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The *Butler University Botanical Studies* journal was published by the Botany Department of Butler University, Indianapolis, Indiana, from 1929 to 1964. The scientific journal featured original papers primarily on plant ecology, taxonomy, and microbiology. The papers contain valuable historical studies, especially floristic surveys that document Indiana's vegetation in past decades. Authors were Butler faculty, current and former master's degree students and undergraduates, and other Indiana botanists. The journal was started by Stanley Cain, noted conservation biologist, and edited through most of its years of production by Ray C. Friesner, Butler's first botanist and founder of the department in 1919. The journal was distributed to learned societies and libraries through exchange.

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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THE CABIN CREEK RAISED BOG, RANDOLPH COUNTY, INDIANA

By RAY C. FRIESNER AND J. E. POTZGER

INTRODUCTION

High moors, or raised bogs, are a rather common physiographic feature of northern Europe, but in North America they are more or less limited to coastal areas. Some of these American raised bogs are described by Ganong (5) for New Brunswick, by Nichols (10) and Dachnowski (2) for Maine, and by Rigg (11) for southeastern Alaska. In more recent years a few raised bogs have also been reported for inland areas in North America. Gordon (7) described one at Urbana, Ohio, and Rigg (11, 12) one at Itaska Park, Minnesota, and another at Yellowstone Park.

All authors who described raised bogs stressed their infrequent occurrence, especially in interior locations. It was, therefore, more than the first thrill of contact with a raised bog which enthused the authors about discovery of a raised bog in centrally located Indiana. Naturally, a detailed study was planned at once. We called it Cabin Creek Raised Bog because of its location in the floodplain of Cabin Creek. The peat mass is a prominent feature of the landscape: it rises 10 feet above the floodplain at the maximum elevation. The answer to the question of its origin, nature of the peat, history of the development, and configuration of the topography now covered by the peat was sought in numerous borings and in pollen profile studies.

Cabin Creek Bog is located about 500 feet south of Cabin Creek, 6 miles north of Modoc, Randolph County, Indiana, along Highway 1. The whole region is glaciated terrain, dating to activity of Early Wisconsin glaciation. It is approximately 50 miles south of the limits of Late Wisconsin glaciation in Indiana. The topography is rolling, and at some places marked by numerous granitic erratics. A number of smaller bogs and a completely filled-in extinct lake (filled to a depth of 34 feet) on the farm of Mr. Reed are only a short distance south of the Cabin Creek Bog.

SURVEY OF REPORTS ON SOME RAISED BOGS

From the description of raised bogs in Europe it appears that some raised bogs of North America differ from those of Europe both as to initial origin and factors involved in the formation. Brehm (1) says that high moors of northern Europe are frequent along borders of lakes, or they may occur where lakes have completely filled in, rising above the level of the old shore line. He says that the name originated from the fact that the peat forms convex elevations in the central portion to rise above the perimeter. He describes the contour as being like a watch crystal. The central portion may at times be several meters higher than the rim. Intensive growth of Sphagnum is given as cause of such peat accumulations. Heil (8) states that high moors may occur in lowland areas as well as on upper slopes of mountains. These moors are surrounded by a moat into which excess water from the elevated mass flows. Thienemann (13), as well as Lenz (9). stresses the fact that high moors of Europe are formed under conditions of calcium deficiency and high acidity.

In North America raised bogs are chiefly along coastal areas of Maine, New Brunswick, and southeastern Alaska. In Maine they seem to be limited to a belt not over 30 miles inland from the coast. Dachnowski-Stokes (3) classifies the eastern bogs of this type under the heading of "Champlain series of peat profiles." He says, "The raised dome-shaped surface is due to an upward growth and periodic accumulation of Sphagnum mosses . . . the groundwaters are generally soft and otherwise low in mineral salts."

Bogs of the Champlain series are, thus, very similar to the high moors of Europe. However, many of the raised bogs of our eastern coastline owe their initial development, perhaps also their very existence, to artesian springs, as Ganong (5) has pointed out for the hogs of New Brunswick.

Riggs (11) describes in detail the raised bogs of southeastern Alaska. While they, too, are similar to the European bogs in that Sphagnum is the cause of their formation, he finds that some are apparently caused by artesian springs. Water flows from some of them. The same author also attributes formation of the young raised bog in Yellowstone Park to artesian springs.

For eastern inland areas Gordon (7) described a raised bog at Urbana, Ohio. This particular bog has some features in common with the Cabin Creek Bog. Chief of such similarities are high alkalinity of the water, origin from artesian springs, dense mats of Chara in the small streams flowing from the peat mass, elevation of the mass by 10 to 13 feet, absence of Sphagnum and ericads, prairie grasses as an important element associated with typical bog plants. The Indiana bog, however, differs from the Ohio bog in that the hydrostatic pressure has not elevated the peat mat, leaving open water beneath.

Considering the various reports on raised bogs, we may be justified to say that three types of raised bogs are found in America, viz., (1) raised Sphagnum bogs similar to those of Europe, as reported by Nichols (10) for Maine, and by Rigg (11) for southeastern Alaska; (2) raised bogs due to artesian springs and Sphagnum as chief contributor to the peat formed (Ganong, 3); and (3) raised bogs due to artesian spring water, high in calcium, with mosses, sedges, and grasses as chief peat formers. This latter type is found in inland areas, and it presents two variants. The one variant has vegetation encroaching on springs, finally to be lifted up by the hydrostatic pressure; the other variant has weakly expressed hydrostatic pressure which gives rise to wet areas favorable to luxuriant growth of mosses (Drepanocladus) as well as growth of sedges and grasses. The accumulating remains will form an ever-deepening layer of peat, this by uniform deposition will gradually build up a convex mound. Of the former type Gordon (7) reports a striking example at Urbana, Ohio, and the Cabin Creek Bog is an excellent example of the latter type.

