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# Dipterocarpaceous fossil leaves from Ghish River section in Himalayan foot-hills near Oodlabari, Darjeeling District, West Bengal

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The fossil leaves belonging to the extant genera *Dipterocarpus* Gaertn. and *Shorea* Roxb. of the family Dipterocarpaceae have been described from the Middle Siwalik sediments exposed in Ghish River near Oodlabari in Darjeeling District, West Bengal. The occurrence of both these genera in the Siwalik sediments is phytogeographically significant and suggests the prevalence of warm humid climate during the deposition of Siwalik sediments in this region.

**Key-words**—Palaeobotany, Leaf-impressions, *Dipterocarpus*, *Shorea*, Middle Siwalik, West Bengal (India).

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## सारांश

पश्चिमी बंगाल में दार्जिलिंग जनपद में ऊदलाबाड़ी के समीपस्थ हिमालयी गिरि-पादों में घिशनदी खंड से डिप्टेरोकार्पेसीय अश्मित पत्तियाँ

जसवन्तसिंह अन्तल एवं महेश प्रसाद

इस शोध-पत्र में पश्चिम बंगाल में दार्जिलिंग जनपद में ऊदलाबाड़ी के निकट घिश नदी में अनावरित मध्य शिवालिक अवसादों से डिप्टेरोकार्पेसी कुल की डिप्टेरोकार्पस गेयर्टन एवं शौरिआ रॉक्सबर्ग नामक प्रजातियों की अश्मित पत्तियों का वर्णन किया गया है। शिवालिक अवसादों में इन दोनों प्रजातियों की उपस्थिति पादभौगोलिक दृष्टि से महत्वपूर्ण है तथा इससे यह प्रस्तावित होता है कि इस क्षेत्र में शिवालिक अवसादों के निक्षेपण के समय उष्ण और नम जलवायु विद्यमान थी।

THE exposure from where the present leaf-impressions have been collected lies on the right bank of Ghish River (26°52' : 26°56') near Oodlabari, Darjeeling District, West Bengal. It is about 3 km upstream from the mouth of the river and about 7 km from Oodlabari. On the basis of lithological study in the area Mallet (1875), Bose (1891) and Acharyya (1972) classified the Siwalik sediments of this area into Lower and Middle Siwalik. According to Misra (1984) the Siwalik of the area are divisible into Lower, Middle and Upper (see Antal & Prasad, 1996, p. 2). Thus, accordingly the present locality belongs to Middle Siwalik. The specimens have been deposited in the Museum of Birbal Sahni Institute of Palaeobotany, Lucknow.

A large number of leaf-impressions and fruits belonging to the genera *Dillenia* (Dilleniaceae), *Alseodeia* (Flacourtiaceae), *Calophyllum* (Clusiaceae), *Hopea* (Dipterocarpaceae), *Grewia* (Tiliaceae), *Bursera* (Burseraceae), *Cynometra* and *Albizia* (Fabaceae), *Lagerstroemia* (Lythraceae), *Vernonia* (Compositae), *Diospyros* (Ebenaceae), *Alstonia* (Apocynaceae), *Callicarpa* (Verbenaceae), *Cinnamomum* and *Actinodaphne* (Lauraceae), *Mallotus* and *Macaranga* (Euphorbiaceae), *Ficus* (Urticaceae), *Euphoria* (Sapindaceae) and *Bambusa* (Bambusaceae) have already been reported from the Ghish River section by Antal and Awasthi (1993). The study on the fresh collection of leaf-impressions from the area reveals the presence of two more

phytogeographically important genera—*Dipterocarpus* and *Shorea* of the family Dipterocarpaceae, which have been described and discussed in this paper.

### SYSTEMATIC DESCRIPTION

#### Family—Dipterocarpaceae

#### Genus—*Dipterocarpus* Gaertn.

*Dipterocarpus siwalicus* Lakhanpal & Guleria 1987  
Pl. 1, figs 1, 2

There is only one specimen in the collection.

