

STUDIES OF POST-GLACIAL VEGETATIONAL HISTORY FROM THE KASHMIR VALLEY, 2. BABA RISHI AND YUS MAIDAN

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ABSTRACT

The paper presents results of pollen-analytical investigation at two sites in the middle altitude on the northern face of Pir Panjal. One of the sites, Yus Maidan, is a vast meadow surrounded by fir-blue pine forest and the other, the Baba Rishi swamp, is situated within the blue pine-fir forest. The pollen diagrams from Yus Maidan reveal the encroachment of the forest at the site in the recent past whereas Baba Rishi site has been forested even before the origin of the swamp. Further, the pollen diagrams show that oaks existed as constituents of the forest and have been exterminated recently.

INTRODUCTION

POLLEN diagrams from the Kashmir Valley have hitherto been constructed from high altitude about 3,300 m.a.s.l. (Toshmaidan: SINGH, 1963) and from the Valley basin about 1700-1800m.a.s.l. (Haigam Lake: VISHNU-MITRE & SHARMA, 1966). An attempt to study the Post-glacial vegetational history of the middle altitude has been made by us. The chief object of this study has been to examine the changes that have taken place in the forest belt at this altitude and to build up the knowledge concerning the shifts in vegetational belts in response to Postglacial climatic changes. The search for a deeper swamp at this altitude proved futile; consequently we had to pollen-analyse the materials from the shallow swamps. Two swamps have been studied for the purpose. The Yus Maidan swamp occurs in a vast meadow surrounded by blue pine-fir forest. The Baba Rishi swamp, so-called because it is situated in the vicinity of shrine of famous saint, Baba Rishi, occurs within the blue pine-fir forest. The altitude of both the swamps is between 2500-2700 metres above sea level.

Field and Laboratory methods are the same as reported earlier (VISHNU-MITRE & SHARMA, 1966).

POLLEN-ANALYSES

1. Yus Maidan Mire

LOCATION

Of the three mires situated at an altitude of 2500-2700 metres in a meadow about two miles from Nagam on Srinagar Yus Maidan Road close to Kakavring village on the right bank of the nalla about 50 metres to the South West from the main road, the deepest amongst them (middle one), determined after trial borings, was selected for study.

The meadow is surrounded on all sides by Pine-Fir forest with Pine about 70 per cent, Fir about 20 per cent and Spruce about 5 per cent. The vegetation in the meadow comprises species of *Ranunculus*, *Anemone*, *Potentilla*, *Trifolium*, *Gramineae*, *Plantago major*, *Launaea* and *Artemisia*. The water-logged part is populated by species of *Potamogeton*, *Eriocaulon*, *Polygonum*, *Marsilea*, etc.

In the meadow or in its vicinity, no cultivation is done. The region is frequently visited by herdsmen who bring cattle, herds of sheep and goats for grazing during the summer season.

STRATIGRAPHY

The basin of the mire (app. 20 sq. metres) is filled with clayey silt of brown grey colour. Neither moraines nor organic debris, seeds or fruits were recovered from the sediments. The peat borer struck the hard rock at the bottom. Only the top ten samples yielded sufficient pollen and in the rest the pollen is \pm absent.

POLLEN DIAGRAMS

(Text-figs. 1 & 2)

Only four (a to d) vegetational stages described below have been recognized. The

stages a-f in this and the other diagram are of local significance only.

Stage "a"

Conifer (Fir-spruce-pine)-mixed-oak-woods phase

The curves for oaks, *Morus*, *Populus* show a gradual decline. Similar behaviour is shown by *Acer* whereas *Betula*, elm, walnut, *Salix* show consistently increasing trend.

Amongst the conifers pine, fir, *Cedrus* and *Taxus* show a consistent rise. *Picea* maintains uniform values throughout this stage.

The undergrowth comprises *Viburnum* and *Ilex* which shows a rising trend. Sporadic pollen of *Symplocos* is also present in the beginning of this stage.

The ground vegetation is represented by dominance of *Artemisia* which shows a steep decline towards the top of this stage though still maintaining high values. Gramineae shows an ascending trend. Chenopodiaceae, Compositae, Ranunculaceae show gradual decline. *Plantago* and *Epilobium* show a continuous rise whereas Labiatae and *Justicia* are sporadically represented.

Polypodiaceae which has higher values to start with shows a gradual decline.

Bryophytic spores show a rising trend.

Amongst the algal constituents *Botryococcus* is present in fairly good percentages but shows declining trend.

Lemna and *Eriocaulon* are represented by sporadic pollen.

