THE ORIGIN OF SHOLA FOREST IN THE NILGIRIS, SOUTH INDIA

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ABSTRACT

The formation of Shola forest, the closed evergreen woods in the vicinity of Ootacamund in the Nilgiris in south India, commenced about 35,000 years ago through gradual invasion of the grasslands under a regime of low precipitation, absence of frost and high speed winds. The present disjunct distribution of the Shola forest is due to destruction of the forest probably by Man and much of the grasslands today seem due to anthropogenous activity.

INTRODUCTION

THE closed evergreen woods occurring above 1700 m in the Plateau on the higher hills in the Nilgiris, Annamalai and Palni Hills in South India are called the Sholas. Comprising members of Myrtaceae, Lemnaceae, Styraceae, Ternstroemiaceae with an undergrowth of rubiaceous shrubs and *Strobilanthes sensu latu*, the Sholas distributed in patches between the sheltered folds of the round topped hills and attaining a height of 16-80 m. constitute the only temperate forest in South Indian tropics. The plateau is studded with vast stretches of grasslands, some of which are now brought under plantations of *Acacia, Cinchona, Eucalyptus*, tea and coffee. Not only the status of grasslands whether natural or man-made is not clear but also it has not been possible to understand the seral stages towards the formation of Shola forest since the Shola forest has stopped regeneration. On account of that we have recently called the Sholas as a living fossil plant community (Vishnu-Mittre & Gupta, 1968).

In order to solve the above two ecological problems, pollen analytical investigations of peat deposits have been commenced at Ootacamund. A general survey has revealed that peat deposits abound in this region. It is largely nekron mud derived from sedges, which fills the swamps and marshes.

Phytosociological studies have shown that differences in the rainfall regime in the West (200″-300″) and in the East (60″-80″) of the plateau are reflected in the composition of the Sholas. For instance *Sideroxylon, Eurya, Nothopodytes, Meliosma wightii, Lonicera, Viburnum* and *Heyenia trijuga* are poor in the Sholas in low rainfall area; and *Euonymus, Microtropis, Ternstroemia japonica, Gordonia obtusa, Gymnosporia, Turpinia* and *Memecylon malabaricum* are poorly present in high rainfall area. Besides *Elaeocarpus oblongus, Achronychia pedunculata* and Apocyanaceae are extremely rare or absent in the high rainfall area, and *Elaeocarpus ferruginea, Hypericum hookerianum, Syzygium arnottianum* and *S. calophyllifolium*, Senecios and Ebenaceae are extremely rare or absent in low rainfall area. Besides the precipitation, frost, the transitional level for which is seen at 1700-2000 m., has further affected some species such as *Impatiens*. Temperature is on the whole equable throughout the year. The Sholas are subjected to the influence of high speed winds.

POLLEN-ANALYSES

Studies of the late Quaternary vegetational history of Nilgiris through the application of Pollen analysis have been carried out at the Kakathope and the Rees Corner Swamps at Ootacamund. The serpentine swamp at Kakathope, about 4 miles from Ootacamund, has been reclaimed and brought under cultivation. There is no Shola forest around but plantations of *Eucalyptus* and *Cinchona* abound. The swamp at Rees Corner, about 3 miles from the city, is flanked at a short distance by patches of Shola forest. The basins of the swamps are filled with homogenous, dark organic mud. The bottom deposits at Kakathope are reddish-brown in colour when fresh but turn black on exposure. The basin at Kakathope swamp being 5.30 m. deep is the deeper of the two.

