POLLEN ANALYSIS OF THE MICHILLINDA PEAT SEAM

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The Michillinda peat seam is exposed along the shores of Lake Michigan, near Muskegon and thus lies about 60 miles north of the South Haven seam studied by Zumberge and Potzger (1955). It consists of about 50 in. of peat lying on gravel and sand over silt and is overlain by dune. The basal layer has been dated at 5250 B.P. (M–473) and the top at 4100±250 B.P. (M–472). It thus represents about 1000 yr of accumulation and approximates, perhaps accidentally, the rate of peat accumulation calculated by Sears and Jensen (1933) for the Erie basin. We are indebted to Professor James Zumberge for the opportunity to study this material, and to the National Science Foundation for financial assistance.

Results of our analysis are shown in detail in table 1. As indicated by the column of total counts, pollen was very scarce in some layers, the peat at certain depths being heavily diluted by sand as shown in figure 3. Carbonized plant remains are also abundant, particularly in the sandy layers, but whether they are due to fire or decomposition (muck formation) we cannot say. Our main conclusions have been drawn from those spectra representing a count of more than 100, although in general the lower counts confirm the higher ones.

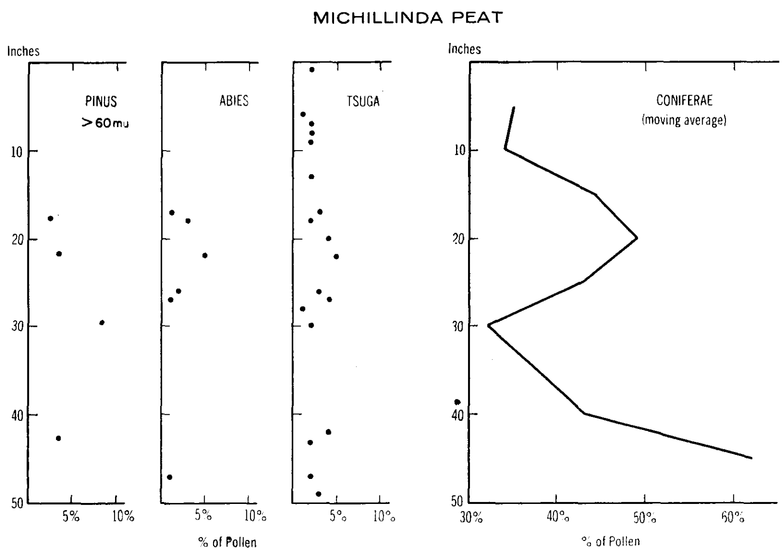

FIGURE 1. Decreasing trend of conifer pollen. Abundance at 20 in. due to mesophytic Abies and Tsuga.

While we have on file a conventional diagram of the profile, we believe that the essential results can be visualized more simply from the accompanying figures 1 to 3. All are based on the 19 analyses (out of 50 made or found negative) that registered more than 100 grains tallied.

At the right in figure 1 is drawn the moving average (0–10 in., 5–15 in., etc.) for total percentage of conifer pollen.

At the left, in separate columns, are entered the profiles of white or red pine (*P. strobus* and/or *resinosa*), fir (*Abies*), and hemlock (*Tsuga*), respectively. The

