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SOME FOSSIL LEAVES OF *LITSAEA LANUGINOSA* NEES. FROM THE KAREWA BEDS AT LIDDARMARG, PIR PANJAL, KASHMIR

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INTRODUCTION

IN the year 1911, Mr. C. S. Middlemiss of the Geological Survey of India during his geological studies in Kashmir, made a collection of about 200 specimens of fossil plants from Liddarmarg, a small village situated on the densely forested northern slopes of the Pir Panjal Range, which rises on the southern side of the valley in a series of high mountain chains.

The fossiliferous beds, which have yielded a fossil flora of 30 genera and 40 species (Puri, 1941, pp. 7–8) belong to the Lower Karewa formations. These deposits on recent geological evidence, are considered to be Lower Pleistocene in age. At first they were considered to form a part of the Upper Karewas (see de Terra and Wodehouse, 1935, p. 5) which are of the Upper Pleistocene Age, but later on de Terra (see de Terra and Paterson, 1939, pl. 55 ; pp. 109–114) changed his views in favour of the Lower Pleistocene Age for these beds. This view was long ago hinted at by Middlemiss (1911), when he referred the fossil beds at Liddarmarg as "Older Karewas".

The plant-bearing outcrops occur at an altitude of 10,600 ft. above sea-level and, as Middlemiss (*loc cit.*, pp. 121–22) writes, "are exposed in two stream beds near the present Gujar (herdsmen) encampment of Liddarmarg (lat. 38° 48′ ; long. 74° 39′). The dip is of the usual slightly inclined character, and the beds were found to contain a flora of well preserved leaves." This collection was examined by Middlemiss who, with the help of Mr. I. H. Burkill, was able to identify most of the fossil

leaves and announced (*loc. cit.*, p. 122) the occurrence, among the collections, of a few leaves of *Cinnamomum*, one of which according to them was specifically identical with *C. Tamala* Nees., a moderate-sized tree of the tropical and sub-tropical Himalayas.

The entire collection of Middlemiss, together with the original identifications, was kindly lent to me in 1939 by the Director, Geological Survey of India, for study at Lucknow under the guidance of Professor B. Sahni, F.R.S. On my examination of this material I find that a large number of the fossil leaves were unnamed and most of the original identifications of the named specimens the labels of which were fortunately preserved with the fossils, on comparison with my identifications have proved to be erroneous. A comprehensive description of the fossil flora discovered in this material, and another collection made in 1932 by Dr. H. de Terra from a different spot in the same locality, will be published in a series of papers at a later date. But a short note dealing with the description of hitherto unfigured and incorrectly identified leaves supposed to be of "*Cinnamomum Tamala*", but which are identical in all respects with living leaves of *Litsæa lanuginosa* Nees., is given in the following few pages.

Description

Phylum	..	Angiospermæ.
Subphylum	..	Dicotyledonæ.
Division	..	Archichlamydeæ.
Order	..	Laurales.
Family	..	Lauraceæ.
Genus	..	*Litsæa.*

Litsæa lanuginosa Nees.

(Pl. IV, Figs. 1–4)

The leaf fragments described below are poorly preserved impressions embedded in a fine-grained, compactly set clays, which are mostly greyish black in colour. The clays are composed of irregularly bedded layers, several inches thick, and it is, therefore, rarely possible to recover a complete leaf by splitting bigger blocks along the plane of bedding.

The entire collection before coming into my hands was heavily coated with some preservatives applied with a view to preserve the specimens as Middlemiss (*loc. cit.*, p. 122) wrote "there by painting them at Mr. Blyth's suggestion, with gelatine first and canada-balsam varnish afterwards, I was able to preserve a large number showing all the delicate venation, serrated edges, and in one or two instances even the deep red tints of the original fallen leaves".

Plate IV, Figs. 1–3 show natural size photographs of three leaf fragments, which represent the basal half of leaves, the apical parts being entirely missing in all. The shape of the fossil leaves cannot be definitely ascertained on account of their fragmentary nature but by comparing them with living leaves of this species it seems probable

that they had oblong-lanceolate lamina. The fragments show a slight variation in size. The lamina measures 2·5″ long by 1·1″ in the broadest part in the smallest specimen (Fig. 1) and it is 2·5″ × 1·4″ in Fig. 2. In the largest fragment (Fig. 3) it is 4·85″ × 1·9″. By a comparison of the fossil fragments with living leaves it is suggested that the broadest part in a fragment is probably the middle part of the lamina from which it gradually narrows down into a wedge-shaped base seen prominently in Fig. 2. The base in Fig. 3 is slightly distorted and curved to one size, due probably to a break in this region of the leaf, which might have been caused before or at the time of its deposition. In this specimen a bit of the petiole is also preserved. The margins are entire ; the apex is broken in all specimens and cannot be definitely ascertained but it seems to have been acute as in living leaves.

