

SOCIETY FOR GROWING AUSTRALIAN PLANTSCYCAD & ZAMIAD STUDY GROUP NO. 28JANUARY - FEBRUARY, 1987

Leader: Len P. BUTT - Phone No. 07 - 8483515

Asst: Brian Runnegar

Dear Len,

The first important thing about pteridospermae - "seed ferns" is that they were a diverse group, almost exploding morphologically with possibilities that are present when a new "system" comes into being. I don't know for sure whether the cycads arose from seed ferns or whether there was an intermediate order. I think they arose directly (along with related taxa now extinct). The cycads dispersed some 9,000 miles (best estimate) to here in North Carolina some 200 MYBP. These were cycads, later separated from those of Africa, Australia, India, etc., not something like cycads. Sometime prior to that this line had evolved pinnate leaflets from simple leaves (if you accept the simple leaves attributed to some cycad fossils), the seed had evolved from platyspermic (seed imbibes water in germination and water pressure cracks seed along seam at microphyll as in Cycas) to radiospermic as in all other genera and polyxylic stem evolved to supuxylic stem. All of which takes a little time. I don't think there was intermediate order(s).

Early pteridospermae had seed on leaf that then concentrated at edges, reduced in number and moved to base of leaf on either side of stem and then moved down onto stem - 6 each side in cycads. I've read all three versions of cycads and Bennettitales. However, Bennettitales had advanced female cone while morphology of pollen distribution parts were primitive. Cycads started with advanced male cone and primitive megasporophylls. One could be in the ball park presumably considering they came from 2 separate lines of pteridospermae - at different but \pm equal stages of evolution.

Obviously, the female cone of all genera other than cycas is more advanced than the separate megasporophylls of Cycas. That perse', however, does not indicate that the genus Encephalartos is younger than that of Cycas.

I'll try to explain. One genus evolves from another under certain circumstances. Suppose those circumstances were present in Africa today and *C. thoursii* evolved a new genus. Biochemistry would change radically, but most of the external morphology would be the "same". It would probably have the same (or similar) reproductive parts. It would still look as "old" - but it would be the youngest. (Microcycas doesn't look that different from some S. American *Zamia* - nor *Zamia* from *Ceratozamia*). The point is that *Cycas* and *Encephalartos* had a common origin, but the lines of evolution had diverged a long, long time before these 2 genera evolved. Sometime I'll plot out lines of evolution based on chromosome karyotype and it may help - too complex to do now. Both genera were in place 130 - 140 million years ago when India split from Gondwana and *Cycas* was well dispersed and evolved even then - *C. thoursii* had a maximum of 5 pairs of ovules, margins of and shape plate of megasporophyll had obviously evolved, for example, etc. (This may help: after Gondwana split, Indian, Asian and Australian *Cycas* species (all so far tested) underwent drastic climatic changes and evolved with substantial advancement in chromosome karyotype - *C. thoursii* didn't and remained unchanged. So it is older as a species than *C. revoluta*, *C. circinalis* of India with 12 ovules/sp. - to which it is intimately related, etc.)

I might note that the basic biochemistry is related to but decidedly primitive relative to those of other genera. (Note also that some species of *Cycas* have some features more advanced than some species of other genera).

Cycas may be older chronologically than *Encephalartos* but what really is true is that it has many morphological and biochemistry features that are more primitive than *Encephalartos*. You may have noted that I didn't use *Macrozamia* versus *Cycas* as you did. *Macrozamia* is not the same genus that left Gondwana - it underwent major biochemistry and chemistry and anatomy changes in adapting to subsequent conditions and therefore it is younger than *cycas* - and *Encephalartos*.

I hope I haven't confused you further; it is confusing. Please ask questions - I may or may not have answers.

What I'm giving you is front-line botany - solving the enigmas of cycad karyotypes and integrating with morp., biochem., geologic paleobotanic data provides the basis for a lot of answers. Very little of this is published as yet. So a number of the "pieces" I'm giving you are different than the answers you'd get from most botanists. Few, if any, would realise that *Macrozamia* is older than *Encephalartos* - only Stevenson did because his working on anatomy (and his work proves it independently).

It wasn't that long ago that I thought that *Cycas* retained its primitive morphology because Asian habitat climate remained sufficiently benign - and, in discussions, other botanists agreed. Now, in the realm of conjecture, I'm wondering how to prove - one way or another - whether *C. circinalis* line didn't precede that of *C. revoluta*, i.e. the "wet" types in *Cycas* preceded the "arid" types. And there's a good basis for it - the stomal details etc. of the "wet" types is very primitive while that of *C. revoluta* and related taxa are very advanced. And *Cycas* did arise in a very wet time in history.

