A PRELIMINARY POLLEN ANALYSIS OF THE EAST McCULLOCH PEAT BED.*

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This paper reports the results of a preliminary study of a column of peat taken from the East McCulloch peat bed in northern Iowa. The object of the completed study will be to reconstruct the course of post-glacial climate in that region. The present report must of course be regarded as subject to future modification and correlation.

The percentages of pollen found preserved at successive depths of the peat bed have been taken to indicate the composition of the vegetation about the bog when successive strata of peat were formed. Changing percentages of pollen are construed as suggesting a changing vegetation and a corresponding change in climate.

THE PEAT BED.

The East McCulloch peat bed lies in Section 32, Twin Lake Twp. (Twp. 94 N, R 24 W) Hancock county, in north central Iowa. It covers an area of perhaps eighty acres. The bog was drained in 1920.

Hancock county lies near the eastern edge of the area once covered by the Wisconsin glacier. The soil survey of Wright county (1) (just south of Hancock county) describes the topography of that county as follows: "The country has two general types of topography, a relatively smooth till plain and a morainic hilly region. A line drawn from the center of the northern boundary of the county to a point on the southern boundary about five miles west of the southeast corner will roughly divide the till plain on the west from the morainic hills on the east." The soil survey of Hancock county is not yet available but the range of morainic hills mentioned extends on northward into this county. The East McCulloch peat bed lies about a mile within these hills.

Presumably, these hills mark a period of slow recession with numerous readvances of the glacial ice while the comparative

*Contribution from the Botanical Laboratory of the University of Oklahoma, N. S. No. 10.

smoothness of the till plain would suggest rapid melting. Since the East McCulloch peat bed lies just within these morainic hills, its pollen record may be expected to include most of the period following the beginning of the rapid retreat of the ice.

MATERIALS AND METHODS.

Samples were taken during the summer of 1929 with a Davis peat sampler at six inch intervals through the depth of the peat bed. These were temporarily wrapped in newspaper

TABLE I.

FOSSIL POLLEN BY PERCENTS FOR EACH FOOT OF DEPTH IN McCULLOCH BOG.

	Top	1′	2′	3′	4′	5′	6′	7′	8′	9′	10′	11′	12′	13′	14′	15′
Abies	1	....	....	3	2	1	....	....	....	1	5	16	....	**24**	....	11
Acer	....	....	....	....	1	....	....	....	....	....	1	....	....	....	....	....
Amaranthaceæ and Chenopodiaceæ	6	....	3	**32**	**32**	**37**	5	11	**21**	**17**	6	....	....	....	....	....
Betulaceæ	....	....	1	1	....	....	....	....	1	1	11	**28**	....	**16**	....	1
Carya	....	....	....	1	3	....	4	2	5	5	5	....	....	1	....	....
Compositæ	1	4	7	1	3	....	3	1	4	7	3	1	....	3	....	2
Cyperaceæ	21	4	....	7	14	7	7	10	8	7	6	3	....	1	....	....
Fagus	....	....	....	....	....	....	....	....	....	....	1	1	....	....	....	....
Gramineæ	**39**	**74**	**70**	**33**	**24**	**35**	**69**	**60**	**23**	**17**	13	14	....	5	....	3
Juglans	....	....	....	....	....	....	....	....	....	....	1	....	....	1	....	....
Picea	1	....	2	1	1	....	....	1	1	1	1	8	....	**20**	....	**69**
Pinus	1	4	1	1	2	3	1	1	4	5	4	1	....	6	....	11
Potamogeton	1	....	....	1	1	1	....	....	....	....	1	....	....	....	....	....
Quercus	3	5	4	2	6	4	3	4	**20**	**27**	**28**	14	....	11	....	3
Salix	1	....	3	1	2	....	....	2	2	1	....	....	....	7	....	..
Sparganium	5	1	....	1	1	10	....	1	2	....	3	4	....	....	....	....
Tilia	....	....	....	....	1	....	....	....	1	....	1	....	....	....	....	....
Typha	....	....	1	....	1	1	....	....	....	1	1	....	....	1	....	....
Ulmus	....	....	....	....	....	....	....	....	....	....	1	1	....	1	....	....
Unknown	20	8	9	16	7	2	8	8	9	11	9	9	....	4	....	1

and later transferred to one half pint tin paint cans and treated in a pressure cooker to prevent bacterial action. When opened in the laboratory the samples were in perfect condition.

