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A Farmdalian Pollen Diagram From East-Central Iowa

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Pollen analysis of the Butler Farm buried peat in east-central Iowa suggests that a spruce-pine forest grew in the area during the Farmdalian Substage. Pine decreased and spruce increased in dominance as the peat accumulated. Radiocarbon dates indicate that the peat was deposited from 28,800 to 22,750 RCYBP. It is overlain by late Wisconsinan loess and underlain by a Sangamon paleosol developed on Illinoian till. The regional pollen data suggest a general cooling trend through Farmdale time.
INDEX DESCRIPTORS: Farmdalian Interstade, Iowa, Paleoclimatology, Paleoecology, pine, pollen, spruce.

During the investigations of the loess stratigraphy and soil geomorphology in Muscatine County, Iowa, buried peats were encountered at several sites. The thickest peat was analyzed for pollen. This is the first pollen record of Farmdalian age reported from this area of Iowa.

The site is located on the farm of Joe Butler about 11 km east southeast of Wilton, Muscatine County (SE¼, SE¼, sec. 14, T. 78 N., R. 1 W.) at an elevation of 236 m. (Fig. 1). It is on the broad, flat upland surface of the Illinoian till.

STRATIGRAPHY

The upland area around the site is mantled with Wisconsinan loess and eolian sand ranging from 5.2 to 6.5 m thick overlying peat or the Sangamon paleosol developed on Illinoian till. A detailed description of the stratigraphy is included in the Appendix.

POLLEN ANALYSIS

The Butler Farm buried peat was sampled at 4 cm intervals. The humic-gley paleosol at the base of the peat was also sampled but no pollen was found. Pollen was extracted following Faegri and Iversen (1975) and was mounted in silicone oil. More than 300 grains were counted from each sample.

The radiocarbon dates place the age of the peat within the Farmdalian Substage (Interstade) of Illinois (William and Frye, 1970). This substage occurs between the Altonian and Woodfordian substages of the Wisconsinan Stage and dates of approximately 28,000-22,000 years ago. The Farmdalian was a period when ice retreated from Illinois and the lower Great Lakes. It apparently corresponds to the last part of a complex mid-Wisconsinan interstadial as described in the eastern Great Lakes (Dreimanis and Goldthwait, 1973).

Throughout the Farmdalian Substage, pollen deposition at the Butler Farm site was dominated by *Pinus* and *Picea* (Fig. 2). *Abies* was present but generally in quantities less then 1%. *Larix* was deposited continuously near the top of the peat and intermittently near its base. *Betula* pollen has a maximum of 10% but generally was present in values of less than 5%. The pollen of thermophilous taxa (e.g. *Quercus, Fraxinus pennsylvanica,* and *Platanus*) sporadically occurred in low percentages throughout the peat. Cyperaceae pollen was the most common anemophilous herb type. Non-arboreal pollen (NAP) percentages were rarely greater than 30% and were commonly less than 20% of total pollen.

The pollen diagram (Fig. 2) is not divided into pollen assemblage zones. *Pinus* values are higher than *Picea* near the base of the diagram while the opposite is true at the top. The transition is gradual and continues with minor reversals throughout the diagram. Confidence intervals after Maher (1972) are added to the *Picea* and *Pinus* curves. These 0.95 confidence limits indicate that some percentage changes between levels are statistically significant but apparently show no correlation with other pollen percentage changes.

The increase in *Betula* pollen near the middle of the diagram corresponds to an absence of *Larix* pollen and a decrease in *Abies* pollen percentages. *Ambrosia, Artemisia,* and Rosaceae are also more common near the middle of the diagram. These changes are subtle, however, and probably without important climatic significance.

