

ON SOME GINKGOALEAN LEAF IMPRESSIONS FROM THE RAJMAHAL HILLS

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INTRODUCTION

THE record of fossil Ginkgoalean leaves from India is comparatively meagre. The earliest reports were made by Feistmantel who described two species of *Ginkgoites*—*G. lobata* Feist. (1877a, 1877b, PL. I; FIG. 1) from Jabalpur; and *G. crassipes* Feist. (1879, p. 31, PLS. XV, XVI, FIG. 12) from the Madras coast. The genera *Phoenicopsis* and *Czekanowskia* are also mentioned (FEIST., 1877², p. 19). Feistmantel (1881, p. 121, PL. 46A) also described *Rhipidopsis densinervis* from the Damuda beds of Godavari district, although Sitholey (1943, p. 188) suspects that it may be a species of *Psymgophyllum*, since the specimen differs from 'typical *Rhipidopsis* in the absence of small basal segments'. After a gap of over a quarter of a century Seward (1907) found *Psymgophyllum Hollandi* in Sir Henry Hayden's collection of Permo-Carboniferous plants from Kashmir, although two years earlier Seward and Woodward (1905, PL. 9, FIG. 3) had described as *Psymgophyllum* sp. an incomplete leaf from a collection by Noetling from the Vihi Valley in Kashmir. Seward (1912, p. 7) also founded another species *Psymgophyllum Haydeni* from a material collected by C. S. Middlemiss from Golabgarh Pass in the Pir Panjal Range; and Seward and Sahni (1920, p. 37) referred some detached leaf impressions of doubtful identity to the genus *Phoenicopsis*. After another gap of over two decades Sitholey (1943) referred to *Psymgophyllum Haydeni* another specimen collected by Wadia from Dandlutar in Pir Panjal, and simultaneously Ganju (1943) added yet another species *Psymgophyllum Sahnii* from Sirin spur, Vihi district, Kashmir.

The present collection describes three leaf impressions from the Rajmahal series in Bihar. These specimens were collected by the authors in 1949 and reported to the annual meeting of the Palaeobotanical Society at Lucknow in 1950. One of these probably represents the genus *Baiera* and the other

two may perhaps be species of *Ginkgoites*. They are the first reports from the Rajmahal series of the Upper Gondwanas of India.¹ The exact localities from which the specimens were collected are noted in the text.

DESCRIPTION

Specimen 1 (FIG. 1, locality Maharajpur)—From an exposure nearly a quarter of a mile to the south-west of the railway station near the base of the second hillock.

The fossil is preserved as a leaf impression of a dark yellowish-brown colour on a soft shale. Lamina fan-shaped, deeply lobed and attached to a petiole. The maximum length of the middle lobes is indeterminable due to the absence of the upper portion of the impression. Overall breadth of lamina 5.5 cm.; petiole 1.3 cm. long and 1 mm. broad; lateral segments 2.8 and 3 cm. long. Lamina divided into 6 primary segments, middle incision almost down to the petiole, other incisions reach more than two-thirds the depth of the lamina. Primary segments in turn divided once, their incisions reaching almost to the middle. The entire lamina may thus have divided into a dozen linear segments with an average width of 2.5 mm. per lobe. Venation faintly clear only in the third primary segment from the right. There appear to be 5 veins which, in the ultimate dichotomy, will, therefore, number two or three per segment.

Due to unsatisfactory preservation all attempts to study the cuticular structure have failed.

The leaf is organically attached to an axis-like impression whose structure, however, cannot be made out. A small swelling is associated with the base of the leaf which

1. While this communication was practically ready for the press, the authors' attention was drawn to a note by Sah (1952) on the occurrence of Ginkgoales in the Rajmahal series of Bihar. The specimens reported by Sah are all from one of the two localities from where the authors have made their collections.

may have been the short shoot on which it was actually borne.

Specimen 2 (FIG. 2, locality Sakrigalighat)—Whitish impression on a soft greyish shale. Lamina deeply incised into 4 linear segments. Probably only a part of the leaf. In two of the segments thin streaks, six in each, resembling veins, are faintly visible. They seem to run parallel, but their bifurcation cannot be made out. The largest segment is nearly 22 mm. long and 4 mm. broad.

Specimen 3 (FIG. 3, locality Sakrigalighat) — Three main segments, each dividing into two(?) attached to a stout stalk. This specimen, too, is probably incomplete. It is indifferently preserved. The lobes are deeply incised, their apices are either truncate or got broken during manipulation. The deepest incision reaching almost the apex of the stalk seems to suggest that the blade may have been equally divided into two halves as in the case of the first specimen. Venation not clear.

The central secondary segments at the point of bifurcation are 2 mm. and 2.5 mm. broad.

IDENTIFICATION

In his exhaustive treatise on the fossil Ginkgoales Florin (1936, pp. 44-45) has given a comprehensive key dealing with the classification of the genera known at the present time. The relative part of the key is reproduced below:

I. Foliar leaves either undivided or divided more or less deeply into 2 to 8 primary lobes which are tongue-shaped and wedge-shaped towards the base. These are frequently in two groups, one on the right and the other on the left. Normally they are further deeply divided only once in the middle or still deeper into secondary lobes which include in the middle zone of the leaf 4 to 6 or more subparallel veins.

A. Venation, distant to moderately close, showing less than 20 veins per cm. in the apical part.

(a) Foliar leaves: in epidermal structure or other anatomical characters of systematic importance closely resembling those of *Ginkgo biloba* L. (recent) . . . *Ginkgo*.

(b) Foliar leaves: epidermal structure or other anatomically important characters either unknown or strongly different in one or more aspects from those of *Ginkgo biloba* (recent) . . . *Ginkgoites*.

