Past Environments through Palynology: A Short Appraisal with Reference to the Western Ghats

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SUMMARY

The science of palynology has proved to be a good tool to reconstruct the past, to build up archaeological scenarios and to record climatic changes during the Holocene period. However, the terms employed to denote climate, like arid and humid, are often used without proper definitions, ignoring intricacies of climate. Sometimes the species whose pollen grains are used as markers of dryness or wetness are themselves not very faithful indicators. In yet other cases the vegetation change registered through pollen spectrum is solely attributed to climate without considering the anthropic interference or other factors of environment like shifts in courses of river or pests and diseases.

Taking the Indian region as an example where the spatial and temporal variations of climate are pronounced, the deficiencies in expressing the climate in its multifaceted complex, and in deriving the climate change, are exposed by a critical analysis of two well acclaimed papers on palaeo-palynology.

INTRODUCTION

Palynology is the study of pollen grains and spores. Their morphological characteristics lead to the identification of plants at specific, generic or yet family level. Since most of the plant species are indicators of climate or environmental features and since pollen grains remain preserved in certain habitats like peaty soils, fresh water or marine sediments for centuries and even millennia, palynology plays a significant role in deriving the past environmental changes through the dating of the sediments.

Vegetation – the link between the pollen and the environment

The sequence of succession i.e. change from forest to grassland to crop land or vice-versa over the past millennia (Holocene period) can be reconstructed by

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examining the pollen grains in a soil or sediment profile at regular intervals. The time-frame is established through C14 or a more sophisticated method. The Palynologist's role ends with the identification of the taxa. A proper interpretation of the pollenic data in environmental terms requires an ecologist or biogeographer. For example, a species like *Cullenia exarillata* A. Robyns is a sure pointer of evergreen forest and *Careya arborea* Roxb. of tree-savanna. Apart from pointing out vegetation, some species may indicate a definite humid climate, some aridity and yet others may be of intermediate situations and therefore of lesser indicator value. Similarly there are species characteristic of a certain soil type or of human interference. The ecologist has to assess the situation on the merit of the case seeking help from other disciplines like algology, geology, geomorphology, archaeology etc., as ecology is a multidisciplinary subject.

PITFALLS IN INTERPRETATION OF POLLEN DATA

Sometimes it happens that the change in vegetation deduced from pollen data is attributed solely to the climate and that too in very broad terms such as humid or arid. There is practically no indication of the quantum of rainfall. Also often ignored is the pattern of rainfall in terms of the length of dry season or season(s) of occurrence of rains (Meher-Homji, 1994). The southern part of the Western Ghats in Kerala receives about 3000mm per annum, but the dry season is short (of 2 months duration). Agumbe in Karnataka, in the middle part of this hill range, receives rainfall of the order of 7000mm but experiences a dry season of 5 months. The tree *Cullenia* is confined to the Ghat region where the dry season does not exceed four and a half months.

In certain cases the role of anthropogenic factors or physiographic changes like shifts in the course of rivers, or yet of a pest in bringing about a change in the density of a species and consequently in vegetation, is ignored, and a climatic interpretation is sought to explain the change in the pattern of plant distribution. The elm (*Ulmus*) in Europe suffered a decline because of a disease, but earlier studies attempted to put the blame on climate change. A marshy area fed by a river would bear a moist forest type but with the shift of the river it would show a change in floristic composition in consonance with the local dry conditions. One may not invoke a climate change in this case.

In some studies the taxa selected as markers of arid or humid phase are not very faithful indicators. The pioneering investigation of Gurdip Singh et al. (1974) establishing several stages of aridity and humidity in the desert of Rajasthan is much acclaimed and very frequently cited in literature (Bryson and Swain, 1981). However, only a seasoned vegetationist will not be convinced of taxa like *Artemisia, Mimosa rubicaulis* Lam., *Oldenlandia, Maytenus, Syzygium*

cumini (L.) Skeels and Cyperaceae pointing to a very humid phase (Vishnu-Mittre 1974a, 1974b; Meher-Homji, 1994). *S. cumini* is reported in the flora of Jaisalmer in the heart of the desert. Cyperaceae prevails around the lakes in deserts especially in good monsoon years. What could have been positive evidence of a humid climate in the past in the now arid Western Rajasthan was actually the recovery of the pollen of the deciduous forest species of the Aravallis from the profile of the Sambhar lake.

Caratini et al. (1991) analysing a marine core off Karwar, facing the estuary of the Kalinadi river have brought out a convincing palaeo-palynological evidence of a vegetational change from an evergreen forest type to a savanna (grassland) in the Uttara Kannada district of the Western Ghats around 3500 years B.P. However, the reason assigned for the change, viz. declining humidity, is not entirely convincing. Anthropic interference as a factor for the change also needs consideration.

