

SOME FOSSIL PLANTS FROM THE PO SERIES OF SPITI (N.W. HIMALAYAS)

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ABSTRACT

The paper deals with some fragmentary remains of fossil plants from the Po series of Spiti, collected in July 1952 from two different plant-bearing beds near the village of Tabo. The present collection strengthens the view of Gothan and Sahni that the age of the Tabo plant-bearing beds is Lower Carboniferous.

INTRODUCTION

THE first collection of fossil plants from the Po series of Spiti was made as early as 1904 by Sir Henry Hayden of the Geological Survey of India. He collected these plants from two different localities. From one of the localities, about half a mile N.N.E. of Po, Spiti, a solitary specimen of *Rhacopteris* was picked up by him along with some marine fossils. This he thought came from the Fenestella shales, the age of which is regarded by the geologists as Middle Carboniferous. The second locality, near the village of Tabo (32°5': 78°27'), is on the left bank of Spiti river. From this bed only a few fragmentary remains of plant material were collected. All these specimens were identified by Zeiller (in HAYDEN, 1904, p. 47). He recognized three distinct genera, *Rhacopteris*, *Sphenopteridium* and *Sphenopteris*. Later Gothan and Sahni (1937) re-examined Hayden's collection and identified the following species: *Rhacopteris ovata* (McCoy) Walkom, *R. inaequilatera* Feistmantel (non Goepfert), *Sphenopteridium ? furcillatum* Ludwig sp., *Sphenopteris* sp. (*Rhodea* sp.). Out of these only the first species was from the Fenestella shales. Gothan and Sahni on the evidence of the plant remains considered the age of the plant-bearing beds at Tabo as Lower Carboniferous.

For a long time after Hayden no collection was made from these localities. In June

1950, a few more specimens of *Rhacopteris* were collected by one of us (Shukla) during a visit to the locality in the company of Mr. G. Kohli of the Geological Survey of India. In July 1952, we visited the plant-bearing beds at Tabo together with Mr. G. Kohli. A large number of fossil plants were collected from Hayden's locality at Tabo and by one of us (Shukla) from a new locality near it. The new locality, which is rather difficult to access, is on a high ridge of N.W. of Tabo. At this place the majority of the specimens collected are *R. ovata*. Only a few specimens of *R. inaequilatera* and two specimens of *Rhodea* were collected. At Hayden's locality which is on the left bank of Spiti river about 1½ miles upstream from Tabo, there are two outcrops about 150 yards from each other. The fossil plants here are few in species and most of them are fragmentary. From both localities remains of *Sphenopteridium*, *Sphenopteris* and *Rhacopteris* were collected. Some of these have a fairly good preservation but most of them are not well preserved. Besides *Rhacopteris ovata*, we have collected a few more species of *Rhacopteris*, which are described below.

DESCRIPTION

Fossils from the Higher Shale Band on the Ridge N.W. of Tabo

Rhodea sp.

Pl. 1, Fig. 1

The specimen (PL. 1, FIG. 1) consists of a large number of fragmentary fronds of *Rhodea* with flexuous rachis and small pinnules. Pinnules alternate, usually free, divided into two to four narrow spreading segments. In some, segments almost capillaceous. Ultimate pinnae lanceolate, touching each other laterally.

Due to the very fragmentary nature of the fronds specific determination is not possible.

Rhacopteris ovata (McCoy) Walkom

Pl. 1, Fig. 2

Most of the specimens collected resemble very much *R. ovata* described by Gothan and Sahni (1937). No complete specimen could be obtained. Fragmentary pieces consist of simple pinnate fronds with straight rachis. Pinnules alternate, close, almost touching, upper side broadly rounded, with a stout and straight petiole. Veins united at the base, spreading widely and dichotomously divided.

The figured specimen (PL. 1, FIG. 2) has got a straight rachis about 10.2 cm. in length and 2 mm. in breadth. Pinnules preserved only on one side, touching or slightly overlapping, broadly oval, length of the pinnules about 2 cm.

Rhacopteris inaequilatera Goepf. sp.

Pl. 1, Fig. 3

This species is not so well represented here as *R. ovata*. The figured specimen (PL. 1, FIG. 3) is only a portion of a frond collected in counterparts. It has a single, more or less straight rachis, 7.2 cm. long and 1.5 mm. wide. Pinnules alternate, very close or almost touching, semi-flabelliform and asymmetric. Length of the pinnules 2.4 cm. Veins not close, bifurcating after leaving the base of the pinnule.

These specimens closely resemble some of the *R. inaequilatera* described by Feistmantel (1890).

