOOK ONGELYSTE DONASIES ONTVANG VAN BUITELANDSE LEDE) WORD MET DANK ERKEN:**

| Number Nommer | NAME / NAAM | Amount Bedrag | Number Nommer | NAME / NAAM | Amount Bedrag |
|---|---|---|---|---|---|
| 2591 | Alberts, B.C. | R 14.00 | 1428 | Du Rand, L. | R 94.00 |
| 2264 | Allen, J.E. | 5.00 | 0971 | Du Toit, K.P. | 44.00 |
| 2184 | Anthony, Leon | 70.00 | 2650 | Economakis, A. | 44.00 |
| 2223 | Avenant, S.F. du T. | 14.00 | 2571 | Edwards, A.J. | 44.00 |
| 2201 | Barnard, Eben | 44.00 | 2148 | Elliot, V. | 44.00 |
| 2489 | Bassingthwaighte, I.B. | 44.00 | 2426 | Engelbrecht, A.W. | 44.00 |
| 2390 | Berga, A.S | 14.00 | 0817 | Erasmus, C.S. | 10.00 |
| 0776 | Besseling, J. | 88.00 | 1863 | Erasmus, P.M.S. | 28.00 |
| 0399 | Bischofberger, K. | 24.00 | 2638 | Evert, John G. | 138.00 |
| 1559 | Bohi, K. | 4.00 | 1963 | Fokkens, J.F. | 106.00 |
| 2723 | Booysen, Louis C. | 14.00 | 2044 | Fourie, J.J.A. | 94.00 |
| 2701 | Booysen, Pieter & Lorraine | 44.00 | 0689 | Fourie, M.J. | 14.00 |
| 0947 | Booysen, J.J. | 24.00 | 1335 | Gould, T.M. | 14.00 |
| 2577 | Bossy, M.C. Eric | 44.00 | 2285 | Grobler, Phil | 34.00 |
| 2655 | Botes, Riaan | 88.00 | 2502 | Groenewald, D.M. | 44.00 |
| 0276 | Botha, T.J.R. | 4.00 | 0420 | Hanaczeck, H.W. | 44.00 |
| 0848 | Bothma, J.W. | 44.00 | 0601 | Hart, G.B. | 24.00 |
| 1857 | Boucher, R. | 14.00 | 2326 | Helm, Marius | 4.00 |
| 2265 | Brooks, F.A. | 50.00 | 0115 | Henman, Enrico | 4.00 |
| 1807 | Brumme, D. | 14.00 | 0433 | Henning, N.G.C. | 94.00 |
| 1191 | Bruwer, P.C. | 4.00 | 1794 | Hoog, J.R. | 44.00 |
| 0616 | Buhr, E.W. | 14.00 | 2718 | Hurly, Michael | 44.00 |
| 2576 | Byleveldt, G. | 44.00 | 2593 | Janse van Rensburg, A.E. | 48.00 |
| 0949 | Christie, A.N.R. | 24.00 | 2448 | Janse van Rensburg, J.B. | 44.00 |
| 2679 | Claassen, Louis J. | 44.00 | 1002 | Janse van Rensburg, J.M. | 14.00 |
| 2312 | Coetzee, Derrick F. | 14.00 | 1217 | Janse van Rensburg, J.P. | 6.00 |
| 2389 | Coetzer, Ed & Jossie | 88.00 | 0745 | Kloppers, John S. | 200.00 |
| 2429 | Curling, C.A. | 144.00 | 0853 | Kruger, P.W.B. | 30.00 |
| 2612 | Daniel, A.N. | 44.00 | 1672 | Kuschke, M.M. | 44.00 |
| 2247 | Day, G.L. | 294.00 | 2666 | Longmore, Kevin | 44.00 |
| 2233 | De Andrade, A.G. | 144.00 | 0159 | Loubser, J.D. | 44.00 |
| 2267 | De Beer, C.M. | 44.00 | 1676 | Louw, J.P. | 30.00 |
| 1956 | De Beer, H.J. | 28.00 | 1324 | Lovatt, M. | 94.00 |
| 1675 | De Jager, F.J. | 50.00 | 2641 | Mackenzie, Paul | 52.00 |
| 0080 | De Jong, J.J. | 9.00 | 2525 | Maher, Alan | 14.00 |
| 0410 | De Haas, G.N. | 14.00 | 2665 | Marais, Thys | 85.00 |
| 2472 | De Villiers, Tielman J. | 100.00 | 2203 | Maritz, H.P. | 94.00 |
| 1817 | Dexter, Peter | 44.00 | 2675 | Meyer, Julius O. | 4.00 |
| 2039 | Diedericks, W.J. | 14.00 | 2607 | Mini, M. | 34.00 |
| 1403 | Doddemeade, P.W. | 14.00 | 2150 | Minnaar, D. | 44.00 |
| 1649 | Doepel, W.R. | 65.00 | 0006 | Minnie, Ollie | 4.00 |
| 2664 | Du Plessis, C.J. | 44.00 | 2585 | Mitchell, J.R. | 14.00 |
| 2703 | Du Preez, Jaco. | 44.00 | 1908 | Monteux, G. | 210.00 |