METHODS OF STUDY

The present vegetation of the peat mass was studied intensively at all seasons over a period of two years. The original surface configuration of the land now covered with peat was determined by means of borings at 50-foot intervals along eight radii which all passed through the centrally located deepest place (boring 7). The floodplain of Cabin Creek served as base line for determination of elevations by aid of a hand level. Peat samples for complete pollen profile studies at one-foot intervals were taken at five borings, viz., borings 4, 5, 6, and 7. Customary procedures for securing samples for pollen analysis with a Hiller-type borer were followed. Preparation of slides for pollen count was according to the Geisler (5) method. The maximum count for any one foot-level was 100 pollen grains, and at levels where pollen representation was very sparse, pollens present on five microscope slides were counted and tabulated. For boring 4 only the bottom two foot-levels were studied to determine the time when depositions began. Since borings 5 and 6 were located similarly to boring 1, no pollen study was made of these peat samples.

Sediments were examined for marl with HCl reaction, and some concept on amount of marl present was formed on degree of violence of effervescence which resulted. An arbitrary scale of 4 was used to express these differences. Every sample was then examined microscopically to determine the source of the organic matter contained (table I).

CAUSES UNDERLYING FORMATION OF THE BOG

As stated previously, the Cabin Creek Bog is similar to the one at Urbana, Ohio, as well as to some of the eastern bogs of New Brunswick, and to the one at Yellowstone in that springs provided the necessary moisture for peat accumulation. To the south, Cabin Creek Bog borders on a higher morainal mass from which water must have flowed under considerable hydrostatic pressure. This finds expression in several streams which today flow from the topmost levels of the peat to nearby Cabin Creek. In no case did we find open water beneath the peat, but rather a fairly compacted mass of peat through which water was forced by some head pressure. The deep hole (boring 7) was perhaps initially water-filled, and so the early filling was due to water-deposited, finely divided material, composed mainly of inorganic particles and marl, but small pieces of wood, a few leaves of mosses and parts of sedges also appear. This type of deposition operated to the 13-foot level. From the 12-foot to the 8-foot level mosses and sedges contributed the organic sediment constituents. From the 7-foot to the 1-foot levels peat was formed chiefly by wood, and marl was absent. In all of these but the 4-foot level HCl gave no reaction (table I). Three types of sediments, thus, played a part in the total accumulation of the fill, viz., those which settled out in water, remains of marsh plants, and woody material contributed by shrubs and trees. The speed of accumulation no doubt varied, too. The bottom 28 foot-levels (deposited during the Picea period) represent, perhaps, a smaller time interval than the top-most three levels, which have accumulated since the close of the Picea period.

Accumulation at boring 1 was all on land. In general there is a correlation between deposits here and those at boring 7 at the close of deposition in water (12-foot level) except that wood played a minor role in formation of peat at boring 1, while mosses were more important. At boring 1 only the 7-foot level shows the unusual absence of marl while at boring 7 sediments from levels 7 to 1 gave no marl reaction with HCl. Why woody peat at the 7-foot level should be followed by sedge peat is difficult to explain. It may indicate a dry period during which shrubs and trees invaded the peat mass. In a general way, there is some similarity in the process of sedimentation between levels 7 to 1 in boring 1 and levels 12 to 1 in boring 7, but pollen records in the two profiles do not correlate at these horizons. In boring 7 Picea still shows great importance at the 4-foot level while at boring 1 pine-oak has already replaced spruce at the 6-foot level.

HISTORY OF THE VEGETATION BASED ON POLLEN PROFILES

The Cabin Creek Bog differs from all raised bogs studied to date by the complex topographic configuration over which it has spread. i. e., a very deep depression (boring 7) with extremely steep sandy slopes (boring 1). Naturally one would, therefore, also expect differences in the manner in which organic matter accumulated to form the present-day mass. The deep depression has to the 28-foot level an accumulation of pitch-black, finely divided material which for the greater part consisted of inorganic particles and marl, but some small fragments of wood, sedges and mosses were found. Water deposition is evident to the 12-foot level, when the marl-inorganic material was replaced by moss-sedge peat (table I). Wood replaced mosses and sedges as source of the peat at the 7-foot level, and continued to the topmost level.

On top of the sandy slope (boring 1) the sandy soil is abruptly overlain by three feet of a coarse, raw Drepanocladus* peat. This is succeeded by 3 feet of sedge-moss peat, one foot of wood peat, 4 feet of sedge peat, and all is topped off by 2 feet of sedge-wood peat. Marl played an important role in the total deposit except at the 7-foot level where a dark-brown wood-sedge peat gave no reaction with HCl.

* We are indebted to Dr. William C. Steere for determination of the moss.

