

Existence of the genus *Shorea* in the Himalayan foot-hills of India since 5600 year B.P.

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ABSTRACT

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Fossil woods collected *in situ* for the first time from the Holocene sediments of Purniyagiri area near Tanakpur, Champawat District, Uttarakhand have been studied in detail. The anatomical features like, medium to large vessels, broad, heterogeneous rays and presence of gum canals in concentric rings and vasicentric tracheids indicate its affinity with the modern woods of *Shorea* Roxb. of the family Dipterocarpaceae. The presence of fossil wood of this taxon in the Holocene sediments is phytogeographically important.

Key-words—Fossil wood, *Shorea*, Dipterocarpaceae, Holocene, Phytogeography, Tanakpur, Uttarakhand.

भारत के हिमालयी गिरि पादों में 5600 वर्ष पूर्व से शोरिया वंश का अस्तित्व

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सारांश

टनकपुर के निकट पूर्णागिरि क्षेत्र, जिला चंपावत, उत्तरांचल के होलोसीन अवसादों से प्राप्त तत्रैव एकत्रित की गई जीवाश्म काष्ठों का विस्तृत अध्ययन किया गया है। शारीरिक लक्षण जैसे मध्यम से विशाल वाहिकाएं, चौड़ी, विषममंगी किरणें तथा संकेंद्री वलयों में गोंद विशाखाओं की विद्यमानता और वाहिकाकेंद्री वाहिनिका डिप्टेरोकार्पेसी परिवार के शोरिया की आधुनिक काष्ठों के साथ इसकी बंधुता इंगित करती हैं। होलोसीन अवसादों में इस वर्ग की जीवाश्म काष्ठ की मौजूदगी पादपभौगोलिक रूप से महत्वपूर्ण है।

मुख्य शब्द—जीवाश्म काष्ठ, शोरिया, डिप्टेरोकार्पेसी, होलोसीन, पादपभूगोल, टनकपुर, उत्तरांचल।

INTRODUCTION

ALTHOUGH several studies on the origin and history of tropical forests in different regions of Uttarakhand (Uttaranchal), India have been carried out based on pollen proxy records to deduce the serial stages involved in the formation of present sal forests during Holocene through the investigation of sediment core (Chauhan *et al.*, 2002). But very little attention has so far been paid to the plant megafossils

entombed in these sediments. Only a few fossil leaves showing resemblance with extant genera, *Celtis*, *Mallotus*, *Prunus* and *Ficus* are known from Holocene sediments (Tiwari *et al.*, 1979; Mahajan & Mahabale, 1973; Prasad *et al.*, 2002). With a view to generate palaeobotanical data (megafossils) to reconstruct Holocene floristics, the present study has been made on the fossil wood collected from Tanakpur area, Uttarakhand (Uttaranchal).

The present fossil locality, Purniyagiri lies in the Tanakpur area (29°4' N: 80°07' E) of Champawat District in the Himalayan foot Hills of Uttarakhand (Uttaranchal), India (Fig. 1). The sediments of Himalayan foot hills were deposited continuously by various rivers for last 20 Ma which provides an excellent opportunity to study the flora and fauna embedded in these fluvial sediments. In this area the Holocene sediments are deposited in between the hillocks of foot hills by the erosion of Siwalik sediments. These Holocene sediments are composed of usually hard yellowish sandy clay with some small to large pebbles (Fig. 2).

So far, there is no record of fossils from Holocene sediments of this area. However, a few leaf impressions showing close resemblance with the genus *Mitrephora*, *Sterculia*, *Millettia*, *Cynometra*, *Chonemorpha* and *Persea* belonging the families Anonaceae, Sterculiaceae, Fabaceae, Apocynaceae and Lauraceae have been reported from the Siwalik sediments (About 12 Ma) of Purniyagiri area (Lakhanpal & Guleria, 1978; Shashi *et al.*, 2006).

