LEAF-IMPRESSIONS FROM HIRPUR (LOWER KAREWA), KASHMIR

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ABSTRACT

The paper deals with leaf-impressions of *Rosa macrophylla* Lindl., *Viburnum cotinifolium* Don, *Salix wallichiana* Anders and *Potamogeton* sp. from Hirpur. *Viburnum cotinifolium* and *Potamogeton* are new additions to the already known megafossils of the Lower Karewa. Occurrence of these taxa reflects warm-temperate and wet climate in this area during their deposition.

INTRODUCTION

Occurrence of plant-remains in the Karewa beds of Kashmir is known since 1864 when GODWIN-AUSTEN observed leaf-impressions for the first time in the tilted Hirpur rocks in the flank of Pir Panjal. In 1911, MIDDLEMISS collected some leaf-impressions from Gogajipathri and Liddarmarg which were identified by BURKILL (MIDDLEMISS, 1911). DE TERRA AND PATERSON (1939) realising the potential of plant megafossil study in determination of climatic cycles, made preliminary investigation of fossil plants comprising leaves, fruits, seeds, cones, and diatoms collected from Ningal Nullah, Botapathri, Laredura, Dangarpur, Nagbal as well as from the above two localities. PURI (1943-1965) in a series of papers described a large number of megafossils from the same localities (for references see PURI, 1948, 1957), a classified list of which was given by VISHNU-MITTRE (1965) while reconsidering the floristics and ecology of the Lower Karewa plants.

Although this flora has been periodically used in reconstructing the plausible climatic events in the Kashmir Valley as well as to support the theory of Pir Panjal upheaval, yet there are various problems concerning the identification and stratigraphic position of the fossils which need to be looked into critically. DETERRA AND PATERSON (1939) divided the Lower Karewa Formation into I—V Lithozones in chronological sequence. They placed all the plant megafossil bearing beds in the Lithozone IV which according to them represents the upper part of Lower Karewa, whereas no record of plant fossils was made from other lithozones. However, VISHNU-MITTRE AND ROBERT (1973) have found leaf-impressions in the Lithozone III at Nichahoma. Recently we have collected a good number of both leaf-impressions and carbonised woods from near Hirpur, the type locality of the Hirpur Formation (BHATT, 1976). The huge section from which we collected fossils is exposed within an area between Hirpur and Dubjan in the Upper Rembiara Valley and represents a stratotype of the Hirpur Formation. Out of three conglomerates —informally numbered as I, II & III, in the Hirpur Formation as stratigraphic marker to control the sampling (AGARWAL *et al.*, 1981), I & II are seen well exposed between Hirpur and Dubjan. Here the beds overlying and underlying conglomerate I and II, consisting of mud, sandy-clay, sand and lignite have yielded a considerable number of leaf-impressions and carbonised woods. From these findings it is quite evident that the whole Lower Karewa sequence is fossiliferous and therefore all the plant megafossils described by earlier workers from various localities situated at varying altitudes may not have been laid down at one and the same time.

The material for the present study was collected from Hirpur (33°41′ : 77°44′), exposed infront of Hirpur village, a few meters away towards upstream from the log bridge across Rembiara river. The leaves are preserved as impressions in the mud lying in between two lignitic beds below the conglomerate II. In this collection only four types have been recognised which are described here in detail.

SYSTEMATIC DESCRIPTION

Family—ROSACEAE
Genus—**Rosa** Linn.

Rosa macrophylla Lindl.
Pl. 1, Figs. 5-6

Leaf symmetrical, elliptic; length 3.0 cm, maximum width 1.5 cm; apex acute; base acute to slightly cuneate; margin toothed; texture chartaceous; petiole normal, 1.5 mm in length; venation pinnate, simple, craspedodromous; primary vein (1°) stout, straight, unbranched; secondary veins (2°)—angle of divergence moderately acute (varying from 50°-40°), moderately thick, uniformly curved, number of secondaries in left half 10, in right half 11; intersecondary veins present, simple, intramarginal vein absent; tertiary veins (3°) fine, straight, oblique to curved, arrangement random reticulate to percurrent, simple reticulum; course random to orthogonal; areoles imperfect, oriented, triangular to pentagonal, medium to small; veinlets not seen.