Stage "b"

Spruce-pine-oak-birch-walnut-Morus-wood phase

This phase is ± the continuation of the previous phase with some major changes such as the gradual decline of oaks, *Celtis* and poplar, increase in birch, elm and walnut. *Acer* disappears altogether. Values of *Morus* rise to 12 per cent in the middle of the upper half with a sharp decline thereafter. *Salix* shows a gradual decline. *Corylus* disappears after some time. *Myrica* appears in the beginning of this stage, attains fairly good values and thereafter, declines towards the close of the stage.

Amongst the conifer constituents pine and *Picea* show consistent rising trend whereas

fir shows a gradual decline to minimum towards the close of this stage. The low curve for *Cedrus* becomes sporadic. The declining *Taxus* disappears towards the middle of this stage. *Ephedra* is in extremely low values, after that it also disappears.

Amongst the undergrowth *Ilex*, *Viburnum*, Myrtaceae are sporadically present though *Ilex* forms ± continuous curve throughout.

The ground vegetation largely comprises Gramineae, *Artemisia*, Urticaceae, Caryophyllaceae and Chenopodiaceae etc. Gramineae though showing a decline at the beginning of this stage dominates but towards the close of the stage is reduced to 12 per cent. *Artemisia* shows a sharp decline and is lowly represented towards the close of the stage. The curve for Urticaceae starts rising in the beginning of this stage, reaches its maximum in the middle and thereafter it sharply declines. Chenopodiaceae, *Plantago*, Ranunculaceae and Rutaceae show a little increase in the middle and afterwards dwindle away. *Impatiens* about 28 per cent in the preceding stage declines sharply to extremely low values towards the close of this stage.

Polypodiaceae attains high values towards the middle of the upper half, after that it is sporadically present.

Sporadic spores of Bryophytes are present in the beginning, thereafter they are absent.

The low values of *Typha* are seen in the lower half but disappear afterwards. Cyperaceae rises until the middle, thereafter it gradually declines.

Algae is represented by low and gradually declining values of *Botryococcus* disappearing towards the middle of the stage.

Stage "c"

