ORIGIN OF 'FLOATING ISLANDS' IN THE LAKES AT KHAJIAR AND REWALSAR IN HIMACHAL PRADESH

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ABSTRACT

In the present communication, the origin of 'floating islands' in the lakes at Khajiar and Rewalsar, both situated in Himachal Pradesh, has been discussed. For the first time, the origin of 'floating islands' at the above two sites is determined through stratigraphical and pollen analytical investigations, supported by C-14 assays. Age of the 'floating island' at Khajiar is estimated to be about 700 A.D. The 'floating islands' seen at Rewalsar, which are of different shapes and sizes, are inferred to be of much recent origin as compared to the one at Khajiar.

INTRODUCTION

OCCURRENCE of several 'floating islands' in the lake at Rewalsar is mentioned in the Punjab States Gazetteer (1904) under the erstwhile Mandi State. Kashyap (1920), first drew the attention of botanists towards their existence at this site. A few years later, Sahni (1927) reported the occurrence of a large 'floating island' in the lake at Khajiar, Dist. Chamba. Sahni was greatly impressed by the gregarious growth of *Phragmites communis*, confined strictly to the 'floating island' alone at this site. Even today, this reed is neither seen on the fringes of the lake, nor elsewhere in the area within several miles — a rather interesting phenomenon of its distribution. Sahni (*loc. cit.*) further stressed upon the need for successional studies to unravel the mystery of the 'floating island' and also suggested a closer investigation about its origin, which according to him, held "clue to the whole story".

Outside Himachal Pradesh, the 'floating islands' — natural or man made, are also known from the Kashmir Valley. Rao (1960) cursorily reports that the Kashmir Valley 'floating islands' are formed chiefly by the compact growth of *Typha angustata* and *Cladium mariscus*. Raina (1962) suggests their derivation from a mat woven from *Typha* leaves loaded with clay. Dutt *et al.* (1964), however, consider the skeleton of the 'floating-gardens' in the Kashmir Valley to be artificially made up of long reeds of *Phragmites communis* which is abundantly available around the lake. Kaul and Zutshi (1966) refer to the occurrence of both natural as well as artificial 'floating islands' in Kashmir lakes, but they maintain that it is difficult to differentiate one from the other. The origin of the natural 'floating islands' according to the above authors is yet unknown.

The present paper deals with the stratigraphical reconstruction of the lake deposits at both Khajiar and Rewalsar, and the pollen analytical investigations of the solitary 'floating island' at the former site. These studies were aimed to uncover the successional history of the lake basins as well as to trace the origin of the 'floating islands' at these two lakes.

Stratigraphical investigations were carried out by means of a Hiller peat auger provided with a 50 cm chamber. Bore-holes were dug at close intervals along a section of the deposit at both the sites. Reconstruction of the lake deposits was then undertaken in order to elucidate the main features.

KHAJIAR LAKE

(a) *Location and Stratigraphy* — The lake at Khajiar lies at a height of *c.* 1950 m. above sea-level, about 13 km. NE of Dalhousie on the forest track to Chamba. Except for a small circular patch of open water of about 60 m. diameter, the lake is filled to the top with lake-sediments, consisting mainly of peat, coarse as well as fine organic detritus, and clay. The infilled part of the basin is at present seen forming a marshy area around the open water. This is succeeded by an open meadow which in turn is encircled by a dense *Cedrus deodara* forest. The latter gives way to the mixed oak-conifer woodlands lower down, and the fir-spruce forests at higher levels.

A series of borings made along a section running NE-SW of the infilled part of the lake reveal that, but for the upper half to one metre of the lake deposit, the peat comprised mainly of *Phragmites* remains, forming the bulk of the organic deposit filling the lake basin (Fig. 2). It is also clear from the section that prior to the deposition of *Phragmites*-peat, the fine organic detritus and the sediment with abundant remains of *Botryococcus* colonies, was being laid down under deep water conditions. *Phragmites* appears to have invaded with perhaps the shallowing of the lake-basin. The sequence of *Phragmites*-peat is interrupted by a bed of clay running laterally all through the deposit. Following the deposition of the clay-bed, the *Phragmites* once again, appears to have become preponderant as evident from the continued formation of *Phragmites*-peat in the upper levels. The otherwise continuous sequence of *Phragmites*-peat is also interrupted by watery gaps from which it seems reasonable to believe that thick mats of *Phragmites*-peat floated unanchored over the open water of the lake in the past.