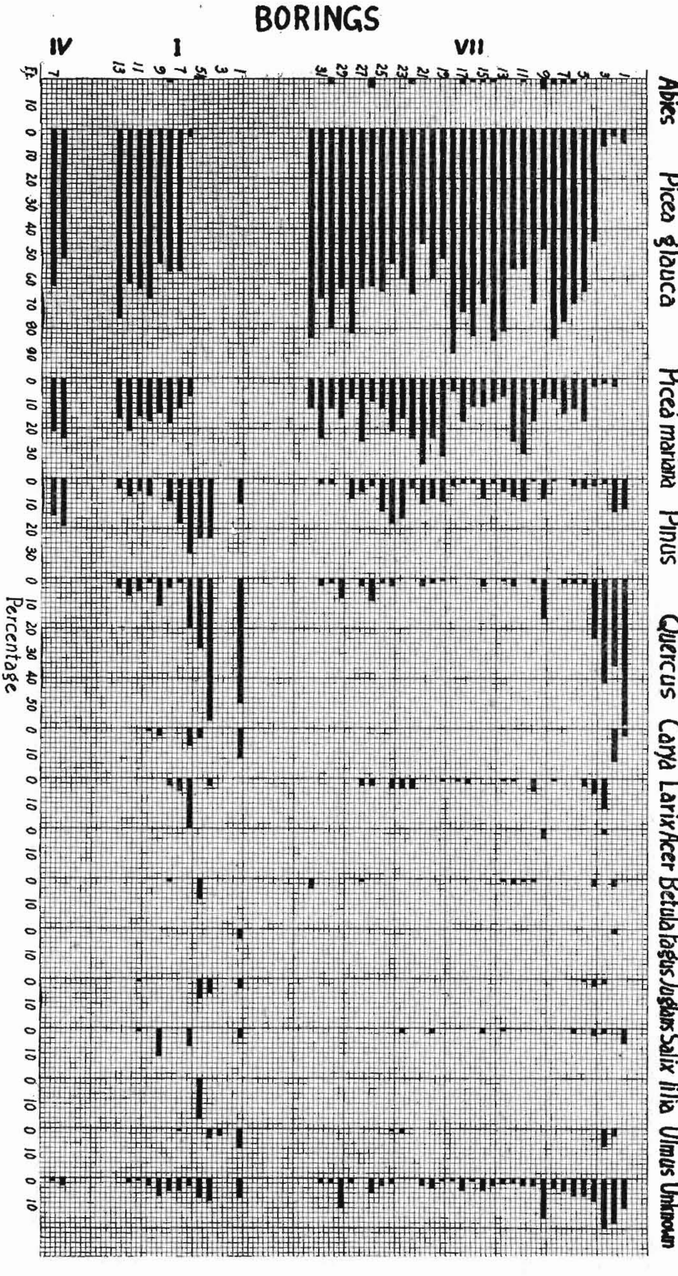

Fig. 1. Pollen ropfile, Cabin Creek Bog.

In lower levels pollen was quite abundant, and was excellently preserved, but in the topmost levels pollen representation was very sparse. The writers have never before encountered so many foot-levels where Picea controlled as at boring 7. With some fluctuations between *Picea mariana* and *P. glauca,* spruce contributed the major pollen accumulation throughout 28 foot-levels, which at the 4-foot level began to give way rather suddenly to Quercus (fig. 1). While Quercus has higher representation in topmost levels than any one other genus, a mixed mesophytic forest is indicated by the large number of broad-leaved genera which enter the profile (fig. 1). In the profile from the ridge location (boring 1) Picea indicated dominance during a time in which 7 foot-levels accumulated. These two records on accumulation very likely represent closely similar time intervals. This means that the depression (boring 7) filled very rapidly by water wash from the adjacent steep slopes and by deposition of marl.

Pinus never reached abundance which indicates dense pine forests. This is in agreement with most pollen profiles from Early Wisconsin glacial areas in Indiana. The pollen record indicates that the accumulation of peat on the sandy ridge and the filling of the deep depression, as well as the shallower outer rim (boring 4) took place simultaneously perhaps soon after removal of the ice. Certainly, the wbole area covered by the raised bog began accumulating before close of the Picea period (fig. 1).

PRESENT VEGETATION OF THE BOG

The present-day species occurring on the bog proper may roughly be divided into those which are typical of the general region in which the bog is located and those which are limited, in this region, to tbe bog area. The species of this latter group are preceded in the list below, with either an asterisk (*) or a number corresponding to a distributional group to be discussed in the following paragraphs. The nomenclature used is that of Deam's Flora of Indiana with subsequent modifications as published in "Indiana Plant Distribution Records." (Deam et al., 4)

Among the species limited to the bog proper, five distributional features are illustrated, viz., (1) prairie species, (2) species on the northern limits of their distribution, (3) species on the southern limits of their distribution, (4) disjuncts, (5) typical bog shrubs.

Perhaps the most striking feature of the more elevated portion of the bog is the very high percentage of its area occupied by prairie species. Among these are: *Andropogon gerardi, A. scoparius, Sorghastrum nutans, Filipendula rubra, Dodecatheon meadia, Silphium terebinthinaceum,* and *Aster praealtus* var. *angustior.* Gordon (7) found a similar situation on the Urbana bog. Another striking feature is the absence of ericads.