**Fossils from Left Bank of Spiti River
about 1½ Miles Upstream from Tabo**

Sphenopteridium sp. a

Pl. 1, Figs. 4-6

In all, seven specimens were collected. They are fragmentary and probably belong to the apical region. Rachis, where preserved, is stout. Pinnules are elongate and cuneate, narrowed to a short stalk at the base, sometimes the outer margin dissected near apex as if dividing the pinna into two (PL. 1, FIGS. 5, 6). Fine, closely set and divergent veins arise from near the stalk.

These specimens show a great similarity with *Sphenopteridium cuneatum* described

by Walkom in 1934 from Currabubula. The structure of the pinnule is very similar. To some extent the pinnules of some of our specimens (PL. 1, FIG. 6) also resemble *S. dissectum* Goepf. sp. described by Kidston (1923).

Sphenopteridium sp. b

Pl. 1, Figs. 7-10

Numerous small pinnae of *Sphenopteridium* have been collected but only three of them are figured here (PL. 1, FIGS. 7-9). Rachis is not so thick as in the preceding species. Pinnules are elongate and obliquely placed on the rachis, wedge-shaped, shallowly lobed, mostly with 2 incisures (PL. 1, FIGS. 7, 8), sometimes ending in a blunt point by two straight lines meeting in a wide angle (PL. 1, FIGS. 9, 10), and contracted into a short stalk at base. Veins numerous, closely set and bifurcating.

As is seen from the photographs the specimens are very fragmentary and so specific determination is difficult. Possibly the specimens represent more than one species.

Sphenopteris sp.

Pl. 2, Figs. 11, 12

The fronds collected are too fragmentary for any specific determination. Pl. 2, Figs. 11 and 12, shows two such detached pieces of pinnae. The specimen in Pl. 2, Fig. 11, consists of a small piece of pinna measuring 2.8 cm. in length. Rachis thin and slightly flexuous. Pinnules lanceolate, gradually tapering from the base to an acute point. The rachis bearing the tertiary pinnae is slender. Pinnules narrow, deltoid and alternate.

These specimens are quite different from the one figured by Gothan and Sahni (1937).

Rhacopteris ovata (McCoy) Walkom

This species has already been recorded by Gothan and Sahni in 1937. This time we have collected numerous specimens. In fact, it seems that in this region it was the dominant species.

Rhacopteris cf. *circularis* Walton

Pl. 2, Figs. 13-15

Only four specimens have been collected, out of these two are in counterparts and none of them is complete. One of them seems

to be from the apical region (PL. 2, FIG. 15). In this the rachis is straight, not very wide, measuring 1.5 mm. The pinnate frond is 5.2 cm. long and about 1.6 cm. broad. Pinnules alternate, slightly overlapping and obliquely set to the rachis. Margin slightly crenulate. Pinnules more or less circular, contracted at the base with a short stalk. Veins not close, radiate from the stalk and bifurcating before attaining the margin.

The other specimen figured in Pl. 2, Figs. 13 and 14, has a stout rachis 2.5 mm. in width with longitudinal striations. Pinnules distant, more or less opposite, set obliquely to the rachis. Margin of pinnules entire, some of them are lobed, subcircular, contracted at the base to form a short stalk. The veins closer than in the specimen in Pl. 2, Fig. 15, radiating from the stalk and dichotomizing.

To judge by the characteristic form of the pinnules these specimens belong to *R. circularis* Walton (1926). They also resemble those described by Frenguelli (1943) under the same name, although the pinnules of the latter are bigger.

Rhacopteris inaequilatera Goepp. sp.

Pl. 2, Figs. 16, 17

Next to *R. ovata* this species is the commonest one in this region. Pl. 2, Figs. 16, 17, shows a specimen consisting of three small pieces of pinnate fronds. The largest frond has a slightly flexuous rachis, 1 mm. wide, pinnules variable in length, alternate, more or less distant, semi-flabelliform, slightly lobed towards the apex, obliquely placed to the axis. Veins close, most of them bifurcating.

Rhacopteris sp. a

Pl. 2, Fig. 18

Out of three specimens collected only one is figured here. The specimens consist of one or two pinnules attached to a rachis; one of the specimens is only a detached pinnule.

Frond pinnate, rachis fairly stout and straight. Pinnules distant, flabelliform, crenate, contracted at the base to form a short stalk and placed at right angles to the axis. Veins radiate from the stalk and dichotomize before reaching the margin.

The figured specimen measures 4 cm. in length, the width of the rachis being 2 mm. and the length of the pinnule 1.7 cm.