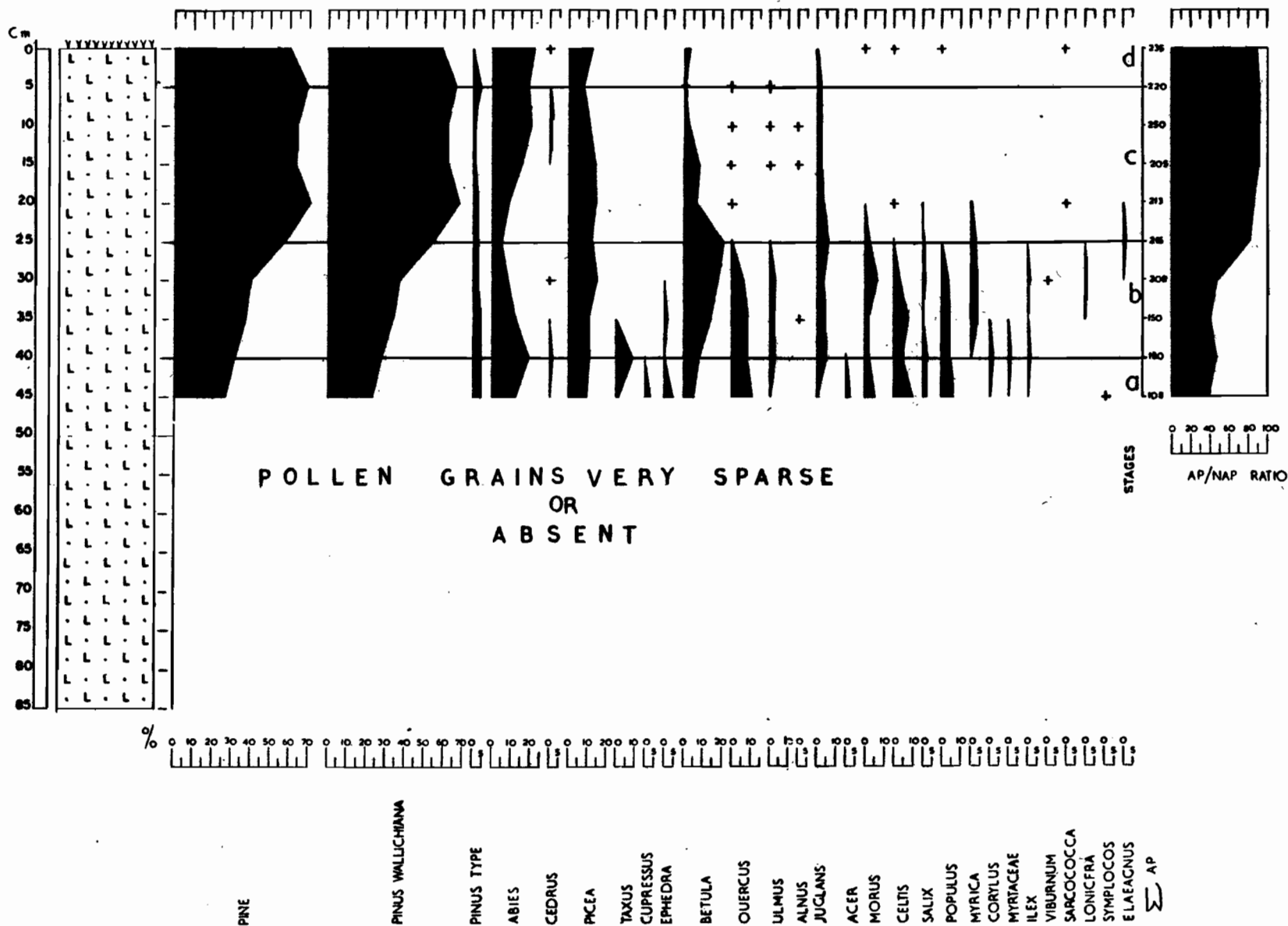
Pine-fir-spruce-birch-walnut-wood phase

This stage is characterized by the maximum rise of the conifers and extreme reduction or disappearance of most of the broad-leaved constituents.

Oaks are only sporadically present so are elm, alder, *Celtis* and *Salix*. Birch of which 20 per cent is present to start with gradually declines becoming sporadic towards the close of the stage. Walnut maintains uniform values after a little decline in the beginning. *Morus* and *Myrica* disappear in the lower half of the stage.

ARBOREAL POLLEN DIAGRAM FROM YUS-MAIDAN (KASHMIR-1962)

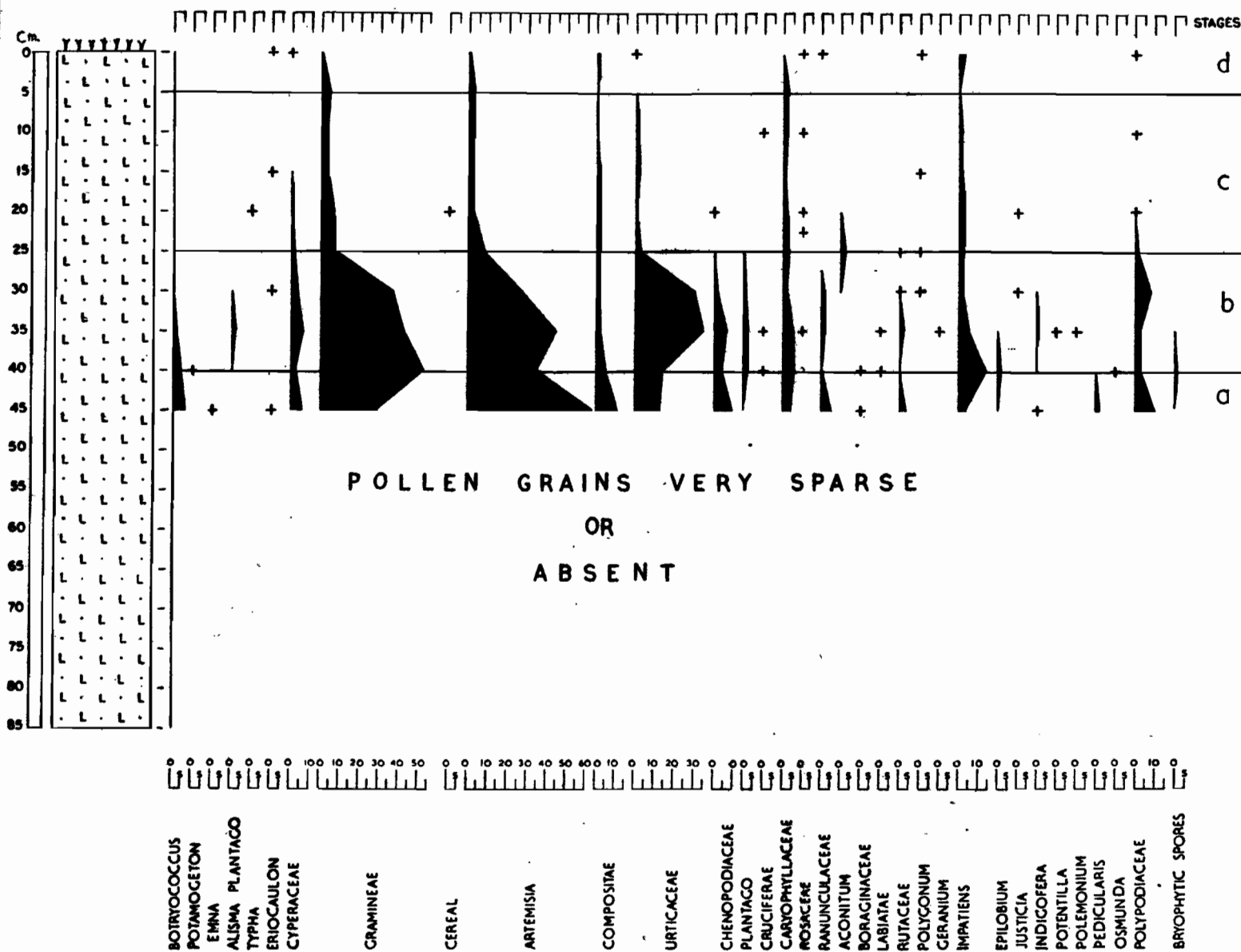
(PERCENTAGES CALCULATED IN TERMS OF AP)