Two species of southern distribution in Indiana are on the northern limits of their range on this bog. *Melica nitens* is present in a large luxuriantly growing colony on the leeward slope of the crest of the highest elevation. It is here growing only short distances from the drainage ditch of one of the permanenty-flowing artesian springs. *Viburnum dentatum* var. *deamii* is found in a small colony on a peat deposit which has encroached upon an arm of a gravel ridge extending into the bog from the southeast corner. This colony is also only a short distance from another of the numerous artesian springs of the elevated portion of the bog. A considerably larger colony of this shrub is found in a wet area about 11 miles southwest of the bog, just across the county line in Henry county.

Among the species of northern distribution, four are here on the southern limits of their range, viz., *Muhlenbergia setosa, Juncus brachycephalus, Cypripedium reginae,* and *Aster umbellatus.* The last named species also occurs in disjunct colonies on the Illinois Drift Plain four counties farther south. By far the larger number of northern species of special interest occurring on the bog are disjuncts in this area. Among these disjuncts are: *Panicum albemarlense* known elsewhere in Indiana only near the northwest corner of the state in Porter, Jasper, and Pulaski counties and in Kosciusko county (in the north central part of the state); *Panicum implicatum* occurring here and in adjoining Henry county, three counties south of its general distribution; *Hierochloe odorata* four counties south of its general distribution; *Eleocharis rostellata* occurring here and in Henry county, four counties south of its general distribution; *Rhyncospora capillacea* occurring here and in Henry and Wayne counties, four counties south and southeast of its general distribution.

Other species exhibiting similar disjunct distribution are: *Triglochin palustris, Tofieldia glutinosa, Salix lucida, Lathyrus palustris, L. palustris* var. *linearifolius, Gerardia purpurea, G. paupercula* var. *typica, Chelone glabra* var. *linifolia* forma *velutina, Lobelia kalmii,* *Bidens connata* var. *petiolata,* and *Prenanthes racemosa.* Another species which is both very rare and local in Indiana and which occurs here is *Melanthium virginicum.*

Among the typical bog shrubs of the area are to be found: *Salix lucida, Rhus vernix, Rhamnus lanceolata, Potentilla fruticosa, Cornus stolonifera,* and *Viburnum lentago. Physocarpus opulifolius* and *Corylus americana* are also abundant on the bog.

Three species of Chara are found growing in the lime-charged water flowing from the numerous artesian springs. Most common of these are *Chara foetida* and *C. contraria.* Of unusual interest is *Chara brittoni* which has been determined by Mrs. Fay Daily and, so far as is at present known to her, is known only from the type specimen except for this location on the Cabin Creek bog and another on the Mill Creek bog, in La Porte County, Indiana.

LIST OF SPECIES OCCURRING ON CABIN CREEK BOG

In the following list are given those species which occur on the bog proper. Species preceded with either an asterisk or a number are found only on the bog. Others occur in the region off the bog as well as upon it. Species preceded with "1" are prairie plants; with "2" are on the northern limits of their range in Indiana; with "3" are on the southern limits of their range in Indiana: with "4" are disjuncts; and with "5" are typical bog shrubs.

Onoclea sensibilis

Equisetum arvense
1 Andropogon gerardi
1 Sorghastrum nutans
1 Panicum implicatum
4 Muhlenbergia setosa
Sphenopholis intermedia
Dactylis glomerata
Glyceria striata
* Cyperus odoratus
4 Eleocharis rostellata
* Scleria verticillata
Carex vulpinoidea
4 Juncus brachycephalus
4 Tofieldia glutinosa
Smilacina racemosa v. typica
Polygonatum canaliculatum
Trillium sessile

* Dryopteris thelypteris pubescens
Sparganium eurycarpum
4 Triglochin palustris
1 Andropogon scoparius
4 Panicum albemarlense
4 Hierochloe odorata
* Phragmites communis
2 Meliea nitens
Poa sylvestris
* Cyperus odoratus
Scirpus atrovirens + Scirpus sp
4 Rhyncospora capillacea
Carex hystercina
Symplocarpus foetidus
Juncus torreyi
* Melanthium virginicum
Smilacina stellata
Trillium flexipes
T. flexipes f. walpolei

+ Drosera rotund.
Ribes americana

Hypoxis hirsuta
3 Cypripedium reginae
* Populus tremuloides
Salix discolor v. latifolia
Corylus americana
Ulmus americana f. alba
* Humulus americana
* Boehmeria cylindrica v. drummondiana
Commandra richardsiana
Acnida altissima
Claytonia virginica
Caltha palustris
Ranunculus hispidus
R. recurvatus
* Cardamine bulbosa
5 Physocarpus opulifolius
1 Filipendula rubra
Agrimonia parviflora
Prunus americana
5 Potentilla fruticosa
* Apios americana
Geranium maculatum
Rhus glabra
5 R. vernix
Hypericum mutilum
Ludwigia palustris v. americana
Zizea aurea
Thaspium barbinode
* Oxypolis rigidior
Lysimachia ciliata
* L. longifolia
1 Dodecatheon meadia
* Gentiana procera
* Phlox maculata
Polemonium reptans
Verbena hastata
Stachys tenuifolia v. hispida
* S. tenuifolia v. platyphylla
Physalis subglabrata
Mimulus alatus
4 Gerardia paupercula v. typica
4 G. purpurea
2 Viburnum dentatum v. deamii
5 V. lentago
Valerianella intermedia
Lobelia siphilitica
* Liatris spicata

Iris virginica v. shrevei
Spiranthes cernua
Salix cordata
4 Salix lucida
Quercus bicolor
Q. muhlenbergii
Laportea canadensis
Parietaria pennsylvanica

