TECHNICAL INFORMATION SERIES
July 1976 Number 3

A LATE-GLACIAL POLLEN SEQUENCE FROM NORTHEASTERN IOWA: SUMNER BOG REVISITED

KENT L. VAN ZANT

GEORGE R. HALLBERG

IOWA GEOLOGICAL SURVEY
DR. STANLEY C. GRANT
Director and State Geologist
123 North Capitol Street
Iowa City, Iowa 52242

TECHNICAL INFORMATION SERIES
JULY 1976 NUMBER 3

A LATE-GLACIAL POLLEN SEQUENCE FROM NORTHEASTERN IOWA: SUMNER BOG REVISITED

KENT L. VAN ZANT
GEORGE R. HALLBERG

IOWA GEOLOGICAL SURVEY
DR. STANLEY C. GRANT
DIRECTOR AND STATE GEOLOGIST
123 NORTH CAPITOL STREET
IOWA CITY, IOWA 52242

A LATE-GLACIAL POLLEN SEQUENCE FROM NORTHEASTERN IOWA: SUMNER BOG REVISITED

Kent L. Van Zant, Research Assistant,
Department of Geology, University of Iowa
(present address: Department of
Geology, Beloit College).

George R. Hallberg, Chief, Research Division,
Iowa Geological Survey

ABSTRACT

Palynologic, stratigraphic, and radiocarbon evidence indicate the presence of a hiatus within the sediments of Sumner Bog, Bremer County, Iowa. This changes previously published interpretations of the bog. Deposition ceased and erosion and weathering ensued at the bog during the mid-postglacial. The pollen evidence indicates that during the late-glacial a closed coniferous forest composed of abundant spruce and larch trees replaced an open forest vegetation which still contained spruce and larch trees but had abundant herbaceous openings. The low percentage of fir pollen within both of these pollen assemblages suggests that fir trees were only a minor constituent of the vegetation. The very low percentage of pine pollen indicates that pine trees were not growing in northeast Iowa during this portion of the late-glacial.

INTRODUCTION - PREVIOUS INVESTIGATIONS

Sumner Bog is located one mile north of Sumner, Bremer County, Iowa (NW¼ of sec. 13, T.93N., R.11W.). In the past few years the "bog" has been tiled and planted in row crops. Sumner Bog was first sampled in 1964 by Walker in conjunction with his investigation (1966) of bogs on the Des Moines lobe. Three radiocarbon-dates were obtained from the bog sediments. These dates, and a very simplistic pollen diagram were reported by Ruhe, *et al.*, (1968). Kleiss (1970) also studied Sumner Bog in his analysis of hillslope and soil evolution in Bremer County.

A revised version of the simple pollen diagram reported by Ruhe, *et al.*, (1968) is shown in figure 1. Ruhe, *et al.*, (1968, p. 29) interpreted this diagram:

> A preliminary scan of the pollen spectrum of the Sumner Bog shows the dominance of conifers and hardwoods until 6,130 years ago . . ., followed by the dominance of grass. After 2,930 years, resurgence of oak is indicated in the grassland regimen.

This interpretation has been repeated elsewhere (Kleiss, 1969, p. 34).

This pollen data prompted the need to revisit Sumner Bog. The interpreted dominance of conifers until 6,130 RCYBP (radiocarbon years before present) is 4,000 RCY too young compared to other regional pollen data (this will be discussed in detail later). Also, the rather high percentages (and fluctuations) of "other" arboreal pollen in the 6,130 RCY to the present might shed some light on the vegetation history of eastern Iowa. The present authors were also interested in obtaining a late-glacial pollen sequence from a site east of the Des Moines lobe.

