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A.S.G.A.P. CYCAD, ZAMIAD AND PALM STUDY GROUP
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Once more the newsletter is a little late this timebut I have been on two weeks break in Coffs Harbour and Sydney. Information from any member seems to have dried up this year so far, so how about a few letters in the mail, please. Only wish we had meetings and a closer contact, which would save me scraping the bottom of the barrel. Sometimes this effort is by courtesy of Udo Kunzel of Germany and as most of it is botanical it may not be for the lay-person, but as no one comes to the party, we must use what we can.

The lepidozamia so well described is L. hopei and I have found it many times while brousing through Northern Queensland.
Macrozamia communis as described by Dr. L.A.S. Johnson 1959. Macrozamia fawcettii C. Moore a N.S.W. species often described in habitat by P. Kennedy.

Macrozamia macdonnelli (F. Mueller). A really choice one commonly in the Macdonnell Ranges. Very slow in cultivation growth, larger seed than most, believed to be relict and relative to M. riedlii (W.A.)

ZAMIACEAE

(a) LEPIDOZAMIA

Lepidozamia hopei Regel (1876)

In his monograph on the *Cycadaceae*, Schuster calls this species *Macrozamia denisonii* var. *hopei* (Hill) Schuster, while Johnson (1959) in his work places it as an independent species into the genus *Lepidozamia* established by Regel in 1876.

The *Lepidozamia* genus has two known species; *Lepidozamia hopei* occurring in a narrow area in the north-eastern corner of Australia and *Lepidozamia peroffskyana* in a narrow strip on the East Australian coast (see Map on page 18). The author obtained (courtesy of Mr Johnson) from the Botanical Gardens of Brisbane a dried-out stem sample of *Macrozamia hopei*, about 30 cm long and 12 cm in diameter. The surface of the stem lacked the traces of leaf scars; it was yellowish brown and uniformly smooth.

The stem of the *Lepidozamia* may reach a height of 20 m; on its peak the leaves, 2 to 3 m long, form a leaf tuft. A leaf consists of 160 to 200 pairs of leaflets. The female strobile may be up to 60 cm long with a diameter of 20 to 25 cm.

Macroscopic examination. From the dried-out stem a thin disk was cut. Its surface was cleaned after softening in water. Photo 1 [nat. size] shows this surface.

In cross section, the polyxylic structure of the stem is apparent. The diameter of the broad dark pith is 6·5 cm (a). In the ground tissue of the pith, proper and common vascular bundles and mucilage canals (dark spots in Photo 1) are scattered. Outside the pith there is the first, so-called normal vascular bundle ring (c, d); its xylem portion is 7 mm, its phloem portion 3 mm thick. The first abnormal xylem ring is somewhat thinner (4 mm); the phloem ring is barely 2·5 mm thick. These data agree with the statements of Worsdell made about 70 years ago. The double vascular bundle ring is surrounded by a thin cortex (e), and a periderm (d) hardly 1 to 2 mm thick.

Microscopic examination. Cross section. The pith largely consists of more or less isodiametric, thin-walled, loose parenchyma cells (Photo 5 [×100]) whose interior contains remarkably large (35 to 40 μ), somewhat eccentric starch granules. Semi-composite starch is frequent among them. The walls of the parenchyma cells are very thin, even simple pitting is very rare in them. Among the thin-walled ground tissue cells thicker-walled idioblasts are arranged in places (Photo 6 [×300]). The vascular bundles of the pith are meandering to and fro and a regular cross-sectional picture can but seldom be made (Photo 2 [×7]). In them, the xylem consists of 35 to 40 tracheids; the phloem portion is subordinate and inconspicuous. A few parenchyma cells are filled with calcium oxalate crystal druses; sometimes there are even two druses in one cell. The mucilage canals usually occur close to the bundles (Photo 5). On the edge of the pith, at the ends facing the pith of the vascular bundles, no transfusion cells have been observed although such cells were described by Worsdell. There are at most a few thick-walled idioblasts at the endings of the xylem bundles. The diameter of the mucilage canals of the pith is 180 to 190 μ. Their inner walls are lined with epithelial cells (Photo 5).

The vascular bundle ring is divided into collateral vascular bundles by the primary rays issuing from the pith (Photo 1). The xylem portions of the broader vascular bundles conically taper toward the pith. The primary rays, 3 to 6 cells wide, include the common vascular bundles of the pith and usually also the mucilage canals (Photo 7 [×50]). In the primary rays, the ray cells are elongate ellipses or rectangles; their radial dimension is 370 to 400 μ, their maximum width 70 μ. The cells of the uniseriate rays are much shorter radially (50 to 100 μ); their width is about the same. The walls are exceedingly thin, without any noticeable pitting (Photo 4 [×100]). Some cells are filled with calcium oxalate crystal druses. Some pith rays include thick-walled sclerenchyma cells looking like septate fibres (Photo 7).