TABLE 1

Pollen analysis—Michillinda peat seam

Depth	Conifer.	Decid.	NAP	Counts	Abies	Cupress.	Larix	Picea	Pinus	Tsuga	Acer	Alnus	Betula	Carya	Castan.	Fagus	Ilex
0–1	48	39	13	271				14	33	02	14	07	01	02		01	01
1–2	45	39	16	31				26	19		16			03		06	
2–3	41	41	19	37				05	32		14			03			
3–4	55	39	06	18				06	50		28						
4–5	23	65	12	142				01	22		23	06	02	07	01		04
5–6	26	57	17	326		01		07	17	01	25	07	02	03		01	02
6–7	45	43	12	173			03	09	31	02	21	05	01	02			01
7–8	35	55	09	182			01	03	29	02	23	01	02	08	02	01	01
8–9	33	54	13	216		01	01	04	25	02	16	05	03	02	02	03	02
9–10				0													
10–11	20	71	09	35					20		23		09			09	03
11–12	42	47	11	76		03		08	28	04	09	07	03	01		09	
12–13	31	57	12	167		01	03	01	24	02	07	04	07	02		12	01
13–14	34	61	05	64		03	05	09	14	03	25	02		03	02	11	03
14–15	47	45	08	86	02		01	21	20	02	14	02	01	02		05	02
15–16	36	55	10	73	03	08			22	03	19	10			04	05	
16–17	49	42	09	212	01	03	01	08	34	03	16	03		02	01	03	
17–18	54	39	07	322	03	02	01	13	34	02	12	03		02	07	03	01
18–19				10					100								
19–20	64	28	08	53		04		17	40	04	08			04	02	08	
20–21	53	47		15				07	47		07	40					07
21–22	54	37	09	146	05			12	32	05	10	04				05	
22–23				0													
23–24	42	55	12	131				04	38		13	08	02	06	08	01	04
24–25				0													
25–26	48	45	07	292	02	02		12	29	03	14	05		03	04	04	
26–27	44	47	09	265	01	02	01	08	29	04	18	06	01	03	02	03	01
27–28	31	55	14	172		01	01	05	25	01	24	09	02	02	02	02	01
28–29				0													
29–30	38	54	08	719		01	01	03	31	02	14	11	01	02		02	
30–31	31	48	21	52					29	02	13	17		04			
31–32	37	54	08	83			01	08	27	01	18	18		04		01	
32–33	45	48	07	96				08	33	03	20	18					
33–34				0													
34–35				0													
35–36	58	25	17	12					50	08	17	08					
36–37	49	47	04	73				07	42		11	05		07	10		
37–38				0													
38–39	50	50		8					50		37						
39–40				0													
40–41	55	39	06	51			02	02	48	04	18	02		06		04	
41–42	55	33	12	156		01		01	49	04	01	03		01	05		01 C
42–43	32	53	14	187			02	06	22	02	23	03	01	01	12	02	01
43–44	46	38	15	91		02	02	07	27	08	02	04			05	03	
44–45				0													
45–46	53	47		17				12	41		06				35		
46–47	71	25	04	134	01	01	01	16	48	02	10	04				01	01
47–48	74	21	05	38			03	18	47	05	08	05					
48–49	89	10	01	103		05	02	06	73	03	02	02	01				01 Ny
49–50	79	09	12	43				47	33		02			02			

TABLE 1—(Continued)

Depth	Liquid.	Quercus	Salix	Tilia	Ulmus	Chenop.	Compos.	Cyper.	Drosera	Ericac.	Gram.	Myrioph.	Nuphar	Polyg.	Typha	Unknown	Spores
0–1		10			04	01	04	01			04	01 A				02	04
1–2		15					06									10	
2–3		19			05		11				05					03	
3–4		11					06										
4–5		13			07	01					04	01 A	01 R			05	02
5–6		11		01	06	02	03	02	01 M	03 L	02	01 A	01 R	02 P	01 Cp	01	01
6–7		09			05		04	01		01 L	03		03		01 Cp		04
7–8	01 J	13			04		02	01		01	02		02	01		01	04
8–9	02 J	11	06		02	01	02	01			03		01	04		02	03
9–10																	
10–11		20	03		06		03				06						06
11–12		08	04		07		03				01		04	01		01	03
12–13	01	15	03	01	05		06	01			01		01	01		02	02
13–14		14			02		02	02								02	05
14–15		14			05		02	01			03			01			01
15–16		11	04		01	03	03				03			01			03
16–17		09	01	01	04	01	01				06			01		01	05
17–18		07	01		04		02	01			02			02		01	06
18–19																	
19–20		02			06		02	02					04				
20–21																	19
21–22		12	04		01		02	02			01		01			01	03
22–23																	
23–24		08			05		03	01		02	02					04	06
24–25																	
25–26		08	03	01	03		02	02			01		01	01		01	04
26–27		07	01	01	04		02	01		01	02		01		01	01	03
27–28		06	03		04	01	05	02			02	01	01			02	04
28–29																	
29–30	01	18	02		03	01	02	01			02	01	01		01	01	02
30–31		08			06		02				10		02			08	06
31–32		13									06		01			01	02
32–33		07	03				02				05						02
33–34																	
34–35																	
35–36							17										
36–37		11			03		01									03	08
37–38																	
38–39			13														
39–40																	
40–41		10					02				04						06
41–42		22					03	02			07						
42–43		06	02	01	02		01	02	01		03					07	03
43–44		16	04	01	01		03	06			01		02	01		02	02
44–45																	
45–46		06															41
46–47		07	01		01						04						07
47–48		03	05					03			03						13
48–49		04									02						
49–50			05			02	02	02			02				02		