| Number<br>Nommer | NAME / NAAM | Amount<br>Bedrag | Number<br>Nommer | NAME / NAAM | Amount<br>Bedrag |
|---|---|---|---|---|---|
| 2488 | Morrick, G | R 14.00 | 0147 | Tate, D.M. | R 14.00 |
| 2086 | Mostert, P.J. | 34.00 | 1708 | Terblanche, J. | 14.00 |
| 2476 | Myburgh, L.M. | 24.00 | 1708 | Terblanche, J. (vir Zimbabwe) | 10.00 |
| 2220 | Naude, L.J. | 14.00 | 2237 | Udemans, Willie L. | 44.00 |
| 2725 | Nel, Allan M.& Jolanda | 14.00 | 1760 | Uys, A.G. | 14.00 |
| 2634 | Nel, Chris | 58.00 | 1144 | Van den Heede, A.M.P. | 100.00 |
| 1423 | Nel, J.J.G. | 8.00 | 0136 | Van der Merwe, J.F. | 1.00 |
| 0237 | Nell, J.M. | 28.00 | 2727 | Van der Walt, Corn M | 14.00 |
| 2452 | Nelson, S.C. | 44.00 | 2724 | Van der Westhuizen, Leon C. | 50.00 |
| 1194 | Niemand, H. & D. | 14.00 | 1728 | Van Deventer, J.C. | 88.00 |
| 1968 | Oberholzer, Niël & Thea | 58.00 | 2667 | Van Deventer, Trevor | 46.00 |
| 2300 | Pautz, M.J. | 44.00 | 2297 | Van Geems, J.J. | 14.00 |
| 0078 | Pinker, C.E. | 17.00 | 1173 | Van Helsdingen, Johan | 14.00 |
| 0734 | Platford, R.J. | 25.00 | 2711 | Van Jaarsveld, Jorrie & Magda | 69.00 |
| 2409 | Pretorius, J.J. | 44.00 | 2105 | Van Jaarsveld, Wynand J.V. | 44.00 |
| 0631 | Prozesky, J.G. | 14.00 | 1258 | Van Rooy, Leon | 44.00 |
| 1917 | Quinn, Peter & Linda | 44.00 | 2470 | Van Rooyen, A.L. | 14.00 |
| 1197 | Reinach, Norman | 19.00 | 1924 | Van Rooyen, H.C. | 14.00 |
| 2005 | Roos, P.B. | 14.00 | 1925 | Van Rooyen, J.C. | 14.00 |
| 0415 | Rudman, R.R. | 24.00 | 2688 | Van Schalkwyk, Coreen A. | 50.00 |
| 1446 | Schmid, Roelf | 5.00 | 2707 | Van Staden, Mike & Helena | 14.00 |
| 2524 | Schoeman, P.J. | 18.00 | 1819 | Van Vuuren, J.A. | 294.00 |
| 2202 | Schutte, M. | 14.00 | 2644 | Van Vuuren, W.A. | 58.00 |
| 0447 | Scriba, J.H. | 18.00 | 2610 | Van Wyk, N.R. | 14.00 |
| 2256 | Sim, Henry | 4.00 | 1891 | Van Wyk, R.J. | 14.00 |
| 1959 | Smalberger, H.C. | 94.00 | 2604 | Van Zyl, Daan | 34.00 |
| 2399 | Smit, C.A. | 14.00 | 2060 | Veldkamp, J.A. | 88.00 |
| 1815 | Snyman, P.H.R. | 14.00 | 2661 | Velthuysen, D.N. | 14.00 |
| 2249 | Sole, Terry | 28.00 | 0681 | Venter, F.F.C. | 44.00 |
| 2401 | Sopp, Willie | 44.00 | 2320 | Venter, Marlene | 38.00 |
| 0911 | Steenkamp, K. | 4.00 | 1033 | Vice, A.R. | 173.00 |
| 2713 | Stoffberg, M.C. | 94.00 | 1945 | Viljoen, Frank | 4.00 |
| 2484 | Stoltz, D.H. | 14.00 | 1949 | Viljoen, Norman | 14.00 |
| 2254 | Stolz, A.H.G. | 50.00 | 2013 | Visser, George | 8.00 |
| 2341 | Strobes, J.M.L. | 44.00 | 0847 | Walters, J.W. | 94.00 |
| 2715 | Sutherland, Andrew C. | 14.00 | 0047 | Wentzel, Stephanus | 44.00 |
| 2422 | Swanepoel, Andy & Elize | 44.00 | 0448 | Wessels, F.H. | 44.00 |
| 0139 | Swanepoel, Johan | 24.00 | 0008 | Wohlberg, H. Edgar | 44.00 |
| 0651 | Swart, M.L. | 44.00 | | | |
| | | | | **TOTAL / TOTAAL** | **R7045.00** |

