SOME RECENT DATA ON THE XYLOTOMY OF CYCAS, ZAMIA AND GINKGO

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(Received August 1, 1958)

a) Vessel formation in Cycas revoluta (C) and Zamia skinneri (Z)

In the course of the xylotomic preparation of a trunk of an approximately 15 years old *Cycas revoluta* and cca. 25 years old *Zamia skinneri* a so-called »maceration« was also prepared. On careful examination of the maceration a striking special cross-wall could be detected in the interior tracheids in each of the two species. At first sight it was taken to be a trabecula, however, more precise examination revealed that a simple perforation is involved. At the fusion of the two vessel members the outer dentation of *Cycas revoluta* (Fig. 1. C) the conspicuous median lamella dividing the two vessels, the similarity of thickness of their walls and the pronounced circular shaped character of the perforation confirm beyond doubt the assumption that we are not dealing with a trabecula, but with some kind of perforation, — a simple one.

After a review of the literature (1—8) the conclusion could be drawn that this vessel formation as regads the xylotomy of *Cycas* is a quite new phenomenon — at least to the best of the author's knowledge — considering that so far there were no literary data mentioning vessel formation in *Cycas* and in *Zamia skinneri* (Fig. 1. Z).

b) Dacrydioid (circoporus) pits in the ray cells of the Ginkgo biloba

At the xylotomic examination of the *Ginkgo* wood — on a slide on which the longitudinal tracheid walls also contained spiral thickenings — several ray cells contained besides the typical *Ginkgo* pitting of their cross field also a spherical or elliptical so-called circoporus dacrydioid pitting filling out almost completely the cross field (Fig. 2. G.). In the cross field of *Ginkgo* generally 2—3, but sometimes also 4—5—6 small pits can be found showing either a scattered or araucaroid arrangement. This is seen on most of the cross fields of *G.* photo x300 magnification. However, as can be seen on the upper third of the photo in one of the horizontally proceeding ray cell cross fields large pits $22 \times 22\ \mu$ in diameter, spherical or elliptical $22 \times 32\ \mu$ in size can be detected. The upper right corner of the photo exhibits the same kind of half pits, they can also be seen in the ray cells at the bottom of the photo. So far circoporous and dacrydioid pits have only been found in the

Podocarpaceae, i. e. in the *Dacrydium*, *Microcachrys*, *Phyllocladus*, *Acmopyle* and *Podocarpus genera*. Of the Taxads at most the pits of *Taxus canadensis* could be compared with these large circular pits, however, the so-called pinoid pitting of *Pinaceae* is already different. On the other hand, the

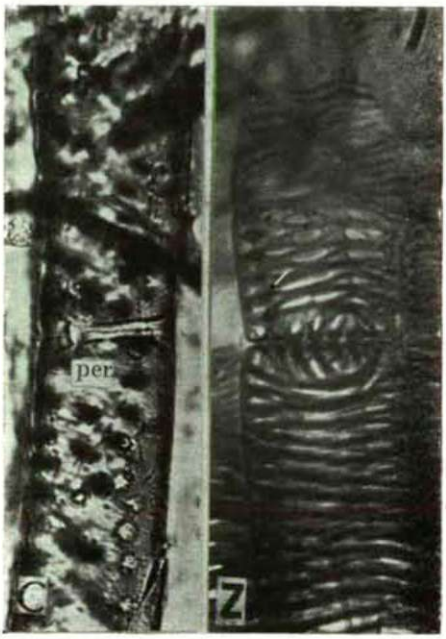

Fig. 1. **C** — *Cycas revoluta*, the fusion of two tracheids; simple perforation (x300). in the wall of the ray cell (x600).
Z — *Zamia skinneri*, the fusion of two tracheids (x300).

similarity of the pitting of *Podocarpaceae* and partly of that of *Taxaceae* gives rise to the idea if there is not some kind of relationship between the *Ginkgo* and particularly *Podocarpaceae* families, but perhaps also between these and the *Taxaceae* one, or at least in this respect there is some kind of genetical link. *Fig. 2. D.* shows the *Dacrydium elatum* x600 magnification. The fact of *Taxaceae*, but rarely also *Ginkgo* containing spiral thickenings although the thickenings are not identical, seems after all to support this assumption. Considering that as to the best knowledge of the author the literature does not mention »circoporous« or »dacrydioid« pitting as regards Ginkgo this phenomenon seemed of interest.

c) Identical structure of the spiral thickening in Cycas (C) and Ginkgo (G).

