Butler University Botanical Studies

Volume 9 Article 13

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Butler University Botanical Studies
(1929-1964)

Edited by

Ray C. Friesner

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During the years of the journal's publication, the Butler University Botany Department had an active program of research and student training. 201 bachelor's degrees and 75 master's degrees in Botany were conferred during this period. Thirty-five of these graduates went on to earn doctorates at other institutions.

The Botany Department attracted many notable faculty members and students. Distinguished faculty, in addition to Cain and Friesner , included John E. Potzger, a forest ecologist and palynologist, Willard Nelson Clute, co-founder of the American Fern Society, Marion T. Hall, former director of the Morton Arboretum, C. Mervin Palmer, Rex Webster, and John Pelton. Some of the former undergraduate and master's students who made active contributions to the fields of botany and ecology include Dwight. W. Billings, Fay Kenoyer Daily, William A. Daily, Rexford Daudenmire, Francis Hueber, Frank McCormick, Scott McCoy, Robert Petty, Potzger, Helene Starcs, and Theodore Sperry. Cain, Daubenmire, Potzger, and Billings served as Presidents of the Ecological Society of America.

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A POLLEN PROFILE FROM REED BOG, RANDOLPH COUNTY, INDIANA

By CHARLES D. GRIFFIN

Sediments from lakes and bogs have given valuable records which indicate succession of forests and climatic changes since glacial retreat at the close of Pleistocene times in the geographical area now known as Indiana. The closing chapter of this history has, however, not yet been written, for every pollen profile adds new discoveries of variations in forest composition which may be due to difference in geographical location or to microclimatic variations. Thus, we might consider each new bog record a contribution toward reconstruction of forests of the past which covered the soils of Indiana. There are, especially, many unanswered questions with respect to forest succession along the line of junction between Early and Late Wisconsin glaciation in Indiana. Into this picture we fit the study of the pollen records from Reed bog where today corn fields mark the culmination of great vegetational changes which ranged from coniferous to primarily broad leaved forests.

Reed bog is located in the southern portion of Randolph County, Indiana, and is approximately 5½ miles north of the town of Modoc along Indiana State Highway 1. Central Randolph County marks the southern termination of the Union City Moraine which is the outer border of Late Wisconsin glaciation in eastern Indiana. Reed bog, therefore, is associated with the Bloomington Morainic System of the Early Wisconsin drift sheet.

A half mile north of Reed bog is the Cabin Creek raised bog studied by Friesner and Potzger (5). A comparison will be made between the pollen profile of Reed bog and those of Cabin Creek and other Early Wisconsin bogs in Indiana.

METHODS

Because Reed bog has been under cultivation, it was considered wise to omit peat samples near the surface because of the soil disturbance and effect of oxidation upon pollen. The first sample, therefore, was obtained at the 3-foot level.

The depth of the bog is 34 feet. Samples of peat were taken at each foot-level from three feet below the surface to 34 feet below with a Hiller type borer. Additional samples were taken at 12′3″, 13′6″ and at 22′5″ because of a visible change in the color and texture of the peat at these points. The preparation of the peat for counting of fossil pollen was done according to the Geisler alcohol method. The stain used was a 1% aqueous Gentian Violet and the mounting medium was glycerin jelly. Approximately 200 pollen grains of significant tree genera and species were counted at each level except near the surface where the pollen was sparse.

