ANGIOSPERM LEAF-IMPRESSIONS FROM THE KASAULI BEDS, N.W. HIMALAYAS[1]

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ABSTRACT

Some dicotyledonous and monocotyledonous leaf impressions recently collected by the author from the Kasauli beds are described and figured. So far the only plant remains known from these beds were some leaf fragments referred to a palm *Sabal major* Heer, discovered by H. B. Medlicott (1864), briefly described by Dr. Kane in Medlicott and later figured by Feistmantel (1882). Since Medlicott's discovery of over 85 years ago no plant fossils have been recorded from these beds, which are probably much richer in fossils than has been generally believed.

INTRODUCTION — PREVIOUS RECORDS OF FOSSIL PLANTS FROM THE KASAULI BEDS

DURING a recent visit to Kasauli (*ca.* 6,000 ft. alt. in the Simla Hills, N.W. Himalayas), I collected several fragments of leaf impressions of dicotyledons, and one fragment belonging probably to a palm leaf, in the coarse grey or dull green sandstones composing the Kasauli beds.

The only plant fossils hitherto known from these beds are a few leaf impressions of palms collected over 85 years ago by H. B. Medlicott (1864) and mentioned in his memoir on the Sub-Himalayan ranges of north-western India, where we find a brief description, without figures, by Dr. Kane (loc. cit., pp. 97-99). These fragments were later figured by O. Feistmantel (1882, FIGS. 3-5) and referred to *Sabal major* Heer.

Through the courtesy of the Director, Geological Survey of India, I have been able to examine the original specimens figured by Feistmantel in his Figs. 3-5. The photograph now published (PL. 1, FIG. 1) gives a somewhat more accurate idea of the leaf shown in Feistmantel's Fig. 3 than the sketch in Feistmantel's plate.

The identification of this small leaf with Heer's well-known species (HEER, 1855, TAB. 35, 36, FIG. 12, p. 88 and TAB. 41, FIG. 7) has never been questioned, though a modern palaeobotanist would probably expect more satisfactory proof than a general correspondence in form and venation. This is the best-preserved fossil we yet have from the Kasauli beds, being an impression on a specially fine-grained grey-green rock, which is unlike the usual coarse sandstone forming the great mass of this thick series. But it gives no clue to the epidermal structure or other details. We may provisionally accept Feistmantel's determination for lack of further data. The two smaller fragments (FEISTMANTEL, 1882, FIGS. 4, 5) which Kane had referred to *Flabellaria rapifolia* Sternberg may also belong to *Sabal major*, as Feistmantel suggests. Schimper and others have, in fact, regarded these two species as identical — a view which can neither be proved nor refuted without more detailed information.

OCCURRENCE OF THE FOSSILS NOW DESCRIBED

The few fragmentary leaf impressions here described are all preserved in the coarse-grained grey or dull green, more or less micaceous sandstone which forms the bulk of the thick series of rocks known as the Kasauli beds. All my specimens were found as loose blocks and, with one exception which was picked up on the roadside near Lady's Grave, they were all discovered within the precincts of the Kasauli Club. Some of the fossil-bearing slabs were taken from a roadside parapet at the Arcadia cottage belonging to the Club, others formed the paving stones of an open rain-water drain near the tennis courts. All attempts to discover plant remains *in situ* in the rocks now exposed in this vicinity were futile. A search in other localities at Kasauli, where the highly inclined strata were well exposed, also proved infructuous. There is no doubt, however, that our fossils belong properly to the Kasauli beds, and that with further

1. This short paper which was left by Professor B. Sahni in manuscript form has been very kindly edited for publication by Professor T. M. Harris, F.R.S., of the University of Reading, England. I am deeply grateful to him for this great kindness. — MRS. SAVITRI SAHNI

investigation these beds will reveal a much richer flora than is yet known from here.

Owing to the coarse grain of the rock, all my specimens are very poorly preserved, and even in the best of them there is no trace left of the finer venation. Nor is there any sign of a carbonized crust which might yield information about the epidermal characters.

I was unable to locate the outcrop of fine-grained greyish-green rock in which the palm leaf collected by Medlicott is preserved. Unfortunately, no details of the locality were given by that geologist; but if the original spot or stratum can be discovered, it should yield impressions much better preserved than those in the coarse sandstone; moreover, this rock seems to be much richer in plant remains than the coarse sandstone.

DESCRIPTION OF THE FOSSILS

A. Monocotyledons

The parallel-ribbed impression shown in Fig. 2 probably belongs to a palm leaf but it is too fragmentary to indicate whether it represents a fan palm or a feather palm. More likely it is part of a fan palm but it can scarcely be identical with *Sabal major* Heer.

B. Dicotyledons

Among the remaining specimens in this small collection, in spite of the very bad preservation, it is possible to distinguish at least three species probably referable to three different genera. To judge by the form of the leaf, and the venation so far as it is preserved, all of these are almost certainly dicotyledons. The firm and as a rule deeply impressed outline left by the leaves in such a coarse sandstone suggests a coriaceous texture.

