

CONTRIBUTIONS TO THE MARSHALL LAMBERT SYMPOSIUM

THE LATE CRETACEOUS (MAASTRICHTIAN) FLORA OF THE HELL CREEK FORMATION IN SOUTHWESTERN NORTH DAKOTA

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The valley of the Little Missouri River in southwestern North Dakota contains extensive exposures of the Late Cretaceous Hell Creek Formation. While the Lancia-age vertebrate fauna from the Hell Creek and time-equivalent Lance Formation is well known from several localities in central and eastern Montana, Wyoming, southwestern North Dakota, and western South Dakota, extensive recovery of plant macrofossils has only occurred in southwestern North Dakota. Fossil plants were collected here in the late 1930s by Roland Brown from the U.S. Geological Survey (USGS) and by Erling Dorf and students from Princeton University. Since 1981, I have collected fossil plants from the 110-meter-thick Hell Creek Formation and overlying Paleocene Ludlow Member of the Fort Union Formation (Ludlow and Slope Formations of North Dakota Geological Survey usage). Over 12,000 specimens have been collected from 36 Ludlow and 66 Hell Creek quarry sites in Slope and Bowman Counties. The fossil plant specimens are housed at the Yale Peabody Museum in New Haven, Connecticut, and the Denver Museum of Natural History. The 102 plant quarries occur in a lithostratigraphic framework based on over 40 measured stratigraphic sections calibrated to the geochronologic time scale using magnetostratigraphy (paleomagnetic analyses by Lisa Tauxe, Dave Clark, and Jason Hicks indicate that the Hell Creek Formation represents the last 2-3 million years of the Cretaceous in North Dakota). Palynology is the most precise technique for locating the Cretaceous-Tertiary (K/T) boundary in terrestrial rocks. Douglas J. Nichols (USGS) has studied the palynomorphs of the sections in Slope and Bowman Counties. The K/T boundary near Marmarth lies near, but not exactly at, the Hell Creek-Ludlow formational contact. The K/T boundary is marked by the extinction of dinosaurs and very high levels of plant extinction (30 percent of the palynomorphs and 80 percent of the leaf morphotypes). At Pyramid Butte, north of Marmarth, the palynological K/T boundary is associated with an iridium anomaly and shocked mineral grains.

The megaflora of the Hell Creek Formation is dominated by flowering plants (angiosperms) which account for approximately 90 percent of both species and specimens. The remaining 10 percent of the flora is composed of conifers, cycadophytes, ferns, sphenopsids, and bryophytes. A large percentage of the flora has not yet been formally described. Distinct floral changes occur within the Hell Creek Formation. The upper 20 meters of the formation has a flora that is very different from the flora of the lower 90 meters. The composition of the Hell Creek flora, as a whole, contrasts dramatically with slightly older Cretaceous floras such as those from the Meeteetse (Early Maastrichtian), Judith River (Campanian), and Two Medicine (Campanian) Formations and with the younger floras of the Fort Union (Paleocene) Formation. The older floras have a much higher relative proportion of conifers, cycadophytes, and ferns. The younger Fort Union floras have the same relative proportion of major plant groups but a completely different species composition and a much lower species richness.

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On the basis of these paleobotanical studies, the Denver Museum of Natural History is presently building a 1300-square-foot reconstruction of a forest that represents the flora of the upper part of the Hell Creek Formation. This exhibit will require fabrication of approximately 70,000 leaves (and even a few dinosaurs), and will open to the public in late 1995.