The fossil shows close resemblance with three species of *Prunus* (viz. *P. avium*, *P. prostrata* and *P. puddum*) and four species of *Rosa* (viz. *R. laevigata*, *R. macrophylla*, *R. moschata* and *R. webbiana*). However, out of these the fossil is best comparable with *Rosa macrophylla* in all its characters.

Specimen – B.S.I.P. Museum No. 36012

Family—CAPRIFOLIACEAE
Genus—**Viburnum** Linn.

Viburnum cotinifolium Don
Pl. 1, Figs. 3-4

Leaves appear symmetrical; wide elliptic-obovate, preserved length 2.5-4.0 cm, preserved width 2.0-3.0 cm (in one half), maximum preserved width 5.2 cm at the basal region; apex broken; base wide acute to obtuse; margin entire in the lower half, serrate in the upper half; texture seems chartaceous to coriaceous; petiole not preserved; venation pinnate, simple, craspedodromous; primary vein (1°) massive, straight to slightly curved, unbranched; secondary veins (2°)—angle of divergence moderately acute (varying from 60°-30°), moderately thick, uniformly curved, branched; intersecondary veins absent; intermarginal vein absent; tertiary veins (3°) fine, pattern seemingly percurrent, course simple, unbranched, approximately at right angle to mid vein, arrangement predominantly opposite, distant; higher order of venation not visible; areoles not seen; veinlets not seen.

The fossil specimens show close resemblance with *Parrotiopsis jacquemontiana* of Hamamelidaceae and two species of *Viburnum*, viz., *V. cotinifolium* and *V. erubescens* of Caprifoliaceae.

Parrotiopsis jacquemontiana which apparently shows very close resemblance with the fossil in its size, shape, venation, etc. can on careful consideration be differentiated from it in two significant differences. Firstly, the midrib in *P. jacquemontiana* is not straight as

seen in the fossil specimens but tends to move outward whenever it gives rise to secondaries (i.e. it gives an appearance as if number of weakly undulated fragments have fused to form the midrib). Secondly, 2-3 secondaries immediately arise (in one half of the leaf) from the base of the leaf in the fossil (Pl. 1, Fig. 4) whereas in *P. jacquemontiana* only single pair of secondaries arise from near the base. Besides other characters, these two characters with which the fossil differ from *P. jacquemontiana* are also seen in the genus *Viburnum*.

Hence the fossil is best comparable with *Viburnum*, and out of the two species mentioned it shows closest resemblance with *Viburnum continifolium*.

Specimen—B.S.I.P. Museum Nos. 36010-36011

Family—SALICACEAE
Genus—**Salix** Linn.

Salix wallichiana Anders
Pl. 1, Figs. 1-2

Leaf asymmetrical, narrow elliptic to narow oblong, preserved length 2.2-4.1 cm, width 0.6-0.9 cm ; apex wide acute ; base acute to cuneate ; margin entire ; texture seems thick chartaceous; petiole normal, 0.6 cm long; venation pinnate, eucamptodromous; primary vein (1°) massive, curved; secondary vein (2°)—angle of divergence narrow acute (ranging from 40° near the base to 25° near the apex), moderately thick, uniformly curved, branched, joining superadjacent secondaries by finer veins without forming prominent marginal loops; number of secondaries up to 19 pairs; intersecondary veins present, composite; intermarginal vein absent; tertiary veins (3°) fine, obliquely arranged, orthogonal reticulate to percurrent, higher order of venation not seen; areoles and veinlets not seen.

In size, shape and venation the fossil leaf shows close resemblance with those of *Salix* of the family Salicaceae. A large number of species of *Salix* were compared with the fossil and it was found that the leaves of *Salix wallichiana* show close similarity with the present fossil.

Specimen—B.S.I.P. Museum No. 36009

Family—POTAMOGETONACEAE
Genus—**Potamogeton** Linn.

Potamogeton sp.
Pl. 1, Figs. 7-9

Leaves appear symmetrical, seemingly elliptic; preserved length 2.5-3.5 cm, maximum width 2.5 cm; apex broken; base obtuse; margin entire, straight, texture appears to be thick chartaceous; petiole almost broken; venation parallelodromous, number of primaries arising from the base (10 on one side of the midrib), closely placed, angle of divergence 60°-40°, 60° in the basal region, gradually decreasing upwards, moderately thick; secondaries (2°)—numerous, joining the two adjacent primaries at an angle of 70°-80°, slightly wavy.