Fossil history in cycads isn't all that it might be - to say the least. As best we know it, male cones were advanced at outset - cones don't fossilise that easily. There are stages of development through to the late Cretaceous - co-existing with more advanced morp. forms. Shortly thereafter all "borderline" and many "resistant" taxa became extinct - the smooth barked arkiferous taxa, for example, One fossil - Jurassic I think - had megasporophylls linked together but not formed into a helical cone. It helps to recall that even today there is a wide range of living primitive and advanced features. Another thing - its customary to use a species as typical of genus. Works find as a first approximation - but *Z. roezlei* (*Z. chigua*) is a far cry from *Z. pumila* (*Z. floridana*), for examples. In chromosome cytology, it was first thought that all gymnosperms were $2n=20$, later all Cycads were one number, then one number was the same for all species of a genus, now there are genera where the number is the same for genus but karyotypes very different (*Cycas*, *Zamia*) and where number is different and karyotype is different within genus (*Zamia*, *Encph.*) So you have to be very careful about generalisations. From this distance, I don't know what to make of the Glen Idle *Cycas* taxonimically.

.../

It's a beautiful plant, of course. If it differs only in colour (perhaps a difference in waxy coating?), usually this is not recognised taxonomically (for example, there are blue and green forms of *E. horridus*, *lehmanii*, etc). On the other hand, Loren Whitelock is a splitter and goes overboard on thinking many taxa should be species level sometimes - so who knows. (If so, it would be reclassified eventually). This assumes no differences other than colour - and there may be, though I don't know that Loren could have determined that in the time available without sporophylls etc. None of the above has any bearing, of course, on horticultural value and interest. There are huge differences of opinion as to what constitutes species, sub sp. and forms. It's doubly difficult because lineage often not direct lines, characters do not evolve in fixed sequence, etc. Loran rarely writes a letter - I used to have access to a toll free phone so talked to him regularly. I don't know and sure can't afford regular phone rates so our contact now is mostly indirect. Will write him though and try to find out his intent.

Please be a bit patient re data sheet form - my wife does typing via printer, printer tape ran out and couldn't get one locally, got tape and now son who's been in Germany (in army) for 2 + yrs. just came back with new bride for 2 wks. so it will be at least a couple of weeks. The form covers most things, except tricky parts of sporophylls, leaflet details, seed weights, dimensions (cover, shell, endosperm, membrane, etc.). If you wish I can make out another sheet of these; I omitted because some parts are extra tedious and some require a knowledge of specific botanic descriptive terms. These are critical though and require sending sporophylls, seed, leaflet (which I intend to have drawn to same scale). I will send back to you and/or source as desired the specific data I collect.

You may want to start considering who lives or travels where in relation to different habitats or has access to reproducing taxa from known habitats. In addition to just collecting data generally, I can write up problems background about specific localities, taxa, groups of taxa, etc. if it would be helpful. There are a lot of side things also - as latin, French, German translations - I'm working at them though I'm not expert in languages.

QLD

29° (25° 23°49')	146°20' 150°24'	Bundaberg, near Mt Morgan	
23°33'	150°30'	Rockhampton W of gin gin to ranges W of Rockhampton	C. kennedyana? C. media 'Undescribed'
22°30'	149°30'	3 mi W of St Lawrence	C. media
21-22'	149°30'	Road Sound Range	
20°42'	148°40'		
19°10'	146°20'	12 mi N of Ingham	C. media
18°55'	146°10'		
17°10'	146°	Cairns	Carrnsiana?
17°	146°	Yule Pt.	} (Same?)
17°	146°	12 Mi N of Cairns	
(15-15°30')	144-144°20'	Kennedy River (?)	
15°28'		JM 2718	
15°15'	145°	Cooktown	
(14-15°)		Normanby River (?)	
12°55'	145°±	50 km N of Cooktown	
10°50'	142°40'	Bamaga Mt Powell (near), Halewells area near Cooktown S of Mackay Telegraph Station Northern Cape York	'Undescribed' 'Undescribed'
		Petford. Normanby Range near Pt Denison	Carrnsiana C. kennedyana
		Tinaroo Dam	
		Mt Jukes	

NT

< 12-17°16'	155-137°±	Islands and W coast of Gulf of Carpentaria	C. angulata
16°x'	136°x'	Barrooloola	C. angulata
12°30'±	130°50'±	Darwin (area)	C. armstrongii
14°-14°40'	132-135°	12-16 km N of Katherine	C. calcicola
13°00'	130°45'	Mandora Rd. Bamboo Creek	" "
12°47°S	133°21'E	E. Alligator River Pt. Esmeralda	" "