The vegetation associated with the Late-Wisconsinan glacial ice in Iowa has been interpreted from buried wood fragments and pollen deposited in lakes and bogs. Radiocarbon-dated wood of glacial age has been identified predominantly as *Picea*, *Tsuga*, and *Larix* (Ruhe, 1969, p. 188). These pieces of wood have supported the existence of these

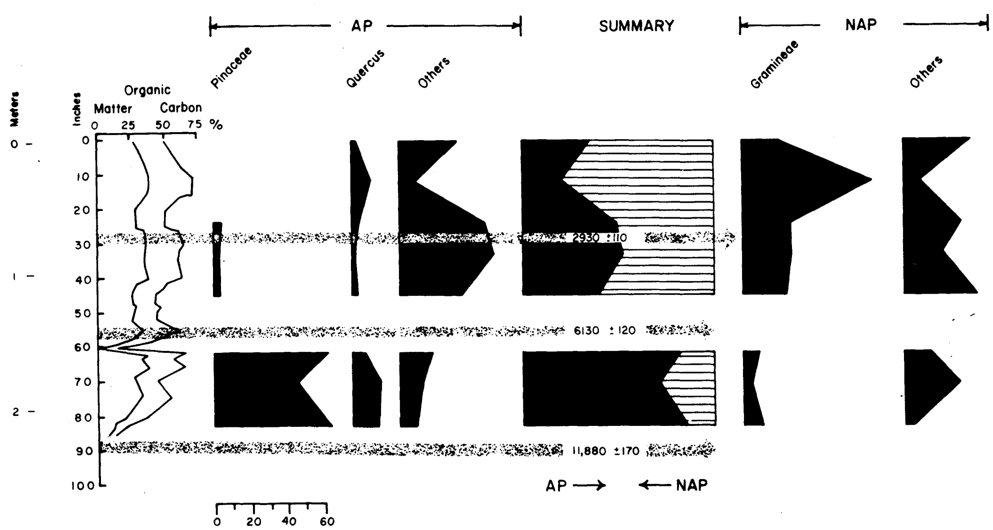


Figure 1. Organic stratigraphy, pollen spectrum scan, and radiocarbon dated horizons in Sumner Bog, replotted from figure 11 in Ruhe, *et al.*, 1968, p. 30.

trees in the upper Midwest but have not indicated their abundance.

Pollen studies have supported the presence of coniferous trees in Iowa during the late-glacial and have provided a means for measuring their relative abundance (Lane, 1931; Walker and Brush, 1963; Brush, 1967; Durkee, 1971). Some pollen studies from Iowa have shown high percentages of *Pinus* and *Abies* pollen at times when these pollen types were present in low percentages elsewhere in the region. For example, Durkee (1971) reported greater than 30% *Pinus* pollen in the late-glacial at Woden Bog, and Brush (1967) reported greater than 20% pine pollen at Colo Bog when *Pinus* was present in only small percentages elsewhere in the Midwest at the same time (e.g., Wright *et al.*, 1963; Jelgersma, 1962; Watts and Bright, 1968; McAndrews, 1967; J. Gruger, 1973). Wright

(1968) suggested that some pine trees may have survived the late-Wisconsinan glacial climate in small stands in the upper Midwest, but he did not envision pine stands sufficient to produce greater than 30% of the pollen rain. Pine appears to have spread northwestward into the upper Midwest across the Great Lakes area but stopped its transgression before reaching the plains states (Davis, 1974; McAndrews, 1967).

Similarly, percentages of *Abies* pollen in the late-glacial sediments of Iowa (e.g., greater than 75% at Colo Bog, Brush, 1967) were higher than fir pollen percentages from elsewhere in the region (e.g., Wright, *et al.*, 1963; Jelgersma, 1962). To explain these higher values of pine and fir pollen, Durkee (1971) postulated a refugium for these trees in Iowa during the late-Wisconsinan glacial advances.

METHODOLOGY

The bog was cored by the authors and Dr. R. G. Baker in July, 1974, with a two inch diameter soil probe. A one inch diameter probe was used for the lowest 35 cm because the wider diameter probe could not be pushed through the basal silts. An attempt was made to locate the pollen and radiocarbon-dated site cored by Walker from the measurements for site Q given by Kleiss (1969, p. 118). Cores were taken at various places to confirm the presence of similar stratigraphy throughout the bog.