Polygonum persicaria
P. punctatum
* Arenaria lateriflora
* Aquilegia canadensis v. coccinea
Thalictrum revolutum
Heuchera americana v. brevipetala
4 Parnassia glauea
* Geum laciniatum
G. vernum
Rosa palustris
Cassia hebecarpa
4 Lathyrus palustris
4 L. palustris v. linearifolius
Euphorbia commutata
Impatiens biflora
5 Rhamnus lanceolata
Viola papilionacea
Circaea quadrisulcata v. canadensis
Cicuta maculata
* Angelica atropurpurea
5 Cornus obliqua
Cornus racemosa
5 C. stolonifera
Fraxinus americana
* Fraxinus nigra
F. quadrangulata
Hydrophyllum virginianum
* Physostegia virginiana
Monarda fistulosa
* Pycnanthemum virginianum
4 Chelone glabra v. linifolia
4 C. g. var. 1. forma velutina
* Pedicularis lanceolata
Galium asprellum
G. triflorum
* Lonicera prolifera
4 Lobelia kalmii
* Eupatorium maculatum
E. perfoliatum

Not prop
Rosaceae

Solidago altissima
S. canadensis v. gilvoeaneseens
* S. ohioensis
* S. patula
* S. riddellii
* S. uniligulata
Ambrosia elatior
A. trifida
* Helianthus giganteus
Helenium autumnale
H. a. var. parviflorum
* Cacalia tuberosa
* Cirsium muticum
* Prenanthes altissima
4 P. racemosa
E. rugosum
Aster novae-angliae
1 A. praealtus v. angustior
3 A. umbellatus
— Erigeron philadelphicus
Silphium integrifolium
1 S. terebinthinaceum
Rudbeckia hirta
Bidens comosa
4 B. connata v. petiolata
B. coronata
* Senecio aureus v. intercursus
Cichorium intybus

CHARACTER OF THE BOTTOM OF THE BOG

Figure 2 shows four transects taken along eight radii from the deepest part of the bog. All four transects show that the peat and marl have been deposited upon a considerably dissected base. The numbers at the base of each transect represent the boring numbers whose depths are represented on each transect. The broken line represents the level of the margin of the bog (nearest Cabin Creek) which was taken as the bench mark for determining all other elevations and depressions. The west-east transect passes through the deepest depression (as do all of the transects) and also the highest elevation of the deposit. The latter is at boring no. 1 and is 10 feet above the bench mark. Boring no. 52, on the southwest-northeast transect, showed an elevation of 9 feet 6 inches and boring no. 5, on the northwest-southeast transect, showed an elevation of 9 feet 3 inches. These three borings are on a nearly straight line running a little west of north to a little east of south, as may be seen by reference to figure 4, in which the location, elevation and depth of all borings are given. The first figures in the parentheses opposite the boring numbers are the elevations of the surface above the bench mark, while the second figures of each parenthesis are the depth of deposit below the bench mark. The bottoms of these three borings are 3 feet, 1 foot 6 inches, and 9 inches respectively below the bench mark level. These highest elevations are, apparently, on top of a sand ridge. In figure 2 it will be seen that the bog-bottom along the transect running west from the center passes through three pronounced ridges with alternating valleys after leaving the deep central valley.

The north-south transect (figures 2, 3 and 4) passes for the greatest distance through the deepest portion of the bog basin. Borings no. 7 and 33-36 show depths below the bench mark of from 32 to 28 feet 10 inches. Apparently this was an ancient stream bed whose course was filled with glacial deposit on both the north end (borings 37-39) and the south end (borings 61-67). This valley remained about 150 feet wide after glacial till was deposited as may