WA

17-18°±	121-122°	Old Bluffs. Mt Broom, Herbert	C. furfuracea
15°5x'	126°±	King Leopold Range NE of Mt Haker	C. lanepoolii
15°30'	124°30'	Camden Sound area	C. media
15°49'	128°44'	Kununurra	C. pruinosa
		The grotto, Carr Boyd Range	" "
		Middle Springs Deception Range	" "
		Near Lawley River / NW area of E. of Mt. Haker, SE of Tunnel Creek.	C. basaltica

Dear Len,

I have (a draft of) the form that can be used in the field with Cycas. Got one side typed and the printer ribbon ran out and they don't have them here in town. Finally got one and now my son is due in tomorrow. So it will be a couple of weeks before it is finished.

Had wondered why you were so hung up on fern affiliation - then I checked Chamberlain for something and saw why. Chamberlain is one of my very favourite people, he was brilliant and I wish he were here today. Some of his views changed as more was learned and I believed he'd have changed others had he had the advantage of knowing all that has gone on since he left. You might be interested in a story: I've done some serious work on chromosome karyotyping and Chamberlain and later some of his students did some of the earliest chromosome numbers in cycads - which he reported in very positive terms. The students were young women, very competent botanists. I won't call them 'groupies' as some were nuns, but they obviously revered him. In reporting their results they even described how they counted around the edges etc. to make their results come out right. His results (and theirs) were quite incorrect - he was more or less following early leaders in chromosome cytology - and he didn't have advantage of shrinking chromosomes as we do today. I respect him no less.

I have begun putting habitats - seed data together and hope to include 1st approximation with this. I haven't worked with Australian data for a long time and haven't yet gotten all my data sheets together nor gone back to literature for habitats - nor even habitats noted in the bulletin you sent, but its moving. It's amazing always how assembling data points needs and directions. Easy question: Where is Petford? I suspect where general vicinity is - but it's not shown on my map.

I have had only one seed labelled *C. kennedyana*, no habitat cited. I could guess that its from vicinity of Kennedy River - but I don't know. Do you have a copy of its literature description (or for *C. armstrongii*?), any information on it and/or its habitat? I suspect it may not be a valid species - but we can't afford to assume that.

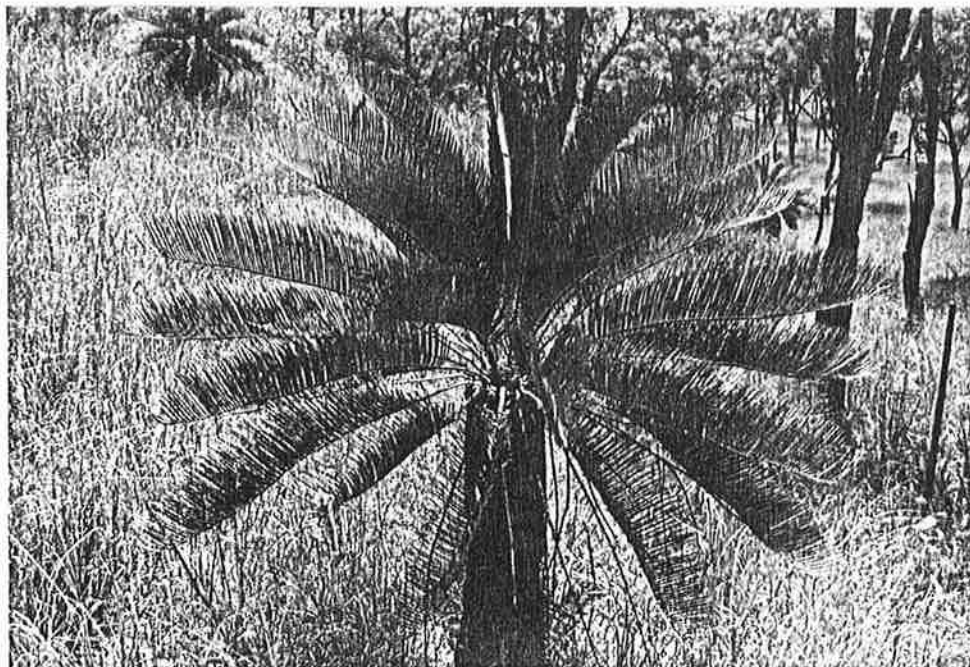
Have had seed from both Cairns and Petford labelled *C. cairnsiana*. Have seen reference to Petford dwarf which would seem to indicate subterranean or, at least very short stem whereas *Cairnsiana* is described as having stem to often 4 to 5 metres. If true,

doesn't necessarily mean they're different species but almost surely they'd have differences in reproductory characteristics. My mapping so far looks unnaturally barren around Gulf of Carpentaria and coastal area between Darwin&Camden Sound? Melville Island? Would sure like to see seed from Camden Sound region (leaflet, sporophylls).