Separation of the pollen from the peat was accomplished in the usual way (3). All reagents used were filtered.

The determinations of the pollen were made with the aid of the key and drawings of Sears (2). Dr. Sears' personal collection of fresh pollen slides was also very helpful in many cases. In a great many instances the oil immersion lens was resorted to for identification of the pollen. For such forms as

Quercus, *Salix*, *Acer*, and in many cases the Gramineæ, the oil offered means of certain identification when the 4 mm. lens left some doubt.

RESULTS AND DISCUSSION.

Table I is a complete list of all pollen counted from the peat core. Each six-inch level was studied separately and the resulting numbers were totaled for each foot of depth. At least one hundred pollen grains were counted from each six-inch level. The presence of spores of Fungi, Bryophytes, and Pteridophytes was noted but they were not included in the total on which the percentages were based.

The groups which appear in greatest numbers at each level are indicated by bold faced type in each depth column.

Figure 1 is a diagram showing relative abundance of pollen of different taxonomic groups at each depth.

At fifteen feet spruce pollen is most abundant with other conifers making up most of the rest of the pollen found. Spruce diminshes greatly at thirteen feet but maintains parity there with fir and birch which have increased greatly. Birch forges to the front in quantity of pollen at eleven feet while fir is disappearing and oak and grasses appear in moderate quantities. At the ten and nine foot levels birch, spruce, and fir are markedly on the wane while oak appears in increasing quantities. In the nine foot level amaranthaceous pollen makes its first considerable appearance. Amaranth reaches major proportions in the eight foot level while oak is diminishing and grass remains practically constant. At the seven and six foot levels grass pollen becomes the major constituent and amaranth pollen is considerably less abundant. All tree pollen is comparatively rare in the seven foot and succeeding levels. At five, four, and three feet amaranth pollen again becomes a major part of the pollen found but it again disappears in the three upper levels as grass pollen again increases.

Assuming these pollen percentages to represent the composition of the vegetation the changes shown in this peat bed are—(1) spruce forest, (2) mixed fir, birch, and spruce, (3) birch with fir and oak, (4) oak with birch and grasses, and (5) grassland vegetation from here up with a strong semi-arid element at the nine to eight foot levels and again at the five to three foot levels.

Again assuming that these vegetation units have been dependent in the past on the same climates that control them

