PRELIMINARY REPORT ON THE PALEO-ECOLOGY OF A WISCONSIN AND AN ILLINOIS BOG

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INTRODUCTION

An important line of research and one which during the past fifteen years has received the attention of many European botanists, is known as pollen statistics or pollen analysis. Fossil pollen found in peat are generally well preserved even after all of the rest of the plant has decayed. Using the method of pollen analysis, workers in this field are able to trace the history of the vegetation which appeared on or near the bogs since their beginning. Up to the present very little work has been done in North America, the only published material to the author's knowledge being that of Auer who worked in southeastern Canada, of Lewis and Cocke who worked in the Dismal Swamp, and Sears who worked in the Erie Basin. It is the purpose of this paper to present a preliminary account of the pollen analysis of two bogs; one located at Antioch, Illinois, and the other at Waupaca, Wisconsin, one hundred fifty miles north of Antioch.

DESCRIPTION OF THE BOGS

The Antioch bog is located about three miles southeast of the city of Antioch, Illinois, in a region which was traversed by an ice sheet of the Late Wisconsin glaciation. It covers an area of about seven acres, and a portion of it is covered with rather heavy tamarack timber growing on a solid substratum. The vegetation also includes the following: *Betula lutea, Betula pumila, Salix discolor, Pyrus melanocarpa, Pyrus americana, Cornus stolonifera, Populus tremuloides, Prunus serotina, Corylus americana, Corylus rostrata, Gaylussacia baccata, Vaccinium vacillans, Trientalis americana, Onoclea sensibilis, Osmunda regalis, Osmunda cinnamomea,* and *Cystopteris fragilis.*

The Waupaca bog is located about two and one-half miles north of Waupaca, Wisconsin, along the tracks of the Waupaca & Green Bay Railroad. Like the Antioch bog it is also within the limits of the Late Wisconsin glaciation. It covers an area of about sixty acres. The

slope of the sides of the depression forming the bog is about forty-five degrees and although the area is small, the bog is deep. Much water is present, and the soft, built-up character of the Sphagnum makes the surface springy and sponge-like. Upon the surface of the bog the following vegetation is found: leatherleaf *(Chamaedaphne calyculata)*, bog rosemary *(Andromeda glaucophylla)*, Labrador tea *(Ledum groenlandicum)*, blueberry *(Vaccinium canadense)*, small cranberry *(Vaccinium oxycoccos)*, boneset *(Eupatorium perfoliatum)*, fireweed *(Epilobium angustifolium)*, three-leaved Solomon's seal *(Smilacina trifolia)*, pitcher-plant *(Sarracenia purpurea)*, buckbean *(Menyanthes trifoliata)*, mountain holly *(Nemopanthus mucronata)*, meadow-sweet *(Spiraea salicifolia)*, tamarack *(Larix laricina)*, black spruce *(Picea mariana)*, white pine *(Pinus strobus)*, American aspen *(Populus tremuloides)*, black willow *(Salix nigra)*, shining willow *(Salix lucida)*, cotton grass *(Eriophorum virginicum)*, Carex *(Carex trisperma)*, *Scheuchzeria palustris*, and *Scirpus lineatus*.

Peat Classification

If pollen statistics receives the attention in America that it has in Europe, a universal system of peat classification should be adopted. It is for this reason that the writer has adopted Auer's system, a pioneer worker in Canada and one whose work is very extensive. Auer divides peats into four groups.

(1) The limnic (lake) group consisting of all material deposited under water.

(2) The telmatic (marsh) group made up of peat that has developed on wet grounds. *Carex*, *Amblystegium*, and *Sphagnum cuspidatum* belong here.

(3) The semiterrestrial group developed under drier conditions than the telmatic. It is generally homogeneous and made up chiefly of *Sphagnum*.

(4) The terrestrial group composed of various forest peat-bog types and always having the remains of trees in it.