The venation is apparently pinnate but a closer examination reveals it to be strongly sub-triplinerved at the base. A strong midrib, which has left a fairly deep groove in Figs. 1, 2 and stands out in the form of a ridge in Fig. 3, runs in the lamina dividing it into slightly unequal halves. A comparison of the fossils with living leaves, in which the midrib is marked out on the lower surface, it is suggested that the photographs 1 and 2 are impressions from the lower surface and Fig. 3 is from the upper surface of the leaf. Two or three pairs of prominent secondaries arise in the upper part of the fragments at acute angles, in an alternate manner, on either side of the midrib. They follow a straight course in the lamina and are ending abruptly in the margins. The basal pair of secondaries, which is about half as thick as the midrib, arises from the midrib at very acute angles a short distance above the base and runs as far as middle of the lamina and finally ends in the margins far higher up from its point of origin. In one specimen (Fig. 2) a small secondary rib arises very close to the base on one side of the midrib and follows a straight course in the lamina. The secondaries in one specimen (Fig. 1) are quite close to one another but they are fairly wide apart in other specimens. The second basal lateral on the left side in Fig. 2 arises at a distance of 1·2″ from the basal pair. Tertiary and finer reticulations being poorly preserved in all specimens are not brought out in any of the photographs.

The fossils were confused and referred to *Cinnamomum Tamala* Nees., by Middlemiss and Burkill who failed to notice the differences in the details of venation between the two. Plate IV, Fig. 5 is a natural size photograph of a living leaf of *C. Tamala* which is given here to show contrast in venation with fossils and living leaf of *L. lanuginosa* (Pl. IV, Fig. 4). In addition to the basal pair of secondaries present in the fossils as well as in living leaf of *C. Tamala*, the former have two to three additional pairs of laterals, which are altogether absent in the latter. Each of the two basal secondaries in *C. Tamala* arises from the midrib at acute angles and runs in the lamina, as far up as the apex, making an arch parallel to the margin the convexity of the arch facing outwards and finally ends near the apex. In the fossils the basal laterals while running up do not make arches but follow a straight course as far as middle of the leaf and finally end in

the margins about half-way from the base. In details of venation, shape, size, margins, etc., our fossil fragments are identical with living leaves of *Litsæa lanuginosa* Nees. (see Fig. 4), a tropical tree of the sub-Himalayan regions.

Number of specimens.—Three.

Occurrence.—Liddarmarg at 10,600 ft., in the Pir Panjal Range, Kashmir.

Collector.—C. S. Middlemiss, 1910.

Registered Nos. of figured specimens.—

Pl. I, Fig. 1 : G.S.I. No. K 14/951 (II).
Pl. I, Fig. 2 : G.S.I. No. K 14/948a27.
Pl. I, Fig. 3 : G.S.I. No. K 14/951 (I).

Modern Distribution of *Litsæa*

The genus *Litsæa* is at the present time confined mainly to the tropical regions of Asia and also occurs rarely in boreal parts of America. In Asia, it occurs in the Himalayas, Burma and extends in the south-easterly direction through Malaya Peninsula and Malaya Islands, into tropical and subtropical forests of Australia, New Zealand and New Caledonia. It also spreads northwards from the Himalayas and occurs commonly in North as well as South China, extending as far north as Japan. Towards the south it spreads into Ceylon.

