

## PLEISTOCENE PLANT FOSSILS OF THE LOWER KAREWA BEDS OF KASHMIR

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I had no intention of adding another botanical field of interest when about 1933 Dr. Helmut de Terra, then at Yale, came to Rawalpindi to collect stone age artifacts from the Soan River terraces near Morgah and to collect fossil bones from the Salt Range. He invited me to go to an area near Gulmarg, Kashmir on the north slope of the Pir Panjal Range where he had learned that there were fossil leaves in the clay of an ancient lake or lakes near a place called Laredura at c. 1875 m. and Dangarpur c. 2031 m. of altitude. I had never collected plant fossils and was glad to be able to go with him. Most of the fossils were the leaves of forest trees which had blown on to the surface of the lake or had floated down from higher levels. They had sunk to the bottom and there were many layers of leaves in the clay along with *Trapa* fruits and a few seeds. Many of the leaves were of oaks, maples, birch and willows which seemed to be similar to modern species and some I could not identify. The most interesting seemed to be a *Ginkgo* or a fern leaflet resembling it. I named the specimens as far as I could, without a great deal of microscopic work, and gave a list to Dr. de Terra which he published in 1939 in De Terra, H. and Patterson, T.T., 'Studies on the Ice Age in India and Associated Human Cultures.' Carnegie Inst., Washington, D.C.

I was at this time head of Gordon College, and was teaching as well, and finding that naming the collection we had made accurately would take more time and effort than I could spare I turned the collection over to a talented student, Gopal Singh Puri, who managed to get an M. Sc. and a Ph. D. degree out of papers published on the specimens de Terra and I had collected and additional material he had gathered himself. He obtained his M. Sc., while with me, but I do not know where he went to get his Ph.D., for I lost sight of him for years. In his "Chapters on the History of Botany in India" Burkill states that Puri discovered these beds but this is not the case. I do not know how de Terra found out about them but it may well have been through Middlemiss, a pioneer British geologist in Kashmir who first reported a few plant fossils in 1910.

When I was studying these fossils, nearly fifty years ago, I knew nothing of palynology and that there were probably large numbers of pollen grains in the clay in which the fossil leaves were embedded, and that some of this pollen might have come from additional species which had not contributed any leaves because pollen often travels great distances. I do not have access to Puri's papers here in Michigan but I do not think that any of them deal seriously with fossil pollen. A

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good deal, however, has been done on fossil and more recent pollen in Kashmir. Since Puri worked and a good many papers have been published in *Palaeobotanist*, beginning in Vol. 11 (1962). Most of the papers have been written by Vishwa-Mittre of the Birbal Sahni Institute of Palaeobotany, Lucknow, India. Sharma, Saxena, Gurdic Singh, Mrs. Robert and others cooperated with him on some of his studies. Like Puri he began in Gordon College and he has sent me many of his papers.

In 1966 Vishnu-Mittre in *Palaeobotanist* 15 (1, 2): 157-175 published "Some aspects concerning Pollen-Analytical Investigations in the Kashmir Valley". In this paper he outlines the history of pollen studies in Kashmir. He states that the sub-fossil pollen was first described by Wodehouse and de Terra in 1935 in "Pleistocene Pollen of Kashmir", Mem. Connecticut Arts, Science 9. Wodehouse was the American pollen expert of that period and de Terra the collector. I have not seen this paper. In 1957 pollen analysis began at the Sahni Institute at Lucknow. The first collections were made without proper attention to stratigraphy but it gradually was realized that it was not only necessary to find out what fossils were there but what their relative positions were in the *karewa* beds in order to tell their age, and the changes in the flora as the climate changed.