Supported by comparative studies of pollen of modern flora and of phytosociology of plant communities distributed here, a

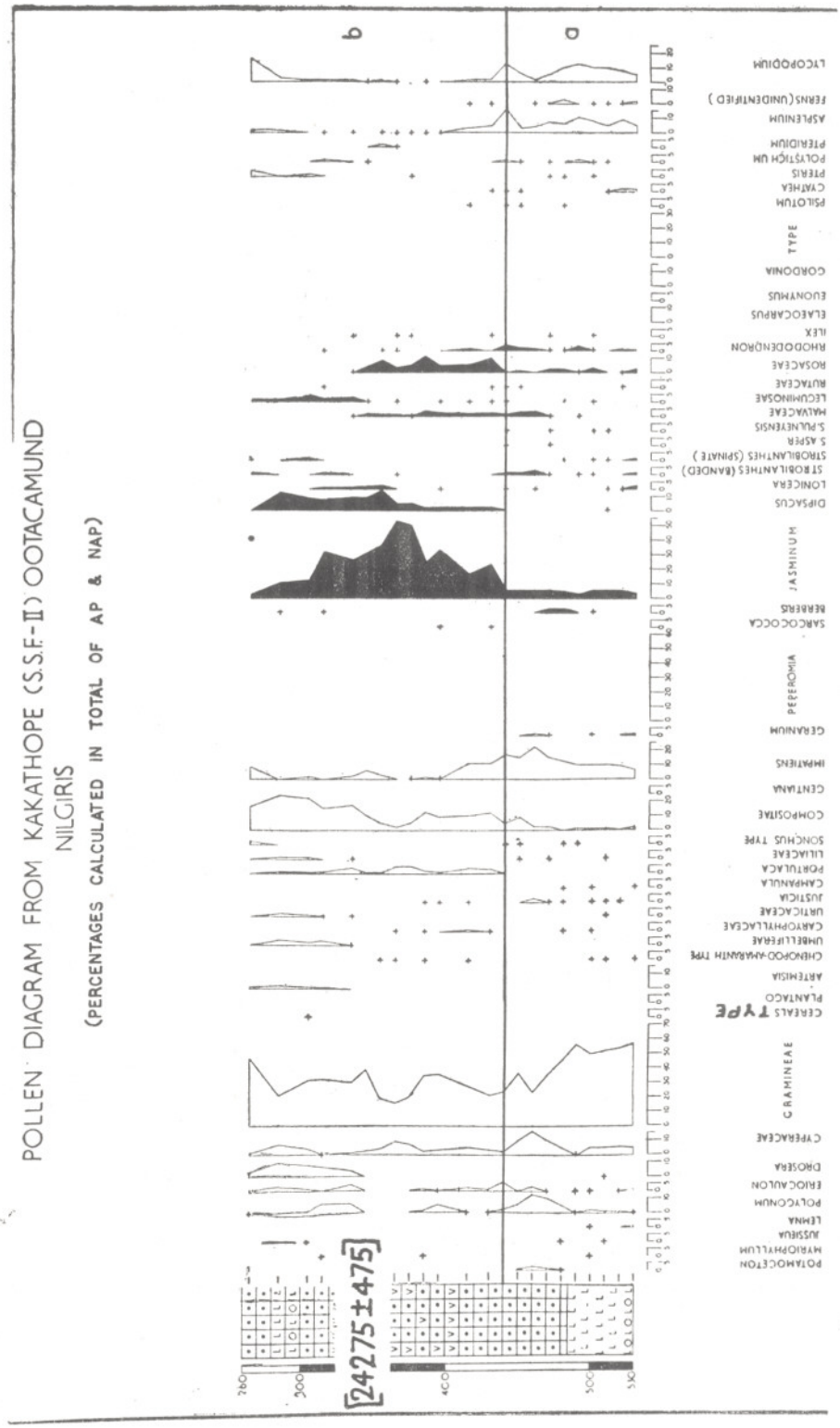

FIG. 1 — Pollen Diagram.