REGIONAL POLLEN RECORDS

Results from three other Iowa sites corroborate the results at Butler Farm. (1) A similar sequence occurs in a buried peat in Blackhawk County, Iowa, which dates between ca. 34,000 and 20,000 RCYBP. This site reveals *Pinus*-NAP zone older than the *Pinus-Picea* assemblage (Mundt and Baker, 1979). (2) Larch wood with peat from near Hancock in Pottawattamie County, Iowa, was dated at 24,500± 800 RCYBP (W-141; Ruhe, 1969). The pollen from the Hancock County peat was sparse and not well preserved. The pollen counts of the best sample from near the top of the peat showed 46% *Picea* and 34% *Pinus*. (3) Lane (1941) also showed high spruce and pine pollen percentages (32-91%) from peats near Wapello, Louisa County, Iowa. He considered the Louisa County deposits to be Sangamon peats. However, they are now considered Wisconsinan, and radiocarbon dates from correlative peats nearby are 23,750± 600 (I-1865) and 23,050± 820 RCYBP (OWU-167) (Ruhe, *et al.,* 1968).

E. Gruger (1972b) presented a pollen diagram (Richland Creek profile I) from peat overlying Roxana silt and underlying Morton loess in Woodford County, Illinois. By stratigraphic definition the Woodford County peat is the Robein silt presumed to be Farmdalian in age (Willman and Frye, 1970). This site is only 120 km east of the Butler Farm site (Fig. 1). Gruger's (1972b) diagram for it resembles the Butler Farm diagram. High *Pinus* percentages near the base of the diagram are replaced by high spruce near the top. NAP, mainly Cyperaceae, formed 25-35% of the pollen rain and thermophilous deciduous species generally less than 5%.

DISCUSSION

The pollen diagram suggests that *Pinus* and particulary *Picea* were the dominant trees near the deposition site during the Farmdalian substage. *Pinus* pollen was more abundant near the beginning of the interstade, but by approximately 24,000 RCYBP *Pinus* was decreasing in the area while *Picea* trees were becoming more numerous. *Larix* and *Abies* trees were also constituents of the forest.