Years ago I had *C. rumphii* type seed from Timor - long enough ago that I didn't measure, analyse. Any contacts?

Sure wish John Mac. was still around, a very nice fellow. He and I had one disagreement - his assignment of *calvicola* and *pruinosa* to affinity with *C. revoluta* because of revolute leaflet margins - can't be, leaflet margins among least conservative characters - relatively easily adaptable. More likely they are arid adaptions of *C. media* or *C. armstrongii*. This is not criticism of John - he didn't consider it that. For that matter, I constantly check my own thoughts and derivations - and have no hesitation to change when the evidence indicates. Please don't hesitate to disagree with me - preferably give reasons why as that removes it from a personal basis.

My latitudes and longitudes may be off - they're rough at this point. In many cases I received seed identified by species or by location - probably you can fill in the parts missing - please do. I'm continuing to amass habitat locations and would appreciate your additions and comments. Next I'll attach these to seed data and then other data - doing this now. Also starting detailed descriptions with references, habitat etc. for each species
Was Darwin once called Essington?



UNDESCRIBED
CYCAS
SPECIES AT
ABERGOWRIE,
QLD.

Cycas Data Sheet

1. Identification. Note species if known. If questionable add (?).
2. Habitat. Location: Distance, direction to nearest town, estimate latitude and long. Nature: (hill, valley, wooded, etc.), climate (esp. annual rainfall), soil (sandy, rocky), other plants, sun/shade.
3. Trunk. Mature plant ht. and dia; Persistent leaf bases? Branching? Suckering?
4. Female "Cone". Collect sporophyll and seed. Count sporophylls per crown. Count ovules/sp.-average and max. Measure total ht. of sp. (Detailed shape and measurements of sp. upper blade and of seed critical). Seed color before/after ripe.
5. Male Cone. Collect several sporophylls (3/4 up). Measure diameter 1/4, 1/2, 3/4 up and ht. Measure peduncle ht. and dia. Count "horiz." and "vert." rows of spor. (Shape, dimensions of sp. and number of sori (pollen sacs) and their distribution and orientation important).
6. Leaves. Count no. per flush. Measure length of leaf and of rachis. Spines: count no. in 1" just below rachis; present in all/part of petiole or also in rachis?; only along groove extension of leaflet insertion or randomly on petiole?
7. Leaflets. Sample (upper 3/4). Count no. of pairs/leaf. Measure length at base, middle, top of rachis. Decurrent (does base extend down to top of next leaflet)? (all leaflets or just upper 1/3 ?); midrib prominent or sunken above/below?; color/luster above/below? Twisted at base? (Shape, dimensions, margins, base data important).
8. Other. Tomentum (hair) color, density, distribution, etc. Any other character or feature of special interest.

Please use additional paper to describe as fully as feasible, any data/material greatly appreciated. Samples will be measured/analyzed in detail and botanically sketched. Please send samples, data with questions/comments to:

John G. Hendricks
110 Brookmeade Dr.
Statesville, NC, 28677 USA

and

LEN P. BUTT
Horticultural Advisor
25 Ortive Street,
Yeronga 4104 Qld.

N.B. PLEASE FILL IN ONE SHEET FOR EACH SPECIES OF CYCAS
IN YOUR AREA AND FORWARD TO JOHN HENDRICKS
WITH A PHOTOCOPY TO LEN BUTT.

PLEASE GIVE DATA SHEET TO ANY
MEMBER GOING NORTH INTO CYCAS
COUNTRY.

Cycas Data Sheet

1. Identification. _____.

2. Habitat. _____

3. Trunk. Ht. _____ Dia. _____ PLB. _____ Branching. _____

Suckering _____.

4. Female Cone. Sp./crown _____ . Ovules/sp. _____ ave, _____ max.

Ht. of sp. _____ . Seed Color _____ orig. _____ ripe.

5. Male Cone. Ht. _____ Dia. _____ (1/4), _____ (1/2) _____ (3/4).

Peduncle ht. _____ Dia. _____, Spor. rows _____ horizontal
_____ vertical.

6. Leaves. No./flush _____ . Length leaf _____ rachis _____.

Spines _____ No. per in. _____ . Spines located _____.

7. Leaflets. Pairs/leaf _____ . Length at top _____ middle _____

bottom _____ . Decurrent _____ . Midrib _____.

Color/luster _____.

8. Other. _____

Contributed by _____