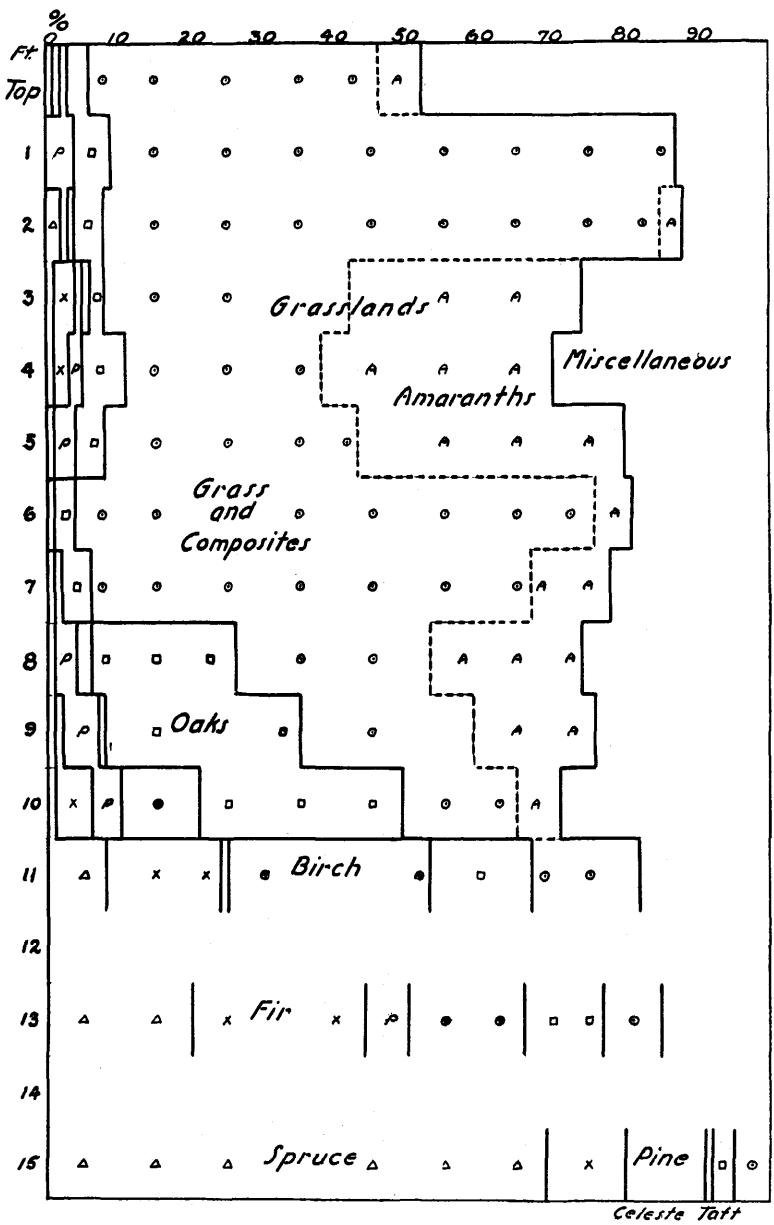

FIGURE 1.
Porportions of different fossil pollen at successive depths.

today we may draw three climatic inferences from this succession of vegetation, (1) warming influences which accompanied the change from coniferous to deciduous forms through the lower quarter of the peat bed; (2) gradual dessication of the climate through the lower half of the peat bed culminating at eight feet; and (3) continuous grassland climate from this point onward with a second period of dessication which reaches a maximum about the four foot level.

In figure 2 the pollen of each genus or family is graphed in columns representing their probable climatic preference.

The following table presents this grouping:

TABLE II.

ASSUMED CLIMATIC SIGNIFICANCE OF FOSSIL POLLEN.

UNKNOWN	LAKE MARGIN PLANTS	CONIFEROUS FOREST CLIMATE			DECIDUOUS FOREST CLIMATE			GRASSLANDS CLIMATE	
		Moist	?	Dry	Moist	?	Dry	?	Dry
	Cyperaceæ Potamogeton Salix Sparganium Typha	Abies	Picea	Pinus	Acer Fagus Juglans Tilia Ulmus	*Betulaceæ Quercus	Carya	Gramineæ Compositæ	Amaranthaceæ

The climatic shift suggested above is borne out in the chart, Fig. 2. Coniferous pollen is of little importance above eleven feet. Herbaceous pollen is most abundant above nine feet. Deciduous tree forms are important only in the eleven to nine foot levels. Correlated with sharp increases in the "Grassland-Dry" column are sharp increases in the column "Lake Margin Plants." It would be expected that climatic dessication would result in lowering lake levels and an increase in these plants. Increase in the latter in the "Top" level where there is no corresponding increase in the "Grassland-Dry" column is largely Cyperaceæ pollen and is probably a result of draining the bog.

That the phenomena indicated above the thirteen foot level are to be correlated with the two dry post glacial periods postulated by Auer (5) and Sears (4) appears likely from the fact that this column runs well back into the post glacial coniferous forest period.

*The Betulaceae may with some reason be regarded as indicators of a cool dry phase of the deciduous forest climate. This is consistent with their position in the accompanying charts and agrees with results obtained in Indiana, shortly to be published.—P. B. S.