Xylem bundles. In the xylem, most tracheids are radially oriented; their walls are uniformly thick (7 to 8 μ), their radial dimension is 50 to 60 μ, their width about the same or somewhat greater. The lumina are invariably rounded (Photo 4), circular or elliptical, while the external outline is rounded polygonal. In the radial walls, bordered pits are readily visible but on the tangential side pits are very rare. Among the tracheids, a few thin-walled wood parenchyma cells are occasionally found.

Cambium. The xylem is in places flanked on its outer side by a cambium 3 or 4 cell layers thick (Photo 4). The cambial cells are smooth and thin walled.

Phloem bundles. Similarly to the xylem the phloem is dissected by primary and secondary pith rays (Photo 4). The structure of the pith ray cells is as in the xylem. The phloem consists for the most part of thick-walled fibres (Photo 4/1) whose lumina are narrow and invariably circular or elliptical. The layering of their walls is sometimes apparent. Among them a few thin-walled parenchyma cells are arranged (Photo 4/2). Very rarely, especially in the external part of the phloem, the holes of sieve tubes could be established (Photo 3 [×30]).

The normal xylem and phloem ring is surrounded by a second, so-called abnormal xylem and phloem ring (cd–cd), which agree in structure with the first ones although they are somewhat narrower (Photo 1).

Cortex. The cortex consists of ground tissue cells of the same structure as the pith. The solitary vascular bundles and the mucilage canals are also of the same structure and arrangement as those in the pith.

On the outer side of the cortex there is a rather broad layer of sclerenchyma cells (Photo 6). These are strictly speaking thick-walled idioblasts, loosely packed in some places and close packed in others. Locally they look like thick-walled twin fibres. In cross section, they are of two kinds: the one is thin walled, the other quite thick walled. The latter seem to be typical stone cells (Photo 6). It is this sclerenchyma layer which gives strength to the wood. The other cells of the cortex are thin walled and unpitted.

The periderm. The periderm cells are rectangular, suberized and close packed, as a rule in radial rows (Photo 1f).

Tangential section. The primary pith rays are multiseriate, 15 to 20 cell layers wide; the secondary pith rays are generally uni- to triseriate (Photo 7). The height of the ray cells ranges from 70 to 150 μ, their width from 50 to 60 μ. Their walls are very thin and smooth. In some pith rays, especially in the sites of corner cells, thick-walled sclerenchyma cells occur, easily recognized by their simple pitting (Photo 7/3). In the tangential walls of the tracheids, bordered pits are very rare. In the broader rays, mucilage canals and vascular bundles coming from the pith are seen (Photo 7/1,2). Among the thin-walled ray cells, thick-walled sclerenchyma fibres are rather frequent (Photo 7/3), which to all probability also pass from the pith into the cortex. All this is readily visible in Photo 7.

Radial section. Pith rays. Most pith ray cells are upright or square (Photo 11 [×300]). Their height is 80 to 120 μ, their width 60 to 70 μ. Their walls are smooth and thin. Definite cross fields are but rarely observed. Between the tracheids and the ray cells there is sometimes what looks almost like scalariform perforation. The ladder steps form in places minor or major groups (Photo 10 [×300]); in other cases the ladder covers the whole length of the tracheid (Photos 8 [×300], 9 [×300]). The pits occurring in some cross fields number 10 to 12; they are generally arranged in 2 or 3 longitudinal rows (Photo 11). Longitudinal parenchyma cells often adhere to the ray cells. Their height is 220 to 250 μ, their width 22 to 24 μ. In some broad rays, there occur some thick-walled ray cells among the thin-walled ones, in conformity with what we have seen in the tangential section.

Tracheids. The most characteristic property of the wood is the typical araucarioid pitting and scalariform perforation (Photos 8–12). In the broader tracheids the bordered pits are alveolarly arranged in 3 or 4 rows. Their apertures are linear, included. In other tracheids—sometimes in direct contact with the former—scalariform perforation and thickening are very frequent; to all probability, it only develops on the sides in contact with the pith rays. This is proved by the fact that in the opposite wall of the same tracheid, bordered pits are arranged in the araucarioid pattern (Photos 8, 12 [×600]). Scalariform perforation or thickening mostly develops along the tracheids. In this respect there is a similarity—strange as it may sound—to the scalariform perforations of palms. No modern pitting has been observed. Such scalariform perforation has not been established up to now except in *Cycas media.* Scalariform thickening is not to be confused with spiral thickening. The helical ridges are of the same thickness in their whole

length while these ladder spokes widen at both ends, indicating that the space between them is due to the coalescence of bordered pits, i.e. that they derive from bordered pits.