Rhacopteris sp. b

Pl. 2, Fig. 19

Some very fragmentary pieces of fronds were collected which have a fairly thick rachis with distinctly lobed pinnules. Veins fine, closely set, arising from the stalk. In some cases only the pinnules were obtained. On the evidence of these alone no specific determination is possible.

?*Asterophyllites* sp.

Pl. 2, Figs. 21, 22

We have only a single specimen, in counterparts. It is too imperfect to enable us to judge distinctly of its nature. It consists of only one node to which are attached long imperfectly preserved verticillate leaves. The length of the leaves and their number not known. There is no trace of any internode.

?*Adiantites* sp. a

Pl. 2, Fig. 20

Only a fragment and its counterpart. Rachis very thin and straight. Pinnules alternate, distant, wedge-shaped, deeply and irregularly incised at the apex and contracted at base into a stalk. Veins not clear.

?*Adiantites* sp. b

Pl. 2, Fig. 24

A single, very fragmentary specimen, consisting of a flexuous rachis which measures 2.7 cm. in length and about 1 mm. in width. Pinnules alternate, distant, wedge-shaped, apex rounded and smooth and the base contracted to form a stalk. Veins not preserved.

?*Rhodea* sp.

Pl. 2, Fig. 23

A very small fragment of a frond, measuring 1.5 cm. in length. Rachis stout. Pinnules segmented due to dichotomous division. In the pinnules the veins bordered by a narrow band of the limb.

CONCLUSION

The age of the Tabo plant beds was discussed in great detail by Gothan and Sahni (1937). On the evidence of fossil plants

they considered the age of the Tabo plant beds as Lower Carboniferous. In the present collection, as in the previous ones, there are specimens whose identification is uncertain. There is no uncertainty, however, about the age of the flora. It is a typical representative of Lower Carboniferous flora and thus supports the view of Gothan and Sahni.

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EXPLANATION OF PLATES

PLATE 1

1. *Rhodea* sp. No. Pl/781, G.S.I. 1/1.
2. *Rhacopteris ovata* McCoy Walkom. No. Pl/782, G.S.I. 1/1.
3. *Rhacopteris inaequilatera* Goepp. sp. No. Pl/733, G.S.I. 1/1.
4. *Sphenopteridium* sp. a No. 3838, B.S.I.P. 1/1.
5. *Sphenopteridium* sp. a No. Pl/731, G.S.I. 1/1.
6. *Sphenopteridium* sp. a No. Pl/695, G.S.I. 1/1.
7. *Sphenopteridium* sp. b No. Pl/728, G.S.I. 1/1.
8. *Sphenopteridium* sp. b No. Pl/729, G.S.I. 1/1.
9. *Sphenopteridium* sp. b No. Pl/697, G.S.I. 1/1.
10. Part of specimen in Fig. 9 enlarged. 2/1.

PLATE 2

11. *Sphenopteris* sp. No. Pl/751, G.S.I. 1/1.
12. *Sphenopteris* sp. No. Pl/719, G.S.I. 1/1.
13. *Rhacopteris circularis* Walton sp. No. Pl/746, G.S.I. 1/1.
14. *Rhacopteris circularis* Walton sp. Counterpart of the specimen shown in Fig. 13. No. Pl/749, G.S.I. 2/1.

15. *Rhacopteris circularis* Walton sp. No. 5763, B.S.I.P. 1/1.
16. *Rhacopteris inaequilatera* Goepp. sp. No. 1918, B.S.I.P. 1/1.
17. *Rhacopteris inaequilatera* Goepp. sp. No. 1989, B.S.I.P. A portion of the counterpart of the specimen shown in Fig. 16. 2/1.
18. *Rhacopteris* sp. a No. 1940, B.S.I.P. 1/1.
19. *Rhacopteris* sp. b No. 1942, B.S.I.P. 1/1.
20. ?*Adiantites* sp. a No. 1915, B.S.I.P. 1/1.
21. ?*Asterophyllites* sp. No. 1918, B.S.I.P. 1/1.
22. Counterpart of the specimen shown in Fig. 21. No. 1989, B.S.I.P. 2/1.
23. ?*Rhodea* sp. No. Pl/730, G.S.I. 1/1.
24. ?*Adiantites* sp. b No. Pl/726, G.S.I. 1/1.

The figured specimens numbered Pl/781, Pl/782, Pl/733, Pl/731, Pl/695, Pl/728, Pl/729, Pl/697, Pl/751, Pl/719, Pl/746, Pl/749, Pl/730, and Pl/726 are preserved at the Geological Survey of India, Calcutta. The rest of the specimens in the two plates are preserved at the Birbal Sahni Institute of Palaeobotany, Lucknow.