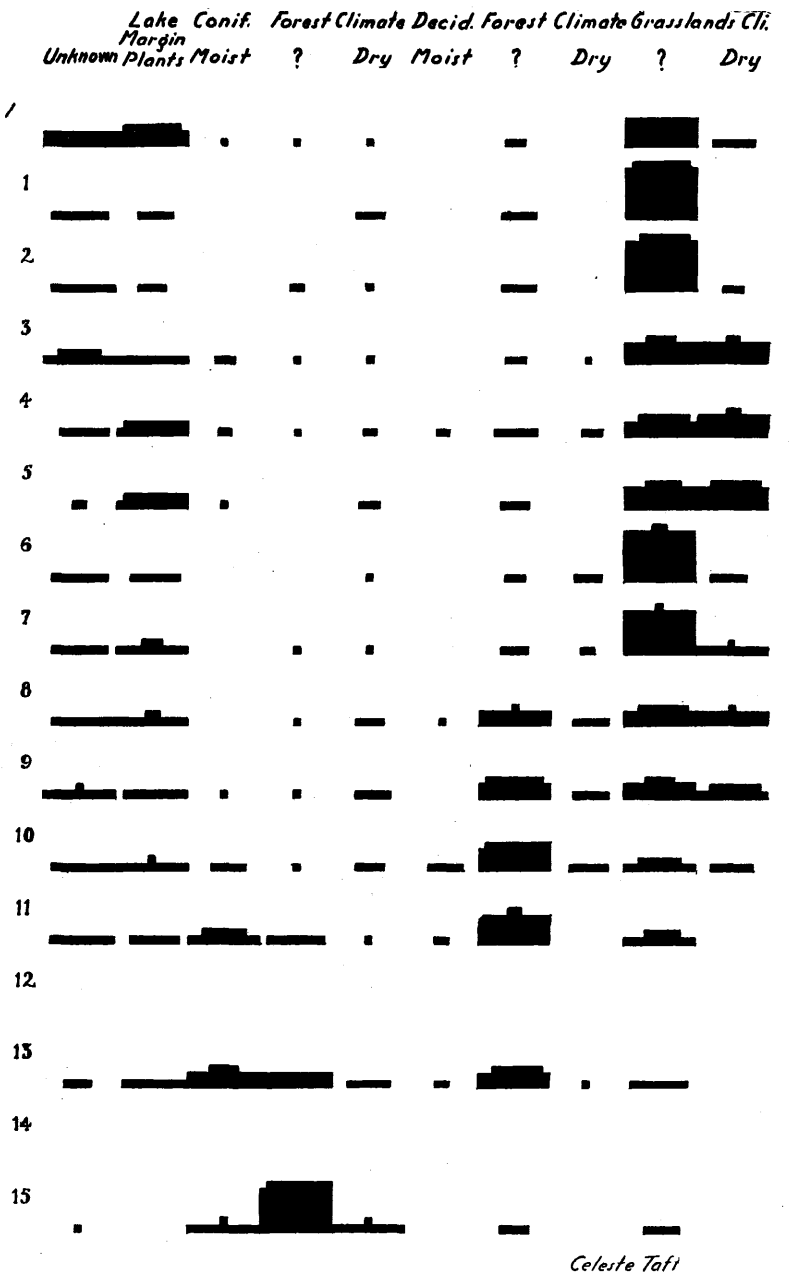

Fig. 2. Proportions of different fossil pollen at successive depths, grouped by probable climate significance.

Above eight feet but little tree pollen is to be found though there is some in each level. Each genus varies from level to level but these variations are of too low an order to be regarded as significant. There is no indication from this study that the forest is replacing grassland in Iowa. It would seem, on the other hand, that the status of the Iowa Prairie as a climax formation would be strengthened since it appears to have developed in the place of a former forest as a response to present climatic conditions.

SUMMARY.

1. Pollen analysis has been applied to the study of peat from the East McCulloch peat bed in south central Hancock county, northern Iowa.

2. Fossil pollen found suggests the following succession of vegetation: (a) Spruce at 15 ft., (b) fir with spruce and birch at 13 ft., (c) birch with fir and oak at 11 ft., (d) oak at 10 and 9 ft. with entrance of herbaceous forms at 9 ft., (e) grasslands from 8 ft. upward with considerable amaranthaceous flora at the 8 ft. and at the 5, 4, and 3 ft. levels.

3. Climatic changes inferred from changes in the vegetation are, (a) warming from 15 ft. to 10 ft., (b) gradual drying from 15 ft. to 8 ft., and (c) grassland climate above 8 ft.—of distinctly arid type at the 8 ft. and at the 5, 4, and 3 ft. levels.

4. No indication was found of recent increase of forest although recent conditions appear to be more humid than those of the 3 ft. level.

The author desires to acknowledge his indebtedness to Mr. W. H. McCulloch for the freedom of his farm and for assistance in collecting samples and particularly to Doctor Paul B. Sears, who suggested the problem, for his help and encouragement throughout the course of the investigation.

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