Morphological Notes.

BY

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With Plate XXX.
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II. PERSISTENCE OF LEAF-TRACES IN ARAUCARIEAE.

WHEN I wrote the note in the last number of the *Annals of Botany*, I was under the impression that the persistence of leaf-traces was a wood-structure confined to the species of *Araucaria*. It now proves to be possessed by other genera belonging to the *Araucarieae*.

I had repeatedly examined a large slab of the wood of Kauri Pine (*Agathis australis*) in the timber museum at Kew without detecting any trace of the structure. I was therefore surprised to notice it as conspicuous as in *Araucaria* in planks of Kauri Pine which I recently examined in the Botanical Institute of the University of Glasgow. I now find it equally so in a hand specimen of the same wood in our museums presented by the Admiralty. It is scarcely less obvious in a specimen of the wood of *Agathis robusta*.

It is also beautifully conspicuous in the early annual zones in the wood of *Cunninghamia sinensis*. In this the leaf-traces certainly persist for some years, but the dimensions of the specimen do not enable me to say to what extent.

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I fail altogether to find any trace of it in the only available specimen of the wood of *Sciadopitys verticillata*, a genus which is included by Bentham and Hooker in the tribe *Araucarieae*. As *Sciadopitys* has been removed by Dr. Masters to the *Taxodiaceae*, the persistence of leaf-traces may be asserted to be a characteristic feature of the former group.

III. THE CARPOPHYLL OF ENCEPHALARTOS.

Many years' study of the *Cycadeae*, the species of which from various causes—which I hope some day to elucidate—have been much misunderstood, assures me that important distinctive characters in the sub-tribe *Encephalarteae* are afforded by the female cones. The carpophylls terminate exteriorly in shield-like expansions, rhomboidal in outline, the superficial sculpture of which in most cases affords unmistakable specific differences. This is apparent at a glance if Fig. 1, *Encephalartos villosus*, Lem., Fig. 5, *E. longifolius*, Lehm., and Fig. 6, *E. brachyphyllus*, Lehm., are compared.

I must confess that I had not given much thought to the meaning or origin of these curious structural differences till, some years ago, I had the pleasure of receiving from my friend Herr H. Wendland, Director of the Botanic Garden at Herrenhausen, Hanover, the first example, as far as I know, of a monstrous Cycad cone. The species was *Encephalartos villosus*, Lem. The cone was for the most part normal except in the upper part, in which the carpophylls had become foliaceous. Fig. 1 is a reproduction of a faithful drawing made at the time by Lady Thiselton-Dyer.

In *Cycas* itself, the morphology of the carpophylls presents no difficulty. They alternate on the main axis with foliage leaves, and are their precise equivalents. But in the *Encephalarteae* all trace of foliar structure in the carpophylls is apparently lost, and I must confess that, though obvious enough when one sees it, I should never have arrived at their correct interpretation without the help of Herr Wendland's striking specimen.

Taking such a case as Fig. 6, *E. brachyphyllus* one might

look a long time without seeing the foliar homology. The peltate extremity of the carpophyll offers a flat expansion, hollowed out in the centre by a shallow rhomboidal excavation. It is only by a comparative study that the meaning and origin of this becomes intelligible.

In Fig. 1 it will be observed that one of the carpophylls has been replaced by, or, if you like, has grown out into a leaf, *a*, reduced in size yet presenting all the essential characters of a normal leaf of the species. At *b* other carpophylls have grown out and taken a foliaceous habit: these are, however, so generalized and reduced that without the help of the more fully developed leaf, their equivalence would be scarcely intelligible. This much is clear: the solid expanded peltate carpophyll is nothing more than a transformed foliage leaf, and capable of being replaced by it.

Now to digress a moment. The carpophylls of *E. villosus*—which is the representative of a small section of the genus confined to eastern tropical Africa from Natal northwards—have the upper margin of the rhomboidal peltate surface prolonged and bent over and downwards, terminating in a toothed edge. A study of the drawing of Herr Wendland's interesting specimen must, I think, lead to the conviction that the teeth correspond to the laciniae of the imperfectly foliaceous carpophylls, and so lead up to the fully developed pinnate leaf. The teeth, then, are the ultimate reductions of pinnae.

It will, however, be noticed that the foliage leaf ends abruptly, and that its apex is atrophied. The rhachis is more or less four-angled, and the terminal cicatrix is therefore obtusely rhomboidal. At *c* it will be seen that would-be foliaceous carpophylls have been arrested in their development and have atrophied truncated extremities.

If we now pass to Figs. 2-5, which are copied accurately by Mr. G. T. Gwilliam from a life-sized photograph of the female cone of *E. longifolius*, we can hardly fail to see that the fully developed cicatrix is gradually developed from the atrophied apex of the carpophyll. The figures are taken at successive levels from the top downwards: Figs. 2-4 are sterile carpo-

phylls; Fig. 5 is an ovule-bearing one. The cicatrix has expanded and become the more prominent feature in the sculpturing of the peltate expansion. Its surface is filled up with tubercles, which probably have some relation to the ends of the fibro-vascular bundles.

Encephalartos brachyphyllus is remarkable for the relatively small number of carpophylls which compose its cone. These consequently attain an unusually large size. The terminal cicatrix is expanded into the large shallow depression already referred to, which occupies the greater part of the external surface of the peltate extremity.

As already pointed out in *E. villosus*, the carpophyll is a reduced and modified equivalent of an entire foliage leaf, the pinnae of the lamina being represented by teeth. In *E. longifolius*, *E. brachyphyllus*, and other species, this is not so, and apparently nothing but the petiole or rhachis has contributed to the structure of the carpophyll. In Fig. 5 it will be noticed that the peltate extremity bears usually four more or less well-marked ridges; two lateral and two vertical. These correspond to similar ridges on the foliar rhachis.

In these cases the carpophyll is entirely petiolar. Below, and concealed by the peltate extremity, it bears a pair of ovules, one on either side. The interesting question suggests itself as to what is the homology of these. In *Cycas*, Sachs (Textbook, 2nd ed., p. 503) says 'the lower pinnae are replaced by ovules.' Probably this is the ordinary view which would be taken for *Cycadeae* generally. But an ovule is a sporangial structure, and it is not easy to see anything in a pinna which is in any way comparable to it. Morphological conceptions must not enslave us, and I see no reason why sporangial structures, like buds, may not appear anywhere.

Fig. 4.

Fig. 6.

Fig. 5.

Fig. 2.

Fig. 3.

Fig. 1.

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Fig. 4.

Fig. 6.

Fig. 2.

Fig. 3.

Fig. 5.

Fig. 1.

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