In the course of xylotomic examinations dealing with the accessory roots of *Cycas revoluta* on slides prepared from the peripheral parts spiral thickenings exhibiting a dense, characteristic structure could be observed, particularly on the tangential slide. (Fig. 3. C/1) Essentially these spiral thickenings differ considerably from those that can be found in some of the genera of *Taxaceae*, *Cephalotaxaceae* or *Pinaceae (Picea, Larix, Pseudotsuga)*. In *Cycas* these spiral thickenings are divided at their origin into small rectangles and

the latter thinning always more eventually become fine spiral fibres as can be seen on parts C/2 and C/3 of the photo. The origin of these spirally arranged fields reaches as far back as the bordered pits situated on the radial surface. Some spiral pairs may also adhere to a bordered pit getting into their way and may surround their apertures. In some cases the originis of these spiral thickenings show a nettlike arrangement.

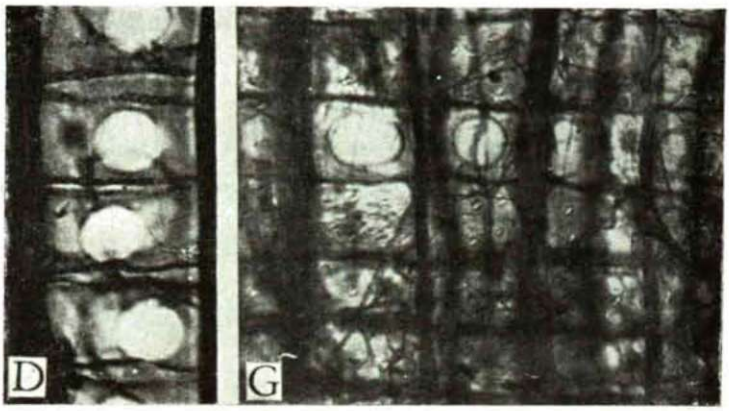

Fig. 2. **D** — *Dacrydium elatum* a characteristic circoporous (dacrydioid) pitting **G** — In the ray walls of the ray cells of *Ginkgo biloba* besides the usual araucaroid (3—8) pits, characteristic dacrydioid pits can also occur (x600).

The most interesting is, however, that the surface ot these spiral lathes is not smooth but that it contains almost regularly spaced small nodules (Fig. 3. C/4). On the cross lathes connecting perpendicularly the two spiral lathes running parallel such nodules can also be detected and at high magnification it seems as if such small nodules cannot only be found on the surfaces of the spiral lathes but that the interior of the small fields also exhibits them or small dentations.

To the best knowledge of the author spiral thickenings showing such a structure have as yet not been described in the literature. Their description seems all the more important as the spiral thickenings observed on other species did not reveal such nodules. It seems possible that this structure is in correlation with the internal micellar structure of the spiral thickenings, whereas concerning their function we have not yet the slightest idea.

After having detected the above spiral structure it was most surprising to find in several slides prepared from an about 100 years old *Ginkgo* tree spiral thickenings with nodules agreeing almost completely with those found in the tracheids of *Cycas revoluta*. Fig. 4. G/1 exhibits that the spiral thickenings of *Ginkgo* run similarly to those of *Cycas* parallel and what is most important these lathes running parallel are also divided into small fields by cross walls at right angles (See Fig. 4. G/2)

The lathes running parallel come gradually always nearer to each other ending in this thread. This structure is shown on G/3. However, the most interesting phenomenon is that on these spiral lathes the same nodules as those detected in the *Cycas* can be found showing a completely similar arrangement