Field Work

Samples of peat were obtained by means of a Hiller peat auger (Fig. 1), for the use of which I am greatly indebted to Dr. George Fuller of the University of Chicago, through whom I first became interested in the problem of pollen analysis. The drill consists of eight sections, each about five feet long, the bottom section having an auger

and a chamber in which the peat is collected. The peat chamber is so constructed that, when the drill is rotated in a clockwise direction, the peat chamber is closed. Upon rotating it quickly about eight times in a counter clockwise direction, the chamber is opened, and a solid core of peat is obtained. To close the container the drill is rotated in a clockwise direction. The auger is then pulled to the surface and by means of a spatula or forceps, the material is carefully removed and

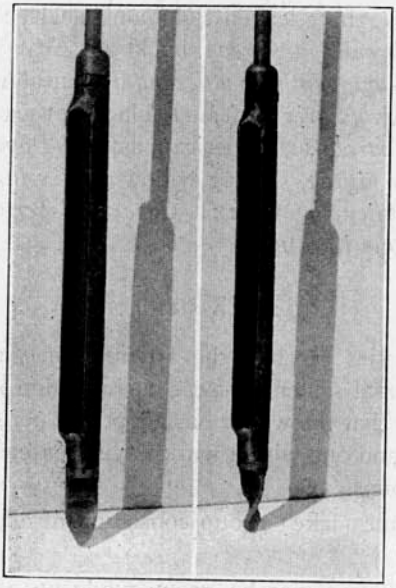

FIG. 1. Hiller peat auger used to collect samples—left, chamber closed; right, chamber open.

placed in numbered glass tubes having a stopper at each end. Borings were made along a line across the longest portion of the bog, the number of drillings and the distance between the drillings depending upon the size of the bog.

LABORATORY WORK

For advice in the method used in the preparation of the microscope slides, the identification, and counting of the pollen, I am greatly indebted to Dr. Fuller of the University of Chicago, Dr. Sears of the University of Oklahoma, and Dr. Erdtman of the University of Stockholm.

Approximately 1 cubic centimeter of material was boiled in ten per cent KOH, centrifuged, decanted, then distilled water was added; it was shaken, and again centrifuged and decanted. By means of a pipette a small quantity of material near the surface of the solid material in the bottom of the test tube was removed and placed on a slide and a warming table, and after most of the water evaporated, glycerine jelly and a cover glass were added. Numerous experiments conducted by Erdtman have shown that reliable percentages are obtained if at least 150 pollen grains are counted in each sample. Figure 2 shows a photomicrograph of a typical slide of treated peat.

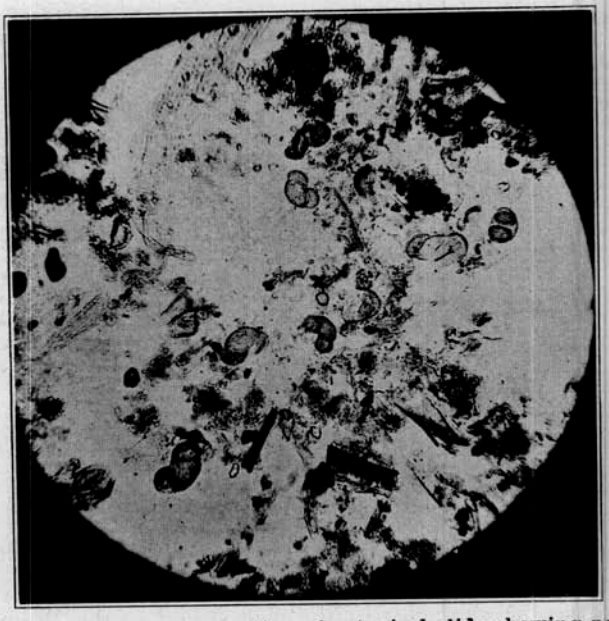

Fig. 2. Photograph of a portion of a typical slide showing pollen grains of some of the conifers.

Results

Figure 3 shows the pollen analysis graph and stratigraphy of the Antioch bog. The numbers to the left represent the depth of the peat in feet and the numbers in the horizontal scale give the percentage of the total tree-pollen. The species of trees are indicated by signs, an index of which is given in the legend. In order to avoid too many lines in the pollen analysis diagram, some of the less common species of trees were omitted.

The bottom one-foot layer consisted of limy ooze. During the early development of the bog, when this material was deposited, Abies and Picea reach their maximum. Above the twenty-one foot level, the peat changes to the limnic type or material deposited under water. In the limnic layer Abies and Picea disappear whereas Quercus, Tilia and Ulmus attain their maximum. Between the ten and eight foot levels the peat is drier and consists chiefly of the remains of plants that grew on wet grounds. Above the eight foot level, the peat is very dry, decomposed, and filled with numerous stumps of trees. As the diagram indicates, Quercus, Tilia, and Ulmus are the predominating trees from the twenty-one foot level to the surface of the bog.