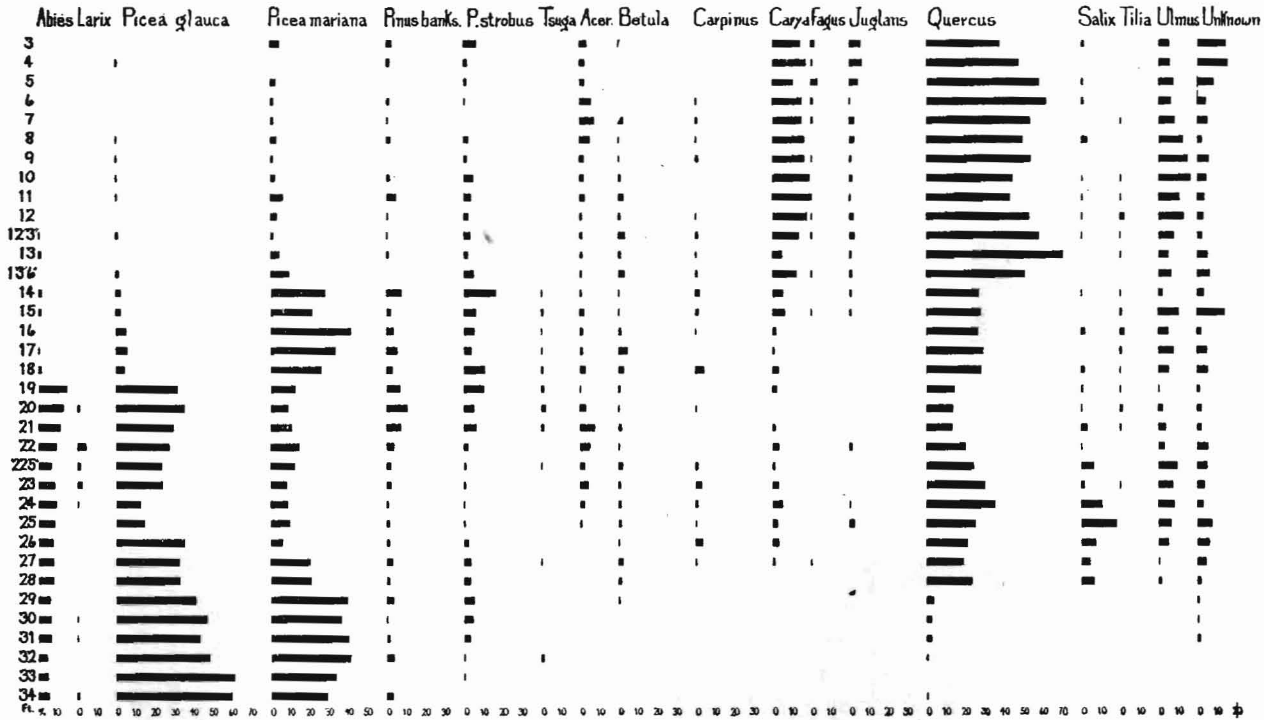
An attempt was made to distinguish between *Picea glauca* and *P. mariana* and between *Pinus strobus* and *P. banksiana*. The entire length of the grain (including the bladders) was used for differentiation. The depth of the bladders (measured between proximal and distal root junctions of bladder with body) and length (long axis) of the body were also used to differentiate damaged or half grains. Based on modern pollen from prepared slides at the Butler University Botanical Laboratories, the above-mentioned species were differentiated according to the following measurements in microns. The figures in parentheses denote means.

	Entire length	Body length	Wing depth
Picca mariana	70-90 (81)	52-75 (60)	34-59 (48)
" glauca	88-108 (101)	68-87 (81)	51-69 (61)
Pinus banksiana	57-67 (63)	38-59 (42)	25-33 (29)
" strobus	51-85 (71)	39-55 (51)	29-47 (39)

OBSERVATIONS

The percentages of fossil pollen for each level are presented in graphic form in figure 1. Abies is represented at the 34-foot level or at the bottom of the deposit by a percentage of 5.5. This percentage gradually increases with several slight fluctuations to a maximum of 14.5% at the 19-foot level, after which the percentage suddenly drops to 1.4. It appears in low percentages for several levels and is absent above 12′3″.