B. Venation very dense, 20 veins or more per cm. in the apical part of the foliar leaves . . . *Ginkgodium*.

II. Foliar leaves divided into primary lobes very deeply (up to $\frac{3}{4}$ or more). These primary lobes may be arranged in two groups and in turn are deeply divided at least once, but mostly repeatedly. All the lobes narrowly linear or almost so, including not more than 2 to 4 parallel veins in any part . . . *Baiera*.

The remaining genera are so markedly different from these four as well as from the specimens described above that they need not be considered here.

Specimen 1, according to this classification, may perhaps belong to the genus *Baiera* for the following reasons: The primary incisions are very deep; the secondary incisions are also deep reaching almost the middle of primary segments; the ultimate lobes are narrow and linear; and the veins not more than 4 in each segment.

The generic and specific determination of Ginkgoalean leaf impressions is not an easy task. This is particularly the case with the genera *Ginkgoites* and *Baiera* which seem to merge into one another at several points. While dealing with the subject Seward (1919, p. 16) remarked that "as with the definition of species within the genus *Ginkgoites* so also the adoption of *Ginkgoites* or *Baiera* is to a large extent, the result of individual preference and merely expresses an attempt to classify in an arbitrary fashion the numerous types of leaves that in themselves afford no sure guide as to precise affinity".

Another eminent worker, T. M. Harris (1935, pp. 47-50), discussing the differences between these two largest genera of the group has referred to the following schemes:

I. Leaf divided into several segments . . .

Baiera.

Leaf merely indented . . . *Ginkgoites*.

II. Leaf with distinct petiole, outline of lamina as a whole being semi-circular . . . *Ginkgoites*.

Leaf without a petiole . . . *Baiera*.

Harris agreeing with Kräusel (1917) supports the second scheme, while Lundqvist (1918) supporting the first one observes that the question of the presence or absence of a petiole is "purely subjective".

Reviewing the whole problem Seward (1919, p. 34) has observed: "Leaves assigned to *Baiera* vary within wide limits as regards the size, the number of linear seg-

ments and their angle of divergence. In many cases the leaves are petiolate though in several instances the petiole is represented by a narrow basal region of the lamina as in *Psygmo-phyllum*. It is stated by some authors that the veins are subdivided but though dichotomy is less frequent in *Baiera* and may be absent in narrow parallel-sided segments, it is by no means rare."

It is obvious that the schemes noted above do not solve the problem, and the confusion continues to exist. Nor does epidermal structure help us to come to a definite understanding, since Harris (1935), quoting Oishi (1933, p. 251), states that "A comparison of cuticles of *Ginkgoites* and *Baiera* species shows that its structure cannot be used as a basis for separating the two genera".

In view of the above discussion the assignment of specimen 1 to the genus *Baiera* must be regarded as tentative and subject to revision when more details are available. For obvious reasons no attempt is made for the time being to assign it to a definite species.

The identity of the other two specimens is still more obscure. They are not only incomplete but are also very indifferently preserved. The smaller number of segments and a larger number of veins per lobe in the second specimen suggest a comparison with *Ginkgoites* to which genus specimen 3 perhaps also belongs. These two speci-

mens are from the same locality from which Sah (1952) has reported his collection. Our specimen 2 is perhaps comparable to his Fig. 2, while his Fig. 1 representing a very incomplete specimen roughly recalls our specimen 1 although the two are collected from places about 9 miles apart.

Amongst the Mesozoic plants of Queensland described by Walkom (1917, 1918, 1919 and 1924) the Ginkgoales, particularly the genera *Baiera* and *Ginkgoites*, are prominently represented. It is quite possible that our specimens are referable to the generalized form *Ginkgo* (*Ginkgoites*?) *digitata* Brongniart which exhibits as great a variation in its leaf form as the living representative *G. biloba* L. As Sah (loc. cit.) points out, the Rajmahal specimens are not comparable to Feistmantel's *Ginkgo lobata* and *G. crassipes* because of their laminae being divided into distinct lobes.

The importance of this contribution lies in the fact that Ginkgoalean leaves have been described for the first time from the Rajmahal series of the Indian Gondwanas from two new localities.

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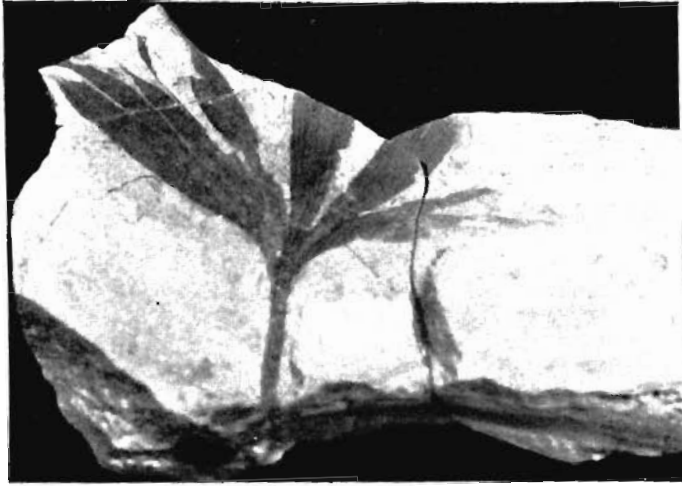
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EXPLANATION OF PLATE 1

1. ?*Baiera* sp. Leaf impression attached to an axis. $\times ca.$ 1.5.
2. ?*Ginkgoites* sp. $\times 2.5$.
3. ?*Ginkgoites* sp. $\times ca.$ 2.5.



1



2



3