ON SOME ABNORMAL LEAVES OF GINKGO

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While searching for flowers on a young maiden-hair tree at Lahore in 1920 I noticed a few abnormal leaves such as those shown in figure 1. The two lower margins of the triangular lamina, which in a normal leaf converge into the petiole, were bent over on the upper side and were more or less completely fused together so as to make a funnel. The same feature, with slight variations, was seen in 1924 on two trees at Mussoorie (West Himalaya) and more recently on one of the two plants at Cambridge (England) which are being trained as creepers against the south wall of the Botany School. In one case there were two little funnel-shaped pockets placed side by side at the base of the lamina (fig. 1 f). During the last twelve years I have searched in vain for similar leaves on many other trees, e.g., at Dehra-Dun, Calcutta, Vienna and the *Ginkgo* avenue in Dresden. Most of the abnormal leaves were gathered from the big male tree at the Municipal Gardens, Mussoorie, where a dozen were collected only from the lower branches; the other trees yielded only two or three specimens each.

The creepers at Cambridge were grafts from Montpellier, the plant which yielded the abnormal leaves being a female; the origin of the other trees is not known to me. The maiden-hair tree is such a familiar plant in the Far East that this abnormality will probably be well known in that part of the world, but I have not come across any reference to it in the literature. Professor Seward, who was kind enough to read this note in typescript, has recently informed me that he has observed this feature more than once.

Description.

As fig. 1 shows, all transitions are to be found between a normal flat lamina and a complete funnel. Even in the normal leaves the slightly thickened lower margins of the lamina (involute in the bud) often meet in an angle on the adaxial face of the petiole, while the more or less attenuated margins of the petiole may be continued some distance beyond this angle.[1] Velenovsky describes the same feature in a more marked degree in the leaves of seedlings.[2] In figs. 2–4 the

[1] Seward and Gowan (1900) pl. IX, figs. 39, 41; Sprecher (1907) figs. 57–59, 64, 65.

[2] Velenovsky (1907) p. 457, fig. 291 a, D-E.

structure of three funnel-leaves as seen in serial transverse sections is diagrammatically shown. Even in a normal leaf, the two petiolar bundles are somewhat inclined towards each other; in an abnormal