*Description*—Leaf simple, symmetrical, elliptic, preserved size 14.2 x 6 cm; apex slightly broken, seemingly acute; base acute to seemingly obtuse; margin entire; texture coriaceous; petiole not seen; venation pinnate, eucamptodromous; primary vein (1°) prominent, stout, almost straight; secondary veins (2°) 16 pairs visible, 0.5 to 1.4 cm apart, angle of divergence 40° to 55°, narrow to moderate, arise somewhat straight and curved just near the margin, unbranched; tertiary veins (3°) fine with angle of origin RR, percurrent, usually straight, sometimes branched and oblique in relation to midvein, predominantly alternate and close.

*Specimen*—No. BSIP 37411.

*Locality*—Right bank of Ghish River near Oodlabari, Darjeeling District, West Bengal.

*Horizon*—Middle Siwalik.

*Affinities*—The main diagnostic features of the fossil leaf such as elliptic shape, nature of base and apex, entire margin, coriaceous texture, course of secondary veins and percurrent, closely placed tertiary veins strongly indicate that the fossil leaf shows its affinity with the leaves of the extant genus *Dipterocarpus* Gaertn. of the family Dipterocarpaceae.

About 20 modern species of the genus *Dipterocarpus* were examined and it was found that three species, viz., *D. alatus* Roxb. (C.N.H. Herbarium sheet no. 50833), *D. macrocarpus* Vesq. (FRI Herbarium sheet no. 16410) and *D. tuberculatus* Roxb.

come closer to the present fossil. Of them, *D. tuberculatus* Roxb. shows closest affinity with the fossil.

A number of fossil leaves resembling the modern genus *Dipterocarpus* are known from the Tertiary of India and other places. These are *Dipterocarpus antiquus* Heer and *D. atavinus* Heer from the Tertiary of Sumatra (Heer, 1883), *D. labuanus* Geyler, *D. nordenskioldi* Geyler and *Dipterocarpus* sp. from the Tertiary of Labuan (Geyler, 1887), *Phyllites dipterocarpoides* Crie 1888 from Pliocene of Java, *D. siwalicus* Lakhanpal & Guleria 1987 from the Siwalik sediments of Jawalamukhi, Himachal Pradesh, Koilabas, western Nepal (Prasad, 1990) and Kathgodam, Uttar Pradesh, India (Prasad, 1994).

On comparing of the present fossil with the above already known species, it has been observed that it shows close affinity with the fossil leaves *D. siwalicus* Lakhanpal & Guleria 1986 reported from the Siwalik beds of Kathgodam, Uttar Pradesh.

The leaves of *D. siwalicus* and the present fossil are elliptic in shape and have the same course of secondary and tertiary veins, therefore it has been described under the same species.

The extant species *D. tuberculatus* Roxb., with which the fossil shows closest affinity, is a large evergreen to deciduous tree growing in plains and low hills in the valley of Myanmar. It also grows in Cochin-China and Thailand (Brandis, 1971; Gamble, 1972).

#### Genus—*Shorea* Roxb.

*Shorea miocenica* sp. nov.  
Pl. 1, figs 3, 5

This species is based on two specimens, in which the basal part is broken.

*Description*—Leaf simple, symmetrical, wide elliptic, preserved size 8.5 x 6 cm and 11 x 7.6 cm; apex acute; base broken; margin entire; texture coriaceous; venation pinnate, eucamptodromous; primary vein (1°) moderate, almost straight,

### PLATE 1

*Dipterocarpus siwalicus* Lakhanpal & Guleria

1. Fossil leaf in natural size showing shape, size and venation pattern; Specimen no. BSIP 37411.
2. A part of fossil leaf magnified to show details of venation. x 2.

*Shorea miocenica* sp. nov.

- 3-4. Fossil leaves in natural size showing shape, size and venation pattern, specimen nos. BSIP 37412 and 37413.
5. A part of fossil leaf (fig. 3) magnified to show details of venation. x 2.