(b) *Floating island* — In the open water of the lake is a free-floating ' island ', having a gregarious growth of *Phragmites communis*. It frequently glides over the lake surface due to wind action, with shoots of *Phragmites* acting as sails.

The ' floating island ' (Fig. 1) is oval in outline, measuring about 15 m. in length, 10 m. in width, about 2 m. in thickness at the middle, and is made up of a thick mat of the remains of *Phragmites communis*. The luxuriant growth of *Phragmites* is constantly maintained by the active regeneration from old rootstocks. Apart from *Phragmites*, a few other isolated plants are also seen growing on the ' island '. They are *Acorus calamus*, *Polygonum aviculare*, *Ranunculus diffusus*, *Ludwigia adscendens* (=*Jussiaea repens*) and a very rare stoloniferous 3-foliate aquatic plant *Menyanthes trifoliata* which in India is so far known from Kashmir only. An unidentified fern in its sterile form and seedlings of *Rubus niveus* were also seen growing on the ' island '. Except for the upper 50 cm or so, the entire mass of the ' floating island ' remains submerged, but as the

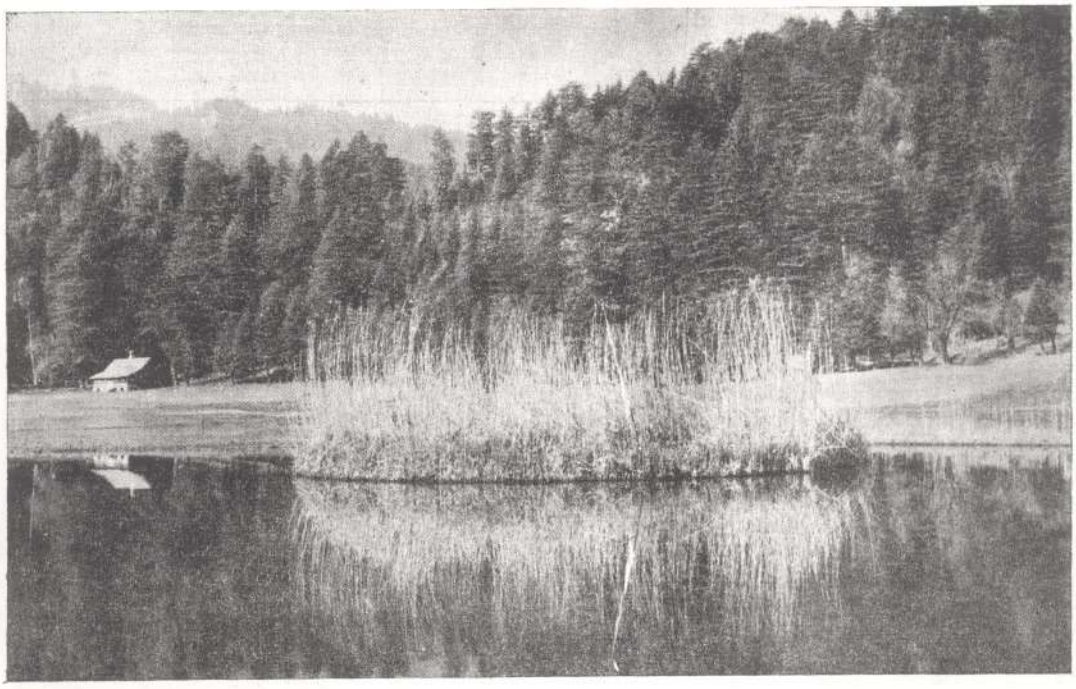

FIG. 1 — The ' floating island ' of *Phragmites communis* in the Khajiar lake.