TEXT-FIG. 1

NON ARBOREAL POLLEN DIAGRAM FROM YUS-MAIDAN (KASHMIR-1962)

(PERCENTAGES CALCULATED IN TERMS OF AP)



TEXT-FIG. 2

Amongst the conifers pine attains its maximum values with a slight declining trend in the upper half of the stage. Fir gradually rises to fairly high values towards the top of the stage. After attaining its maximum values in the upper part of the preceding stage and lower part of this stage spruce shows a declining trend. *Cedrus* reappears in the upper part and is sporadically present towards the close of this stage.

A solitary pollen grain of *Sarcococca* and stray pollen of *Elaeagnus* in the lower part of the stage is also present.

The ground vegetation is extremely reduced. Low but continuous curves are formed by Gramineae, *Artemisia*, Compositae, Urticaceae, Caryophyllaceae and *Impatiens* while the other constituents are sporadically represented. Cyperaceae continues with very low values up to the middle of the stage thereafter it disappears. Poly-podiaceae is sporadically present and so are *Eriocaulon* and *Typha*.

Stage "d"

Pine-fir-spruce-wood phase

This phase is characterized by the overwhelmingly high values of conifers [pine and fir (about 20%) and spruce]. *Cedrus* is present only sporadically. The broad-leaved elements are \pm altogether absent except very small percentages of birch and elm. Oak is altogether absent. *Morus*, *Celtis* and *Myrica* are represented by single grain each.

The undergrowth is represented by a single pollen of *Lonicera*.

The ground vegetation is represented by very low values of Gramineae, *Artemisia*, Compositae, Caryophyllaceae and *Impatiens*. Sporadic grains of Cyperaceae, *Eriocaulon*, Urticaceae, Rosaceae, Ranunculaceae, *Polygonum* and Poly-podiaceae are also seen.

2. Baba Rishi Mire

LOCATION

Baba Rishi mire is situated amidst the conifer forest on the right side of the Tang-marg-Baramula road about a few kilometres away from Tangmarg. This mire is \pm dry at the margins while the central part is water-logged. The deep water and steep

margins of another mire located hardly about a few metres away prevented sampling in it.

The mire is situated within the fir-pine community with stands of *Taxus baccata*. The undergrowth is altogether absent within the forest but *Indigofera gigantea* and *Plectranthus rugosus* grow along the margins or where the trees are sparse.

The ground vegetation around the mire comprises *Dryopteris* community with *Juncus*, *Eriocaulon*, *Alisma* *Plantago*, Cyperaceae, Gramineae, *Ranunculus*, *Anemone*, etc.

STRATIGRAPHY

The trial borings were carried out to select the deepest point for final sampling. The peat borer touched the bottom at 90 cm. The details of the profile selected for pollen-analysis are given below.

1-30 cm.

Sediments comprising organic mud with rootlets and fragments of rhizomes. Few seeds of *Carex*, *Cyperus* and *Eriocaulon* were recovered. In sample seven a calyx of a very tiny flower (unidentified) was recovered.

30-60 cm.

Sediments comprising clayey organic mud. Rootlets, seeds and fruits absent. 60-90 cm. All clayey slit. No megascopic plant remains.

The floor of the basin of this shallow mire is made up of gritty material and it is filled up by eroded silt or clay from the adjoining slopes. From 30 cm. upward the clay is missing and the profile contains several rhizomes and rootlets alongwith organic mud.

POLLEN DIAGRAM

(Text-fig. 3)

The six vegetational stages (a to f) recognized are described below.

