

# New species of *Fissistigma* and *Terminalia* from the Siwalik sediments of Balugoloa, Himachal Pradesh

R.N. Lakhanpal & N. Awasthi

*Birbal Sahni Institute of Palaeobotany, 53 University Road, Lucknow 226007*

Lakhanpal, R.N. & Awasthi, N. 1992. New species of *Fissistigma* and *Terminalia* from the Siwalik sediments of Balugoloa, Himachal Pradesh. *Geophytology* 21 : 49-52.

Two new species, *Fissistigma siwalika* and *Terminalia balugoloensis*, based on leaf-impressions, are described from the Lower Siwalik beds of Balugoloa near Jawalamukhi (Himachal Pradesh). These fossil leaves exhibit close similarity with those of the extant *Fissistigma rubiginosum* (A.DC.) Merr. and *Terminalia alata* (Heyne) Roth var. *nepalensis* (Haines) Fernandez respectively.

**Key-words** - Fossil leaves, *Fissistigma*, *Terminalia*, Siwalik, Balugoloa, Himachal Pradesh.

## INTRODUCTION

Balugoloa is a small locality of Lower Siwalik sediments situated about 12 km northwest of Jawalamukhi in Himachal Pradesh. It has yielded a small collection of leaf-impressions out of which some have been described as species of *Berchemia*, *Dipterocarpus*, *Ficus*, *Fissistigma*, *Lagerstroemia*, *Smilax* and *Ziziphus* (see Lakhanpal & Guleria, 1987). In this collection there is also a big chunk of hard coarse sandstone displayed in the Birbal Sahni Institute of Palaeobotany Museum which bears two well preserved leaves, one showing affinities with *Terminalia* and the other with a species of *Fissistigma* different from that which is already known from Balugoloa. These form the subject matter of the present paper.

## GENERAL DESCRIPTION

**Family** - Annonaceae

**Genus** - *Fissistigma* Griff.

*Fissistigma siwalika* sp nov.

Pl.1, fig.1

**Description** - Leaf simple, symmetrical, almost complete, oblanceolate, preserved length 14.5 cm, maximum width 5.3 cm a little below the apex; apex almost rounded; base not preserved; margin entire; texture subcoriaceous; petiole not preserved; venation pinnate, eucamptodromous; primary veins prominent, stout in the basal region, sharply thinning out towards the apex, straight, unbranched, secondary veins 14 pairs preserved, might have been 2 or 3 more in the basal

portion, angle of divergence  $45^{\circ}$ , alternate to subopposite, turning up towards the margin; intersecondaries not seen; tertiary veins percurrent, course AO, simple, relationship to primary vein oblique, angle nearly constant, arrangement predominantly opposite; higher order of venation not discernible.

**Holotype** - Specimen no. BSIP 36790 A

**Discussion**- In its rather large size, oblanceolate shape, subcoriaceous texture, stout but sharply thinning out midrib, large number of secondaries with percurrent and closely placed oblique tertiaries, this fossil leaf shows closest resemblance with those of the modern *Fissistigma rubiginosum* (A. DC.) Merr. In this regard the leaves on sheet no. 19001 in the Herbarium of the Forest Research Institute, Dehradun show remarkable similarity. In view of such close affinity we have placed our fossil in the genus *Fissistigma*. Although a species of *Fissistigma*, *F. senii* (Lakhanpal, 1969) based on a leaf-impression, is already known from Balugoloa, the present fossil leaf is very different in its size, shape, number and angle of divergence of secondary veins and the course of tertiary veins. Hence, we have assigned the present fossil to a new species, *Fissistigma siwalika*.

The modern species, *Fissistigma rubiginosum*, which shows the closest resemblance with our fossil, is an evergreen climbing shrub growing in tropical forest in Assam, Bangladesh (Sylhet and Chittagong), Burma (Martaban and Tenasserim), Thailand and Borneo.