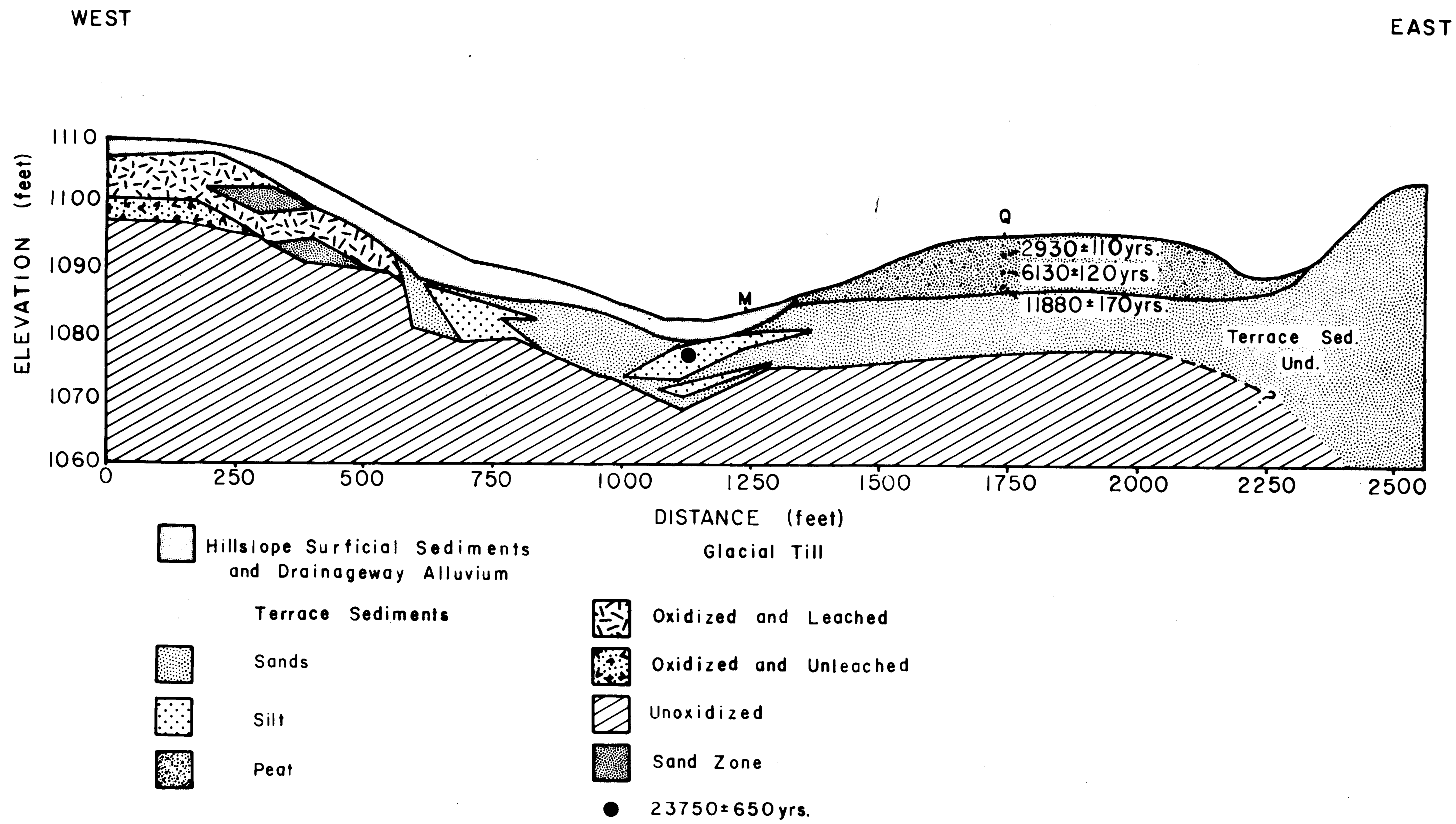
One core was sampled at 5 cm intervals and processed for pollen following the method of Faegri and Iversen (1964).

Pollen grains were identified using keys in Faegri and Iversen (1964), McAndrews, *et al.*, (1973) and Kapp (1969) and by comparison to the reference collection of the University of Iowa. The vegetation of the area was reconstructed using standard palynological techniques (e.g., Davis, 1963).