Stage "a"

Pine-fir-elm-salix-poplar-wood phase

Amongst the broad-leaved constituents *Salix* and *Populus* are present in fair percentages, but they show a declining trend. Similar behaviour is shown by *Quercus* and *Acer* whereas birch and elm show an increasing trend. Alder is absent.

Fir maintains consistently high values throughout but it declines towards the close of this stage. Pine and deodar show decline from the beginning of the stage while the spruce maintains low and uniform values. *Taxus* makes its first appearance towards the close of this phase.

The undergrowth is represented by *Viburnum* which maintains uniform values throughout but declines towards the top and *Berberis* which shows a decreasing trend disappears before the close of the stage.

Gramineae, *Artemisia*, Caryophyllaceae and *Geranium* show an ascending trend whereas Urticaceae, Chenopodiaceae and many other constituents of ground vegetation show a decreasing trend.

Algae are absent. *Lemna* is represented by very low values and shows gradual increase. *Alisma plantago* is lowly present to start with but later disappears.

The curve for Polypodiaceae maintains low and consistent values but *Osmunda* shows a declining trend.

Stage " b "

Pine-fir-spruce-oak-elm-birch-wood phase

The increasing trend in the curves for oaks, elm, *Morus* and walnut in the middle of the phase with the corresponding decrease in pine and fir characterize this phase. Towards the top of the stage almost all the broad-leaved elements are reduced to minimum values.

After a decline in the middle of this phase fir and pine both show an increasing trend. *Cedrus* shows a continuous decrease. Spruce behaves somewhat differently. It continuously increases up to the middle of the stage then it shows a slight decline. *Taxus* attains its maximum towards the middle.

The shrubby vegetation represented by *Viburnum* dwindles away towards the middle of this phase.

The ground vegetation comprising Gramineae, *Artemisia*, Chenopodiaceae, Caryophyllaceae etc. shows a general decline with some fluctuations. *Polygonum* which appeared for the first time towards the close of the preceding stage shows a consistently increasing trend. It is interesting to note that the cereal pollen which appears at the beginning of this phase forms a continuous curve with high values in the middle but disappears towards the close of this stage.

Polypodiaceae shows a continuous decline to minimum at the top of the stage. A slight but consistent increase in *Osmunda* is noted.

A single colony of *Pediastrum* is met with in the middle of this stage.

Lemna shows an ascending trend but declines to low values towards the top of the stage. *Alisma plantago* is sporadically present. Cyperaceae shows a maximum rise in the middle and then dwindles away.

Stage " c "

Pine-fir-cedrus-mixed-wood phase

This stage is characterized by considerable reduction in the broad-leaved constituents and a gradual increase in the conifer constituents especially fir and *Cedrus*.