MATERIAL AND METHODS

Few pieces of fossil woods were collected from a log embedded in the Holocene sediments exposed in the Thuligid-Purniyagiri road cutting section near Tanakpur area,

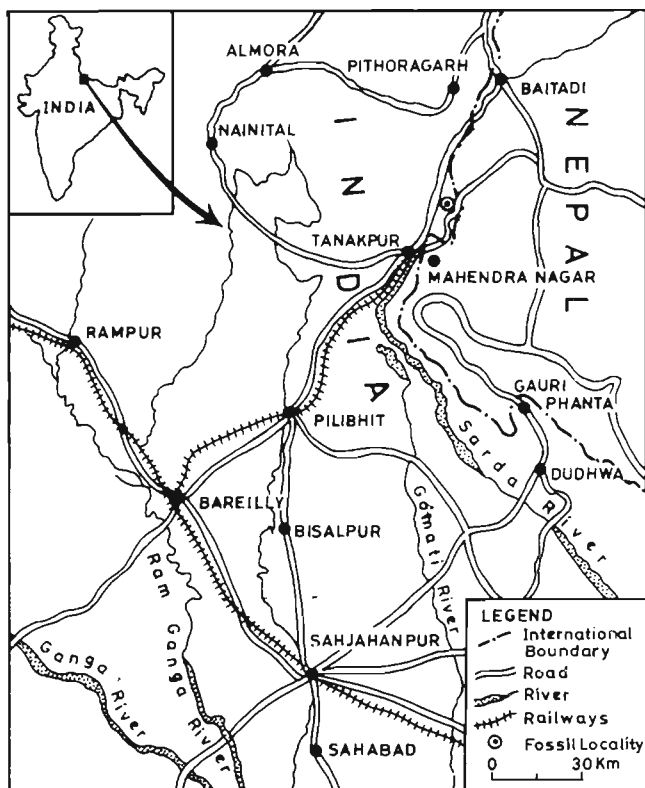


Fig. 1—Map showing location from where fossil was collected.

Champawat District, Uttarakhand (Uttaranchal). The fossil wood was hard, semicarbonised and brownish in colour. The wood was sliced into thin pieces on different planes (T.S., T.L.S., R.L.S.) with the help of Microtome. Wood slides were prepared in Canada Balsam and observed under high power microscope. The fossil wood has been dated to 5600 years B.P. by Wallac 1220 Quantulus Ultra Low Level Liquid