RESULTS AND DISCUSSION

The organic materials of Sumner Bog are inset in terrace sediments as shown in figure 2. The fluvial sediments of the terrace have been dated at 23,750± 650 RCYBP (Kleiss, 1970). Figure 3 shows the details of the bog stratigraphy. The authors hypothesized an unconformity in the bog sequence in order to explain the question of conifers seemingly present at Sumner until 6,130 RCYBP. Such a hiatus was not an unlikely possibility. In the midst of the organic materials, in the core which was used for the pollen and radiocarbon dates shown in figure 1, at a depth of 60-62 inches occurs a silt loam containing a relatively small amount of organic carbon. The silt loam is dark grayish brown (2.5Y 4/2) to dark gray (5Y 4/1) and overlies peat or muck. However, these underlying organic sediments do not exhibit their usual black color (N 2/0 or 10 YR 2/1). Instead, they are oxidized to a dark reddish brown (5 YR 3/2) color. Kleiss (1969, p. 118) reported four inches (62-66 inches) of this oxidized muck below the two inches of silt loam in the original pollen core (site Q, fig. 3). The numbered cores in figure 3 were taken in the vicinity of site Q by the authors and show the variations in the materials in the level, uneroded area of the

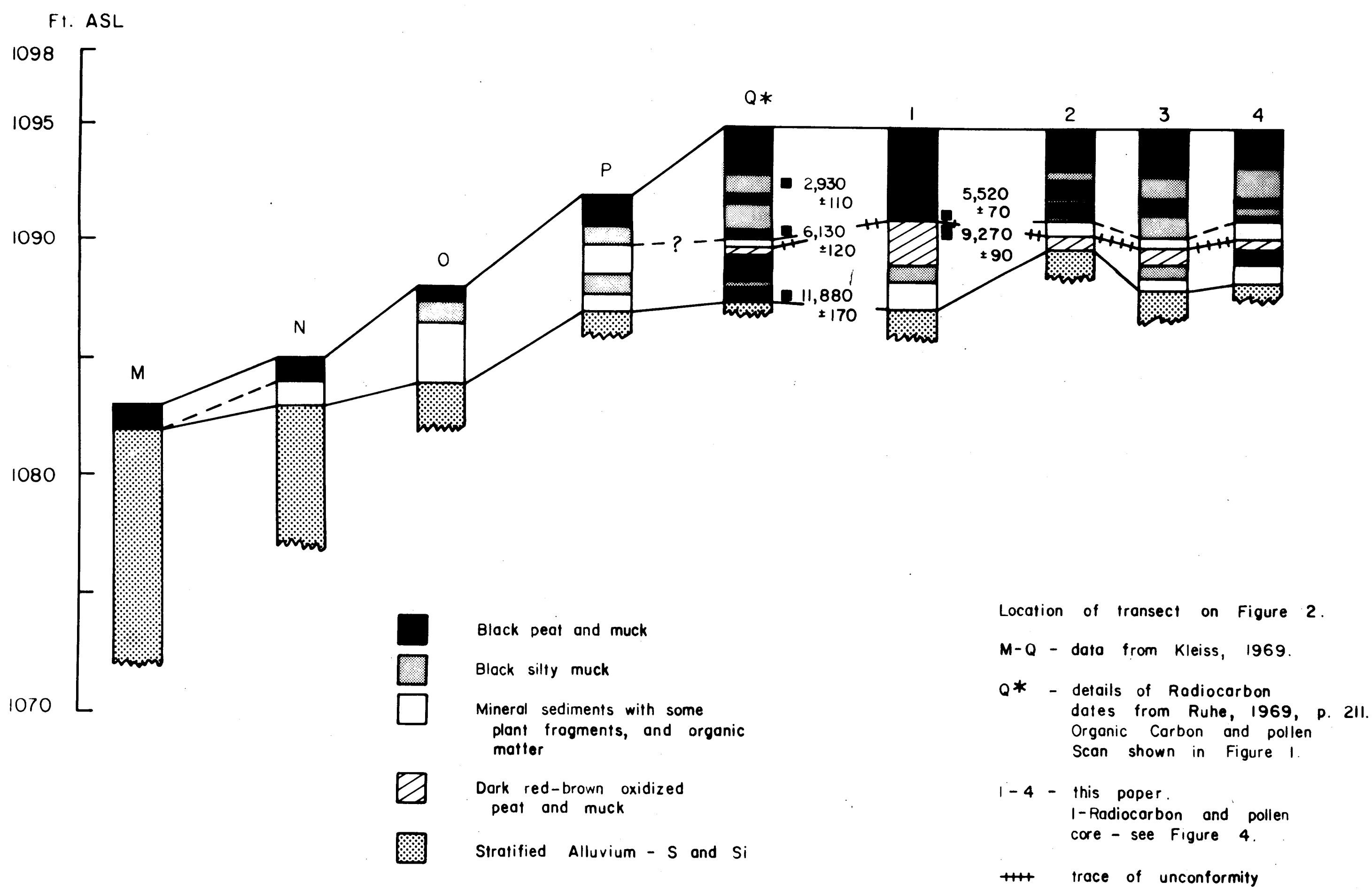
Figure 2. Geologic setting of Sumner Bog (after Kleiss, 1969).