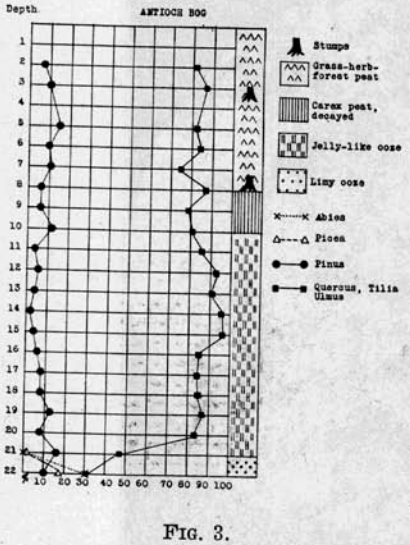

FIG. 3.

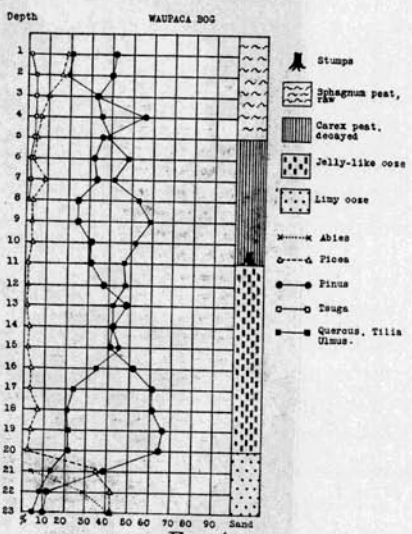

FIG. 4.

Comparing the character of the peat found in the Waupaca bog (Fig. 4) with that of Antioch, one may readily see, as Auer has pointed out in his work on the Canadian bogs, that there are distinct regularities in the stratigraphic development of both bogs. In the Waupaca bog the three foot layer at the bottom consists of the same type of peat found at the bottom of the Antioch bog. Above the bottom three-foot deposit, from the twenty foot level to the eleven foot level, the peat is similar to that above the bottom layer at Antioch. Likewise, decayed Carex peat is found above the limnic peat. The only difference between the two bogs is the presence of a layer of raw Sphagnum peat found above the decayed Carex layer in the Waupaca bog instead of the grass-herb-forest peat as found at Antioch.

As the stratigraphic changes may or may not indicate climatic changes during the post-glacial period, let us compare the pollen diagrams of both bogs for further evidence. It is a well known fact that the distribution of vegetation is dependent upon climatic conditions and according to Auer—"The Pollen content of the successive layers of the individual bogs is a direct indication of the comparative abundance of the different trees growing at the time the peat layers were formed." In the Waupaca bog we find practically the same succession of trees as found at Antioch. Abies and Picea reach their maximum in the bottom layer and are followed by an increase of Quercus, Tilia, and Ulmus in the upper layers.

Considering both sources of evidence, the stratigraphy and pollen statistics, the climatic changes during the post-glacial times may be divided into three periods. The first, when Abies and Picea reached their greatest development, was probably dry and cool. The stratigraphy shows that during the second period a secondary lake spread over the area. The fact that the hardwoods were very abundant, seems to show that the climate was wetter and warmer than during the first or primary lake period.

In both bogs the secondary lakes were overgrown with marsh vegetation. This condition, together with the appearance of tree stumps in this stratum, appears to indicate that the climate during the third period was dry. As Quercus, Tilia, and Ulmus also reached their maximum during this time in the Waupaca bog and likewise were very abundant in the Antioch bog, the climate probably was also warm. The presence of raw Sphagnum in the upper layers of the Waupaca bog may indicate a moist, cool period as Picea slightly increases and the hardwoods decrease.

Whether or not the data presented shows climatic changes since the last glacial invasion, it at least shows the succession of vegetation since that time. In this connection it is of interest to compare the data with some of the theories advanced regarding post-glacial migration of plants. One of the best appeared almost thirty years ago in Transeau's paper dealing with bog plant societies. Figure 5, from Transeau's article, shows the present distribution of the forests, prairies, and plains. What happened to the vegetation when the glaciers covered the northern half of North America, he pictures in Figure 6. In front of the glaciers the vegetation consisted of the tundra type similar to that found at the present time in Greenland and Alaska. South of the tundra, it is likely that the northern conifers appeared, followed by the deciduous forest and southern conifers.