Dicotylophyllum, sp. 1

Figs. 3 and 4 depict two specimens which, in view of their general agreement in the gross features, I am inclined to refer to one species. The better of the two fragments shows the lower half of what was evidently an almost sessile leaf with an entire margin. The petiole, only 5 mm. long, is slightly curved and thickened at the basal end. It is continued into a stout midrib from which several strong, straight secondary veins come off on either side at an angle of about 60 degrees. These secondary veins run parallel to each other, as in many modern Apocynaceae and some other families. The tertiary veins are not preserved. Better preserved specimens discovered later may enable one to determine the systematic position of this species which is provisionally referred to the form genus *Dicotylophyllum*.

Dicotylophyllum, sp. 2

Fig. 5 shows the nearly complete outline of an oblong lanceolate leaf, over 10 cm. long by 3 cm. broad, with an entire margin and a petiole 2·5 cm. long seen bent to one side. There is a distinct midrib, which forms a slight ridge, with the two halves of the leaf sloping off to right and left. There is no trace whatever of the finer veins.

Dicotylophyllum, sp. 3

In Fig. 6 another coriaceous-looking leaf is seen, which obviously belongs to a distinct genus, as shown by the venation. The midrib is rather thin and inconspicuous, and from near the base two main lateral veins rise obliquely at a narrow angle (about 40 degrees). (Of these veins, only the one on the right is brought out in the photograph.) Of the finer venation there is again no trace. The leaf was buried in the sand in a slightly folded condition.

AFFINITIES AND GEOLOGICAL AGE

With so little to go upon in the way of morphological characters it is out of the question to assign any of the dicotyledonous leaf impressions to natural genera. Strictly speaking, this is true even of the palm leaf which Feistmantel has referred to *Sabal major* as suggested above: there is no convincing proof of identity with Heer's species.

Palm leaves of the same general type are known from the Eocene of Häring in the Tirol (Ettingshausen, 1853, Tab. 2, 3), as well as from later stages in the Tertiary. The general resemblance of the specimens figured by Feistmantel from Kasauli (1882, Figs. 3-5) with Lydekker's specimens from the Murree beds at Chakoti, also referred by Feistmantel to Heer's species, supports a Tertiary age.

The reference of the Kasauli beds to the lower Miocene is, however, well established on geological grounds. For one thing we

know that these beds are younger than the Eocene Subathu beds which they overlie with the intervening Dagshai beds conformably below them. Secondly, the Kasauli beds must be older than the Siwaliks (Upper Tertiary: Middle Miocene to Pliocene) at the foot of the Himalayas near Kalka, which are separated by the main boundary fault. Whether this fault actually marks a depositional margin, as believed by H. B. Medlicott, Middlemiss and others, or, as now seems much more likely (*see* EVANS, 1938; WADIA, 1938), it is an overthrust fault (or a parallel series of overthrust faults), it is agreed on all hands that the beds to the south-west of this tectonic line are younger than those higher up the slopes of the Sub-Himalayas towards Kasauli. Thirdly, there is the well-established continuity of the Kasauli plant beds with the Murree beds in a band striking north-west across the Ravi, Chenab and Jhelum rivers as far as Kashmir. The geological relations of the Kasauli beds have been discussed by several geologists since the time of Medlicott (1864): see Oldham (1893, pp. 350-351, 355); Wadia (1939, pp. 260, 316); and Krishnan (1943, pp. 455, 456). The stratigraphical relations of the various formations here mentioned are well illustrated in a section given by W. D. West.

We may thus safely accept the age of the Kasauli flora as Lower Miocene.

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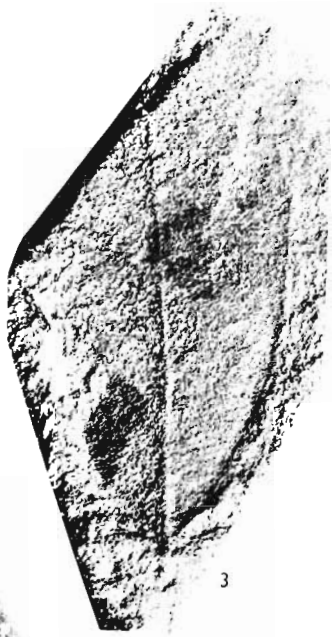
EXPLANATION OF PLATE 1

All the figures are of natural size

1. '*Sabal major*' Feistmantel's specimen (11/647) refigured.
2. Leaf fragment, possibly of a palm.
3, 4. *Dicotylophyllum*, sp. 1.
5. *Dicotylophyllum*, sp. 2.
6. *Dicotylophyllum*, sp. 3.

1



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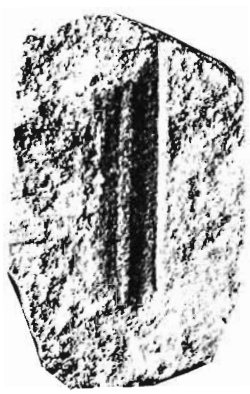

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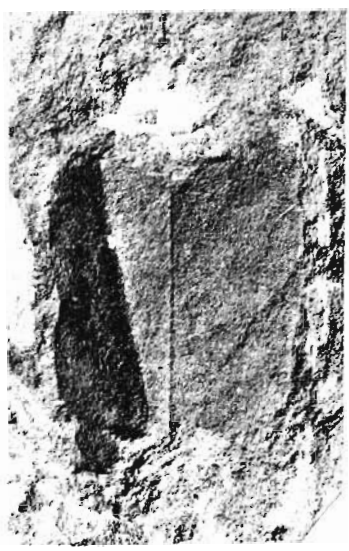

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