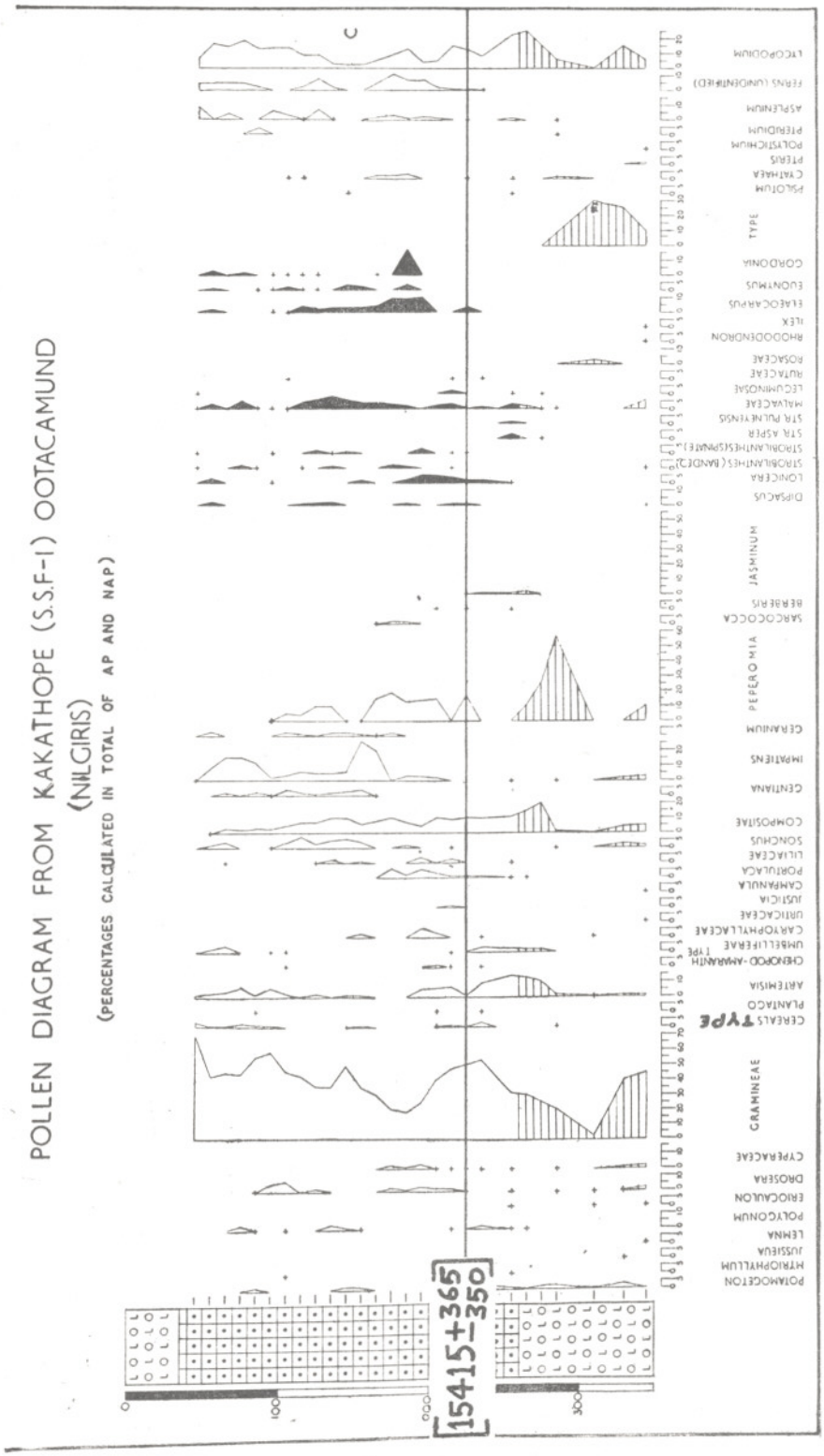

FIG. 2 — Pollen Diagram.

The lower shaded part is from the overlap in stratigraphy as seen in Fig. 1. The sediment being bouldery clay in Fig. 2 shows marked differences in pollen sequence (cf. shaded part in Fig. 2 with the top part in Fig. 1). The shaded part is not considered for interpretation instead the corresponding overlap in Fig. 1 has been taken into consideration.

pollen sequence (based on pollen sum of terrestrial plants) from each of the swamps has been built up. It has, however, not been possible to recover and identify pollen of all the constituents of flora here perhaps due to entomophily, low pollen production, differential preservation, and lack of distinguishing characters.

