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SOCEITY FOR GROWING AUSTRALIAN PLANTS

CYCAD & ZAMIAD STUDY GROUP NO. 27

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Dear Len,

In the earlier days of Cycads - and that wasn't that long ago - much of what was written on evolution was based on conjecture and opinion. A lot of it was proven to be wrong. Even the best - Miquel and Chamberlain, the best of the giants, were wrong many times. Since then a lot of things have been measured and found, so we no longer have the excuse or reason that would have applied then. Not that all the answers are known - they aren't. And not nearly enough measurements have been made. But we need to build on what we know can and cannot be, measuring where feasible to extend the basis of understanding. Then, and only then, are intelligent projections in order. But pure speculation ignoring what is and could be known detracts more often than it helps.

Evolution is a systematic affair - but it doesn't follow a set sequence of events, it is strongly influenced by climate, especially moisture, by what has gone before and by the chromosomes involved. So its complex - but any theories must explain the known data and extending the known data base narrow the possibilities. Casual morphology doesn't provide all the answers. For example, it would indicate that Macrozamia is older than Encephalartos based on more prominent relict sporophyll spines. It isn't though. Chromosome karyotypes and biochemical data both indicate that Macrozamia is more advanced - and this is borne out by more advanced vascular characters. To find out why, you have to look at what happened geologically because that resulted in catastrophic climatic changes that resulted in major biochemical (re genus) changes. Chamberlain didn't know about the biochem data nor karyotypes - he only had a few chromosome numbers (which were incorrect).

A lot of taxonomy <u>was/is</u> based on leaflets. In Cycas, the possibilities of difference are limited by the single midrib. On the other hand, the variation in ovules/sp, sp. ht., detailed shape of the sterile upper portion of sporophylls, etc. provide extra sources of information. A taxa with two ovules/sp. may have derived from one with six ovules/sp. - but no way vice versa, etc.

.../2

I guess all this is a long way to point out that a very great deal of factural data of evolution in the Australian Cycas can be developed by systematic counts, measurements and observations - all easy to do - that can advance our understanding of evolution. Conjecture won't help much - there's already plenty of that and all its done is muddy the water. It's done that in some cases by causing data to be combined and therefore obscured. For example, lumping of data like the above obscures the fact that C. rumphii varies in these properties on different islands and mainlands. By following the decrease in ovules/sp., changes in seed shape, changes in sterile sp. platens and margins you can follow a course of evolution - supplemented sometimes by other changes - such as the undulant leaflets as those from Japan. And you know they are rumphii or circinalis as only they and their derivatives have a prominent spongy material in the seed between shell and endosperm and rumphii + circinalis differentiate by differences in seed shell morphology (as well as specific leaflet etc.). I'm sure that evolution of cycas is not going to be done adequately by casual visitors - my friend Loran Whitelock recently visited Australia specifically re Cycas and completely missed a major taxa that I can show to be clearly different than those he found. I have been working primarily so far with cycas from Asia south of the Himalayas. But I intend to arrange for collection of data in Australia if someone else doens't do it. And I'll gladly cooperate with someone or groups.

I know you are sincere in your interest in the evolution of Cycas in Australia as I am of Cycas broadly. The question is whether you want to work together on it or go it alone. I know that my finances and health will not permit me to personally gather the necessary data. And I think that I could be of help to you in interpretation of the data - to the benefit of your book and its contribution. That, however, is something only you can decide. Please let me know. If you do decide to go it alone, I urge you to collect and publish detailed data.

I do have several Australian friends who, I believe, can extend the scope of coverage as necessary. Whatever your decision, I'll be glad to help you in any areas you so desire. I probably have as complete a library of cycad reprints as anyone or with a couple of exceptions of any library or organisation but I don't have all the descriptions of Australian Cycas - unfortunately a lot of them don't give much of a description. Are you into this yet?

.../3

One thing surprises me - as far as I know, none of the Cycas have underground stems - a number of Asian ones do.

Are you aware that one Australian taxa was described as having undulant leaflet margins? And that C. furfuracea is supposed to sometimes have bifid leaflets - I don't know who made the trip up to the furfuracea but it would be interesting to find out if he saw any such leaflets.

I javen't attempted yet either to map locations by taxa nor by climatic conditions. That too needs doing. The Australian cycas I have least botanical data on is C. armstrongii - this is the one J. Mac. told me had different proteins than others (to extent tested).

Do you have any coning cycas in your yard or within easy access that are identified or of known habitat? You need a starting point and that's usually the easiest. One common mistake is not to describe a taxa completely - this is essential if you are interested in evolution. Even John Mac. left out some critical easily measured data (not at all unusual). I can help here.