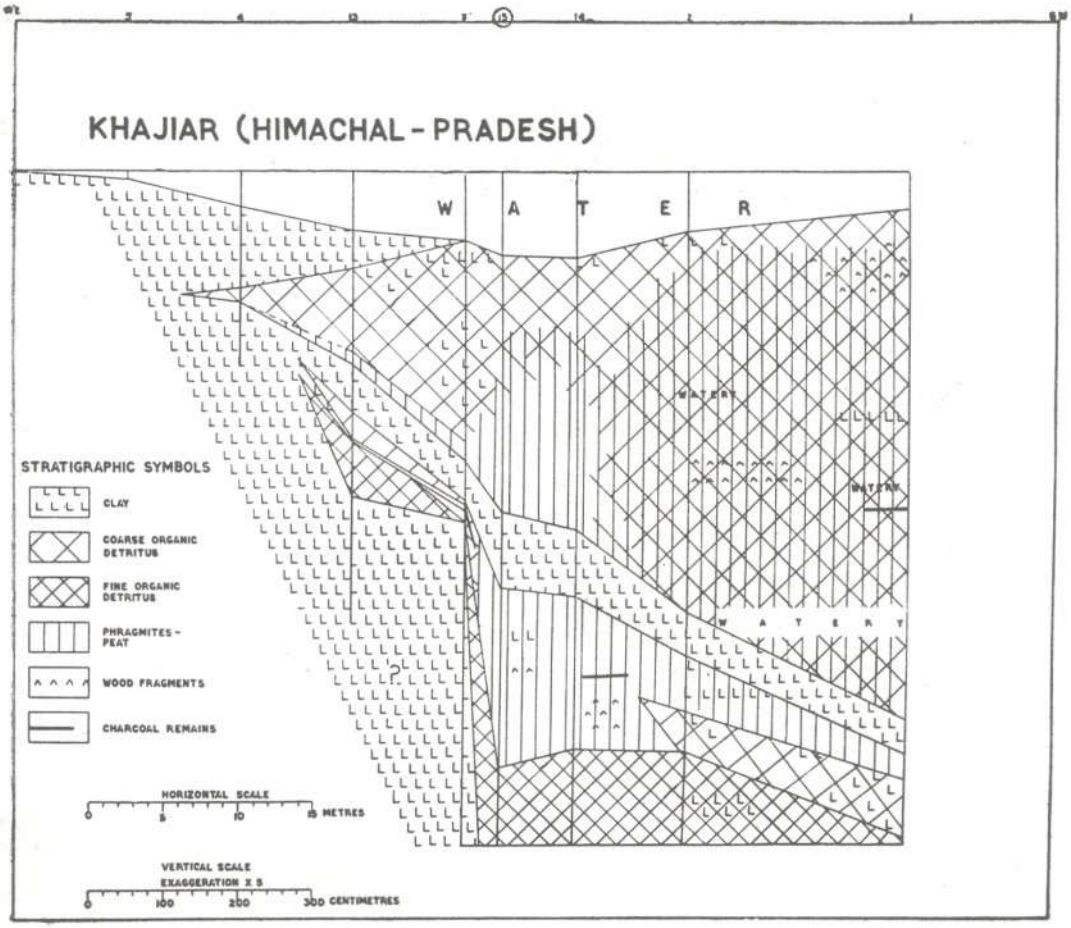

FIG. 2 — Stratigraphical section of the lake deposit at Khajiar.

depth of the water generally exceeds over 10 m. in the middle of the lake, and over 2 m. at the edges, the 'island' is able to glide freely inside the circular rim of the lake. Since the 'island' frequently strikes and cuts against the lake margin—particularly on windy days, the circular disposition of the lake appears to have resulted from this demaging action of the 'floating island' at the lake margins.

The pollen diagram prepared from the 190 cm peat profile of the 'floating island' (Fig. 3), shows a well developed curve for *Cedrus* which rises to 55% at the top of the diagram. The curve for *Quercus*, on the other hand, shows a declining trend and its values fall from 30% to 7%, progressively from the base to the top. The *Pinus roxburghii* curve maintains values between 20% and 40%. The curve for *Abies* increases in the lower half of the diagram and starts declining thereafter, except for a small increase at the top of the diagram. *Pinus wallichiana* forms a low curve and its values remain more or less uniform, except for a slight increase at the top. The curve for *Picea* which rises in the middle, declines in the upper half of the diagram. Broad-leaved elements other then *Quercus* on the whole are represented only by short low curves; they are *Alnus, Betula, Ulmus, Juglans* and *Viburnum*. The 'tree and shrub' pollen ratios fall just before the middle of the pollen sequence and except for a small rise at the top, they tend to remain around 60%.