Macrozamia communis L. Johnson (1959)

It occurs only in the narrow south-eastern coastal strip of Australia. Its stem is often creeping, subterraneous, sometimes rising to a height of 1 to 2 m; in the latter case its diameter is 30 to 60 cm. The leaves are 70 to 200 cm long. The examined material was received from Mr Wilkes in Brisbane. The stem sample probably originates from the apical region because the xylem rings are not complete yet and the collateral bundles are loosely arranged.

Macroscopic examination. The stem sample is of a diameter of about 8 cm. Pith diameter is about 2·5 cm; the xylem is 4 to 5 mm thick, the phloem somewhat less; the thickness of the cortical portion is about 2·5 cm (Photo 1 [nat. size]).

Microscopic examination. Even under a weak magnification it is apparent that the stem consists of a well-developed pith, a narrow xylem and phloem layer and a rather broad cortical portion (Photos 2 [× 30], 3 [× 15]).

The parenchyma cells of the pith are remarkably thin walled, isodiametric, unpitted. Among the parenchyma cells there are sporadic mucilage canals containing a yellow milk-like substance; their diameter is about 180 to 200 μ (Photo 7 [× 100]); their walls are lined with parenchymatous epithelial cells. They are scattered, but some of them constitute a sort of ring immediately inside the vascular bundle ring as a rule near the primary pith rays (Photo 4h [× 100]). The wide pith rays enter gradually between the collateral bundles, to melt outwards into the parenchyma cells of the cortex (Photo 5 [× 100]).

Leaf hypostomatic. On the *upper surface* of the leaflet, the epidermal cells are generally elongate rectangles, trapezoids or lozenges, at most four to five times as long as wide. The lateral walls and sometimes even the terminal walls are slightly sinuous. Their usual size range is 30 to 90 μ by 15 to 30 μ. Mostly arranged in longitudinal rows, the cells meet end to end with transverse or oblique end walls. There are thick-walled (4 to 5 μ) and thinner-walled (2 to 3 μ) epidermal cells; the thicker walls are of layered structure. The two kinds of cell are arranged mosaic-like, with the convexity of the one snugly fitting into the concavity of the next. The thinner walls bear a pattern of very fine and more or less parallel cuticular lamellae, suggestive to a certain extent of the epidermis of *Stangeria*. The thin-walled epidermal cells communicate through simple pits.

Undersurface. 60 to 65 stomata per sq. mm are grouped in narrower or wider bands, each including 6 to 8 rows of stomata. The width of the bands is 400 to 500 μ; that of the interbands separating them is 200 to 250 μ. Shape, arrangement and mutual relation of the epidermal cells are more or less the same in the interbands as on the upper surface. There is a slight difference in that both the thick- and thin-walled epidermal cells are generally somewhat longer in the interbands. On the other hand, the thin- and thick-walled epidermal cells surrounding the stomata are more isodiametric, squat rectangular or polygonal. The stomata are generally overarched by 6 to 8 accessory cells which form a conical crater-like mound slightly rising above the epidermal surface. The length of the guard cells is 35 to 40 μ; their width is 18 to 20 μ. The walls facing the stomatal pit of the accessory cells are 3 to 4 μ thick; their lateral walls hardly attain 1·5 μ. The exterior surfaces of the accessory cells are finely tuberculate. Pit depth is 7 to 8 μ. The slit between the guard cells is longer than the outside diameter of the pit. The stomatal structure of *Macrozamia communis* perfectly agrees with that of the other *Macrozamia* species; it consequently represents a characteristic *Macrozamia* type.

Macrozamia communis (New South Wales; photo by Totterdell)

The xylem bundles are divided up by secondary and tertiary uni- or biseriate pith rays. In section, most tracheids are rounded polygons with a few thin-walled parenchyma cells scattered among them (Photo 6 [× 100]).

Macrozamia fawcettii C. Moore (1884)

Leaf hypostomatic. On the *upper surface* of the leaflet, the cells are arranged parallel to the leaflet axis, joined end to end by oblique, transverse, rounded or tapering end walls or interwedged halfway between the two adjacent cells. Above the veins, the epidermal cells are somewhat longer and narrower but do not differ in structure from the other cells. Cells length is varied, 50 to 300 μ; width is 18 to 22 μ.