## Family - Combretaceae

Genus - *Terminalia* Linn.*Terminalia balugoloensis* sp. nov.  
Pl. 1, fig.2

*Description* - Leaf simple, symmetrical, complete, narrow elliptic, length 18.5 cm, maximum width 5 cm; apex acuminate; base obtuse; margin entire; texture chartaceous; petiole not preserved; venation pinnate, eucamptodromous; primary vein prominent, stout in the basal region, gradually thinning out towards the apex, straight, unbranched; secondary veins 16 pairs, angle of divergence about 60°, alternate, turning up towards the margin and running along it before fading out; intersecondaries not seen; tertiary veins oblique, angle nearly constant, arrangement predominantly opposite; higher venation order not preserved.

*Holotype* - Specimen no. BSIP 36790 B

*Discussion* - The fossil leaf shows closest comparison with the leaves of the extant *Terminalia alata* Heyne ex Roth var. *nepalensis* (Haines) Fernandez in its general shape and size (though larger as well as smaller leaves are also found in the living species); number of secondaries, their distance apart, angle of divergence and course towards the margin; and closely spaced tertiaries running as oblique cross-ties. Although the short acuminate apex as found in the fossil is not a regular feature of the living species, it does occur in some leaves of *T. alata* var. *nepalensis*. From the available palaeobotanical record it is found that five species of *Terminalia*, based on leaf-impressions are known from the Tertiary sediments of the Indian subcontinent as shown below.

Fossil species	Horizon and locality	Reference	Comparable extant species
<i>Terminalia panandthroensis</i>	(a) Eocene of Panandthro, Kutch (b) Siwalik of Surai Khola, Nepal	Lakhanpal & Guleria, 1981 Awasthi & Prasad, 1990	<i>Terminalia coriacea</i> (Roxb.) W&A -do-
<i>Terminalia</i> sp.	Siwalik of Koilabas, Nepal	Tripathi & Tiwari, 1983	<i>T. arjuna</i> Bedd.
<i>T. koilabasensis</i>	-do-	Prasad, 1990	<i>T. angustifolia</i> Jacq.
<i>T. siwalica</i>	-do-	-do-	<i>T. pyrifolia</i> Kurz
<i>T. palaeochebula</i>	Siwalik of Surai Khola, Nepal	Awasthi & Prasad, 1990	<i>T. chebula</i> Retz.

As apparent from the above table, the previously known leaf-impressions are comparable with those of *Terminalia coriacea*, *T. arjuna*, *T. angustifolia*, *T. pyrifolia* and *T. chebula*. The leaves of all these extant species are distinct from those of *T. alata* var. *nepalensis* with which the present fossil is closely comparable. Therefore, we have assigned it to a new species, *Terminalia balugoloensis*, named after the locality Balugoloa from where it has been collected.

*Terminalia alata* var. *nepalensis* is a deciduous tree occurring in the sub-Himalayan tracts in the foot hills, tarai and bhabar from the Punjab eastwards to Assam and Upper Burma (Bahadur & Gaur, 1980).

## ACKNOWLEDGEMENT

We are grateful to the authorities of the Forest Research Institute, Dehradun for kind permission to consult their Herbarium.

## REFERENCES

- Awasthi, N. & Prasad, M. 1990. Siwalik plant fossils from Surai Khola area, western Nepal. In : Jain, K.P. & Tiwari, R.S. (eds)-- *Proc. Symp. 'Vistas in Indian Palaeobotany'*. *Palaeobotanist* 38 : 398-318.
- Bahadur, K.N. Gaur, R.C. 1980. A note of the *Terminalia tomentosa* complex. *Indian J. For.* 3 (4) : 367-369.

## PLATE I

(Both figures are of natural size)

1. *Fixistigma siwalica* sp. nov., specimen no; BSIP 36790A.2. *Terminalia balugoloensis* sp. nov., specimen no. BSIP 26790 B.