Modern Distribution of the Fossil Species

Litsæa lanuginosa, which belongs to the section *Neolitsea* of the genus, is definitely tropical in its modern distribution and occurs in India in the outer Himalayan ranges fairly scattered from Kashmir to Sikkim. It is extremely rare in the north and north-western outer Himalayas and according to Parker (1918, p. 430), who is considered to be an authority on the forest botany of these mountains, the species is absent from the Sutlej westwards. However, an authentic sheet in the Herbarium of the Forest Research Institute, Dehra Dun, shows that the species was collected from Muzaffarabad in Kashmir at an altitude of 4,000 ft. Eastwards, it occurs sparingly in sheltered places between the altitudes of 2,000 and 4,000 ft. above sea-level. It has been collected at Suni along Sutlej river and is also recorded from Simla District near Kalka. Further eastwards, it ascends to higher altitudes and has been collected from Rispana Valley, Mussoorie, at 5,800 ft. and occurs at 6,000 ft. above sea-level in the Sikkim Himalayas. It has been collected in this region from several places in Garhwal, Naini Tal, and Nepal, growing in shady places or occupying cooler aspects of these hills. The species is recorded from as far east as Khasi Hills and grows at an altitude of 8,000 ft. in Manipur, Assam. So far as we know, it has never been found growing or collected from Kashmir Valley, the northern slopes of the Pir Panjal Range, the southern slopes of the Main Himalayas, Murree Hills or the Kagan Valley, and its absence at the present time from all parts of Kashmir, excepting Muzaffarabad, and neighbouring mountain ranges is striking. Although our information

regarding data on the modern distribution of the species is based on literature and authentic sheets in the Herbaria yet its absence from these regions is not improbable and seems to conform to the prevailing climatic conditions in this part of the Himalayas.

Conclusions

The present discovery of *Litsæa lanuginosa*, a tropical species of the Lauraceæ, from Liddarmarg at an altitude of 10,600 ft., furnishes further data in favour of the theory of the Himalayan uplift during the Pleistocene. Its occurrence in the fossil beds at such high altitudes, where it has never been found growing at the present time, is a direct proof to show that the plant-bearing beds have been uplifted since the time *Litsæa lanuginosa* lived in the valley, which must have had a tropical climate at that time. In fact the prevalence of a tropical climate in the Kashmir Valley during Lower Pleistocene times has already been conclusively proved on palæobotanical evidence by the author (1943) and the present discovery lends further support to the idea of an extension of tropical and sub-tropical montane forests in the Kashmir Valley, from where they have now disappeared on account of the changed climatic conditions brought about by the uplift of the Pir Panjal Range.

The incorporation of the present species in the Liddarmarg flora in place of *Cinnamomum Tamala* has not materially altered the general features of the flora, which still continues to indicate a tropical climate as before.

Summary

The paper describes some fossil leaves of *Litsæa lanuginosa* Nees., a tropical species of the Lauraceæ (wrongly referred by I. H. Burkill and Middlemiss to *Cinnamomum Tamala* Nees.) from C. S. Middlemiss's collection of 1910 from the Lower Karewa beds (Pleistocene), which are exposed along two streams near Liddarmarg (alt. 10,600 ft., Pir Panjal Range, Kashmir Valley). The fossils were lent to the author for study by the Director, Geological Survey of India.

L. lanuginosa is confined at the present time to the tropical parts of the Outer Himalayas from the Sutlej eastwards between the altitudes of 2–4,000 ft., but it ascends to the altitude of 5,800 ft. in Rispana Valley, Mussoorie. Further east it occurs in Garhwal and Nepal, and ascends to 6,000 ft. in Sikkim. It is recorded from as far east as Assam in the Khasi Hills and has been collected from as high an altitude as 8,000 ft. from Manipur. It is conspicuous by its absence from North and North-Western Himalayas and does not grow anywhere in Kashmir excepting Muzzaffarabad at 4,000 ft. It is also absent from the neighbouring regions including Pir Panjal Range, the Kagan Valley and the Murree Hills.

This sharp contrast in the past and present distribution of the species in Kashmir lends additional support to the theory of the Pleistocene uplift of the Himalayas, already confirmed by the author on palæobotanical evidence. The idea of an extended occurrence of

a tropical and sub-tropical forest flora into the Kashmir Valley across the Pir Panjal Range during the Lower Pleistocene times thus gains further ground.

This incorporation of *Litsæa lanuginosa* in the fossil flora in place of *Cinnamomum Tamala* does not materially change the general feature of the flora.

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EXPLANATION OF PLATE IV

The figures are from untouched negatives and are of natural size.

Litsæa lanuginosa Nees.

Fig. 1. Fossil leaf fragment (impression of the lower surface).