Picea glauca and *P. mariana* show two general maxima with the peak for *P. mariana* in each case occurring in higher levels than the peak of *P. glauca*. Peaks for *P. glauca* occur at the 33- and 20-foot levels. For *P. mariana,* the peaks come at the 32- and 16-foot levels. The minima for both species are, in general, between the 23- and 26-foot levels. Above the 13-foot level, Picea has a small percentage. However, it occurs in every foot-level sampled. From the limited


Abies Larix Picea glauca
Picea mariana
Pinus banks.
P. strobus
Tsuga
Acer
Betula
Carpinus
Carya
Fagus
Juglans
Quercus
Salix
Tilia
Ulmus
Unknown
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amount of pollen deposited, one might conclude that the two Pinus species were not abundant in the forest association. However, both tend to show higher representation at time of the Picea maxima. Pinus also is represented in every level. During the Picea minima, there is an obvious increase in abundance of pollen of deciduous genera. Acer, Carya, Salix, Ulmus, and Quercus show a marked percentage increase, decline during the second Picea maximum and rise to prominent abundance at 13′6″ to indicate forest dominance.

At several foot-levels, particularly in the 19-, 20-, 21- and 26-foot levels there appear Picea grains which are of larger dimensions than those of *Picea glauca*. The general size range and mean of these in microns is as follows:

Entire length	Body length	Wing depth
96-137 (121)	64-101 (83)	48-103 (78)

SIGNIFICANCE OF THE FINDINGS

The three samples taken between foot-levels (12′3″, 13′6″, 22′5″) because of conspicuous change in appearance of the peat did not reveal a correspondingly great change in forest composition. However, the sample at 13′6″ does mark the beginning of the second decrease in *Picea mariana* and a general increase in Quercus and Carya pollen.

Picea glauca, P. mariana, Pinus strobus and *P. banksiana* were separated according to the size determinations given in the methods section of this paper. The mean body lengths of these grains correspond, in general, with those reported by Cain (2, 3). The abundance of Pinus pollen was not great enough to indicate more than the presence of two species in the Reed bog. However, the large pollen grains of Picea which became very conspicuous at several foot-levels (19, 20, 21, 26) indicate a probable invasion by a new species. This may be a species which has since become extinct or it could be *Picea rubra*, for it is noted with interest that the mean body length of these grains (83 microns) corresponds with the mean body length of modern *P. rubra* pollen reported by Cain (2) as being 82.8 microns.

The pollen spectrum of Reed bog is unusual in that it shows two peaks in abundance of the Picea species and a corresponding increase of Quercus between them. Other bogs of Early Wisconsin origin located farther south of the Late Wisconsin terminal moraine do not show this phenomenon. In these bogs, the pollen profile of Picea shows a sudden or progressive decline from maximum abundance without a succeeding period of recovery. It would seem evident, therefore, that the advance of the Late Wisconsin ice sheet had a pronounced effect upon the vegetation growing immediately below its termination (Union City Moraine) and within the upper limits of Early Wisconsin glaciation in eastern Indiana. In explanation, if a long interglacial warm period caused ice to melt northward beyond the boundary of Indiana, one would expect to find striking successional changes from spruce to broad leaved forests and a reversal in such forest succession with advance of the Late Wisconsin ice sheet.

While the profile from the Reed bog is not an exact counterpart of that from Cabin Creek raised bog, there are some similarities. We find in both bogs the Picea peaks alternating with the two Quercus peaks and the general succession from dominance of spruce to a crown cover of deciduous trees (Quercus, Carya, Acer, Juglans, Ulmus). The pollen spectrum of *Picea mariana* in Cabin Creek bog shows the same behavior in that, with a decrease of *P. glauca* there is a corresponding increase in *P. mariana.* Also, Picea is represented in all levels in both bogs. But, in Cabin Creek, the dominance of Picea occurs almost to the top. This can possibly be explained as being due to the slower deposition in a raised bog. Cabin Creek raised bog must have increased in depth of peat much more slowly, especially towards upper foot-levels, than the Reed bog. The former was influenced by air environment with accompanying oxidizing influences, hence less peat was accumulated in similar time intervals. We must, therefore, read into its foot-levels a much more compacted time scale than into the water-deposited plant remains at Reed bog. The two bog histories are also similar in that Pinus tends to increase with the increase of *Picea mariana.*