bog. These distinct mineral sediments ranged from zero to eight inches thick, and the oxidized peat or muck ranged from four to nearly 24 inches in thickness. These gray silts were always found overlying the oxidized peat. Two radiocarbon dates were obtained from the authors' pollen core (fig. 3-4): 1) five cm (two inches) above this stratigraphic break 5,520 ± 70 RCYBP WIS-814); 2) 5 cm (two inches) below it, 9,270 ± 90 (WIS-811). There is a difference of 3,750 RCY in 10 cm (four inches) of core--substantiation for an unconformity. The dates immediately above the unconformity--6,130 RCYBP (fig. 1) and 5,520 RCYBP--match other dates from this region which mark erosional unconformities that coincide with the maximum warm-dry conditions in the mid-postglacial (e.g., Hallberg, *et al.*, 1974; Knox, 1972).

Numerous samples from the Sumner Bog cores were barren of pollen or contained abundant opaque matter. Samples from the top 120 cm of core number 1 were particularly difficult to count. The opaque matter may be charcoal and attributable to prairie fires during the postglacial. In an attempt to reduce the opaque material, various samples were processed using the method of Mehringer (1967) and three techniques from Gray (1965). These procedures did not sufficiently reduce the opaque matter to facilitate counting. Consequently, only samples with reasonably good preservation and concentration were counted. Most of these samples were within the lowest one meter of the core.

Figure 3. Details of Sumner Bog stratigraphy.