## NOTICE / KENNISGEWING

**LOCAL MEMBERS: all cheques should be made out to the CYCAD SOCIETY OF SOUTH AFRICA (full name) and not just to the CYCAD SOCIETY.**
**PLAASLIKE LEDE: alle tjeks moet uitgemaak word aan die BROODBOOM VERENIGING VAN SUID-AFRIKA (volledige naam) en nie net aan die BROODBOOM VERENIGING nie.**

# THE CYCAD SOCIETY OF SOUTH AFRICA

## BALANCE SHEET AS AT 31 DECEMEBR 2000

| | 2000<br>R | 1999<br>R | 1998<br>R |
|---|---|---|---|
| **ASSETS** | | | |
| NON-CURRENT ASSETS | 1 509 | 2 302 | 1 851 |
| Property, plant and equipment | | | |
| CURRENT ASSETS | 143 411 | 123 956 | 124 366 |
| Inventory - back issues | 9 801 | 9 771 | 8 514 |
| Fixed deposits | 32 605 | 32 605 | 32 605 |
| Cash in bank | 100 969 | 81 580 | 83 247 |
| Petty cash float | 36 | - | - |
| **TOTAL ASSETS** | 144 920 | 126 258 | 126 217 |
| **EQUITY AND LIABILITIES** | | | |
| CAPITAL AND RESERVES | 109 645 | 107 392 | 101 360 |
| Accumulated reserves | | | |
| CURRENT LIABILITIES | 35 275 | 18 866 | 24 857 |
| Sundry creditors | - | 516 | - |
| Pre-paid subscriptions | 35 275 | 18 350 | 24 857 |
| **TOTAL EQUITY AND LIABILITIES** | 144 920 | 126 258 | 126 217 |

I hereby declare that I am a member of the Cycad Society of South Africa, but that I have no interest in its financial affairs. The financial statements have been compiled from information and explanations received from the President and Officials of the Society.

I therefor certify that the Balance Sheet and Income Statement for the year ended 31 December 2000 are in accordance with the accounting records.