It is not so easy to find point-for-point similarities between the two bogs in Randolph County and other bogs of Early Wisconsin origin in Indiana. However, it must be taken into consideration that all other bogs [Otterbein, Richards (10), Yountsville, Swickard (11), Fox Prairie, Prettyman (9)] except the one at Kokomo studied by Howell (6), were much farther removed from the junction boundary of Early and Late Wisconsin glaciations. In these other bogs, Picea, after a high maximum, is usually on the decrease when Quercus appears, and there is no indication of alternating maxima between the two species as there is in the Randolph County bogs. Picea generally does not persist even in low percentages to the upper-profile levels of other Early Wisconsin bogs as it does in Reed and Cabin Creek bogs. This persistence of Picea is usually characteristic of bogs of Late Wisconsin origin, Swickard (11). One similarity appears to be that Pinus usually persists to the top level in all the bogs of Early Wisconsin glaciation but never shows a definite climax. However, Bacon's Swamp, studied by Otto (7), does show a period of Quercus decrease with a corresponding increase in Pinus. Cranberry Pond. analyzed by Barnett (1),, shows a slight Pinus maximum, but it is before the appearance of Quercus.

In conclusion it might be pointed out specifically that the record of late entrance of Carya into the broadleaved forest complex, the erratic and sparse representation of Tsuga and the general trend in succession towards a mixed mesophytic climax, mark the Reed bog profile as typical of Indiana bogs in general.

SUMMARY

1. The study presents a pollen analysis of a bog in an eastern Indiana locality which is associated with the Bloomington Morainic system of the Early Wisconsin drift sheet.

2. Distinction is made between *Picea glauca* and *P. mariana,* and between *Pinus strobus* and *P. banksiana* pollen on basis of size.

3. Abies occurs in low percentages in the lower levels of the bog.

4. The pollen spectrum of Reed bog shows two peaks of prominent abundance of the Picea species and a corresponding increase of Quercus and other deciduous genera between the two Picea maxima. After the second Picea decline, Quercus, along with several other deciduous genera, later including Carya, predominate to the upper levels of the bog.

5. Pinus occurs in low percentages in every level of the bog, but it tends to show higher representation at the Picea maxima.

6. Large pollen grains of Picea are very conspicuous at several foot-levels, suggesting possible presence of a third species of this genus.

ACKNOWLEDGMENTS

The writer expresses his sincere appreciation to Dr. J. E. Potzger for supervision of this research and the critical reading of the manuscript; and to Dr. Ray C. Friesner and former members of the

Botany Department of Butler University for collection of the peat samples. Appreciation is also expressed to Dr. A. G. Vestal of the Botany Department of the University of Illinois for helpful suggestions during the writing of this paper.