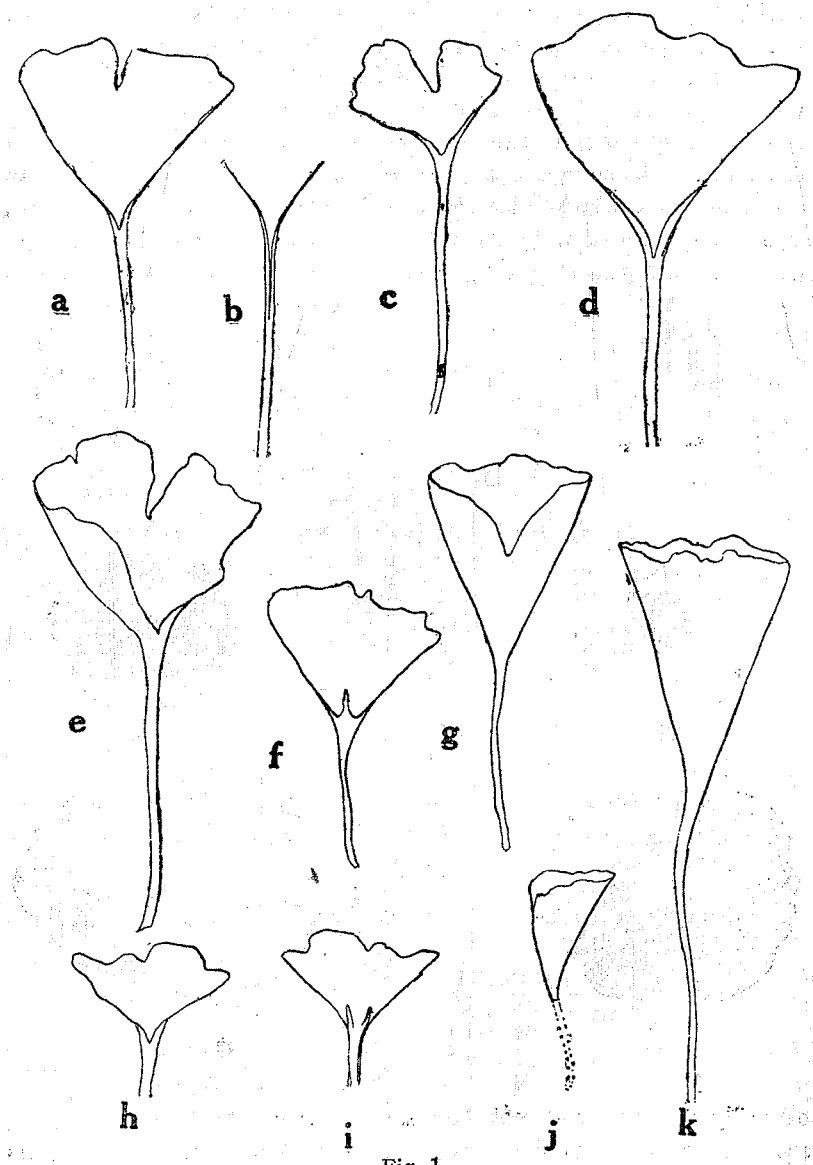

Fig. 1.

Fig. 1. Outline sketches showing transitions from the normal leaf (*a*, *b*) to fully formed ascidia (*k*). In *f* there are two conical pockets at the base of the lamina. In *i* (showing the dorsal surface of the leaf *h*) the petiole is continued into two horn-like processes adnate to the dorsal surface of the lamina. All × 1.

leaf they turn round and directly or almost directly face each other by their xylems, before they begin to undergo branching. The resulting bundles are placed in a ring with the xylem inwards. The central cavity begins to appear as a simple or branched slit lined by a cuticle; the stomata are confined to the outer (morphologically abaxial) surface.

Fig. 4 is interesting as it shows a funnel within a funnel. In the microtome series (unfortunately incomplete)[1] there is no sign of a connexion between the two funnels; but the inverted orientation of the bundles in the inner ring seems to leave no doubt that this is not a case of two separate leaves accidentally placed one within the other. The inner funnel evidently originated as a solid petiole (fig. 4 a) with the usual pair of bundles, but these are inclined towards each

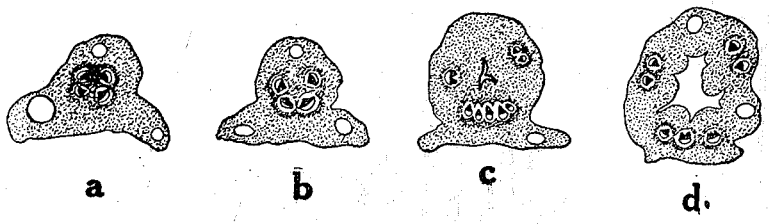

Fig. 2.

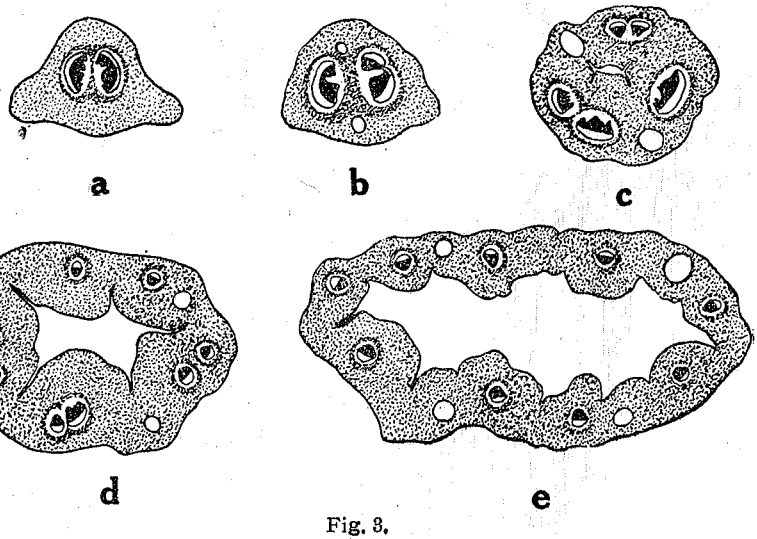

Fig. 3.

