nents of deep-water muds with the physiographic conditions.

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MAESTRICHTIAN PLANT MICROFOSSIL ASSEMBLAGES AND THEIR PALEOGEOGRAPHIC AND PALEOCLIMATIC IMPLICATIONS FOR LATEST MESOZOIC TIME

Reinterpretation of Late Cretaceous pollen and spire distribution patterns shows that large parts of the earth supported broad belts of plant assemblages whose ecotones are oblique to present latitudes but in harmony with those based on paleomagnetic data obtained from Cretaceous rocks. Although many details of upper Mesozoic fossil plant occurrences are still lacking, a general picture is emerging which indicates that climatic differentiation of the earth was well established by late Mesozoic time and that world temperatures were not uniformly warm during this period as has long been suggested.

Soviet palynologists have recognized at least two major Maestrichtian botanico-geographic provinces for northeastern Siberia. The northern one is characterized by both the presence of such form-taxa as *Azonia* and *Triprojectacites,* and also by the absence of subtropical elements found in the province lying adjacent to it. Also present are other plant microfossils such as *Picea, Comptonia, Ginko, Betula, Myrica, Rhoipetelia, Juglans, Engelhardtia, Pterocarya, Planera,* and *Quercites* (*Quercus?*) which are not necessarily restricted to this region and which undoubtedly reflect local edaphic and /or microclimatic conditions. Temperatures based on fossil plants cannot be estimated for this zone because the natural relation of the principal restricted pollen forms have not been established but 180/160 paleotemperatures suggest that northern Siberia had a temperate climate during the late Mesozoic.

South of the northern area lies a broad, NW-SE-trending region which has been interpreted as subtropical since it contains plant remains assignable to the Loranthaceae, Symplocaceae, Olacaceae and Palmae(?). Form-taxa such as *Wodehouseia, Duplosporis, Pemphixipollenites* and *Expressipollis* are locally abundant whereas Triprojectacites, *Proteacidites* and *Orbiculapollis* occur throughout this zone.

South of the subtropical zone an extensive, presumably tropical, belt encompasses most of present Europe and the southern part of the Soviet Union and is dominated by the *Normapolles*-group plant microfossil assemblage. The ecotone of the subtropical and tropical regions can be found in the Late Cretaceous sediments of Kazakhstan where intermingling of forms typical of more northerly areas such as *Aquilapollenites* and *Wodehouseia* are found together with representatives of *Normapolles.*

Palnyological studies of the North American latest Cretaceous deposits reveal the presence of plant microfossil assemblages (and presumably, climatic zones) similar to those of Eurasia. Maestrichtian sediments of northeastern Alaska contain many elements found in the Late Cretaceous subtropical zone of Siberia. Sporadic and small occurrences of *Azonia* in the northeastern Alaskan deposits suggest that the climatic zone correlative with the Siberian temperate region lies farther north of the present eastern Alaskan slope. Abundant representatives of *Azonia* should be found among the Maestrichtian deposits of the Canadian Arctic Islands. A counterclockwise rotation of Alaska has been proposed by Carey and recently expanded by Hamilton in his application of the "plate-tectonic" theory, to explain the origin of the Arctic Ocean. If this rotation took place after the Mesozoic, then typical plant microfossils of the Maestrichtian temperate zone should be found in deposits of this age in northwestern Alaska. Recently, a few *Aquilapollenites* mixed with typical *Normapolles* assemblage have been discovered in Maestrichtian sediments in both northern New Jersey and southwestern Tennessee. It is proposed that a line connecting these points and extending farther southwest forms the approximate boundary of the subtropical-tropical zones of the North American continent. Numerous *Normapolles* in the Late Cretaceous sediments of both the Gulf and East coasts of the United States strongly support its climatic correlativeness with similar aged deposits of Europe and the southern parts of the USSR.

South of the proposed Maestrichtian tropical zone of both North America and Eurasia lies a vicarious subtropical assemblage that is markedly different from that of the subtropical zone on the north. It contains such unique form-taxa as *Constantimisporis, Victorisporis, Andreisporis,* and *Pediculisporis.* This assemblage, in addition, contains some Triprojectacites pollen which also have been found in Libya, Senegal, Gabon, and Somalia. In the western hemisphere, representatives of Triprojectacites have been found in both Jamaica and Brazil. The forms in the Brazilian Maestrichtian are not assignable to any of the presently described form-genera of the Triprojectacites and it is postulated that these pollen producing plants are "end-products" resulting from geographic isolation. Older Cretaceous sediments in Brazil should yield the more familiar Triprojectacites pollen representing the ancestors of these Maestrichtian plants.

It is believed that the proposed intermediate Maestrichtian tropical belt was a formidable barrier to plant migration inasmuch as each of the subtropical belts contains markedly different plant microfossil assemblages. At present, the presence of some northern elements in the southern assemblages can be explained best by Simpson's "sweepstake route" theory in which crossing of barriers by various organisms is largely a matter of chance, determined almost randomly. The actual mechanism, or mechanisms, of seed transport is not known.

Clearly, more comparative palynologic research on Late Cretaceous plant microfossil assemblages of Europe, the USSR, and North America is needed. Investigation of Late Cretaceous deposits in key geographic areas where very little or no information on plant microfossils is presently available, such as the Canadian Arctic Islands, Greenland, the Caribbean, Brazil, and parts of Africa, is necessary before the details of the general trends of Late Cretaceous paleogeography and paleoclimatology can be realized.

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SUPPLY AND DEMAND APPLIED TO NORTH AMERICAN ARCTIC

This paper concentrates on the economic potentialities of petroleum production from Alaska and other possibly productive areas in the North American Arctic regions. Basic distinctions are made between economic and geologic potential, and between exploration, development, and production costs for petroleum. Further distinctions are drawn between fixed and variable costs, between short run and long run costs, and between those expenditures which represent outlays for