There were several taxa of early literature that are not mentioned currently. Some may have been taken care of properly, some such as gracilis have not. This needs to be reviewed also. Sometimes early dispositions are way off base - for example C. inermis (Vietnam) was dismissed as C. revoluta without petiole spines - yet if you check out the morphology data it doesn't match up with revoluta at all but rather with the taxa that evolved from C. siamensis which is quite different.

Well, at least I've given you something to think about. Look forward to hearing from you. Best Wishes, Sincerely, John

'GLEN IDLE BLUE' CYCAS – CHADLEY STATION.

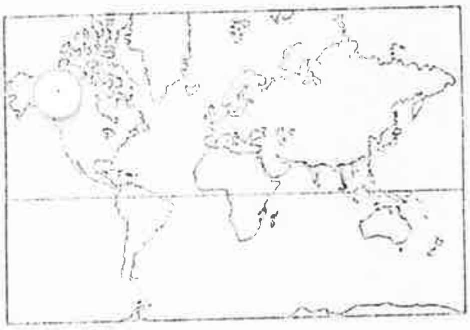
*** EXTRACT FROM BOOK BY MORLEY AND TOELKEN ***

GYMNOSPERMS

CYCADACEAE *Cycads*

The Cycadaceae is a monogeneric family of short to tall palm-like trees.

Distribution This family has a restricted but wide distribution, mainly in the tropics, with its centres of diversity in northern Australia and south-east Asia; one species occurs on Madagascar and the adjacent African mainland.



Worldwide c. 20 species: 1 genus
Australia 10 species: 1 genus

Diagnostic features These plants are palm-like trees with single or, rarely, branched trunks having well developed leaf scars. Leaves are pinnate to 2 m long and spirally arranged around the apex of the trunk. Pinnae or leaflets are linear, flattened, single-veined with or without a recurved margin, and the lower pinnae are often reduced to small spines. The cycads have separate male and female plants with their reproductive structures in cones. The male co[illegible] oblong-ovoid comprising numerous sm[illegible] wedge-shaped sporophylls, spirally arranged and bearing many pollen sacs on their undersurface. The female cone has much longer, larger, and more leaf-like sporophylls, which open out and bear two to eight large ovoid to ellipsoid seeds when mature. The seeds or nuts have a fleshy outer coat which is coloured orange, brown, yellow, or bluish, and a thick inner woody coat.

Classification The Cycadaceae are a group of 'living fossils' or relict plants left from a previous geological era when they and the Zamiaceae were perhaps the dominant trees.

They are closely related to the Zamiaceae from which they differ in having a prominent single nerve in the pinnae.

Single genus, WA, NT, Q, tropics
Cycas L. (10 spp.)

Notes The cycads are an interesting group in that they have mobile swimming sperm and so water is required for fertilisation of the egg nucleus. This feature links the group with the ferns and other primitive seed-bearing plants.

Cultivation of cycads as ornamentals is a common practice, but it must be realised that their growth rate is rather slow so that care must be taken to minimise crowding of the young plant. Generally they are very successful as glasshouse or indoor pot plants.

Nuts from *Cycas media* served as a staple in the diet of many Aboriginal groups in Arnhem Land and Cape York Peninsula (Specht 1958; Roth 1901). Large numbers of nuts were collected and cracked to expose the kernel, which was either first pounded into a flour and then leached of its toxicity (Cape York Peninsula) or leached first and then ground into a flour (Arnhem Land). This flour was made into a dough and baked with hot stones.

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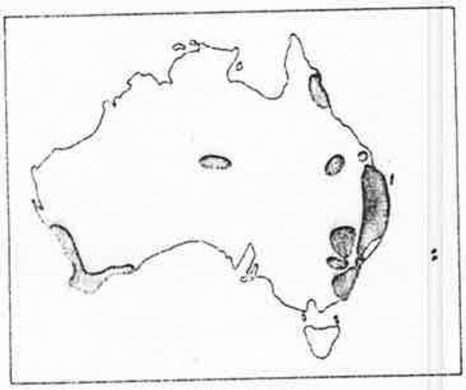
J. MACONOCHIE

ZAMIACEAE *Zamias*

The Zamiaceae is a family of very primitive plants which often resemble palms but are not related to them.

Distribution The family is restricted to the tropical and warm temperate regions of Africa, Australia, and North and South America. Their distribution is disjunct and generally they have receded to small areas following a wider distribution and diversity in earlier geological periods. They grow in a wide variety of habitats and three of the eight genera are restricted to Australia.