A = Artemisia C = Corylus Cp = Caprifoliaceae J = Juglans L = Labiatae M = Malvaceae Ny = Nyssa
P = Polygala R = Rumex

steady decline in conifer percentage from bottom to top is evident, as is the increase in mesophytism between the 30- and 20-in. levels. The absence of sand between these levels also indicates good vegetative cover.

Figure 2 shows the moving average of deciduous percentages. At the left is the profile for beech (*Fagus*) and at the right that for nonarboreal pollen. This figure shows the steady increase in deciduous forest and the climax of the humid, mesophytic trend that begins at the 30-in. level, here manifested by the beech maximum at 12–13 in.

Figure 3 shows by means of vertical bars the range of various arboreal genera through the profile. These have been arranged in order of their successive maxima as indicated by the curve connecting these maxima. The profile begins with predominance of jack pine (*P. banksiana*), Cupressineae (*Juniperus* and/or *Thuja*), chestnut (*Castanea*) and oak (*Quercus*). These predominantly xerophytic indicators then give way to the mesophytic vegetation as already noted between 30 and 10 in. Warming above the 30-in. level is suggested by the disappearance of fir, the advent of sweet gum (*Liquid ambar*) and possibly holly (*Ilex*), also the traces of walnut (*Juglans*) at 7 to 9 in.

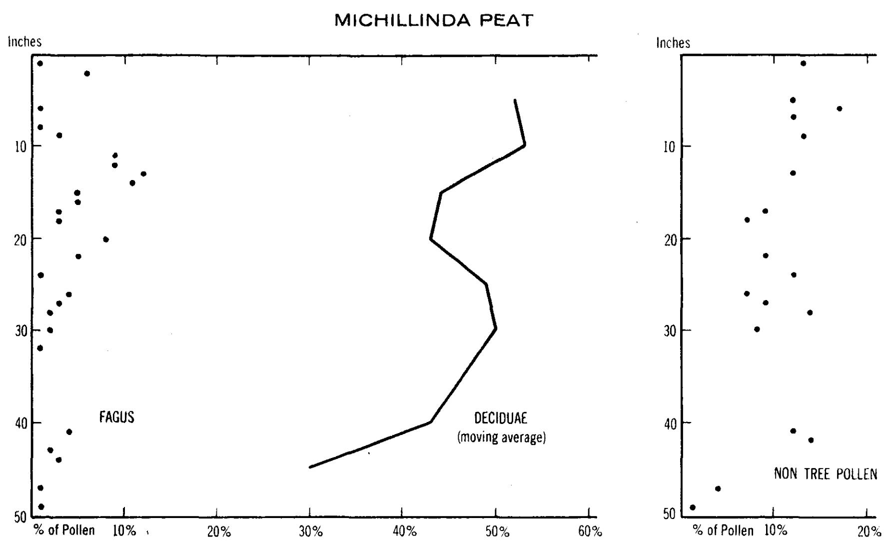

FIGURE 2. Increasing trend of deciduous trees. Fagus indicates mesophytic conditions. Nonforest pollen at right.

Changes above the 10-in. level are less diagrammatic. The renewal of sand movement, the maximum of hickory (*Carya*) and elm (*Ulmus*) and a high percentage (17%) of nonarboreal pollen at 5–6 in. suggest increasing dryness. This we would normally expect, for previous studies in the Great Lakes area show that the beech maximum was followed by one of oak-hickory. Hickory and elm, with their relative intolerance of shade do not follow beech in normal succession. We also consider the high percentage of NAP on the low count levels at 1–3 in. as significant of dry conditions. Spruce, alder, holly, larch, and willow show equivocal patterns. All are swamp or bog forms, the spruce in question being principally *Picea mariana*. Favorable habitats for them may persist throughout upland succession and be initiated between dunes by blowing sand. Maple could be either the mesophytic upland sugar maple (*Acer saccharum*) or, as is more likely in this instance, the swamp red (*A. rubrum*). In any event, the record of these genera does not vitiate the essential significance of the profile as sketched.