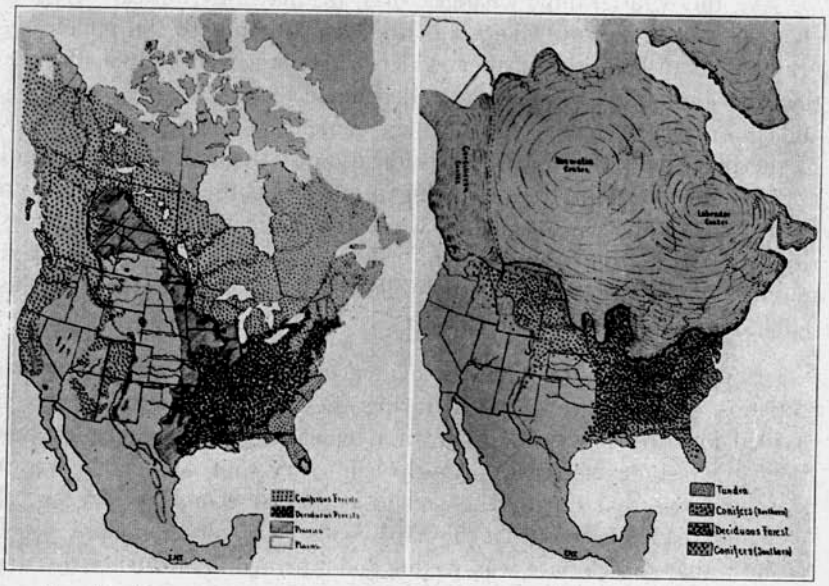

FIG. 5. *(Left)* **Map showing present distribution of forest, prairie, and plains. (After Sargent, 10th Census, Vol. 9.)**

FIG. 6. *(Right)* **Map showing hypothetical distribution of forests and tundra during maximum glaciation of the Wisconsin Epoch. (After Transeau Bot. Gaz., Vol. 36.)**

SUMMARY

1. The Waupaca bog shows four and the Antioch bog three distinct changes in stratigraphic development.

2. The first peat of both bogs was probably formed during a dry, cool period, which was followed by another warm but moist period; as shown by the abundance of broad-leaved trees; this in turn followed by a warm, dry period, and in the Waupaca bog by another apparently cool, moist period.

3. The succession of vegetation appears to have been Abies-Picea, and Quercus-Tilia-Ulmus.

BIBLIOGRAPHY

AUER, VAINO, Peat Bogs in Southeastern Canada, Canada Dept. of Mines, Memoir 162, 1930.

AUER, VAINO, Some Problems of Peat Investigations in Canada, Canada Dept. of Mines, Summary Report, Part C, 1927.

AUER, VAINO, Stratigraphical and Morphological Investigations of Peat Bogs of Southeastern Canada, Helsinki, 1927.

ERDTMAN, G., Literature on Pollen Statistics published before 1927, Geol. Föreningens I Stockholm Förhangl, 196-211, 1927.

ERDTMAN, G., Literature on Pollen Statistics published during the years 1927-1929, Geol. Föreningens I Stockholm, 191-213, 1927.

ERDTMAN, G., Pollenanalytische Untersuchungen von Torfmooren und marinen Sedimenten in Südschweden, Arch. f. Botanik, Bd. 17.

ERDTMAN, G., Pollen-Statistics: A New Research Method in Paleo-Ecology, Science, vol. 73, No. 1893, pp. 399-401, 1931.

LEWIS, L. F. AND COCKE, E .C., Pollen Analysis of the Dismal Swamp, Jour. Elisha Mitchell Sc. Soc. vol. 45, pp. 37-58, 1929.

SEARS, P., A Record of Post-Glacial Climate in Northern Ohio, Ohio Jour. Sci. vol. 30, No. 4, pp. 205-217, 1930.

SEARS, P., Common Fossil Pollen of the Erie Basin, Bot. Gaz., vol. 89, pp. 95-106, 1930.

HUELS, F. W., The Peat Resources of Wisconsin, Wis. Geol. Survey Bull. 45, Economic Series No. 20, 1915.

TRANSEAU, E. N., On the Geographic Distribution and Ecological Relations of the Bog Plant Societies of Northern North America, Bot. Gaz. vol. 36, pp. 401-420, 1903.

WATERMAN, W. G., Bogs of Northern Illinois, Trans. Illinois State Acad. Sci. vol. 16, pp. 214-225, 1923.