The non-arboreal component is mainly comprised of Gramineae and Cyperaceae

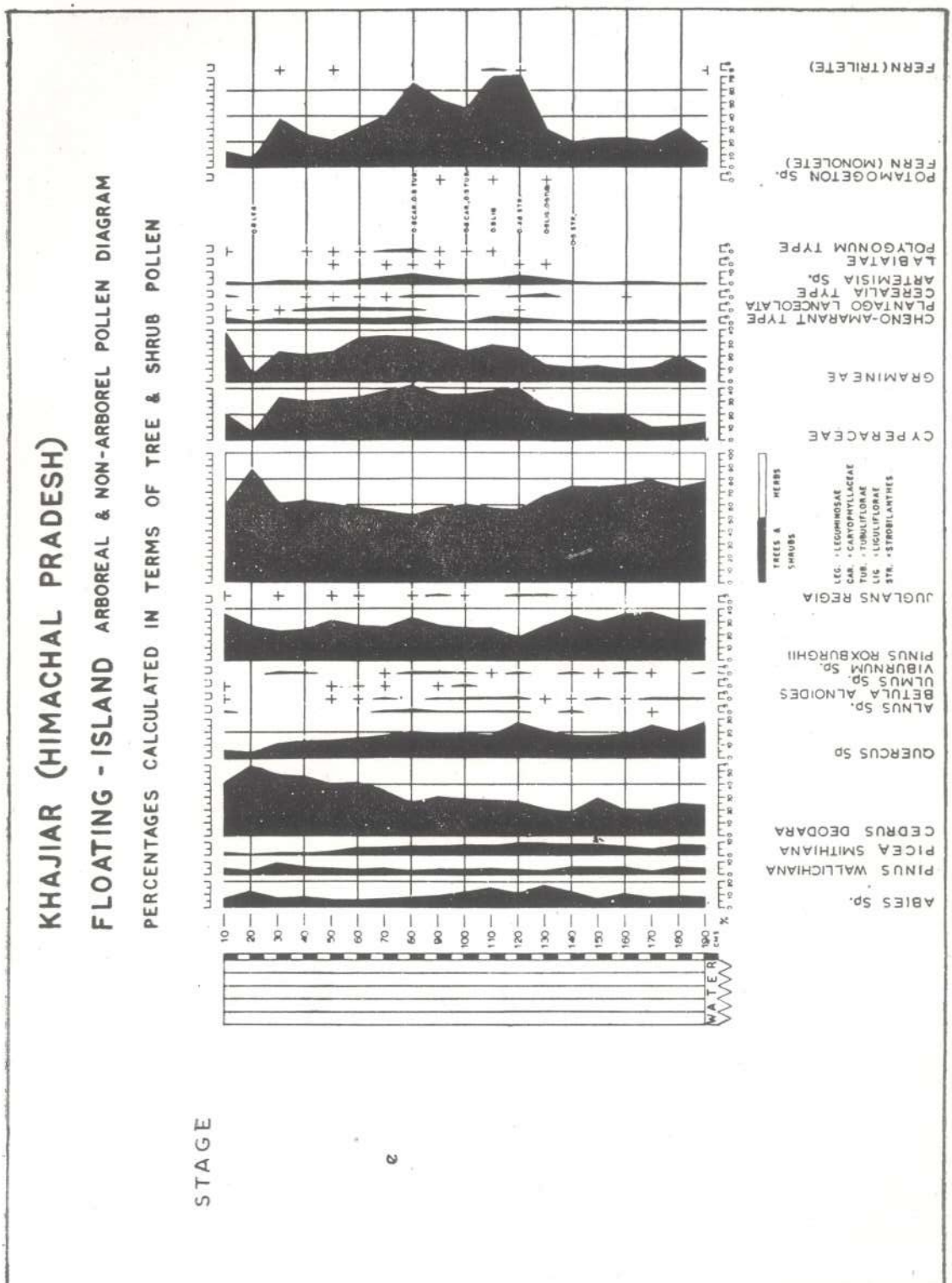

FIG. 3 — Total pollen (AP/NAP) diagram from the 'floating island' at Khajiar. Percentages calculated in terms of total tree and shrub pollen.

whose values in each case, rise in the middle of the pollen sequence, reaching up to 42% and 35% respectively. The rise in the above curves is accompanied by a small rise in the curves for most of other non-arboreal elements, such as Cheno-Amarant type, *Artemisia*, *Plantago*, Cerealia type, *Polygonum* type and Ferns. The rise in the non-arboreal elements in general, follows the fall in the 'tree and shrub' pollen curve. Stray pollen of Labiatae, Leguminosae, Caryophyllaceae, Compositae (Tubuliflorae and Liguliflorae) and *Strobilanthes* is also met within the sequence. The aquatic vegetation is represented by low frequencies of *Potamogeton*.