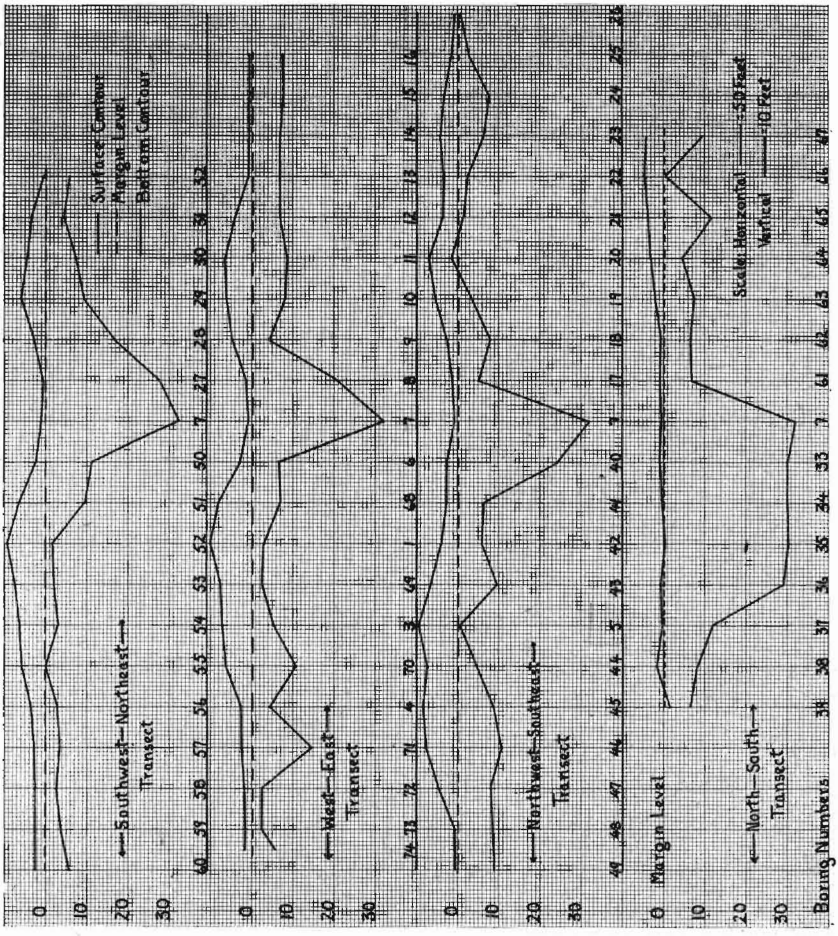

Fig. 2. Cabin Creek Bog. Four transects (eight radii) through center (boring 7) of bog. Broken lines represent the margin-level of the bog. Solid lines represent elevation above and depression below the margin-level for each boring.

be inferred from camparisons of the areas on figure 2, represented by borings 6-9 on the west-east transect, borings 41, 40, 7 and 17 on the northwest-southeast transect, and borings 50, 7, and 27-29 on the southwest-northeast transect. Figure 3 shows an attempt to construct a contour map of the base upon which the material of the

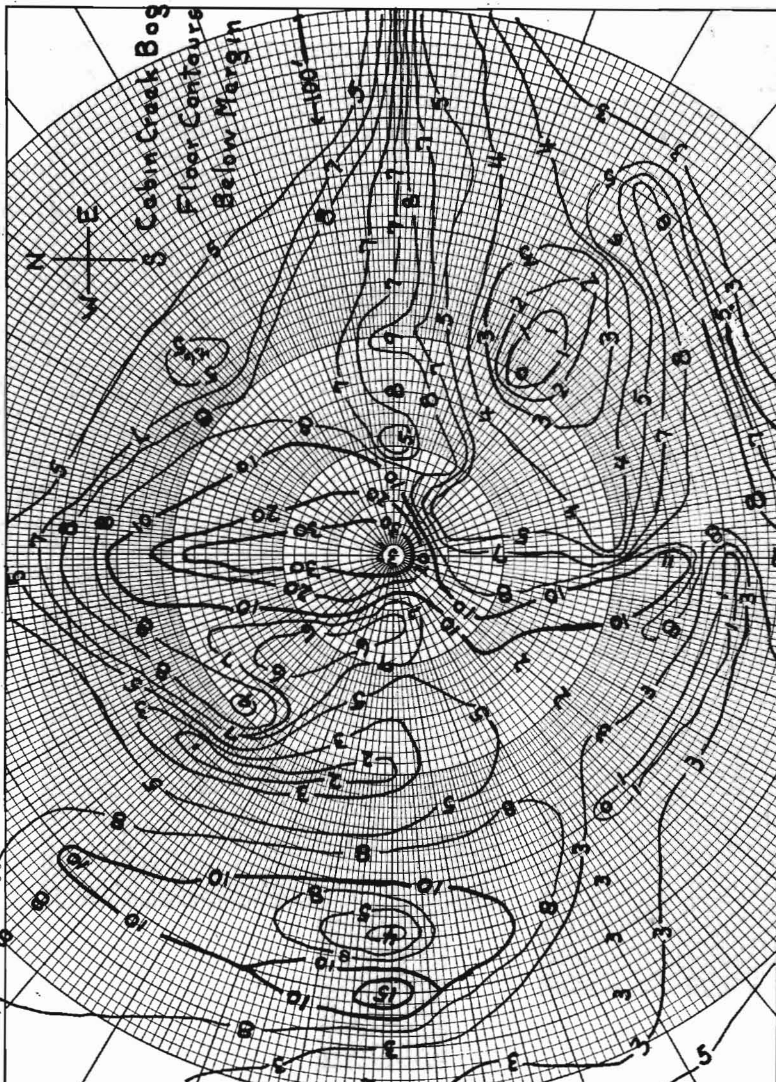

Fig. 3. Contour map of bottom of Cabin Creek Bog. Contour lines represent depth in feet below the margin-level of the bog.

bog has been deposited. This map must be considered to be only approximately accurate. It is based upon the 73 borings whose distribution is shown on the 8 radii of figure 4 and whose depths are represented in the transects of figure 2. The actual depths are