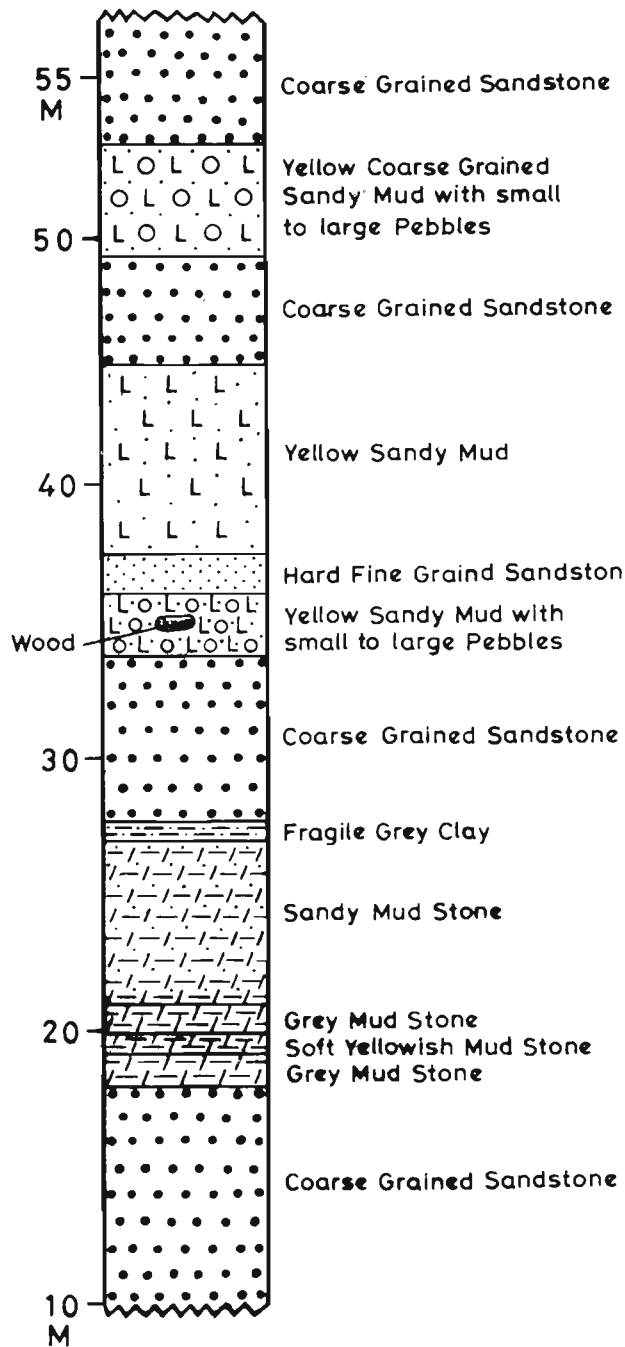


Fig. 2—Showing litho-column of the exposed section indicating the occurrence of wood.