Worldwide 80 species: 8 genera
Australia 17 species: 3 genera

Diagnostic features Generally having a palm-like appearance, these plants have a stem ranging from 20 m tall to one completely underground; they are not or only rarely branched. The spirally arranged fronds are pinnate or bipinnate, with pinnae lacking a mid-rib and with straight, dichotomously branched veins.

Large male and female cones occur on separate plants. The numerous sporophylls are close-packed and arranged either spirally or in apparently vertical rows. The male sporophylls have many small, globose pollen sacs more or less clustered in groups on the undersurface. The pollen sacs open by slits. The female sporophyll bears two (or rarely three) unstalked ovules on its axis-facing margins. The seeds are large and often brightly coloured.

Classification The genera have been arranged in three tribes by Johnson (1959); all three occur in Australia.

The Zamiaceae is one of three families of living cycads, the other two being the monogeneric Cycadaceae and Stangeriaceae (Johnson 1959).

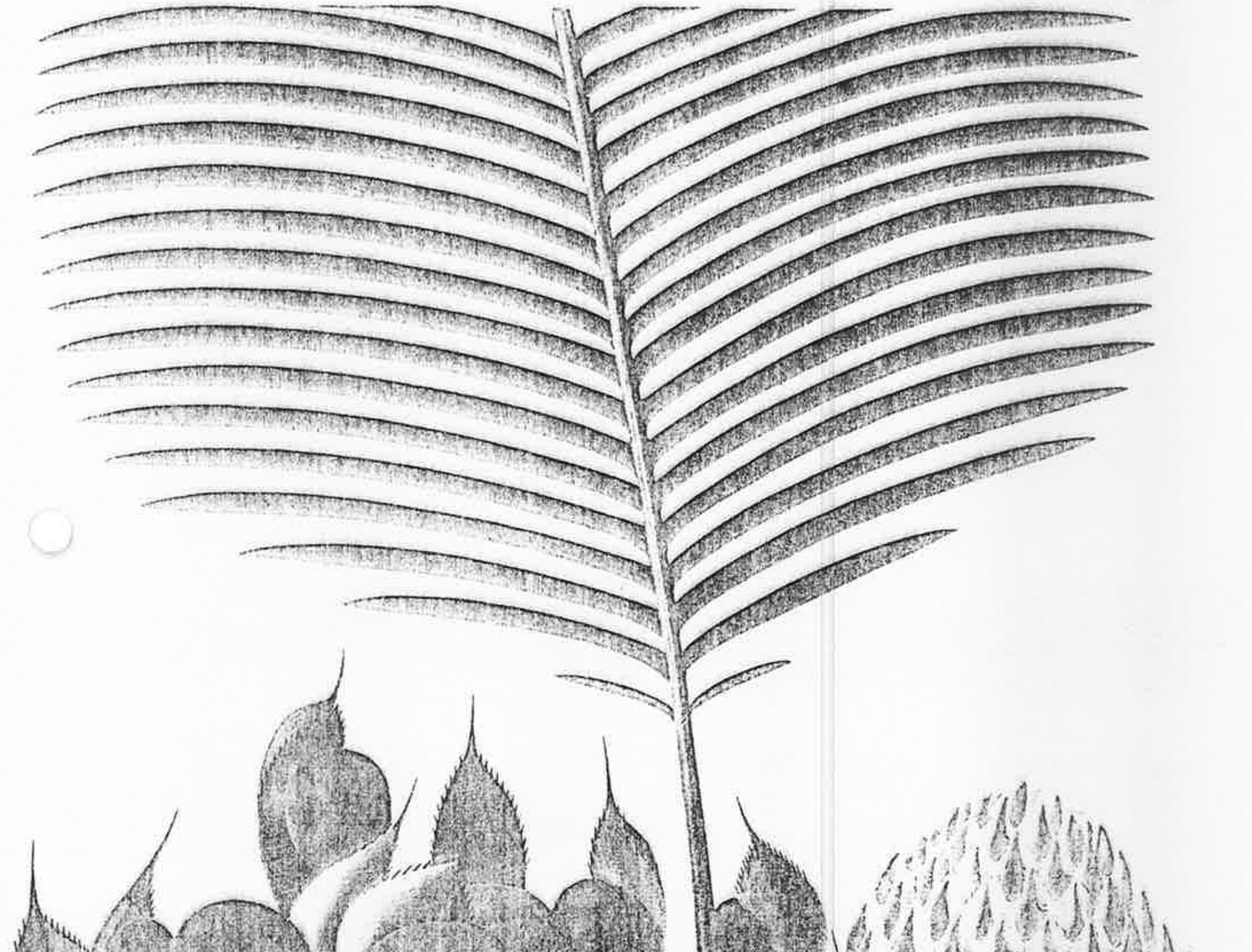
Notes The Zamiaceae was once a much larger and more widely distributed family (Hill 1978; Hill 1980) than at present. It is extremely relictual in distribution. Most members are slow-growing, but are very attractive palm-like plants. The exception to this is *Bowenia*, which lacks an aerial trunk and has bipinnate fronds. It is often mistaken for a fern and is difficult to cultivate. An excellent account of the Zamiaceae is given by Chamberlain (1919).