The most characteristic feature of the fossil is the number of closely placed primaries in each half and numerous secondaries joining the two adjoining primaries. These features can be seen in the leaves of *Aponogeton* and *Potamogeton*. *Aponogeton*, however, differs in having only 4 primaries which are quite distantly placed as compared to the fossil in which 10 primaries are seen very closely placed in one half of the leaf. Thus the fossil shows a closer similarity with *Potamogeton*.

Of the different species of *Potamogeton* the fossil shows very close resemblance with *Potamogeton indicus* and *P. natans*. The leaves of these two cannot be separated from each other on mere morphological grounds.

Specimen—B.S.I.P. Museum Nos. 36013-36014

DISCUSSION

Out of the four families, viz., Caprifoliaceae, Potamogetonaceae, Rosaceae and Salicaceae, reported in the present paper the last two are well represented in the megaflora of Lower Karewa (PURI, 1951, 1945). On the other hand, Caprifoliaceae is meagrely known, and Potamogetonaceae has been reported for the first time.

Salix wallichiana has already been reported by PURI (1945) from Ningal Nullah (alt. 2,743 m) along with four more species, viz., *Salix denticulata* Anders (= *S. elegans* Wall.), *Salix* sp. A, *Salix* sp. B, *Salix* sp. C. The occurrence of *Salix wallichiana* in two widely separated localities perhaps indicate its fairly wide distribution in the Kashmir Valley during the Lower Karewa. It is a widely distributed species found from Kashmir to Bhutan ascending upto 2,740 m and descending down to 610 m in Punjab Plains. The genus *Rosa* is known by three species, viz., *Rosa webbiana*, *R. macrophylla* and *Rosa* sp. The former two are represented by leaf-impressions and the latter by spines. These have been reported from Laredura (alt. 1,830 m) by PURI (1951). Like *Salix wallichiana*, the occurrence of *Rosa macrophylla* at two different sites also indicates its fairly wide distribution in the Kashmir Valley. Presently *Rosa macrophylla* is found in temperate Himalaya from Murree to Sikkim between 1,070-3,050m extending further into China (HOOKER, 1879).

Only one species of *Viburnum*, *V. stellulatum* Wall. has so far been recorded from the Lower Karewa of Kashmir (DE TERRA & PATERSON, 1939, p. 119; PURI, 1948, p. 119), the exact locality of which is not mentioned in the literature. Our fossil specimens of *Viburnum* which are identical to *Viburnum cotinifolium* enriches the presence of this genus in the valley in the past. *Viburnum cotinifolium* is a large deciduous shrub common in North-West Himalaya above 1,230 m frequently seen from Kashmir to Kumaon at an altitude between 1,830-3,050 m and extends upto Bhutan (HOOKER, 1882). The leaf-impressions referred to *Potamogeton* are closely comparable to *Potamogeton indicus* and *P. natans*. The former is found throughout the plains and ascending to Himalaya upto 2,740 m whereas the latter ascends upto 1,585 m in Kashmir.

On the basis of fossil records discussed above it is assumed that warm temperate and wet climate had prevailed around Hirpur at the time of their deposition. However, further work which is in progress will give a fuller picture about the palaeofloristics and palaeoclimatic fluctuations in this part of the Kashmir Valley. Nevertheless, the occurrence of *Potamogeton* depicts the lacustrine deposits. The well preserved nature of fossil leaves has led to believe that the plants might be growing close to the site of deposition rather than transported from a considerable distance. This assumption is confirmed from the present day distribution of *Salix* growing close to the water source. *Viburnum* and *Rosa* can also be seen further away from lakes and rivers.