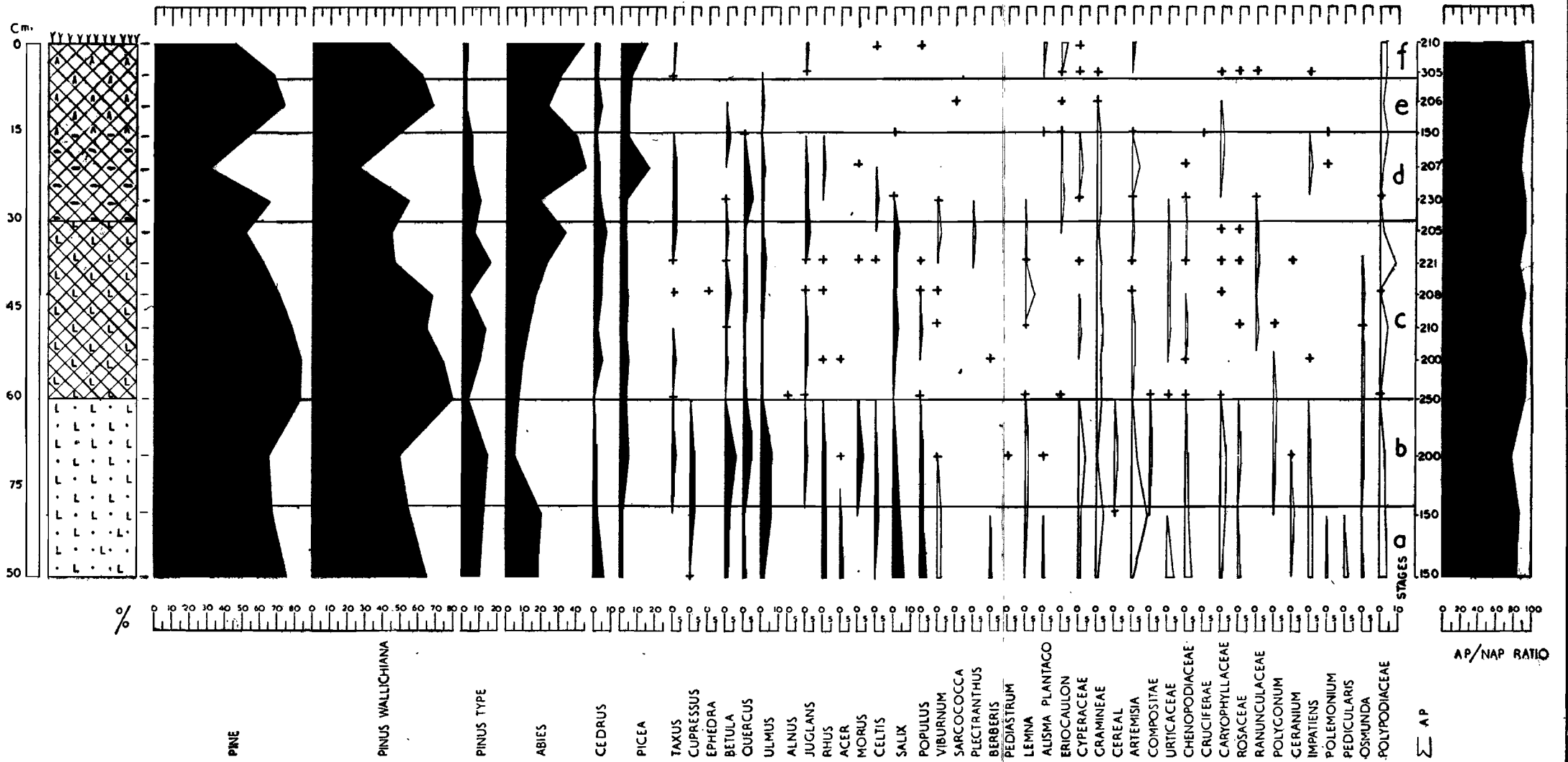
Oaks and elm are very much suppressed throughout the phase but in the middle of the later half they show a slight increase but immediately decline again. Walnut sporadically present at the base and in the upper half of the stage increases slightly towards the top. *Rhus*, *Acer*, *Morus* and *Celtis* are represented by stray pollen only. *Salix* is meagerly present in the lower and middle part while in the rest of the stage it has slightly higher values. *Populus* is sporadically present throughout though it tries to form a continuous curve in the middle of the stage.

Amongst the conifers fir, *Cedrus* and pine gradually show ascending trends but after reaching maximum they decline towards the close of the stage. Pine is replaced by fir. Spruce maintains uniform values throughout. *Taxus* is only sporadically present in the middle but otherwise forms a low continuous curve.

Shrubby vegetation is represented by *Viburnum*, *Plectranthus* and *Berberis*. *Viburnum* appears sporadically in the middle, forms a continuous curve and then gradually declines. The curve for *Plectranthus* appears towards the top of the stage.

The ground vegetation shows an over-all decrease from the preceding stages. Gramineae is present throughout. *Artemisia* curve shows a break in the middle. Urticaceae which was absent in the previous stage reappears. It is sporadic in the beginning but later forms a continuous low curve. Chenopodiaceae, Caryophyllaceae, Rosaceae, *Polygonum*, *Geranium* and *Impatiens* are

POLLEN DIAGRAM FROM BABA-RISHI MIRE (KASHMIR - 1962) (PERCENTAGES CALCULATED IN TERMS OF AP)



TEXT-FIG. 3

sporadically present. Ranunculaceae forms a continuous curve with fluctuating low values.

Osmunda is present throughout in low values but absent towards the top of this stage. Polypodiaceae attains maximum rise in this stage.

Lemna sporadic to begin with attains high values in the lower part of the upper half of this stage and thereafter declines to low values.

Eriocaulon is sporadically present towards the beginning and the close of the stage. *Alisma plantago* is absent whereas Cyperaceae is sporadically present in the middle and upper part.

Stage "d"

Fir-spruce-pine-mixed-wood phase (Conifer-mixed-wood phase)

This stage is characterized by high values of fir and spruce. Oak shows an appreciable rise during this stage. Elm is present throughout in very low values. Alder is absent. Walnut present in very low values disappears towards the close of the phase. *Rhus* forms a continuous curve with low values. *Celtis* is only restricted to the lower half. *Salix* is sporadically present whereas *Populus* is altogether absent.

Fir attains maximum values in the middle of this phase later it declines. Pine shows a steep decline in the middle and later regains it. *Cedrus* declines throughout whereas spruce approaches its maximum in the whole of the sequence and then declines. *Taxus* forms a low curve.