The vegetational sequence from Rees Corner shows high values of Cyperaceae (local origin) and low percentages of Gramineae and herb pollen, suggesting forested conditions. Quite a few constituents of the Shola forest appear in low frequencies suggesting fluctuations within the Shola forest.

The pollen diagrams from Kakathope are divisible into three stages of vegetational development. Stage 'a' reveals high and declining values of Gramineae from 60% to 30% with the gradual rise in shrubby vegetation (*Impatiens*, *Jasminum*, *Berberis*, *Strobilanthes*) and an indication of arboreal vegetation comprising members of Rosaceae, Rutaceae, *Ilex* and *Rhododendron*. Gradual colonization of open conditions by shrubs and trees especially *Rhododendron* is suggested by this stage.

Stage 'b' reveals increase in shrubby vegetation among which *Impatiens* and members of Rosaceae are dominant followed by *Dipsacus* and members of Leguminosae. This indicates an advanced stage towards the formation of Shola forest which is accomplished in early phase of Stage 'c'. *Gordonia*, *Euonymus* and *Elaeocarpus* together with members of Rosaceae, Rutaceae and *Strobilanthes* constitute the Shola forest. Decline of the Shola forest is indicated towards the upper half of Stage 'c', and this phase corresponds with the rise in Gramineae.

The entire sequence, therefore, suggests the manner by which the Shola forest has originated. Stages 'a' and 'b' represent the seral stages towards the formation of it, viz. open conditions, invasion of herbs, shrubs and *Rhododendron* and the invasion of the Shola forest trees as seen in Stage 'c'. The advanced stage in this succession seen in Stage 'b' is dated by radio-carbon to $24,275 \pm 475$ years B.P. The base of Stage 'c', the formation of the Shola forest, is dated to $15,415 \pm 365$. The initiation of the Shola forest in Stage 'a' can be estimated to be about 35000 years B.P. These dates suggest late Pleistocene times corresponding to the last Glaciationin the Western Himalayas.

The initiation of Shola forest took place during a warm and humid climate which was free of frost as indicated by high values of *Impatiens* and more or less similar climate prevailed during Stage 'c' also. The Shola forest comprising *Euonymus*, *Gordonia* and devoid of Myrtaceae is indicative of low precipitation (60″-80″) as obtained today in the eastern part of the Nilgiris. If high values of composites in Stage 'b' are proved to belong to Senecios occurring in high rainfall area in the western part of Nilgiris, they may suggest higher precipitation during Stage 'b'.

The pollen analyses reveal the occurrence of *Potamogeton*, *Lemna* and *Jussieua* at Ootacamund during the late Quaternary. These genera are absent today from there but for the introduced species.

CONCLUSION

This investigation shows that the Shola forest in the vicinity of Kakathope, Ootacamund had originated through gradual invasion of the grasslands about 35,000 years ago, corresponding in time to the last Glaciation in the North. Its modern distribution in patches between folds of the mountains is due to subsequent fellings by Man thus giving rise to vast stretches of grasslands which seem largely due to anthropogenous activity. The precipitation and high speed winds today are mainly responsible for the non-regeneration of the Shola forest, since the forest soil exposed after clearance is eroded away by rain and winds. Both these factors were less operative in the past than they are today.

No evidence has hitherto been obtained that the destruction of the forest by Man was done with a view to clear the land for farming. Several of the Indian wild grasses have pollen as large as those of cereals encountered, hence they are referred to as cereal type pollen. The region is inhabited by the Todas, the nomadic Graziers, the earliest tribe. The farming tribes, the Kotas, the Kurumbas and the Badagas are known to have invaded the region later than the Todas (Grigg, 1880).

Our thanks are due to Director of Agriculture, Madras, for the facilities and kind permission to work at the reclaimed State

Seed Farm, Kakathope, and to Mr. M. Tiagrajan, D.F.O. and Working Plan Officer, Coonoor, for useful discussion on phytosociology of Nilgiris. We are indebted to the Tata Institute of Fundamental Research, Bombay, for dating the samples.

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