other by their phloems, not the xylems; the stomata, too, as expected, are here confined to the concave side of the funnel. The whole structure thus follows the usual law of inversion.[2]

[1] The sections were made by a pupil, as an exercise in microtechnique.

[2] See Velenovsky (1907) p. 410 ff and literature there cited.

Discussion.

My object in writing this note is to describe rather than to attempt a theoretical interpretation of these abnormalities. But a few comparative remarks may be allowed. Ascidia are well known to occur both as a normal and an abnormal feature in many plants;[1] a similar form is often assumed by floral organs, especially stamens and petals, when modified as nectaries. Indeed the peltate leaves so often found in Angiosperms are not essentially different from ascidia. In certain garden varieties of *Codiaeum variegatum* (familiar in gardens under the wrong name of *Croton*) and in *Ficus Krishnae*[2] we have well known cases of leaves variously modified into ascidia.

It is probably futile to attach a morphological significance to the ascidia in *Ginkgo*. In some well known abnormalities described by Shirai, Fujii, Sprecher, Sakisaka and others[3] the collar of the ovule is replaced by a leaf-like lamina; in others a leaf is found bearing one or more ovules or stamens. The lamina in some of these abnormalities tends to envelope the base of the ovule like a cupule. No doubt some of the ascidia described in the present paper recall the cupules of some Pteridosperms. Externally at least, there is a considerable resemblance with *Whittleseya elegans* which Prof. Halle[4] has recently shown to be a campanulate spore-bearing organ. But this resemblance by itself may have no theoretical significance, especially as no ovules or microsporangia have been found enclosed in the ascidia here described.

I have said above that even in normal flat leaves the margins of the lamina often meet on the adaxial surface of the petiole, as in fig. 1 a. The formation of a pocket at the base of the lamina is thus only an exaggeration of the same feature. It is interesting to find that this feature has been figured in several Mesozoic and Tertiary leaves variously referred to the genera *Ginkgo*, *Ginkgoites*, *Ginkgodium* and *Baiera*: *Ginkgo lepida* Heer[5], *Ginkgoites antarctica* Sap.[6], *Ginkgodium Nathorsti* Yok.[7], *Ginkgodium gracile* Tateiwa[8], *Ginkgoites pluripartita* (Schimper)[9]. In reply to an enquiry Dr. T. M. Harris of Cambridge writes that he has also found it in some of his Greenland specimens of Rhætic Ginkgoales; and I

[1] For examples see the general works on plant morphology and teratology by Goebel, Velenovsky, Penzig, Masters, Worsdell, etc.

[2] Velenovsky (1907) p. 410. fig. 262; Molisch (1930) pl. II.

[3] Fujii (1896); Sprecher (1907) p. 144, fig. 161; Sakisaka (1929).

[4] Halle (1930) p. 472–73.

[5] Yokoyama (1906) pl. 9, fig. 2b.

[6] Saporta et Marion (1885) p. 142 fig. 71A; Sprecher (1907), p. 183, fig. 209.

[7] Yokoyama (1889); Seward (1919) p. 63, fig. 659A; Oishi (1931) p. 70.

[8] Oishi (1931) p. 70.