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TABLE I

Pollen percentages—Reed bog

Foot level	Abies	Larix	Picea glauca	Picea mariana	Pinus banksiana	Pinus strobus	Tsuga	Acer	Betula	Carpinus	Carya	Fagus	Juglans	Quercus	Salix	Tilia	Ulmus	Unknown
3				4.8	2.9	6.7		3.8	1.0		14.4	1.9	5.8	37.4	1.0		5.8	14.4
4			0.8		1.6	1.6		2.4			17.7	0.8	6.5	47.6			5.6	15.3
5				2.7		1.4		2.7			10.9	3.4	4.1	58.2	0.7		7.5	8.2
6				1.8	1.4	0.5		6.0		0.9	15.1	0.9	0.5	61.9	0.9		6.0	4.1
7				1.5	0.5			7.7	2.6	1.0	15.4	1.0	2.6	53.8		0.5	8.2	5.1
8			0.5	3.0	2.0	2.0		5.0	0.5	0.5	16.6		2.5	49.7	3.0		12.6	2.0
9			0.5	1.6		1.6		2.0	0.5	1.6	16.8	0.5	1.0	53.4			14.7	5.8
10			0.5	2.1	1.6	4.7		2.1	1.6		19.3		1.6	44.3	0.5	0.5	16.7	4.7
11			0.5	6.4	4.8	3.7		2.7	2.7		19.7	0.5	0.5	43.1	0.5	0.5	10.6	3.7
12				3.7	0.5	2.1		1.0	1.0	0.5	18.3	0.5	2.1	52.9	0.5	2.1	12.6	2.6
12.25	0.5		1.1	1.6	0.5	3.3		1.6	3.3	1.6	13.6	0.5	2.7	58.7	0.5	0.5	7.6	2.2
13	1.5			4.5	1.0	2.0		1.5	1.5	0.5	5.0		1.0	70.5		0.5	5.0	5.5
13.5			1.5	9.8		5.2		1.0	3.1	1.0	12.4	0.5	1.5	51.0			6.7	6.2
14	1.5		2.6	28.2	7.2	16.4	0.5	1.0	0.5	2.1	5.6		1.0	27.2	0.5	0.5	2.1	3.1
15	1.1		2.1	21.7	2.1	6.3	1.1	2.1	0.5	1.6	6.3	0.5	1.1	28.0		1.1	10.6	13.6
16			5.4	41.4	3.9	5.4	0.5	1.5	1.5	0.5	2.0			26.6	2.0	2.5	4.9	2.0
17	0.5		5.6	33.7	5.6	3.6	0.5	1.5	4.6		1.0			29.6		1.0	7.7	5.1
18	1.4		4.3	26.2	2.9	10.5	1.0	2.9	2.9	4.3	2.9			28.1	1.9	0.5	5.2	5.2

TABLE I—(Continued)

Pollen percentages—Reed bog

Foot level	Abies	Larix	Picea glauca	Picea mariana	Pinus banksiana	Pinus strobus	Tsuga	Acer	Betula	Carpinus	Carya	Fagus	Juglans	Quercus	Salix	Tilia	Ulmus	Unknown
19	14.5		32.0	13.0	7.0	10.1	1.5	0.5	1.0		2.0			14.6	1.0	0.5	0.5	1.0
20	13.0	1.0	35.8	9.0	10.9	5.2	2.6	3.1	0.5	0.5				13.5	0.5	1.6	2.1	2.1
21	11.2		29.6	10.7	7.2	6.7	1.5	7.7	1.5		1.0			13.3	3.1	0.5	3.6	2.1
22	9.1	4.0	27.3	14.6	3.5	2.0		5.6	0.5		3.0		1.5	20.2	0.5		3.0	5.1
22.5	6.4	1.6	23.5	12.3	2.1	1.1	0.5	2.7	2.1	1.1	1.0			24.6	6.4		9.6	4.8
23	8.3	2.1	24.0	8.3	2.1	1.0		4.2	1.0	3.1	3.1			30.2	1.6	0.5	6.8	3.6
24	8.7	0.5	12.8	8.7	1.0	0.5		2.6	1.5	1.0	5.1		0.5	35.7	10.7		8.2	2.6
25	8.2		14.8	9.3	1.6	0.5		1.1	1.6	0.5	2.7		2.7	25.1	18.0		6.6	7.1
26	6.8		35.4	6.2	1.6	2.6			0.5	3.7	3.1			21.1	7.3		5.3	5.8
27	7.4		32.4	20.2	3.2	3.7	0.5		2.1	0.5	1.1	0.5		19.1	4.3		0.5	4.3
28	7.8		32.8	20.8	1.6	3.1			1.6					23.4	6.3		1.0	1.6
29	6.0		40.9	39.9	3.5	5.1			0.5					3.5				0.5
30	8.5	0.5	46.5	36.5	0.5	4.5								2.5				0.5
31	8.5	0.5	43.0	40.0	1.5	3.0								2.5				1.0
32	4.5		48.0	41.5	3.5	0.5	1.5							0.5				
33	5.0		61.0	33.5		0.5												
34	5.5	1.0	60.0	29.0	3.0									0.5				1.0