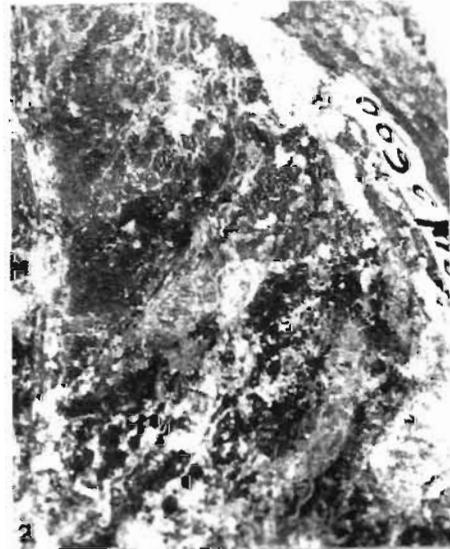


PLATE 1

prominent; secondary veins (2') 9 pairs visible, 1 to 2 cm apart, alternate to subopposite, angle of divergence about 60° (in one specimen about 45°-60°), uniformly curved up, unbranched; tertiary veins (3') fine with angle of origin usually RR, rarely AO, percurrent, straight to curved, rarely branched, oblique in relation to midvein, close; quaternary veins (4') very fine, usually arise nearly at right angle from tertiary, percurrent and branched.

*Holotype*—BSIP Specimen no. 37413.

*Paratype*—BSIP Specimen no. 37412.

*Locality*—Right bank of Ghish River near Oodlabari, Darjeeling District, West Bengal.

*Horizon*—Middle Siwalik.

*Affinities*—The most characteristic features of the fossil leaves are wide elliptic shape, acute apex, entire margin, eucamptodromous venation, acute angle of divergence of secondary veins, and very fine, sharp and percurrent tertiary veins which collectively indicate their resemblance with the leaves of *Shorea* Roxb. of the family Dipterocarpaceae.

In order to find out their specific affinity a large number of herbarium sheets of the genus *Shorea* were examined and when it was concluded that the leaves of *Shorea buchananii* Fisher (F.R.I. Herbarium sheet no. 11583) show closest affinity with the present fossil leaves.

The fossil leaves resembling the genus *Shorea* are known both from India and abroad. Seward (1935) reported two leaves- *Dipterocarphyllum blumei* and *D. geraivense* from the Tertiary of Egypt showing close affinity with the genus *Shorea* of Dipterocarpaceae. Merrill (1923) described two leaves, viz., *S. guiso* and *S. polyspermum* from the Pliocene of Philippines.

Recently, Antal and Awasthi (1993) described a fossil leaf, *Shorea siwalika* from Ramthi River, Darjeeling District, West Bengal. Another fossil species has also been reported by Prasad (1994) as *Shorea neoassamica* from the Siwalik sediments of Kathgodam, Uttar Pradesh, India.

The present fossil leaves have been compared with all already known species and found that they are different in their shape, size and course of secondaries and tertiary veins and hence, have been described under a new species, *Shorea miocenica*. The extant species *Shorea buchananii* Fischer, with

which the present fossil leaves closely resemble, is a large tree known to occur in Myanmar (Anonymous, 1926-30).

## DISCUSSION

The modern comparable taxa of the present fossil leaves which have been described here from Ghish River near Oodlabari, Darjeeling District, West Bengal, do not grow now-a-days in this region. Both these extant taxa, *Dipterocarpus tuberculatus* Roxb. and *Shorea buchananii* Fischer grow these days in the evergreen forests of Myanmar. On the basis of fossil records, it is worth mention that these genera were widely distributed in India during Neogene (Lakhanpal & Guleria, 1987; Prasad & Prakash, 1987; Antal & Awasthi, 1993; Prasad, 1993, 1994). Besides, a number of plant fossils belonging to the family Dipterocarpaceae are known from Southeast Asia (Bande & Prakash, 1986, tables I-IV, pp. 205, 208-209, 212-213, 216, 219) and the earliest record of *Dipterocarpus* stands from the Oligocene of Southeast Asia (Muller, 1981). It is interesting that there is no record of dipterocarps from the Palaeogene of India. Obviously, it indicates that the family Dipterocarpaceae migrated into the Indian subcontinent through Myanmar sometime in the Early Miocene when the land connections between Malaya, Myanmar and India were established.

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