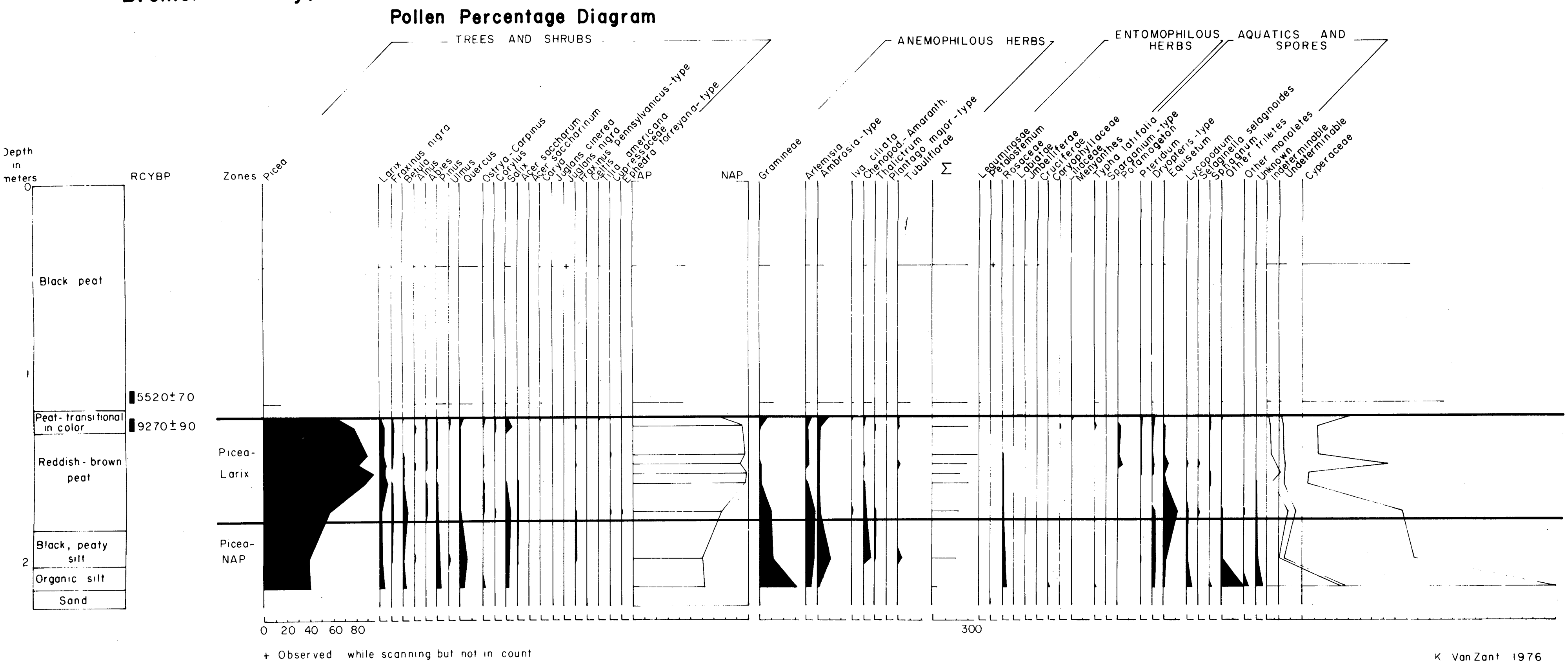
The pollen percentages are graphed in figure 4. An attempt was made to count 300 grains from each sample, but poor preservation, sparse pollen, and abundant opaque matter limited the pollen sum at four levels. The pollen sum included pollen of trees, shrubs, and anemophilous herbs. Pollen of entomophilous herbs, aquatics, and spores were excluded from the pollen sum. Cyperaceae pollen was also excluded because of its potentially local origin.

The lowest meter of the pollen sequence was divided into two pollen assemblage zones. The lowest zone, *Picea*-NAP (non-arboreal pollen) zone, was characterized by approximately 40-50% *Picea* pollen, 40% nonarboreal pollen, and greater than 10% Gramineae pollen. Gramineae and Chenopodiaceae-Amaranthaceae pollen decreased in this zone from their highest percentages on the diagram. Some thermophilous tree species, e.g., *Quercus* pollen, decreased throughout this zone. Cyperaceae pollen also decreased.

The *Picea-Larix* pollen assemblage zone is characterized by very high percentages (55-95%) of spruce pollen, the highest percentages of larch pollen on the diagram, and decreased percentages of NAP.

The vegetation represented by the *Picea*-NAP assemblage zone is interpreted as an open forest environment. Comparisons with modern surface samples (Lichti-Federovich and Ritchie, 1965, 1968) suggest that some aspects of the pollen rain at Sumner Bog during the deposition of this assemblage zone were similar to those of the open lowland forest-tundra

Figure 4. SUMNER BOG
Bremer County, Iowa



region around Hudson Bay today. However, it is difficult (if not impossible) to relate Midwestern late-glacial samples to modern surface samples because of the ubiquitous lack of pine pollen in the late-glacial assemblages (e.g., Wright, 1968; Wright and Watts, 1969). This zone is very similar to some basal pollen zones in northeastern Minnesota (e.g., Kotiranta Lake-la) which have been interpreted as tundra or open forest-tundra based on macrofossil analysis (Wright and Watts, 1969). Conversely, in similar zones in southern Minnesota, macrofossils have shown no evidence for tundra (these sites generally exhibit higher AP percentages than those of the northeast however). A single pollen sample from the Brayton Local Biota in west-central Iowa showed a similar assemblage (Dulian, 1975). This sample was dated 12,420 RCYBP, but it contained macrofossils of spruce (*Picea* sp.), northern red oak (*Quercus rubra*), and beaked hazel (*Corylus cornuta*). These macrofossils document the coexistence of conifers and thermophilous deciduous trees in a pollen assemblage showing only 39% *Picea* pollen and 30% NAP. These pollen percentages and macrofossils seemingly exclude tundra as the dominant local vegetation.

