DIFFERING HISTORIES OF EOCENE ANGIOSPERM DIVERSITY IN EASTERN NORTH AMERICA AND WESTERN EUROPE: DEPENDENCE ON PALEOGEOGRAPHY

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Studies of Eocene angiosperm pollen floras in eastern North America (my work, especially in the eastern Gulf Coast) and western Europe (Boulter, Krutzsch) have shown significant differences in floral diversities between the two regions: in western Europe, maximum diversity was in the early Eocene and it decreased thereafter; in eastern North America, maximum diversity was in the middle part of the middle Eocene. The hypothesis presented here is that paleogeography was an important control on the diversity histories in the two regions: eastern North America was part of a large terrestrial landmass, whereas the terrestrial depositional basins of western Europe were on islands or peninsulas surrounded by the sea. Migrations between eastern and western North America were relatively easy, but migrations within what is now western Europe involved island-hopping, which explains distinct diachroneity of some angiosperm first appearances among different basins there. Western European basins were in contact with a large land mass during late Paleocene time but became isolated and smaller during the middle to late Eocene marine transgression. These changes resulted in decreased genetic exchange and increased probabilities of extinction due to (1) greater competition among species because of a reduced number of niches and (2) presence of small, isolated species populations, leading to local variations in extinctions, which probably explain the observed diachronism of taxon last appearances in different areas of Europe. Terrestrial climatic cooling in western Europe may be linked to decreasing contact between the NW European Tertiary Basin and the warm Tethys Seaway during the middle and late Eocene. In short, some combination of low environmental heterogeneity, geographic isolation, and long-term climatic deterioration probably caused the decrease in angiosperm diversity during the middle and late Eocene in western Europe.

Several factors encouraged increasing or stable diversity in eastern North America but were far less effective in western Europe: (1) Eastern North America underwent greater climatic fluctuations during the Eocene (thus, immigration of taxa with different climatic preferences took place at different times), whereas the islands and peninsulas of western Europe had more uniform, maritime climates. (2) Evolution and immigration of r-selected taxa in eastern North America were favored by distinct dry seasons at certain times during the Eocene and by repeated marine transgressions and regressions that created opportunities for evolution and immigration of r-selected plants on and to freshly exposed coastal plain. In contrast, the predominantly maritime climates of western Europe in the early and middle Eocene favored K-selected plants, which had fewer possibilities for evolution and which had greater difficulty in migrating because island-hopping taxa are mainly r-selected. (3) "Arcto-Tertiary" taxa adapted to cooler climates lived and evolved in the uplands of the Appalachian Mountains, whereas western Europe was relatively flat in the Eocene -- another example of its relative lack of environmental heterogeneity.