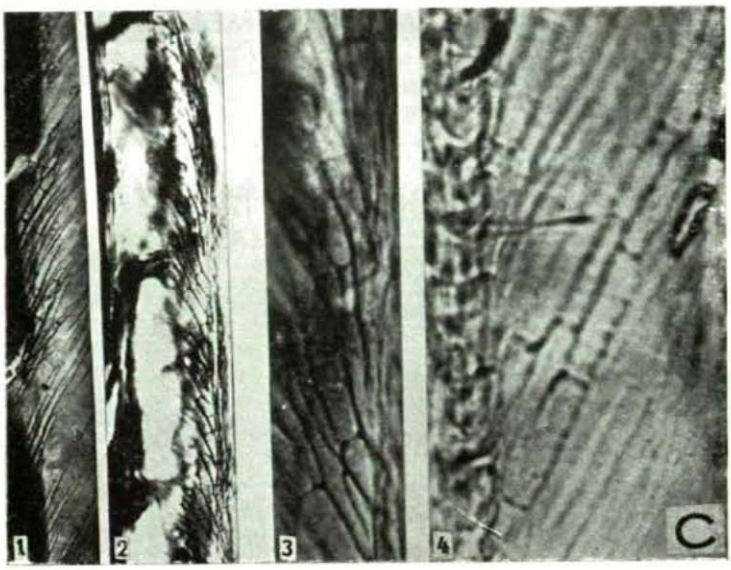

Fig. 3. **C**— *Cycas revoluta.* In the ray walls of the tracheids of some of the accessory roots a spiral thickening divided into sections (C/1 x150) dividing in the vicinity of their origin into reticular small fields can be found (C/2 x150 and C/3 x600). The parts divided into spirals and sections have nodular thickenings (C/4 x900).

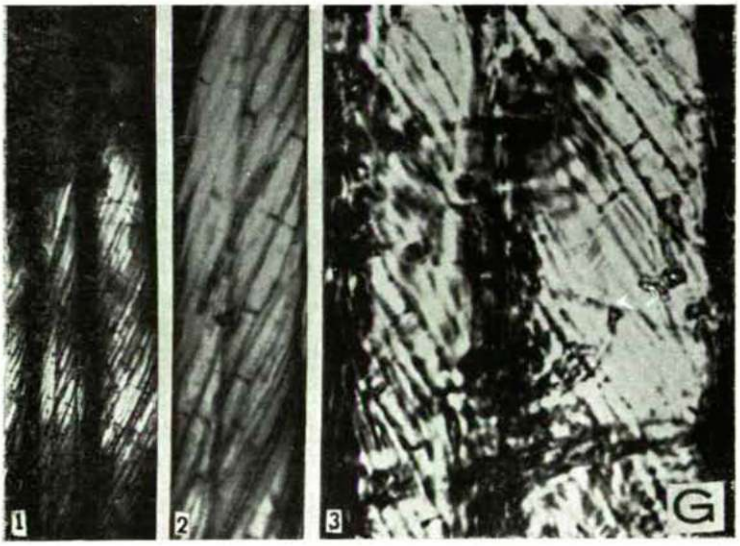

Fig. 4. **G** — In the tracheids of the *Ginkgo biloba* dense and spiral parallel running laths occur they are divided into sections (G/1. x150 and G/2. x600); the lathes exhibit like in the case of *Cycas* spaced nodular thickenings (G/3. x900).

as the latter, i. e. spaced at certain distances, 2—3 μ but not only in the case of the longitudinal, but also in that of connecting cross lathes. Both the *Cycas* as the *Ginkgo* show such a similar nodular structure of spiral thickenings that they can hardly be distinguished. A slight difference can perhaps be found in the origin of the spiral thickenings as far as the latter have in the case of *Cycas* a more less loose reticule structure, whereas in that of *Ginkgo* this reticular structure is not so pronounced.

In view of the fact that such spiral thickenings have hitherto not bee reported in the literature either in the case of *Cycas* nor in that of *Ginkgo*, but not either concerning other gymnosperms or angiosperms their description seemed justified.

The extraordinarily similar structure of the spiral thickenings found in *Cycas* and *Ginkgo* — a stucture not occuring in any other family — suggests the possibility if we are not dealing with some hitherto unrevealed connective feature. *Ginkgo* and *Cycas* both have polyciliar spermatozoids characteristics of the *Pteripsida* tribe, their epidermis cells also show great similarity, but other morphological features also seem to prove that there is a relatinship between *Cycas* and *Ginkgo*. At the establishment of this relationship it seems desirable also to take these identical xylotomic features into account.

Summary

a. On macerating elements of the trunk of the *Cycas revoluta* and *Zamia skinneri* the formation of vessels could be observed. On one of the ends two tracheids fused by means of a simple perforation. Hitherto this kind of vessel formation was unknown in *Cycas* and in *Zamia*.

b. In the ray cells of the *Ginkgo biloba* there occurs besides the known simple araucaroid pitting also dacrydioid pitting which is characteristic for *Podocarpaceae* and has as yet not been observed in *Ginkgo*. This phenomenon seems to suggest a relationship between *Ginkgo* and *Podocarpaceae*.

c. In the tracheids of the accessory roots of *Cycas revoluta*, as well as in the walls of the tracheids of the *Ginkgo biloba*, nodular thickened spiral lathes were found. Probably, the nodes spaced regularly in the lathes are in correlation with the micellar structure of the thickened lathes. It seems reasonable to draw the conclusion that the complete similarity of structure of the two genera is due to a relationship.

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