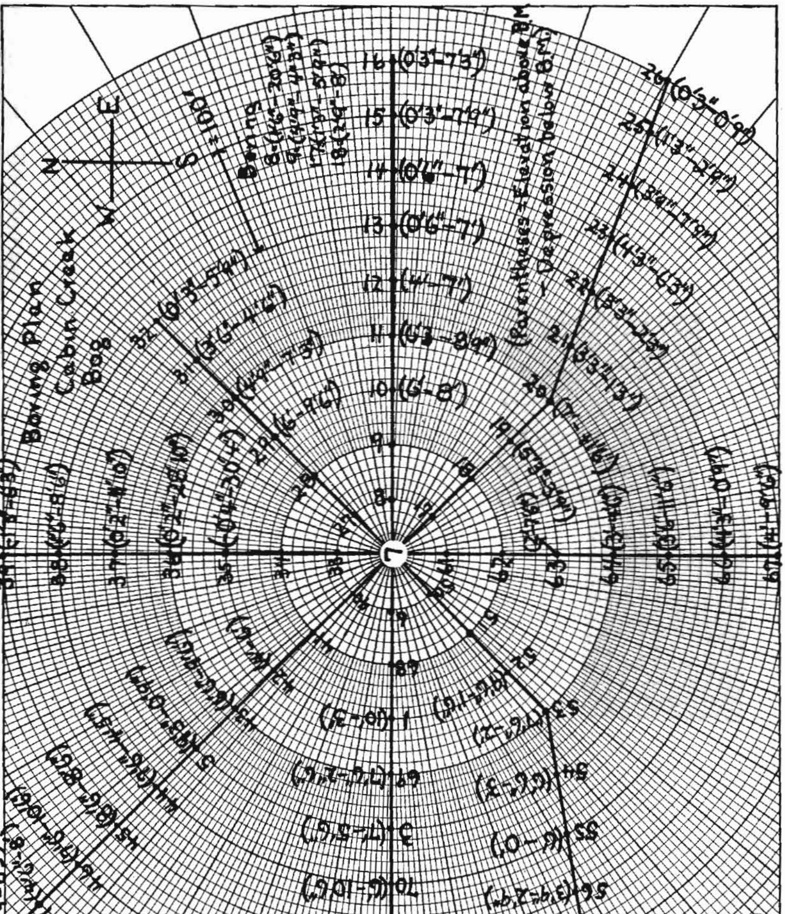

Fig. 4. Distribution of borings, Cabin Creek Bog. Fifures in parentheses represent elevation of top and depth of bottom of borings, measured from the margin-level.

given in the parentheses opposite the boring numbers on figure 4. The contour lines are reasonably accurate on the 8 radii, but they are only approximately so on the areas between the radii. In spite of this inaccuracy, the contour map will give the reader a better concept of the character of the base upon which deposition has been made than mere descriptive words could convey.

DISCUSSION

The pollen profiles serve a dual purpose in this investigation, first of all they are the only means to know something specific about the climatic and vegetational changes since glacial times in the Randolph County area, and secondly they roughly date the time of initiation of sedimentation in the bog. Even though sediments were examined from borings of widely different depths, beginning of accumulation of these sediments was quite simultaneous in all locations regardless of the depth of the base upon which deposition began. The rather limited number of foot-levels given to the forest changes since close of the Picea period hint at slackening pace of peat formation as the bog increased in height. No doubt the increasing height accelerated evaporation rate and this in turn increased oxidation of the plant remains. Sparse pollen representation in upper foot-levels favors such a conclusion.

Reports of raised bogs quite generally state that the elevation of the peat mass totals about 13 to 15 feet. This suggests the probability that such height is perhaps maximum for raised bogs, and oxidation under reduced water content counteracts accumulation of plant remains.

The history of the vegetation since close of the Picea period is compressed into 5 to 7 foot-levels in the Cabin Creek Bog while in the nearby Reed extinct lake it covers 25 foot-levels, which points, again, to retarded accumulation or partial destruction of plant debris as the bog mass became elevated.

The forest changes as well as the composition of the several associations shown by pollen profiles from Cabin Creek Bog add no particular new features to records reported in previous studies of bogs located in territory of Early Wisconsin glaciation in Indiana. The Picea period is usually long, Pinus seldom reaches a pollen representation which suggests a dominant position in the forest complex, and Quercus replaces the conifers without important fluctuations.

Much can also be learned from the accumulated sediments. Water high in calcium carbonate is shown in the abundant marl infiltrations (table I). It is, however, difficult to explain absence of marl in one foot-level in boring 1, and absence of it in 6 foot-levels in profile 7. One is inclined to interpret the similarities in the accumulations as identical time of deposition (comparing level 7 in boring 1 with 12 in boring 7) but the difference in forest composition shown by the two pollen profiles makes such an explanation impossible. According to the pollen representation foot-level 4 in boring 7 and foot-level 6 in boring 1 are representing about the same time interval.

SUMMARY AND CONCLUSIONS

1. The paper presents a detailed study of the Cabin Creek raised bog in Randolph County, Indiana.

2. The configuration of the surface now covered by the peat mass was studied by means of borings made at 50-foot intervals along 8 radii, all of which passed through the centrally-located deepest place (boring 7).

3. The history of the vegetation and the time of initiation of deposition were determined with aid of pollen profiles from 3 borings.

4. Moisture is derived from springs which give rise to several small streams which flow from the peat mass at the present time.

5. Vegetational change was from *Picea glauca* and *P. mariana* to Pinus-Quercus to Quercus and other broadleaved genera.

6. Deposition of the peat and marl, even along the shallow outer rim, began during the Picea period.

7. In the deepest boring (33 feet) the Picea period involves 28 foot-levels and only 7 foot-levels in the nearby boring 1. This is interpreted as being due to more rapid accumulation during the open water stage in the deep depression than on the sandy ridge.

8. In the deepest boring (7), water-deposited material involves 20 foot-levels. Peat is of three types from the standpoint of origin, viz., moss, sedge, and wood, and combinations of these. Moss (Drepanocladus) was an important peat former in lower levels but not in the topmost levels.