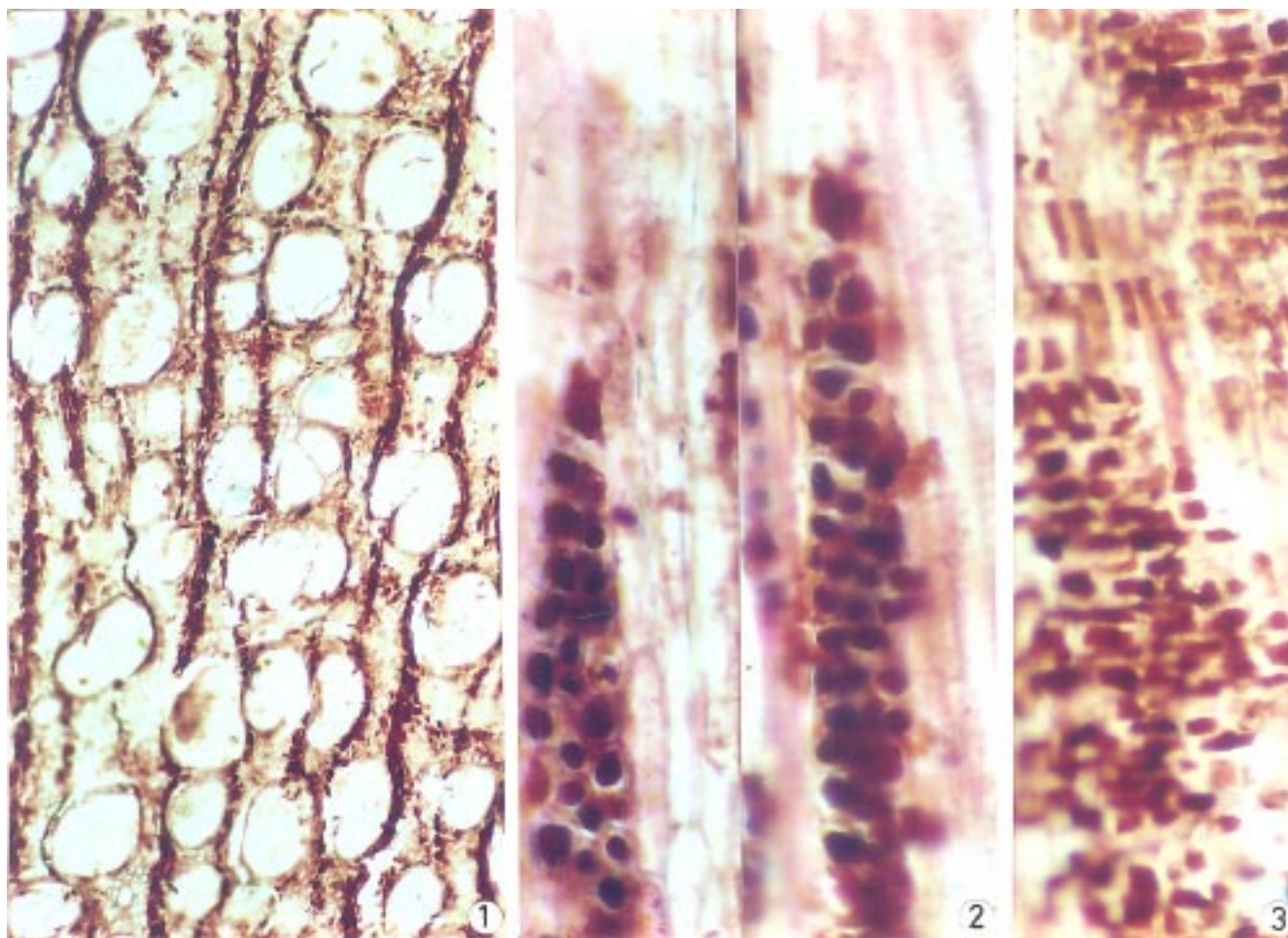


PLATE 1

1. Transverse section of the fossil wood showing shape, size and distribution of vessels, parenchyma and gum canals. x 70. B.S.I.P. Museum No. 39288/I.
2. Tangential longitudinal section of the fossil wood showing structure of the xylem rays and fibres. x 125. B.S.I.P. Museum No. 39288/II.
3. Radial longitudinal section of the fossil wood showing heterocellular xylem rays. x 125. B.S.I.P. Museum No. 39288/III.

Scintillation Counter as per Standard procedure (Rajagopalan *et al.*, 1978). The specimen and wood slides were housed in the Museum of Birbal Sahni Institute of Palaeobotany, Lucknow.

SYSTEMATICS

Dicotyledons

Family—Dipterocarpaceae

Genus—*Shorea* Roxb.

Shorea robusta Gaertn.

Description—Wood diffuse porous. *Growth rings* absent. *Vessels* circular to oval, t.d. 144-144 μm , r.d. 144-240 μm , usually solitary, rarely in radial multiples of

2-3, evenly distributed, tylosed (Pl. 1.1); vessel members 80-100 μm in length with truncate ends, perforations simple; inter-vessel pit-pairs 4-6 μm in diameter, vestured, circular to orbicular in shape, alternate with linear to lenticular aperture. *Vasicentric tracheids* present, paratracheal. *Parenchyma* both paratracheal and apotracheal, paratracheal parenchyma scanty to vasicentric forming 1-3 layered sheath apotracheal parenchyma diffuse and diffuse in aggregate, sometimes forming thick bands enclosing gum canals. *Rays* 3-5 seriate, 4-35 cells, 175-1020 μm in height (Pl. 1.2), 6-8 per mm; ray tissues heterocellular consisting of procumbent cells through the median thickened portion and 1-3 marginal rows of upright cells. Uniseriate rays both heterocellular and homocellular, the later are few and consisting wholly of upright cells, ray cells oval to polygonal in transverse section, thin walled (Pl. 1.3).

Fibres aligned in radial rows in between the consecutive xylem rays, libriform, moderately thick-walled, non septate, round to oval or angular in shape, 20-25 µm in diameter and 780-1240 µm in length, interfibre pits could not be seen. *Gum canals* circular to oval in shape 60-84 µm in diameter (Pl. 1.1).