In chronology and climatic character it agrees with the upper half of the South Haven peat described by Zumberge and Potzger (1956), leading from the pine period that includes a date of 6330±400 to a time just preceding the Xerothermic, and representing a warm, moist interval between two dry ones (Sears, 1931; Potter, 1947). According to Zumberge and Potzer, it began at the time of minimum level of Lake Chippewa in the Michigan basin and continued through rising lake level to a time just preceding the Nippissing.

Sand activity below the 30–in. level, so marked that good counts between 30 and 40 in. were not possible, confirms our evidence of initially dry conditions marking the end of the pine period. It could have been intensified by an increased sand supply due to the then low lake level.

Significance of sand activity between the 5– and 16–in. level is less clear. Despite the mesophytic conditions at 12–13 in. there may have been an increasing supply of adjacent beach sand due to rising lake level. It is curious that sand

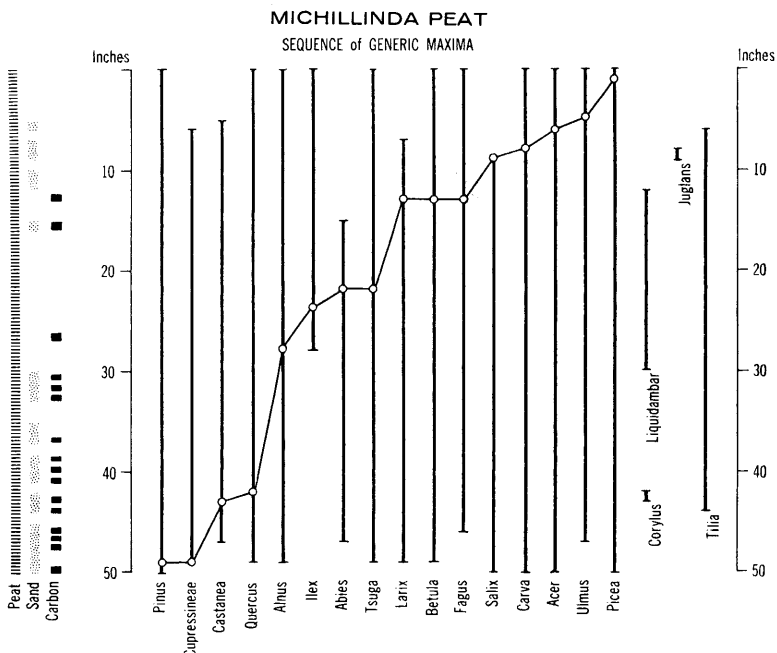

FIGURE 3. Presence of forest genera indicated by vertical lines, levels of abundance maximum by circles.

deposition does not occur from 5 to 0 in. which we predicate as a time of increasing dryness. We can only suggest that the more xerophytic vegetation had, by that time, fairly stabilized the surface. After this lull the deposit was buried by dunes.

The profile suggests some interesting botanical problems that may later yield to improved techniques and the accumulation of further evidence from south and west. An example is the problem of migration of chestnut. This genus, once abundant in the East and in the Ozark region, has been separated from southern Michigan by a calcareous barrier in northwestern Ohio (Transeau and Williams, 1929). Was its early appearance in the Michillinda and South Haven profiles due to northward movement in the Mississippi basin during the pine period or has it some other explanation? Perhaps a reexamination of the material analyzed by Voss (1934) in the Chicago region before modern techniques were in use might aid in solving this and other problems of plant migration and climatic history. Certainly his interpretation of relatively uniform postconiferous conditions does not agree with evidence now available from Iowa, Indiana and Ohio.

SUMMARY

The Michillinda peat seam near Muskegon, Michigan, despite its frequent low pollen counts, affords a classic record of the mesophytic interval, from about 5000 to 4000 B.P., between the pine period (Deevey's B) (1939) and the oak-hickory xerothermic (Deevey's C2). It also records climatic conditions accompanying the rise in the Michigan Basin from the Chippewa low water stage to the time just preceding the Nippissing stage of the great Lakes.

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