9. Marl is abundant except at foot-level 7 in boring 1 and at 6 foot-levels in boring 7.

10. The conclusion is drawn that the 33-foot and 13-foot borings are best dated by their pollen profiles and not by nature of similar sediments.

11. The present vegetation presents a number of interesting features. Among them are: the very large percentage of coverage by prairie species; the total absence of ericads; the presence of a considerable number of disjunct colonies of species whose general distribution is three or four counties farther north or northwest.

12. The bottom upon which deposition of bog materials has been made is much dissected and appears to be a series of sand or gravel ridges alternating with depressions which are often both deep and with steep sides.

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LITERATURE CITED

1. Brehm, V. Einführung in die Limnologie. Julius Springer, Berlin. 1930.
2. Dachnowski, Alfred P. Profiles of peat deposits in New England. Ecology 7:120-135. 1926.
3. Dachnowski-Stokes, A. P., and V. Auer. American peat deposits. Handbuch der Moorkunde, Bd. 7. 1933.
4. Deam, Charles, et al. Indiana Plant Distribution Records. Indiana Acad. Sci. Proc. 52:97-108. (1942) 1943. 53:105-115. (1943) 1944. 54:91-99. (1944) 1945. 55 (1945) 1946.
5. Ganong, W. F. Raised peat bogs in the province of New Brunswick. Bot. Gaz. 16:123-126. 1891.
6. Geisler, Florence. A new method of separation of fossil pollen from peat. Butler Univ. Bot. Stud. 3:141-146. 1935.
7. Gordon, Robert B. A unique raised bog at Urbana, Ohio. Ohio Jour. Sci. 33:453-459. 1933.
8. Heil, Hans. Das Leben unserer Pflanzengesellschaften. Karl R. Oldenbourg. München u. Berlin. 1933.
9. Lenz, Friedrich. Biologie der Süsswasserseen. Julius Springer, Berlin. 1928.
10. Nichols, G. E. Raised bogs in eastern Maine. Geogr. Rev. 7:159-167. 1919.

11. RIGG, GEORGE B. Comparison of the development of some sphagnum bogs of the Atlantic coast, the interior and the Pacific coast. Amer. Jour. Bot. 27:1-14. 1940.
12. ———. A raised cattail-tule bog in Yellowstone National Park. Amer. Midl. Nat. 27:766-771. 1942.
13. THIENEMANN, AUGUST. Die Gewässer Mitteleuropas. Eine Hydrobiologische Charateristik ihrer Haupttypen. Das Handb. der Binnenfischerei Mitteleuropas I Bd. 1921.

TABLE I

Nature of sediment in borings of Cabin Creek Bog.

Foot Level	Color	Degree of Marliness (HCl Test)	Nature of Sediment
		Boring 7	
1	blaek (brownish tint)	none	mainly wood
2	blaek	none	wood-sedge
3	dark-brown	none	wood
4	blaek	1	wood
5	dark-brown	none	wood
6	almost black	none	wood
7	dark-brown	none	wood
8	grayish-brown	2	moss-sedge (somc wood)
9	dark-reddish	4	wood-sedge
10	dark-gray	4	wood-sedge
11	dark-gray	3	sedge
12	grayish-brown	2	moss-sedge
13	gray (oxidizes brown)	4	very little organic material
14	grayish-brown	4	"
15	gray	4	"
16	gray	4	"
17	dark-gray	4	"
18½	dark-brown	4	"
19½	dark-gray	4	"
20	dark-gray	4	"
21	dark-gray	4	"
22	grayish-brown	3	"
23	grayish-brown	3	"
24	dark-brown	2	"
25½	reddish	4	"
26	reddish	4	"
27	reddish	4	"
28	pitch-black, paint-like, oxidizing brown	3	"
29	"	2	"
30	reddish-brown	2	"
31	pitch-black, paint-like	4	"
32	grayish-brown	3	"
		Boring 1	
1	dark-brown	4	sedge-wood
2	gray	4	sedge-wood
3	dark grayish-brown	4	sedge
4	dark-brown	3	sedge
5½	dark-brown	2	sedge
6	grayish-dark-brown	4	sedge

Foot Level	Color	Degree of Marliness (HCl Test)	Nature of Sediment
7	dark-brown	none	wood, some sedge
8	dark-brown; streaked gray	4	sedge, some moss
9	"	4	sedge-moss
10	"	4	sedge-moss
11	"	4	sedge-moss
12	grayish-brown	4	moss
13	gray	4	some moss, sand, marl
		Boring 5	
Surface	black	1	finely divided wood
1	black with lighter areas	2	"
2	black	none	wood-sedge
3	blackish-gray	2-3	wood-sedge
4	dark-gray	1	wood-sedge
5	black	none	wood-sedge
6	gray	3	finely divided wood
7	dark-brown	2	moss-wood
8	dark-gray	3	moss-wood
9	dark-gray	3	moss-wood
10	brownish-gray	2	moss, finely divided wood
		Boring 6	
6½	brownish-gray	4	wood
7½	dark-gray	4	wood, ooze
9	gray	4	wood, some sedge
10	light-brown	4	mostly inorganic, small pieces of wood
		Boring 4	
Surface	black	none	woody
1	black	none	woody
2	black	none	woody
3	black	none	woody
4	dark-gray	none	wood, sand
5	dark-gray	1	mainly inorganic
6	gray, oxidizing reddish	1	wood
7	reddish-brown	1	mainly inorganic, small particles of wood