Modern affinity—The diagnostic features of the present fossil wood such as presence of normal, vertical gum canals in concentric rings, vasicentric tracheids, heterocellular rays and thick walled fibres collectively indicate its affinity with the modern woods of the family Dipterocarpaceae. On the basis of distribution of gum canals in the woods, the taxa of this family have been divided into two groups.

Group I—Gum canals diffuse, solitary and in short tangential rows, e.g. *Anisoptera*, *Dipterocarpus*, *Vateria*, *Vatica*, *Upuna*, *Cotylelobium* and *Monoporandra*.

Group II—Gum canals in concentric rings, e.g. *Shorea*, *Doona*, *Hopea*, *Isoptera*, *Parashorea*, *Pentacme*, *Balanocarpus*, *Dryobalanops* and *Dioticarpus*.

On the basis of presence of concentric gum canals the present fossil wood can be assigned to the genera of group II. From a critical examination of modern wood sections and published literatures on anatomy of all the available species of the genera belonging to this group, it has been concluded that the present fossil wood resembles the wood of the extant genus *Shorea* Roxb. The other genera of this group can be discarded on the basis of mainly vessel size and nature and distribution of gum-canals and rays.

Further, in order to find out the specific affinity of the fossil wood, thin section of modern woods of all the available species of *Shorea* Roxb. have been studied. Besides, literature dealing with the anatomy of other species were also consulted (Pearson & Brown, 1932; Metcalfe & Chalk, 1950; Desch, 1957; Kribs, 1959). Study of anatomical characters of different species of *Shorea* Roxb. suggests that the wood of *Shorea robusta* Gaertn. shows near resemblance with the present fossil mainly in size of gum canal and nature of parenchyma.

Fossil Record and Comparison—There are several records of fossil wood and leaf resembling the genus *Shorea* Roxb. from the Tertiary sediments of India, Nepal, Burma and South east Asian region. Of these, four fossil woods have been described under the form genus *Shoreoxylon* Den Berger from the Quaternary/ Holocene sediments of India and abroad. These are *Shoreoxylon multiporosum*, *S. pulchrum*, *S. posthumi* from the Quaternary of Sumatra (Schweitzer, 1958) and *S. pentecmeoides* from Pliocene-Early Pleistocene sediments of West Bengal (Bera & Banerjee, 2001). But none of the fossils shows affinity with the present fossil wood. The occurrence of this fossil wood forms first record of *Shorea* from Holocene sediments of northern India.

DISCUSSION

The genus *Shorea* Roxb. is the main constituent of the family Dipterocarpaceae which consist of about 180 species and widely distributed in the world from Sri Lanka and India on the west and throughout Myanmar and other countries of South east Asia up to Philippines on the east (Willis, 1973; Pearson & Brown, 1932).

The occurrence of fossil wood of *Shorea* Roxb. in the Himalayan foot hills of Uttarakhand (Uttaranchal) India before 5600 years is very important for phytogeographical point of view. In view of the present day occurrence of *Shorea robusta* Gaertn. in the nearby areas, the fossil woods may most probably belong to *S. robusta* Gaertn., however anatomically it is difficult to distinguish this species from the other *Shorea* species. The evidence from other parts like leaves, fruits, pollen, etc. may confirm the presence of *S. robusta* Gaertn. in future. From the Palaeobotanical data obtained from the Himalayan foot hills (1.6-23 Ma) it is evident that there is no existence of *Shorea robusta* (Prasad *et al.*, 2004), however, a number of dipterocarps including other species of *Shorea*, viz. *Shorea assamica* Dyer., *S. buchananii* Fischer, *S. trapizifolia* (Thw.) Asthon, *S. curtisii* Dyer and *S. stellata* Dyer are known from Tertiary sediments of Himalayan foot hills (Antal *et al.*, 1996). It is also worth to mention that palynological data obtained from Holocene sediments indicate its existence around 3000 years B.P. in Madhya Pradesh (Chauhan, 2002).

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