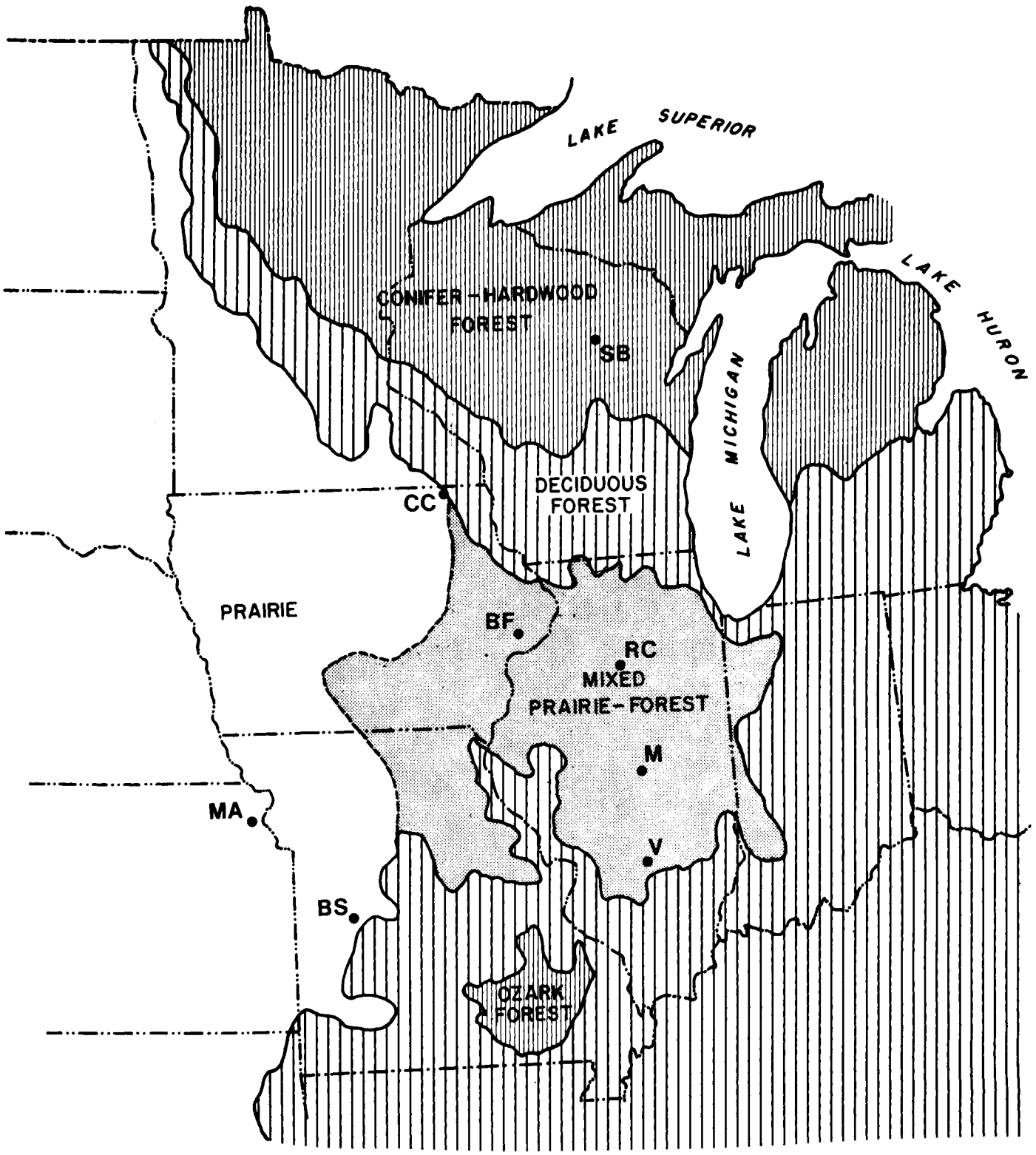

Figure 1. Regional vegetational map showing site locations. BF= Butler Farm, Muscatine Co.; RC= Richland Creek, Woodford Co.; M= Macon County; V= Vandalia, Fayette County; BS= Boney Spring, Benton County; MA= Atchison County; SB= Schelke Bog, Lincoln Co., CC= Cold-water Cave.

