

birds. The stimulating effect of song of one male on the singing of other males is well known both from natural observations and from play-back experiments^{9,10}. The increase in song B in dense populations after the first of June may result from the fixation of territorial boundaries and the resulting relative decline in situations of territorial interaction and situations where a male is on "uncertain" ground.

Observations of the contexts of the two song types, and particularly of the situations in which switching from one to the other occurs, suggest that the song types represent segments of a motivational continuum. This would suggest in turn that their function is rather similar. The function of territorial displays is to defend an area without resorting to physical encounters. The existence of more than one territorial display (such as different song types) allows the recipients to determine the activities and emotional state of the displaying males more precisely from a distance and to discriminate more finely in their responses. This would mean, for example, that there would be no reason to chase and fight to determine the position of a neighbouring male's territorial boundary.

At the same time there is nothing in such a situation to prevent both song types serving another function in mate attraction and pair-bond formation and maintenance, for the meanings of the displays depend on the classes of recipients.

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Phytogeographical Classification of Mesozoic Floras and their Bearing on Continental Drift

ALTHOUGH much palaeobotanical work has focused on Palaeozoic plant geography there have been few attempts to classify Mesozoic taphofloras. The Jurassic flora was thought to be uniform all over the world though Oswald Heer showed that the Siberian Jurassic vegetation (contrary to the contemporaneous European vegetation) had been dominated by the *Ginkgo* allies¹. Nathorst referred to the Mesozoic flora of Siberia and Arctic islands as "Phoenicopsis flora", and Prynada proposed the designation "Siberian" or "Phoenicopsis" flora for this type of Mesozoic vegetation. Vakhrameev^{2,3} coined the term "Indo-European floristic province" for the rest of Eurasian taphofloras of this age, uniting two floristic regions (India and Europe) of rather different aspect. I propose the following phytogeographical classification.

First, the Arctomesozoic or *Phoenicopsis* flora include the Siberian province of Prynada, Alaska, western Canada⁴ and

western Greenland⁵. One of the dominant genera of this flora was *Phoenicopsis*, a gymnospermous plant of Czekanowskialean affinities. *Phoenicopsis* flora is supposed to be approximately equivalent to the temperate forest zone.

Second, there are the Madromesozoic or *Cycadeoidea* flora. The richest localities of *Cycadeoidea* and its allies (Monanthesia, but not the leptocaul bennettites which are widespread in all geofloras) are confined to the Black Hills of Dakota, the Freezeout Hills of Wyoming and north-western New Mexico^{6,7} not far from the area where Axelrod established his Madrotertiary flora⁸. The *Cycadeoidea* flora is well represented also in the European Jurassic and after considerable interval appears in India, Mongolia and Japan⁹. It is absent in the *Phoenicopsis* zone. The difference between these two zones seems to be vegetational as well as floristic. The Madromesozoic zone probably comprised the treeless areas of profuse growth of small pachycaul plants exposed to pronounced aridity, although most of the region was covered with conifer forests.

Third, there is the Notomesozoic or *Pentaxylon* flora. The *Pentaxylales* had been described from the Indian localities. They were identified in some southern hemisphere taphofloras, but never in the northern hemisphere apart from India. Their status in the southern floras was analogous to that of Czekanowskiales in the northern floras. Thus, the strong southern affinity of the Mesozoic Indian flora is evident.

The classification proposed here is relevant to the theory of continental drift. The fossil floras of peninsular India retained their southern affinity up to the Eocene¹⁰. The change of floristic composition of this area coincides with its supposed collision with Asia as the result of either anticlockwise rotation or the strike-slip along the transform faults¹¹. Thus, the palaeofloristic evidence agrees with the plate tectonic version of Indian plate history.

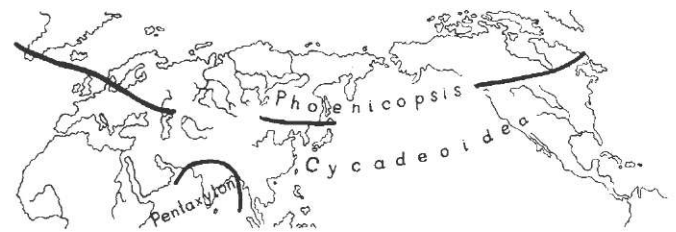


Fig. 1 Scheme of the Mesozoic geofloras.

Reservations must be made as to the other implications of continental drift. Some authors are inclined to explain all disjunct distributions, for example, distribution of the Proteaceae and other angiosperm groups, as the consequence of predrift (Triassic) arrangement of the southern continents¹². Such suggestions do not agree with the fossil record. No angiosperms were found in the southern taphofloras until the end of the Early Cretaceous. The similarities demonstrated between the Palaeozoic *Glossopteris* floras of Gondwana persist after the breakup in the post-drift late Mesozoic floras of this region. It seems that the floristic continuum was not greatly affected by the first stages of expansion due to successful migrations across the land bridges and/or "stepping stones". The Gondwana concept is not necessary for the explanation of all floristic connexions of the southern continents.

According to the plate tectonic theory, the lithosphere is consumed in the trenches bordering the Pacific Ocean, the consumption being superior to the crust accretion along the Pacific ridges. If the Atlantic Ocean is expanding, "it is axiomatic that another major ocean (Pacific) is contracting"¹³. If we accept this we might presume that the floras on opposite sides of the Pacific ocean have been more dissimilar in the Palaeozoic than they were in fact¹⁴. The *Cycadeoidea* flora is represented on both Asiatic and American margins of the