The vegetational history built from the 'floating island' compares closely with the main characteristics of 'Stage e' of the main Khajiar lake pollen diagram (SHARMA 1970). The lower border of 'Stage e' in the main profile is though C-14 dated at 1250 B.P. (*c.* 700 A.D.) (WIS-418), but the pollen diagram of the 'floating island' may not be representing the whole time period of 'Stage e'.

In any case, the history of the 'floating island' cannot be pushed back any further than 'Stage e' i.e. *c.* 700 A.D. In fact, it may be even much younger, unless it is assumed that the bottom of the 'floating island' has continued to be eroded from time to time as a result of its contact with the shallower parts of the lake basin.

REWALSAR LAKE

(a) *Location and Stratigraphy* — The lake at Rewalsar lies at a height of *c.* 1280 m. above sea level, about 16 km. SW of Mandi, on the eastern slopes of outer Himalayas. The lake is more or less rounded-triangular in outline and its circumference exceeds one and a half kilometre. The northern part of the lake basin on the side of the main inlet is filled with sediments consisting of organic detritus, clay, silt and gravel (Fig. 4). There is some evidence of *Phragmites*-peat occurring together with silt, in the upper half of the deposit in the SW of the section. The lake margins are grown with abundant *Phragmites communis* and several other aquatics and amphibious plants. The lake is almost completely surrounded by hills which on the whole exhibit a rather bare and desolate landscape. The mountain slopes are mostly devoid of woodlands, excepting the plantations of *Pinus* and *Cedrus*. The area is otherwise under terrace cultivation.

(b) *Floating island* — The open water is studded with seven main 'floating islands' of different sizes and shapes. The largest amongst these called 'Parbati's island' by the local people, measures about 18 m. and 3·6 m. in length and breadth respectively (KASHYAP, 1920), whereas others are comparatively much smaller in size.

These 'floating islands' have apparently much less free movement and are comparatively less impressive to look at than their counterpart in the lake at Khajiar. Since, these 'islands' have not yet accumulated much peat underneath, the profiles from these 'islands' could not be submitted to pollen analysis as done in case of the 'floating island' at Khajiar.

DISCUSSION

The stratigraphy of the Khajiar lake reveals that, but for the top half to one metre of the organic deposit, *Phragmites* continued to grow unchecked at the site throughout the sub-recent history of the lake. *Phragmites communis* now restricted to the 'floating island' alone at Khajiar is infact, a remnant of the once flourishing *Phragmites*-stand around the lake. It is very likely that the 'floating island' commenced as a part of the *Phragmites*-stand in the lake after getting separated from the mother stand at a later stage. Whether the phenomenon was purely a chance occurrence, or initially induced through the agency of man is difficult to answer. The reason for the extermination of *Phragmites communis* from the lake margin is not clear. It is possible that either the *Phragmites*-stand was cut down by man for thatching purposes at the time of the establishment of the Khajiar village, or it was consumed as fodder for the domestic animals. Comparing the pollen diagram from 'floating island' with that of the lake (SHARMA, *loc. cit.*) and the available C-14 date, it can be inferred that the history of the 'floating island' at Khajiar should not go beyond A.D. 700.

The phenomenon of 'floating islands' loses much of its mystery in the lake at Rewalsar, as *Phragmites communis* still continues to grow at the fringes of the lake, forming thickets along with a number