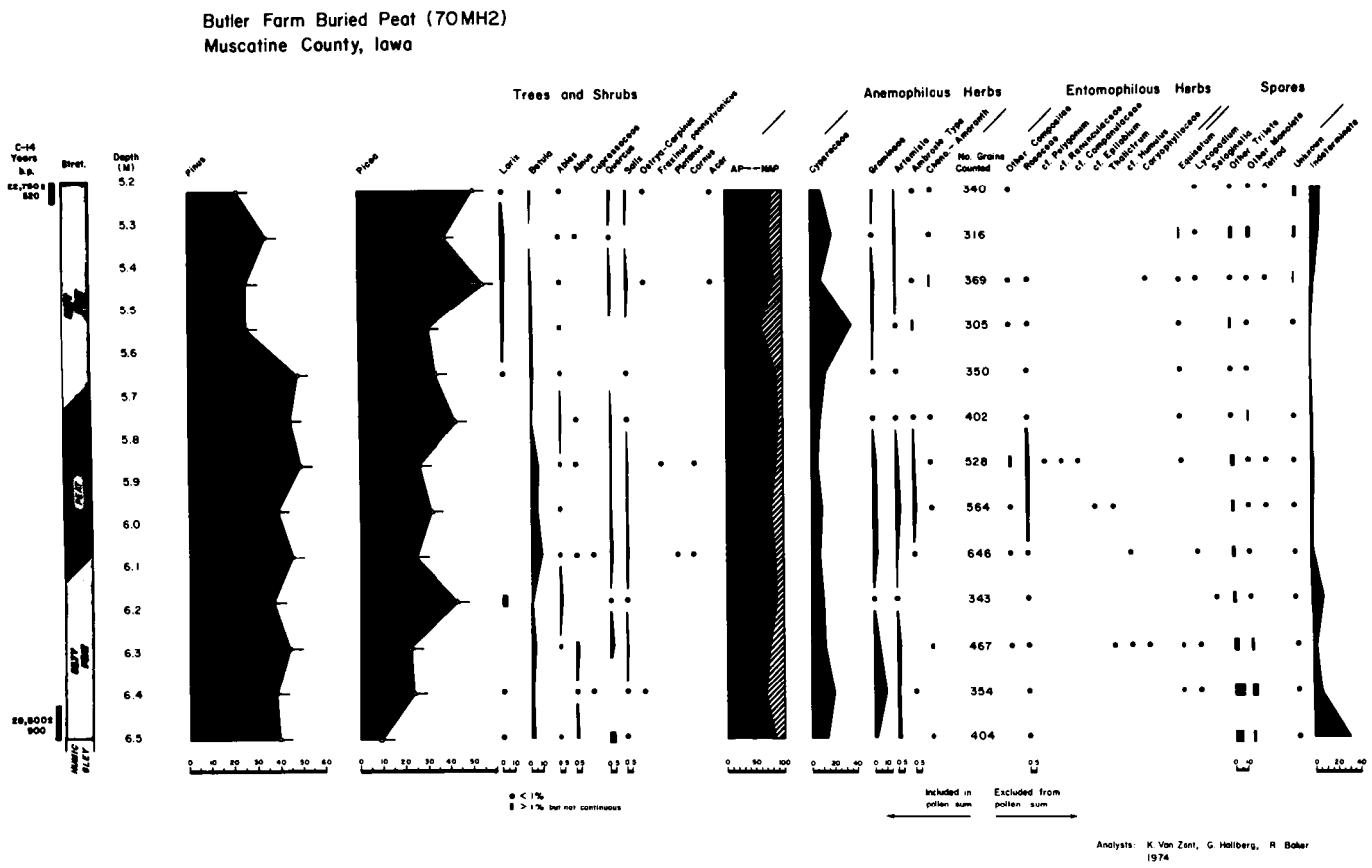

Figure 2. Pollen percentage diagram of the Butler Farm Buried Peat.

Betula, Alnus, and *Salix* were present, or else their pollen was transported by wind into the area. Between approximately 27,000 and 26,000 RCYBP, assuming constant rates of deposition, *Betula* trees increased in abundance. Occasional grains of *Ostrya/Carpinus, Fraxinus pennsylvanica*-type, *Platanus, Acer,* and the fairly continuous presence of *Quercus* suggest that thermophilous species grew at not too great a distance.

Modern surface pollen samples from closed boreal forest in Canada (Lichti-Federovich and Ritchie, 1968) have the following characteristics in common with Butler Farm samples: (1) percentages of *Pinus* and *Picea* pollen generally comprise 70-80% of the pollen sum; (2) Ericaceae pollen is rare or absent; (3) neither *Betula* nor *Alnus* pollen exceed values of 10%; and (4) nonarboreal pollen and the pollen of broad-leaved deciduous trees other than birch are generally present in frequencies less that 2%. Butler Farm samples have fewer characteristics in common with modern samples from other vegetation zones, such as open coniferous forest-tundra (Lichti-Federovich and Ritchie, 1968), grassland-forest transitions (Lichti-Federovich and Ritchie, 1965), or samples from farther east in North America (Davis, 1967).

Comparisons with Davis and Webb (1975) suggest that at the beginning of pollen deposition the pollen rain was similar to the modern pollen rain along the north slope of Lake Huron. At the end of the Farmdalian the pollen percentages compare more favorably with those from the south edge of James Bay. Currently these areas of Canada are northern transitional forest or boreal forest (Davis and Webb, 1975).

These comparisons suggest that the vegetation in Muscatine County during the Farmdalian was closed coniferous forest or northern transitional forest.

Two diagrams from Macon County, Illinois (Fig. 1), indicate that *Picea* increased in percentages throughout Farmdalian time and eventually replaced *Pinus* as the most common pollen type (E. Gruger, 1972b). Farther south in Illinois near Vandalia in Fayette County (Fig. 1), *Picea* pollen appeared in small quantities throughout Farmdalian time and increased in abundance near the end of the substage as *Pinus* percentages dropped. Spruce probably did not grow in Fayette County until about 21,000 RCYBP (E. Gruger, 1972a). Gruger (1972b) postulated a boreal coniferous forest in northern Illinois, giving way toward the south to a transitional region with pine, and a prairie and oak-hickory forest during the substage.