**W J DIEDERICKS**
Pretoria, 9 November 2001

# THE CYCAD SOCIETY OF SOUTH AFRICA

## INCOME STATEMENT FOR THE YEAR ENDED 31 DECEMBER 2000

| | 2000<br>R | 1999<br>R | 1998<br>R |
|---|---|---|---|
| INCOME | 94 090 | 103 225 | 97 255 |
| Subscriptions | 72 645 | 79 692 | 73 718 |
| Donations | 8 497 | 6 599 | 6 597 |
| Sales - back issues | 1 932 | 3 968 | 3 685 |
| Interest received | 10 199 | 12 108 | 12 672 |
| Sundry income | 817 | 858 | 583 |
| LESS: EXPENSES | 91 837 | 97 193 | 64 673 |
| Bank charges | 1 184 | 1 118 | 709 |
| Branch transfers | 2 288 | 2 276 | 2 304 |
| Depreciation | 793 | 1 929 | 2 018 |
| Grants and subsidies | - | 7 000 | - |
| 'Encephalartos' publication and printing costs | 54 019 | 55 847 | 31 836 |
| Postage and photo copies | 32 258 | 27 791 | 26 427 |
| Sundry expenditure | 1 295 | 1 232 | 1 379 |
| NET SURPLUS FOR THE YEAR | 2 253 | 6 032 | 32 582 |
| ACCUMULATED RESERVES AT BEGINNING OF THE YEAR | 107 392 | 101 360 | 68 778 |
| ACCUMULATED RESERVES AT THE END OF THE YEAR | 109 645 | 107 392 | 101 360 |

# CYCAD SOCIETY OF SOUTH AFRICA / BROODBOOM VERENIGING VAN SUID-AFRIKA

## NEW MEMBERS SINCE 5 OCTOBER 2001 TO 4 JANUARY 2002 / NUWE LEDE VANAF 5 OKTOBER 2001 TOT 4 JANUARIE 2002

| | | |
|---|---|---|
| 2705 | VAN DER WALT, Izak-Hendrik | Hermanstraat 95, CAPRICORN, Pietersburg, 0699 |
| 2706 | VORSTER, Mnr P P J | 33ste Laan 777, VILLIERIA, Pretoria, 0186 |
| 2707 | VAN STADEN, Mnr Mike & Mev Helena | DenysReitslaan 27, ROOSEVELDPARK, 2195 |
| 2708 | VAN ZYL, Mnr Johan | Magdalenastraat 541, ROSEVILLE, 0084 |
| 2709 | MARTIN, Adv C H | P O Box 4040, RIVONIA, 2128 |
| 2710 | ROOS, Mr M D & Mrs T J | 43 Staplehurst Gardens, Cliftonville, KENT CT9 3JD, UNITED KINGDOM |
| 2711 | VAN JAARSVELD, Mnr Jorrie & Mev Magda | Posbus 2298, WITRIVIER, 1240 |
| 2712 | GROBBELAAR, Francious & Alice | Posbus 111, LOUIS TRICHARGT, 09200 |
| 2713 | STOFFBERG, Dr M C | Posbus 100755, MORELETA PLAZA, 0167 |
| 2714 | MOTSOENENG, Mr M E | 1391-2 Zone 10, CNR Piseng-Trio, P O SEBOKENG, 1983 |
| 2715 | SUTHERLAND, Mr Andrew C | P O Box 10289, MEERENSEE, 3901 |
| 2716 | DU TOIT, Mnr Cornelis G | Posbus 3540, KENMARE, 1745 |
| 2717 | Mt COOT-THA BOTANICAL GARDEN LIBRARY | Locked Bag No 1, TOOWONG, AUSTRALIA |
| 2718 | HURLY, Michael | P O Box 11438, MAROELANA, 0161 |
| 2719 | GROBLER, Mnr Johan H | Posbus 892, MOOINOOI, 0325 |
| 2720 | RIETJIESBOS BOERDERY | Posbus 24, MONTE VISTA, 7461 |
| 2721 | FOUCHE, Leon | Posbus 102, ROOIHUISKRAAL, 0152 |
| 2722 | EMERICH, Rian | Posbus 6419, WELTEVREDENPARK, 1715 |
| 2723 | BOOYSEN, Louis C | Posbus 12177, QUEENSWOOD, 0121 |
| 2724 | VAN DER WESTHUIZEN, Mr Leon C | P O Box 8547, WESTERN LEVELS, 2501 |
| 2725 | NEL, Mnr Allan M & Mev Jolanda | Posbus 60497, PIERRE VAN RYNEVELD, 0045 |
| 2726 | VAN KOERSVELD, Paul | 8 Bettina Road, RONDEBOSCH EAST, 7780 |
| 2727 | VAN DER WALT, Mnr Corn M | Williamweg 20, CHARLO, Port Elizabeth, 6070 |
| 2728 | VAN DUYKER, Mr Paul S | P O Box 30328, RICHARDS BAY, 3900 |