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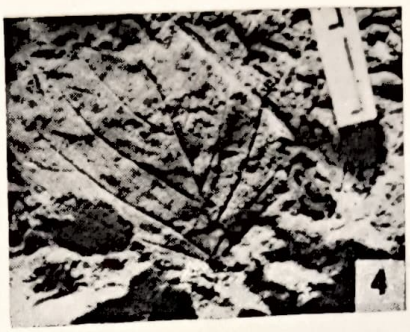
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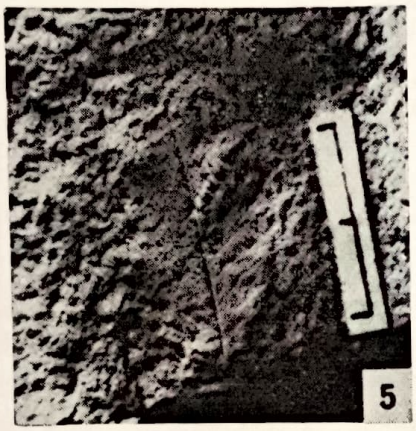
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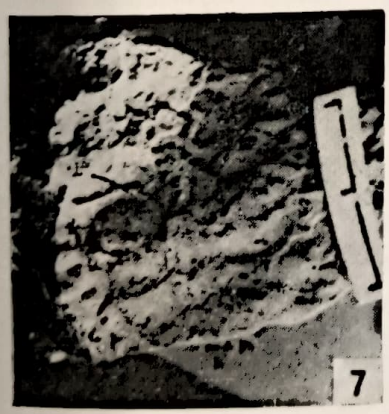
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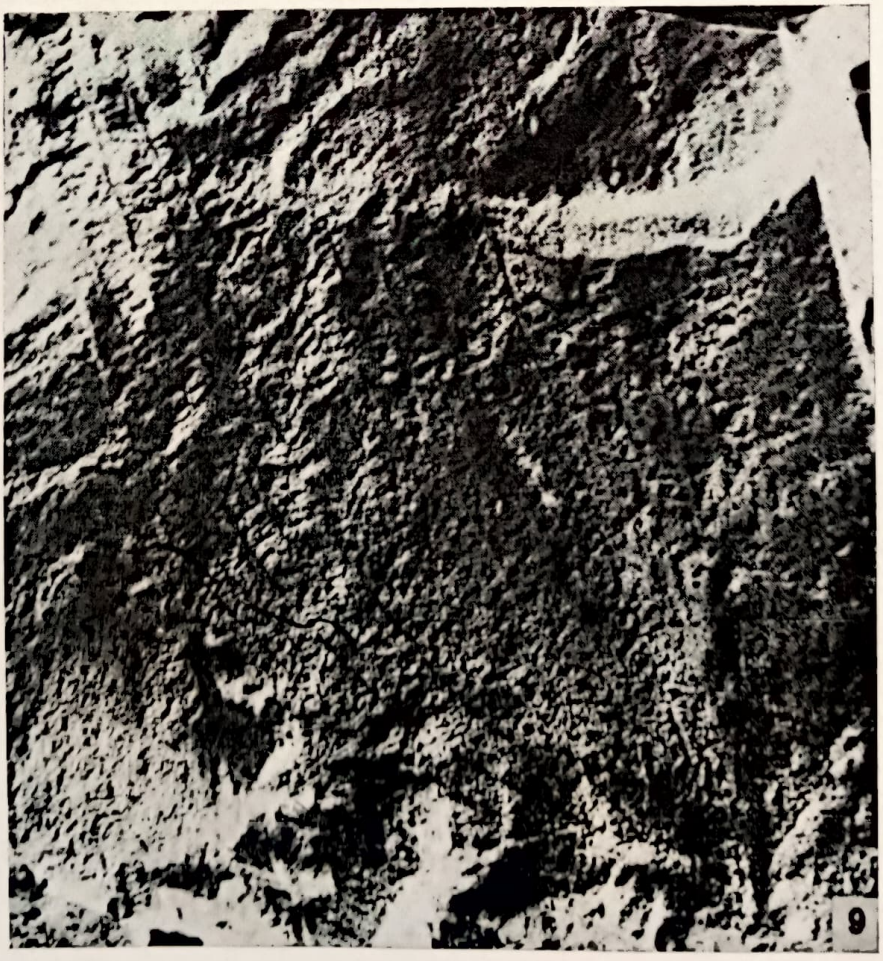
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EXPLANATION OF PLATE 1

Salix wallichiana Anders

1. Leaf, natural size.
2. Leaf, enlarged showing details of venation, ×2.2.

Viburnum cotinifolium Don

3. Leaf, natural size.
4. Another leaf, natural size.

Rosa macrophylla Lindl.

5. Leaf, natural size.
6. Leaf, enlarged showing details of venation, ×2.

Potamogeton sp.

7. Leaf, natural size.
8. Another leaf, natural size.
9. Part of Fig. 8, enlarged showing details of secondaries and tertiaries, ×4.