A similar shift from high pine to high spruce percentages occurred in Lincoln County, Wisconsin, after 40,800 RCYBP in Schelke Bog (Fig. 1) (Dirlam, 1974). If these percentages represent a migration of pine out of northern Wisconsin, then this may be the same event recorded at Butler Farm, Richland Creek, and Macon County, Illinois, during the Farmdalian substage. The decline in pine at Schelke Bog may, however, represent an earlier fluctuation in *Pinus* abundance.

Pollen diagrams from Missouri and Kansas cover the same time period. King's (1973) diagram from Boney Spring, Benton County, Missouri, shows NAP and pine dominance from greater than 40,000 RCYBP until approximately 20,000 to 25,000 RCYBP when spruce pollen dramatically increased in abundance. The vegetation was interpreted as an open pine parkland which changed abruptly to spruce forest (King, 1973).

Two diagrams from Atchison County, Kansas (Fig. 1) indicate that the late Farmdalian pollen rain included relatively high percentages of *Alnus, Salix,* and *Betula* with smaller percentages of *Pinus* and *Picea* (J. Gruger, 1973). These percentages, when compared to modern pollen rain from southern Manitoba and Saskatewan, suggest that the vegetation was similar to the present grassland-boreal forest transition in that area (J. Gruger, 1973). The pollen rain changed about 23,000 RCYBP to high percentages of *Picea* and a decrease in *Pinus* percentages, indicating the immigration of spruce trees.

CLIMATIC INTERPRETATIONS

Recent interpretations of oxygen isotope analysis of speleothems from Coldwater Cave in northeast Iowa indicate a pronounced warming of the climate between 32,000 and 25,000 years BP (Harmon, *et al.*, 1979). The available pollen evidence does not support this hypothesis. The Butler Farm and the regional pollen records indicate that the Farmdalian was cool and moist. There is no evidence of a warming trend, and in fact there appears to be a general cooling trend through the substage. With the cool, moist boreal conditions of the Farmdale, and the lack of loess deposition (because of ice retreat), conditions were optimal for the widespread development and preservation of organic soils and deposits in the Midwest.

APPENDIX

A detailed description of the stratigraphy is as follows:

0.0-1.0 m	Modern solum.
1.0-1.4 m	Oxidized and leached loess.
1.4-2.2 m	Oxidized and unleached loess.
2.2-4.7 m	Oxidized and unleached eolian sand; gradual lower boundary.
4.7-5.2 m	Unoxidized and unleached eolian sand with thin silt (loess) interbeds; distinct lower boundary.
5.2-5.7 m	Black (N2/0) silty peat, some fibrous material and wood fragments; 5.2-5.26 m dated at 22,750± 520 (I-7296) radiocarbon years before the present (RCYBP); gradual lower boundary; IOalb horizon of complex buried soil.
5.7-6.1 m	Black (N2/0; 10YR2/1), as above but with less mineral matter; gradual lower boundary; IOa-Oe2b horizon of complex buried soil.
6.1-6.5 m	Black (N2/0; 10YR2-3/1) silty peat, as above but with more mineral matter; abrupt lower boundary; 6.4-6.5 m dated at 28,800± 900 RCYBP (I-7698); IOa3b horizon of complex buried soil.
6.5-7.0 m	Greenish-gray (5G-5GB 4/1) silty clay, with a few pebbles; pronounced fine angular blocky structure with clay coatings; leached, swale-fill sediments; IIB2b, partially truncated humic-gley Sangamon paleosol.
7.0-7.5 m	As above, silty clay loam grading to clay loam; grades to massive structure; leached swale-fill sediments; abrupt lower contact; IIB3b and Cb of humic-gley Sangamon paleosol.
7.5-8.0 m	Mottled-oxidized and unleached, Illinoian till.

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