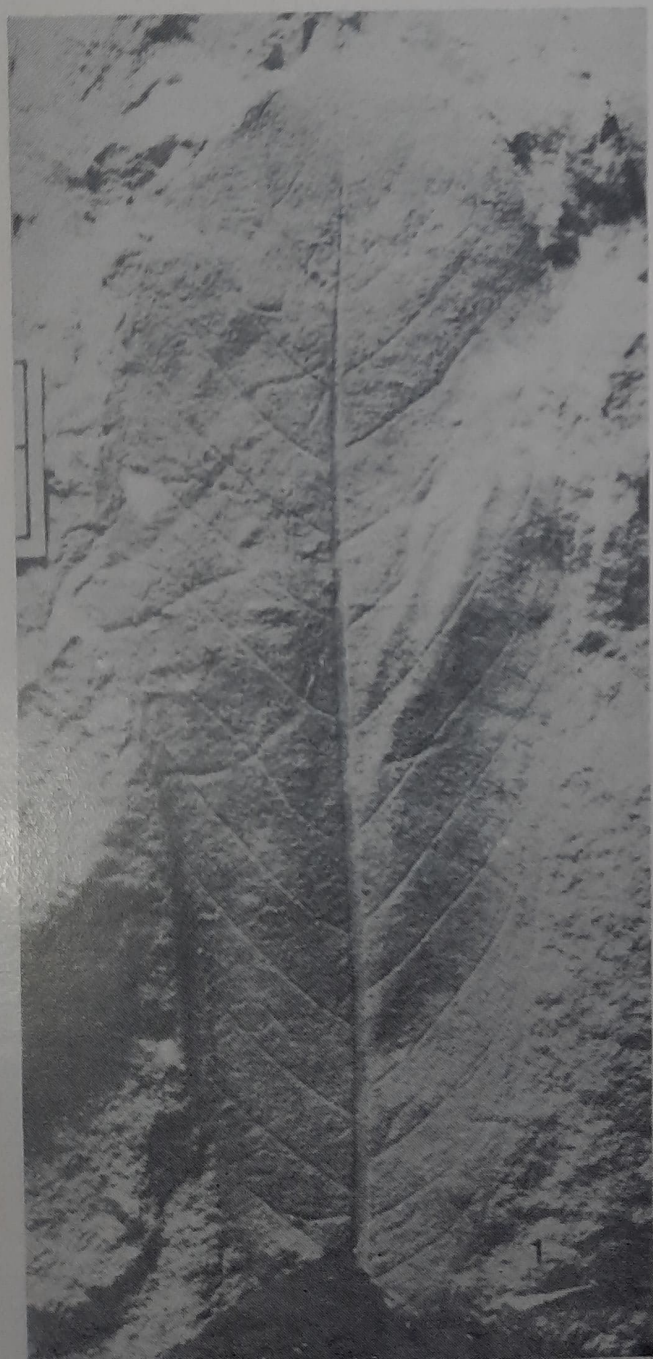


PLATE 1

- Lakhanpal, R.N. 1969. Fossil *Fissistigma* from the Lower Siwaliks near Jawalamukhi, India. In : Santapau, H. et al. (eds)- *J. Sen. Memorial Volume* : 311-312. Botanical Society Bengal, Calcutta.
- Lakhanpal, R.N. & Guleria, J.S. 1981. Leaf-impressions from the Eocene of Kachchh, western India. *Palaeobotanist* 28-29 : 353-373.
- Lakhanpal, R.N. & Guleria, J.S. 1987. Fossil leaves of *Dipterocarpus* from the Lower Siwalik beds near Jawalamukhi, Himachal Pradesh. *Palaeobotanist* 35 (3) : 258-262.
- Prasad, M. 1990. Fossil flora from the Siwalik sediments of Koilabas Nepal. *Geophytology* 19 (1) : 79-105.
- Tripathi, P.P. & Tiwari, V.D. 1983. Occurrence of *Terminalia* in the Lower Siwalik beds near Koilabas, Nepal. *Curr. Sci.* 52 (4) : 167.