The undergrowth comprising *Viburnum* and *Plectranthus* is very lowly represented in the beginning but soon disappears before the middle of the stage.

Ground vegetation is further reduced. Gramineae is present throughout in low values. *Artemisia* present in very low values to start with suddenly rises to 5 per cent and then falls shortly to become sporadic towards the close of the stage. Compositae, Chenopodiaceae, Cruciferae and *Polemonium* are sparsely present. Caryophyllaceae which appears during this stage shows an ascending trend. Similar behaviour is shown by *Impatiens* but it becomes sporadic towards the close of the stage.

Osmunda is absent whereas Polypodiaceae which has sporadic values in the beginning

starts rising from the middle of the stage.

Lemna is present sporadically in the beginning while *Eriocaulon* is represented throughout in very low values.

Stage "e"

Pine-fir-spruce-wood phase

This phase is characterized by the absence of most of the broad-leaved constituents except that of birch and elm. Birch shows decline from the very beginning and disappears towards the middle whereas elm continues in very low values up to the close of this stage.

Amongst the conifers, fir continues to decline and after a sharp decline in the middle it again shows ascending trend. Whereas spruce shows a slow gradual rise throughout, *Cedrus* rises in the middle only. After reaching maximum Pine gradually declines.

Ground vegetation declines further. *Artemisia* and *Polemonium* are sporadically present. Gramineae and Caryophyllaceae have low values and disappear towards the middle of the stage.

Alisma plantago and *Eriocaulon* are sporadically present.

Stage "f"

Fir-pine-spruce-wood phase

This phase is the continuation of the preceding phase. The broad-leaved constituents are \pm altogether absent. There are, however, stray pollen of walnut, *Celtis* and *Populus*.

There is a great shift in the conifer constituents. Pine which attained maximum value in the previous stage declines and is replaced by fir. *Cedrus* does not show any appreciable change. *Taxus* is represented by very low values.

Shrubs are absent.

Ground vegetation also declines further. Cyperaceae, Gramineae, *Artemisia*, Caryophyllaceae, Rosaceae, Ranunculaceae and *Polemonium* are sporadically present.

Alisma plantago and *Eriocaulon* are sporadic to begin with but soon their curves show ascending trend.

DISCUSSION

Vegetational History

a. YUS MAIDAN POLLEN DIAGRAM

This small pollen profile depicts vegetational history in the vicinity of Yus Maidan at an altitude of 2300-2700 metres and it brings out a far recent history than that from the Haigam profile (VISHNU-MITRE & SHARMA, 1966). No means are available to date any of the phases of sequence. It appears that not far back in historic times far more open conditions prevailed in this region as is evidenced by the high values of non-arboreal elements. These open areas, pastures or maidans as they are called, were surrounded by a conifer-broad-leaved-mixed forest in which fir and spruce were more common than pine together with oaks, elms, *Celtis*, *Acer* etc. In this forest the broad-leaved constituents gradually dwindled while birch increased tremendously. Both spruce and blue pine increased whereas fir declined. With the gradual decline of the broad-leaved forest the colonizers—birch and pine—increased tremendously and encroached upon the previously existing open areas and ultimately the forest developed into the Pine-fir-spruce forest. The ground flora present in the small open area largely comprised insect-pollinated species; it is, therefore, that the top part of the pollen diagram does not depict the occurrence of any open area at the moment which may appear contrary to the fact.

The change-over of the conifer-mixed-broad-leaved forest into pure conifer forest appears to indicate change in climate. No evidence of that, however, is obtained in the nature of sediments preserved in the mire. It is, therefore, very likely that the above vegetational succession at Yus Maidan may largely be attributed to human interference rather than to any climatic change.

So far as the agricultural activity is concerned only a single cereal pollen is seen in the lower half of stage "c" but *Plantago* pollen is seen right from the base of the diagram during stages "a" and "b". It therefore, appears that during stages "a" and "b" there was, if not exclusively, much more pastoral activity followed by some farming which was later abandoned as a result of which the forest encroached upon most of the open area.

b. BABA RISHI POLLEN DIAGRAM

A \pm similar vegetational sequence is observed in the Baba Rishi pollen diagram but in contrast to the Yus Maidan pollen profile the Baba Rishi vicinity has been thickly forested right from the beginning. Pine-fir-mixed-woods existed right from the beginning with a very low percentage of the broad-leaved constituents. With the decline of the broad-leaved constituents a pure conifer forest comprising fir-pine-spruce developed as it exists today. The vegetational succession in this profile also seems to be induced by the human factor rather than climate although stratigraphy suggests that with the beginning of stage "c" the climate changed into the cooler and moister phase and this may be a local change in climate. That these changes are largely induced by human hand is evidenced by small farming activity observed during stage "b" which is a brief phase. Because of the dense forest throughout, the pollen diagram seems to have registered much less pastoral activity in this region.