Macrozamia species were processed by Aborigines in a similar manner to *Cycas media* in coastal New South Wales and Queensland (Lawrence 1969; Roth 1901). In the south-west of Western Australia, the deep red seeds were allowed to ripen and fall out of their husks. These seeds were

Fig. 3 **Cycadaceae**: *Cycas cairnsiana*. a. female cone with immature seeds on sporophylls, ×⅔. *C. armstrongii*. b. leaf, ×⅔; c. male cone with numerous sporophylls, ×⅔. (RA).

KEY TO GENERA

1. Sporophylls imbricate, not in vertical rows; fronds pinnate 2
1. Sporophylls apparently valvate, arranged in vertical rows; fronds bipinnate. E. coast Q **Bowenia** Hook. f. (2 spp. end.)
2. Cones unstalked or shortly stalked; sporophyll ends tomentose, produced into a spreading obtuse to acute but not spiny wing, curved upward or downward; pinnae inserted on the adaxial mid-line of the rachis. E. coast Q, NSW **Lepidozamia** E. Regel (1 sp. end.)
2. Cones noticeably stalked; sporophyll ends glabrous, often glaucous; at least the females subterminally compressed to form a more or less vertical surface, on which (in both sexes) the margins form a transverse ridge terminating in a rigid, more or less erect spine. Successive crowns of fronds little separated by a few scales. Pinnae inserted near the edge of the rachis. SW. WA, central Australia, E. coast **Macrozamia** Miq. (c. 14 spp. end.)