In the hypothesis of a decrease in rainfall, one would expect a decline in the number of evergreen forest species in favour of those of a moist or dry deciduous forest and even of thorn forest if the decrease in the quantum of rains was drastic. However, the pollen spectrum does not reveal such a change. What it indicates is the establishment of a savanna. It is a known fact that the savannas in the plains and at moderate altitude in the Western Ghats are essentially the result of fire (Pascal, 1984). This made us suspect the role of man in bringing about the change from forest to grassland (Caratini and Meher-Homji; in press).

The generally accepted date of introduction of cultivation in this region is placed around 1000 B.C. (3000 B.P.) after the introduction of iron (Gadgil and Subash Chandran, 1988). However, it is likely that clearing the land using fire was an effective method a few centuries earlier. According to Sundara (1990) the Neolithic intruders descended from the Upghat region to the Downghat region of the Dakshina Kannada district in the last part of the Second millenium B.C. and resorted to cultivation, probably by the slash and burn method.

Reduction in mangrove pollen around 1300 B.P. is assigned to lessening intensity of humid conditions (Caratini et al. 1991). Gadgil and Subash Chandran (1988) on the other hand point out shrinkage in the mangrove area due to introduction of paddy cultivation in the estuaries. A much lower rate of sedimentation (7cm/100 years) in the recent period compared to the earlier period 3500-4500 years ago (18cm/100 years) has been reported in favour of 'alteration of humid conditions'. However, this is contrary to known facts: one would expect less soil erosion under forested conditions than under grass-savannas occurring 'on slopes' (Caratini et al. 1991). Besides, increase in water yield is linked to removal of natural forest and burning of grasses (Bruijnzeel, 1986), once again an evidence in support of use of fire. Finally, though the proposed drier phase in Karnataka is shown to be parallel to the one in Rajasthan, actually there is a discrepancy in the dates of onset of the drier phase.

A point of concern is that the dates proposed for the setting in of a drier climate vary not only from continent to continent but even from one part of a hill range like the Western Ghats to another part.

Now that more dates would be available under the International Geosphere Biosphere Programme, it would be worth investigating whether such changes were global in nature due to planetary causes, regional or merely local, linked to some very localised factor like deforestation which can alter the pattern of rainfall (Meher-Homji, 1991).

In conclusion, the great merit of the work of Caratini et al. (1991) is that it pinpoints the date of commencement of human activity in the central part of the Western Ghats which changed the forested landscape to savanna type.

REFERENCES

Bruijnzeel, P.S. 1986. 'Environmental impacts of deforestation in the humid tropics: a water-shed perspective'. *Wallaceana* **46**: 3-13.

Bryson, R.A. and A.M. Swain 1981. 'Holocene variations of monsoon rainfall in Rajasthan'. *Quat. Res.* **16**: 135-45.

Caratini, C., M. Fontugne, J.P. Pascal, C. Tissot and I. Bentaleb 1991. 'A major change at ca. 3500 years B.P. in the vegetation of the Western Ghats in North Kanara, Karnataka'. *Current Science* **61**: 669-72.

Caratini, C. and V.M. Meher-Homji 1995. 'The 3500 year B.P. vegetation change in central western Ghats (India): climatic and anthropogenic viewpoints'. Trop. Met. 94 – National Symposium on Climatic Variability. Indian Institute of Tropical Meteorology, Pune.

Gadgil, M. and M.D. Subash Chandran 1988. 'On the history of Uttara Kannada forests', pp. 47-58. In Dargavel, J., K. Dixon and N. Semple (eds) 'Changing Tropical Forests', Workshop Meeting, Australian National University, Canberra.

Gurdip Singh, R.D. Joshi, S.K. Chopra and A.B. Singh 1974. 'Late Quaternary history of vegetation and climate of the Rajasthan desert'. *Philos. Trans. Roy. Soc.* **267B**(889): 467-501.

Meher-Homji, V.M. 1991. 'Probable impact of deforestation on hydrological processes'. *Climate Change* **19**: 163-72.

Meher-Homji, V.M. 1994. 'Climate changes over space and time: their repercussions on the flora and vegetation'. *Palaeobotanist* **42**: 225-40.

Pascal, J.P. 1984. Les forêts denses humides sempervirentes des Ghats Occidentaux'. Institut Français de Pondichéry: *Travaux section Scientifique et Technique* **20**: 1-365.

Sundara, A. 1990. 'The neolithic age and the Parshurama legend in the West Coast: human response to the evironment'. In *Rising Trends in Palaeoanthropology, environmental change and human response.*

Vishnu-Mittre 1974a. 'Plant remains and climae from the Late Harappan and other Chacolithic cultures of India'. *Geophytology* **4**: 46-53.

Vishnu-Mittre 1974b. 'Late Quaternary palaeobotany and palynology in India: an appraisement'. Symposium, Late Quaternary Development in extra-European areas. Spl. Publ. No.5: 16-51. Birbal Sahni Institute of Palaeobotany, Lucknow.