Apart from the more or less conventional description and interpretation of the two pollen diagrams as presented here, certain points arising out of the interpretations deserve consideration.

So far as the dating is concerned, it can hardly be denied that both the pollen sequences depict vegetational changes of a very recent past. The Yus Maidan pollen profile would have us believe that the encroachment of conifer forest at the Maidan has taken place in very recent times prior to that an open and vast meadow existed. The meadow still exists there surrounded by a dense conifer forest. The top part of the pollen diagram from Yus Maidan gives no indication of the present day meadow. The surrounding forest is so mature that one cannot afford to overlook the fact that this forest has existed there since centuries. The non-representation of the meadow in the top part of the pollen diagram may be the result of heavy pressure of grazing. This has certainly affected Gramineae and *Artemisia* also since *Artemisia* is not spared both by Man and his grazing animals in the Valley (VISHNU-MITRE & SHARMA, 1966, p. 212). The decline of Urticaceae remains inexplicable, unless a drying trend in climate is presumed.

There is no evidence of that from the other constituents of the pollen diagram.

The Baba Rishi pollen sequence, however, does not bring out a similar anomaly and there is practically no indication of the occurrence of open conditions in the immediate past. Forests at both the sites are of equal maturity hence more or less of the same antiquity. Nevertheless the two pollen sequences bring out an event of considerable significance and that is the decline in *Abies* towards the close of Stage "a" and its gradual rise to high values towards the top of stage "c". This must have been an event of considerable importance and so wide spread that it has been depicted by the sediments at both sites separated by an aerial distance of about 30 miles. The decline of fir and its recovery is almost spread over two-thirds of the two pollen diagrams. The corresponding fluctuations in the pollen curves do not suggest that this decline of fir may be climatically controlled, the biotic factor seems to have been at play; felling and extraction of fir wood may be the possible causes.

Returning to the anomalous situation presented by the Yus Maidan sequence, it may be remarked that the wide open conditions suggested by the bottom part of this diagram do not seem to be factual so far as the recent times are concerned. Future work should, however, show if the shallow basin of the meadow has incorporation of Late Glacial sediments.

The genus *Alnus* is represented by single grain in both the pollen diagrams, whereas the genus *Quercus* is represented by up to 10 per cent pollen in stages a & b in Yus Maidan pollen diagram and by an extremely low curve and with rise up to 5 per cent in stages b & d in the Baba Rishi pollen diagram. *Alnus* is completely absent from the Valley but stray patches of *Quercus dilatata* and *Q. semicarpifolia* do, however, occur in the Valley (VISHNU-MITTRE, 1963). *Quercus* is not a constituent of forest surrounding the two sites investigated. The

source of oak pollen at Yus Maidan seems to be incorporation of Lower Karewa sediments in the swamp but at Baba Rishi together with this, contamination from air may be the plausible explanation, rather than the occurrence of the genus in the forest in the immediate past. The high values of oak pollen in pollen diagram from Walanwar Mire-W, a shallow swamp from the Valley proper (SINGH, 1963) may equally be due to incorporation of Lower Karewa sediments. Here the oaks are associated with maize pollen the introduction of which in the Valley cannot be considered more than four hundred years old (VISHNU-MITTRE & GUPTA, 1966). The high values of oaks in the top of Haigam profile are obviously due to incorporation of older sediments.

Pollen grains of *Celtis australis*, *Morus indica*, *Cupressus*, *Meconopsis*, *Symplocos*, *Eleagnus*, *Osmunda* have been recognized for the first time from the Postglacial sediments of Kashmir Valley. *Celtis australis* occurs in the Deodar forests in Lolab and is also planted elsewhere in the Valley. *Morus indica* was introduced in the Valley between A.D. 1420 and A.D. 1470 by King Zain-ul-Abidin but Huen Tsang who visited the Valley in A.D. 630 refers to silk industry there.

Pollen of *Sarcococca* has been transported from the southern side of Pir Panjal, since the genus does not occur in the Kashmir Valley today.

Pollen grains referred to *Cupressus* did not show any evidence of a faint pore as in that of *Juniperus*. If they are really of *Cupressus*, a genus absent in the J & K State, then their pollen grains must have come from much longer distances from the Punjab Himalayas.

Pollen grains of *Meconopsis*, an alpine genus, seem to have travelled down from the high altitude and the same may be said of birch pollen. *Eleagnus umbellata* occurs in the Valley, but *Symplocos* pollen has come from the other side of Pir Panjal.

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