a
b
c

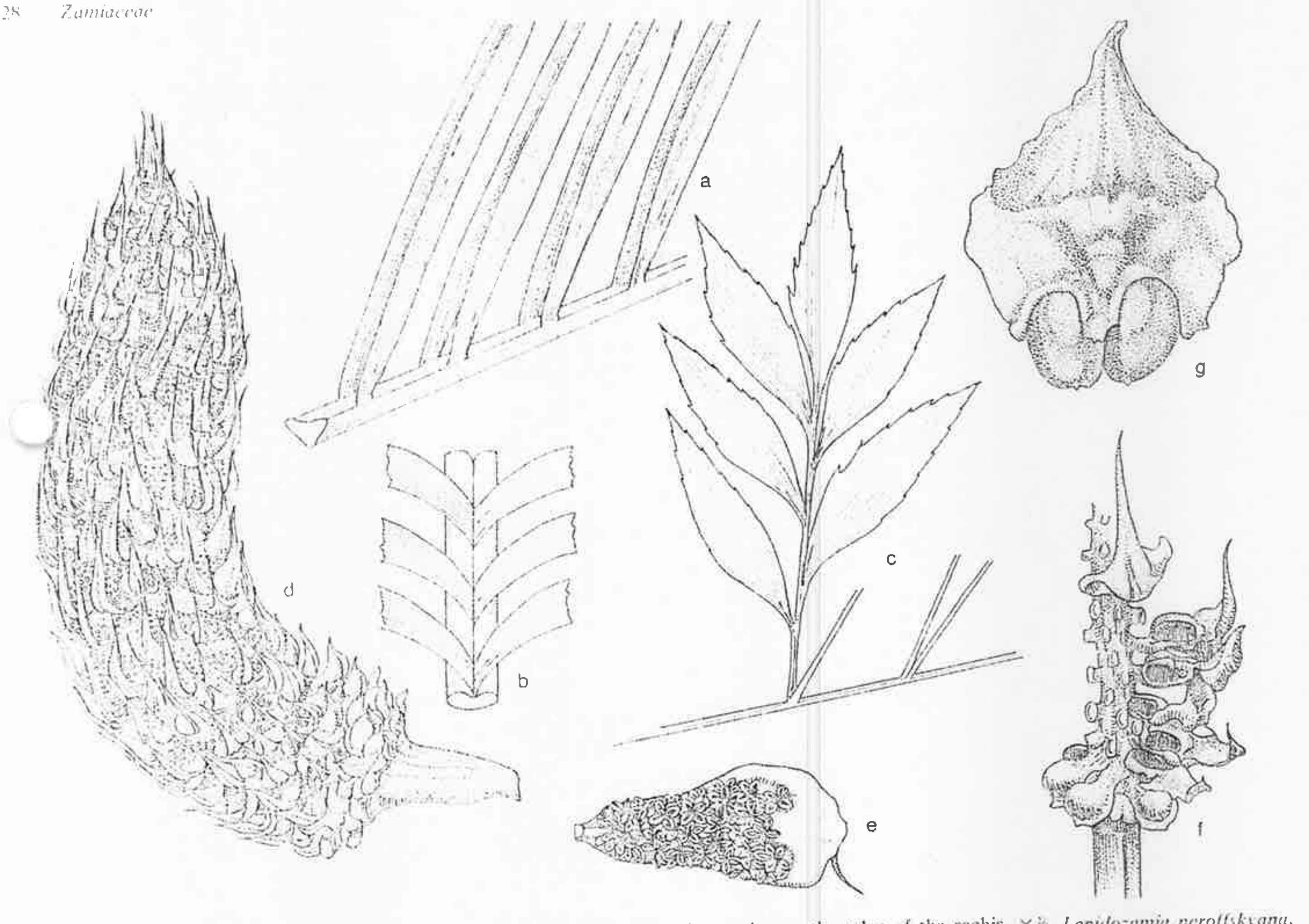


Fig. 4 **Zamiaceae:** *Macrozamia macdonellii*, a, section of leaf with pinnae inserted near the edge of the rachis. ×⅔. *Lepidozamia peroffskyana*, b, section of leaf with pinnae inserted along the mid-line of the rachis. ×⅔. *Bowenia serrulata*, c, section of bipinnate leaf. ×⅔. *Macrozamia fawcettii*, d, male cone. ×⅔; e, male sporophylls with clustered pollen sacs on undersurface, ×2. *M. miquellii*, f, disintegrating female cone. ×⅔. *Lepidozamia peroffskyana*, g, sporophyll with two mature seeds. ×⅔. (I.D).

gathered and buried in heaps 90 to 120 cm deep and then left for eight to nine months. After this they were eaten without further preparation (Hassell and Davidson 1936). Because of the prodigious number of nuts produced and collected, food for many people became available. Beaton (1977) and Gould (1980) argue that this high productivity allowed large numbers of individuals to come together and perform important ceremonies and rituals.

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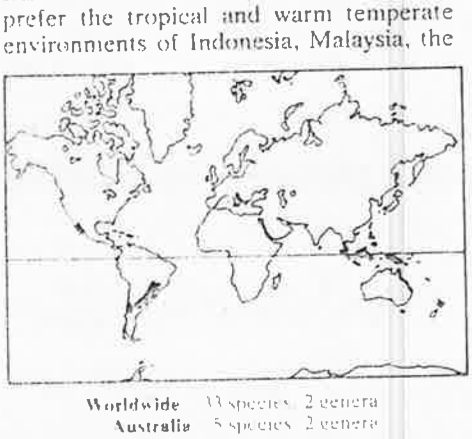
R. S. HILL

ARAUCARIACEAE *Kauri pines, araucarias*

The Araucariaceae is a primitive family of tall, evergreen trees, with characteristic deciduous, woody seed cones.

Distribution Most members of the family prefer the tropical and warm temperate environments of Indonesia, Malaysia, the Philippines, New Guinea, Brazil, north-eastern Australia, northern New Zealand, and the south-western Pacific islands. One species of *Araucaria* (*Araucaria araucana*), inhabits the cooler moist coastal and upland regions of Chile and Argentina.



Worldwide 33 species 2 genera
Australia 5 species 2 genera

Diagnostic features All members of the Araucariaceae are tall, monoecious, evergreen trees, with columnar trunks, covered in scaly, resinous bark. The branches are horizontal, whorled, and persistent in the young trees, irregular and deciduous in the mature trees, leaving circular scars on the bare trunk. The leaves are leathery, elliptical, lanceolate, or awl-shaped, arranged spirally on the main axis, oppositely or alternately on the lateral shoots. The male cones are stiff, dense, cylindrical, solitary in the leaf axils, or sometimes clustered. The female cones are much larger than the male cones, globose to broadly ovoid in shape, symmetrical, with numerous spirally arranged, fan-shaped scales. The seed cones disintegrate at maturity, the solitary seed being shed attached to its cone scale, or it may detach from the scale, and disperse with the aid of a well-developed wing.

Classification *Agathis* and *Araucaria* can be divided into three and four sections respectively (Clifford and Constantine 1980).