There are thick-walled (3 to 3·5 μ) and thin-walled (1·5 to 2 μ) epidermal cells. The thick walls are uniformly smooth, unpitted; the thin walls bear tiny simple pits. Containing chloroplastids, the thin-walled cells are somewhat wider, up to 24 μ.

On the *undersurface* of the leaflet, the stomata are arranged in longitudinal bands of 400 to 450 μ width separated by interbands 250 to 350 μ wide. Size, shape and arrangement of the epidermal cells are the same in the interbands as on the upper surface. Most bands include 4 to 7 rows of stomata, transverse rows (parasticha) are rare. There are about 40 to 45 stomata per sq. mm. The epidermal cells among the stomata are much shorter and much more varied in shape than those on the upper surface. Shapes include triangles, squares, trapezoids and a variety of other forms.

The length including the polar cells of the gaseous-interchange apparatus is 210 to 220 μ of which about 80 to 90 μ is taken up by one elongate polar cell whose width is 13 to 18 μ.

The number of the accessory cells is 4 to 6; their walls are thin and their surface finely pitted.

The end walls facing the stomatal pit of the accessory cells are slightly rounded and much thicker than the others which are perfectly smooth and unpitted. Similar in structure to the thin-walled epidermal cells, these accessory cells sometimes contain chloroplastids.

The endings of the accessory cells overarch the guard cells. Their length is 35 to 45 μ, their width 25 to 30 μ. On the bottom of the stomatal pit there are the two guard cells; the slit between them reaches beyond the circumference of the pit. The endings of the guard cells are tapering and more or less parallel. The length of the guard cells is 35 to 45 μ; the width of one is 16 to 18 μ. The thickened, lignified dorsal portion of the guard cell is 4 to 5 μ thick.

Macrozamia macdonnelli (F. Muell.) A. DC. (1868)

Leaf hypostomatic. On the *upper surface* of the leaflet, the epidermal cells, at most twice to 4 times as long as wide are frequently arranged in more or less regular longitudinal rows. Triangular, square, rhombic, trapezoidal or oblong in shape, in most cases they meet end to end, joining transverse or oblique walls. Their lateral walls are frequently enough sinuous, the height of the waves not exceeding $\frac{1}{6}$ to $\frac{1}{10}$ of the width of the lumen. There are thin-walled (2 to 3 μ) and thicker-walled cells; the walls of the latter are usually of uniform thickness (4 to 5 μ) and of layered structure; their lumina follow the outline of the cell; the lumina of some elongate narrow cells are reduced to mere slits. The length of the thick-walled cells is 60 to 120 μ, their width is 15 to 30 μ; the thin-walled cells are shorter, 20 to 60 μ long and 15 to 30 μ wide. The rectangular cells are frequently elongate in the direction of the veins; in other cases they are quite squat, measuring e.g. only 15 μ in the longitudinal and 30 μ in the transverse direction. The surfaces of both the thick- and thin-walled cells are covered by very fine cuticles (Photos 1, 3); besides these they also bear tiny tubercles.

On the *undersurface* of the leaflet, the stomata occur in longitudinal bands of 400 to 550 μ width separated by interbands only 150 to 200 μ wide. Size, shape, structure and arrangement of the epidermal cells in the interbands agree with those on the upper surface. There are 80 to 85 stomata per sq. mm. In the bands, the stomata form 5 to 8 longitudinal rows on the one hand and almost transverse ones on the other. The almost isodiametric thin- and thick-walled epidermal cells among the stomata form a mosaic-like pattern. The guard cells of the stomata are overarched by 6 to 10 cells; the shape of the lateral and polar cells is so much alike that it is hardly possible to tell them apart. The walls facing the stomatal pit of both the polar and lateral cells are greatly thickened, their other walls are quite thin. The length of the stomatal pit is 35 μ; its width is about the same. The length of the guard cells is 35 to 40 μ, the width of one is 18 to 20 μ. Size and shape of the pit aperture vary in dependence on the number of accessory and polar cells. Pit depth is 7 to 8 μ; the slit between the two guard cells is longer than the outside diameter of the pit. This structure is somewhat suggestive of the stomatal structure of *Cycas revoluta*, but not without substantial differences. The size including the accessory cells of the gaseous-interchange apparatus is 80 to 100 μ by 60 to 70 μ; in other cases, the external walls of the accessory and polar cells form almost perfect circles, also reminding of *Cycas revoluta*.