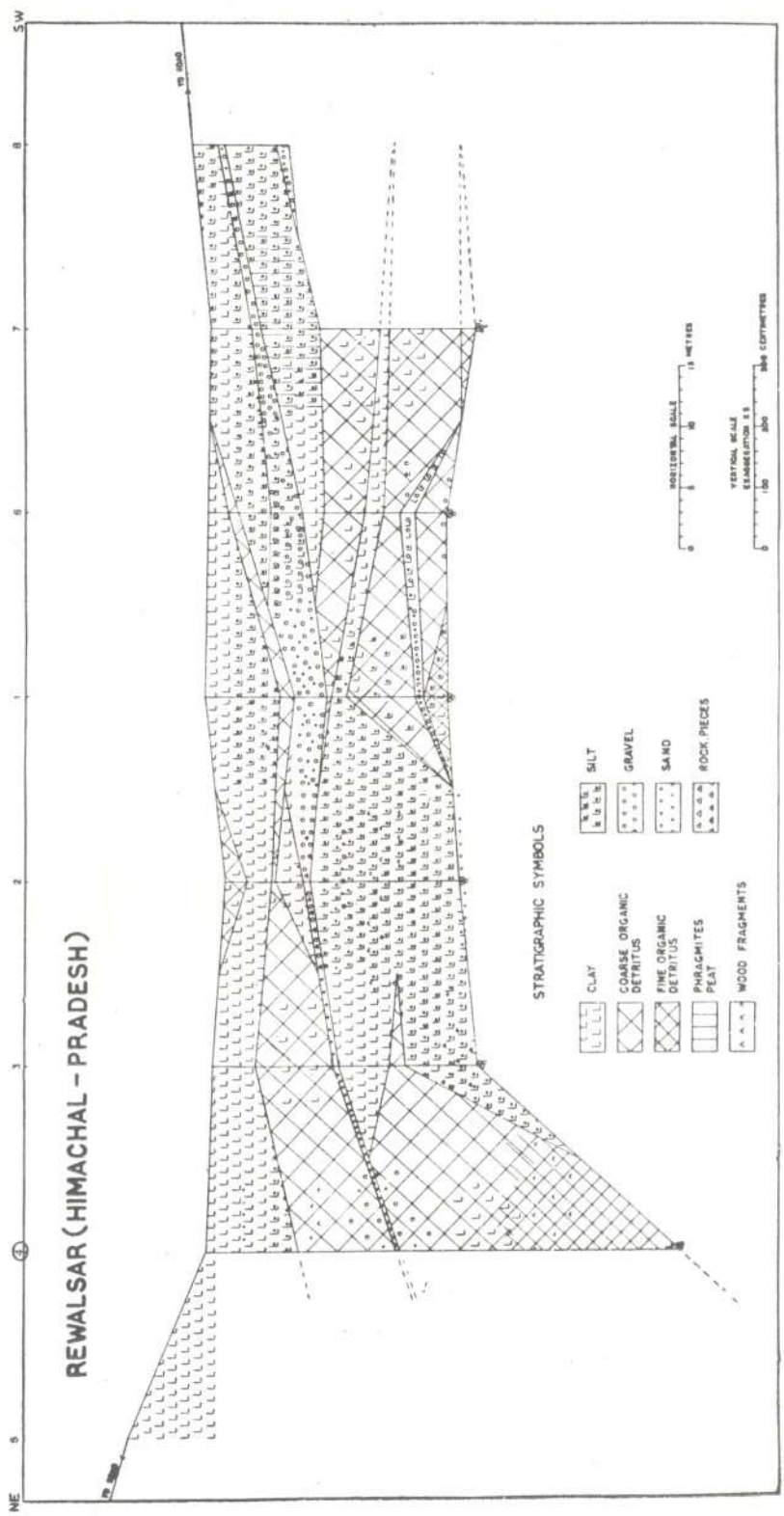

FIG. 4 — Stratigraphical section of the lake deposit at Rewalsar.

of other grasses and sedges. One often comes across a jumble of loosely entangled rhizomes of *Phragmites*, floating deep inside the margin of the lake.

Since Rewalsar happens to be a big centre of pilgrimage for Buddhists, it is quite likely that the creation of several 'floating islands' of *Phragmites* in the lake was initially induced by man for religious worship. It is supported by the fact that the stratigraphy of the lake basin does not show evidence of any large scale deposition of *Phragmites*-peat at any stage. In fact the organic sediment in the lake is largely constituted of organic detritus originating chiefly from grasses—other than the *Phragmites*, and the sedges. From this, it appears that the luxuriant growth of *Phragmites* on the 'floating islands' as well as at the fringes of the lake, is perhaps connected with Buddhist religious practices, and probably it was initially introduced at Rewalsar through the agency of man. Of the several lakes found in the vicinity, *Phragmites* is seen only at Rewalsar which again supports the above view. The facts that the 'floating islands' at Rewalsar have not yet accumulated much peat underneath, and the stratigraphy of the lake basin also does not show evidence of any large scale deposition of *Phragmites*-peat at any stage, lead to the conclusion that the 'floating islands' in the lake at Rewalsar are of much recent origin when compared to the 'floating island' seen at Khajiar.

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