[9] See Seward (1926) pl. 9, fig. 86.

am indebted to him for photographs of a leaf of *Gingoites obovata* Nath. which shows this peculiarity. Dr. Harris, too, holds the view that this character is of diagnostic value. He has, in fact, already used it to confirm his conclusions (based on cuticles) that one of his

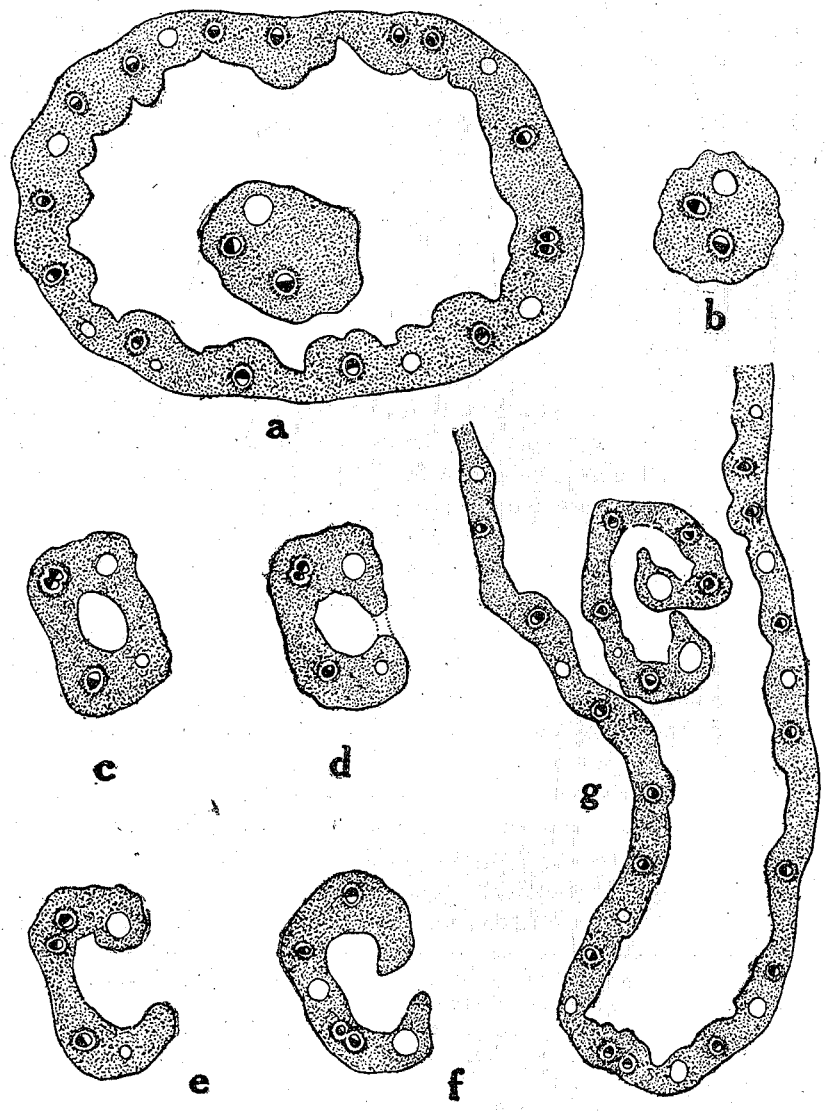

Fig. 4.

Figs. 2–4. Microtome sections of three different ascidia. In figs. 2, 3 the adaxial side is shown facing downwards. In fig. 4 *b–f* the outer funnel is omitted. Xylem black, phloem white. All × *ca.* 20.

Phoenicopsis-like leaves was, and that another was not, Ginkgoalean. Whether the same peculiarity existed in Palaeozoic members of the group it is difficult to say. In fact the attribution of many of the older leaves, such as species of *Psygmophyllum*, *Rhipidopsis* and other genera, to the Ginkgoales is still open to doubt. But if this character is found among any of these Palaeozoic forms it would strongly support their reference to that group. In an interesting paper recently published Dr. O. Posthumus [1] has shown that certain fossil fern leaves (*Dictyophyllum*, *Camptopteris*) resemble those of some living Dipteridineae in a peculiar twist in the base of the lamina: a welcome corroboration of their dipterid affinities, already suspected on other grounds.

It is indeed strange how these little peculiarities sometimes tend to persist through geological time.

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[1] Posthumus (1928).