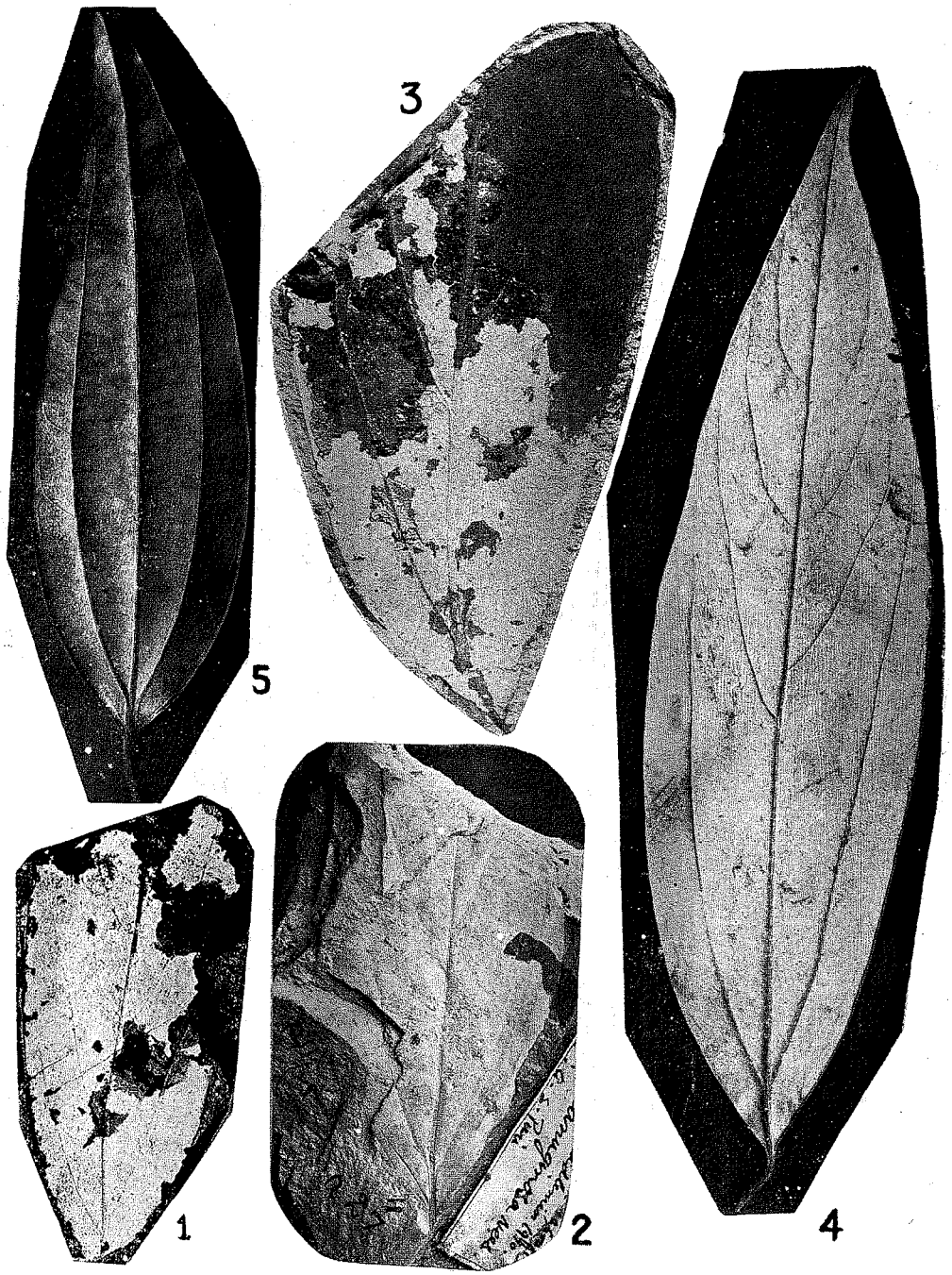
Fig. 2. Fossil leaf fragment (impression of the upper surface).

Fig. 3. Fossil leaf fragment (impression of the lower surface).

Fig. 4. Modern leaf for comparison with the fossils and contrast with modern leaf of *Cinnamomum Tamala* Nees.

Cinnamomum Tamala Nees.

Fig. 5. Modern leaf to show contrast in venation with the fossil fragments and modern leaf of *Litsæa lanuginosa* Nees.



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