Kashmir is much the best place in the Himalayas for these Pleistocene studies, and for pollen studies in general. In the first place the *karewas* of Kashmir seem to be unique in India. Mittre says "The *karewas* (from *karewa*, for mound in Kashmiri) are the terraced and flat-topped mounds exposed in the valley of Kashmir along the northern slopes of the Pir Panjal mountains, ranging from c. 1600 m. to c. 4500 m. above sea level, across the Jammu and Kashmir State. Comprising various kinds of clays, sandstones (sands), conglomerates and lignites, the Lower Karewas are exposed at numerous sites and at different altitudes." Not being a geologist my interest has been largely in what species have been found in these beds, which species are still natives in the valley and which species are still to be found in the Himalayas outside Kashmir.

A great deal of attention has been paid to the fact that in the beds of Lithozone 4, in which most of the fossil species have been found, the oaks are most abundant and that these oaks are very rare in Kashmir today. Some have thought that the only oaks in the valley at present are planted but Mittre states that he has found a grove of *Quercus dilatata* and another of *Q. semecarpifolia*. Puri has argued that the absence of oaks in the valley at present is due to the uplift of the Pir Panjal Range cutting the valley off from the monsoon rains. There is no doubt that the climate of the valley is much drier than are the slopes of the Pir Panjal toward the plains. Mittre states that the disappearance of the oaks is probably due to the activities of early man. The oaks, he thinks, were the best trees for firewood and they were cut down for fuel and possibly to provide land for cultivated fields.

The paper of Vishwa-Mittre of most general interest is "Floristic and



Ecological Reconsiderations of the Pleistocene plant impressions from Kashmir." The *Palaeobotanist* 13 (3): 308-327. 1965. In the Appendix to this paper he has brought together in one list the 130 or so species which have been found at Laredura, Liddarmarg, Ningle Nullah, Dangarpur and two less important sites. There may be a few misidentifications. It does not seem likely that *Toddalia* or *Castanopsis* grew in Kashmir in the Pleistocene. If Mittre is correct in identifying *Larix* it is an interesting find. At present it is found in Nepal and eastward.

The activities of early man might account for the disappearance of the oaks as Vishwa-Mittre suggests but it was not only the oaks which disappeared. It was the non European, more tropical genera which disappeared. The elms, ash trees, maples, birch, roses, *Corylus*, *Aesculus*, *Prunus*, *Berberis*, *Rhamnus* and some other European genera did not disappear after the uplift of the Pir Panjal Range. Early European visitors noticed and reported that the flora they found in Poonch was Indian, but that in the Kashmir valley the flora was "European". In other words they recognized most of the genera in the Vale of Kashmir while there were many Himalayan genera on the Punjab side of the Pir Panjal which they did not recognize. This is the flora which was found in the fossil Karewa flora and which disappeared. Why?

A good many Himalayan semi-tropical genera are represented in the *karewa* flora. Some of them belong to the Indo-Malayan flora and a few come from as far east as Japan and the Philippines. There were six laurels, *Cinnamomum tamala*, *Machilus odoratissima*, *M. duthiei*, *Phoebe lanceolata*, and two *Litsaeas*. There was an *Engelhardtia*, *Mallotus philippinensis*, *Myrsine semiserrata*, *Marlea*, *Lannea* (*Odina*), *Woodfordia*, *Pittosporum*, *Meliosma pungens* and *Ficus cunia*. All of these are growing at the present time below 1500 m., some as low as 1000 m. How did they get up to 2937 m. at Ningal Nullah and 3250 m. at Liddarmarg? *Mallotus* which in Rawalpindi Dt. is found between 2 and 4000 ft. is at 3250 m., at Liddarmarg. It seems to me that the Himalayan uplift accounts for this distribution pattern and for the absence of dozens of species from the Kashmir Valley today which could grow there in the Pleistocene. The botanical evidence supports the geological evidence for the uplift of the Himalayas.

Now that there are electron microscopes which reveal all of the minute sculpturing of spores and pollen grains it will be possible to discriminate better between the pollen grains of closely related species. A good many determinations we have at present are only to the genus. Now that this new efficient tool is available all of the Pleistocene pollen grains should be examined over again.

I do not know of any studies of fossil pollen which have been made in Pakistan.