## NEWSPAPER CLIPPINGS / KOERANTUITKNIPSELS

**Beeld, Donderdag**
**15 November 2001**

### Oudkolonel vas ná 'broodboom-diefstal'

Pietersburg. – 'n Uitgetrede weermagkolonel is gister hier op borgtog van R5 000 vrygelaat nadat hy aangekeer is in verband met die diefstal van broodbome.

Kol. Hennie (Wingnut) Jansen van Rensburg (43) is aangekla nadat mnr. Johan Willemse, leier van die Vryheidsfront in die Noordelike Provinsie, 'n man in sy buurman se tuin betrap het wat besig was om die bome uit te grawe.

Insp. Elke Austen, ondersoekbeampte in die saak, beweer Jansen van Rensburg het "baie, baie" broodbome op sy erf in Die Sirkel nr. 19, Bendor, terwyl hy net vir 13 permitte het.

Jansen van Rensburg beweer volgens Austen dat 'n man wat hom glo R1 900 skuld, gesê het hy kan maar van die broodbome op sy erf gaan uithaal om die skuld te help delg. Die huis waar die broodbome gesteel is, behoort egter aan 'n gesin wat besig is om te verhuis. – **Retha Fourie**

# Broodbome kry nou oral voete in tuine

## Permit nodig om dié gesogte, duur oerplante aan te plant

HARRIET BOX

**BROODBOME raak nou ook uit voortuine in tradisioneel bruin gebiede weg soos met mnr. Wayne Dames van Dennemere in Blackheath verlede Woensdag gebeur het. Twee van sy broodbome is ná 'n jaar van vertroeteling uit sy voortuin gesteel.**

Broodbome is gesogte oerplante en volgens 'n botanis by die Nasionale Botaniese Instituut, mnr. De Wet Bosenberg, is dié plante baie duur en mag dit net deur wettige permithouers aangehou word.

Dames het destyds die plante voor 'n gebou in Bellville gesien, daarvan gehou en besluit om self vir hom 'n paar aan te skaf.

Hy sê:"Ek het R1 000 vir elkeen van my twee broodbome betaal en toe was hulle maar net 'n paar sentimeter hoog. Voor hulle gesteel is, was hulle omtrent 50 cm hoog," vertel die ywerige tuinier.

"Die stelery moes tussen een en vyfuur gebeur het, want ek het nog tot laat gesit en sport kyk. My seun het die honde hoor blaf, maar hom nie daaraan gesteur nie," het hy gesê.

"Broodboom-eienaars in die gegoede noordelike gebiede se broodbome en plante word gereeld gesteel, veral uit voortuine wat nie omhein is nie," het 'n polisiebeampte van die Bellville-polisiekantoor gesê.

By die Kuilsrivier-polisiekantoor sê insp. Patrick Strauss: "Dit is ongewoon vir sulke voorvalle in dié gebiede. Dit kan sekerlik verhoed word as mense 'n buurtwag vir die gebied vorm."

Bosenberg het gesê die kanse dat die bome weer normaal kan groei wanneer dit heraangeplant word, is baie goed, want hulle is goed aangepas vir strawwe omstandighede.

Hy het gewaarsku dat dit onwettig is om broodbome van mense te koop wat nie permitte daarvoor het nie.

"Ek stel voor dat die persoon van wie die broodbome gesteel is dit dadelik aan die polisie rapporteer en ook aan natuurbewaring se mense; op dié manier word daar ten minste 'n rekord hiervan gehou."

Mnr. Wayne Dames in sy voortuin by die twee leë kolle (regs) waar sy gesogte broodbome gestaan het voor dat hulle verlede week gesteel is. Foto: Harriet Bo