Obviously, at the present time it is difficult to interpret the *Picea*-NAP zone except to state that it does represent an open forest. What vegetation comprised the openings is subject to question.

The *Picea*-*Larix* assemblage zone represented closing or closed coniferous forest domianted by *Picea* and *Larix*. The pollen percentages of these two taxa at Sumner compared favorably to modern surface samples from closed coniferous forest (Lichti-Federovich and Ritchie, 1968). The notable exception again was the lack of pine pollen in the fossil record at Sumner. These pollen percentages compared favorably to similar assemblages from other diagrams from throughout the region (e.g., Wright, *et al.*, 1963; Jelgersma, 1962; Watts and Bright, 1968).

The pollen samples at 120 and 125 cm (figure 4) also indicate the presence of a hiatus which was substantiated by the radiocarbon dates (5,520 ± 70 at 110-116 cm; 9,270 ± 90 at 125.5-132 cm). This hiatus was unrecognized by Walker, Ruhe, *et al.* (1968), and Kleiss (1969), and apparently was the reason for Ruhe's (1969, p. 194) extension of the range of coniferous forest in Iowa beyond 10-11,000 RCYBP.

The 9,270 RCYBP date just below the hiatus and at the upper boundary of the *Picea-Larix* pollen assemblage zone (figure 4) is still considerably younger than this zone has been dated elsewhere in the region. For example, the upper boundary of this zone was dated at 10,230 RCYBP at Kirchner Marsh (Wright, *et al.*, 1963), at 11,250 RCYBP at Madelia (Jelgersma, 1962), soon after 11,880 RCYBP at Hughes Peat Bed (Hall, 1971), and at 10,670 RCYBP at Pickerel Lake (Watts and Bright, 1968). The youthfulness of the Sumner date is probably attributable to either the downward movement of younger humic acids during the weathering and oxidation of the peat after erosion exposed it, or to the inclusion of younger material in the radiocarbon-dated sample by contamination from natural mixing after peat formation resumed again at approximately 6,130-5,520 RCYBP. Pollen counts in the uppermost sample of the *Picea-Larix* assemblage zone, at 125 cm, show that as *Picea* and *Larix* percentages declined, Gramineae, *Ambrosia*, and *Artemisia* increased. These taxa are most abundant during the mid-postglacial at other sites in the area and not immediately following the *Picea-Larix* zone (e.g., Wright, *et al.*, 1963). The 125 cm pollen sample, as well as the radiocarbon sample, may contain contamination from above the hiatus.

Because of the poor preservation and abundant opaque material it was impossible to construct a pollen diagram for the 5,520 RCYBP to present portion of the core.

CONCLUSIONS

1. Pollen and physical stratigraphic evidence and radiocarbon dates indicate that a previously unrecognized hiatus exists in Sumner Bog. During the warmest, driest part of the postglacial (ca. 7,200-6,200 RCYBP) organic sediments ceased to accumulate and erosion ensued. Dessication and lowering of the water table allowed the exposed upper surface of organic sediments to be oxidized. Thin mineral sediments were deposited on this unconformable surface. Peat sedimentation resumed ca. 6,130-5,520 RCYBP.

2. A radiocarbon date of 9,270 RCYBP immediately below the unconformity is probably too young, based on pollen evidence. This may be attributed to contamination by younger

organic materials during exposure and weathering or after peat formation resumed on the unconformable surface.

3. Late-glacial vegetation is interpreted as open coniferous forest (possibly open forest-tundra) progressing to a closed coniferous forest of spruce and larch. The low percentages of pine and fir pollen are consistent with late-glacial assemblages elsewhere in the upper Midwest but not with some previous studies from Iowa. Apparently, pine and fir trees were not growing in abundance in northeastern Iowa during the late-glacial.

ACKNOWLEDGEMENTS

Dr. Richard G. Baker helped core the bog, aided in pollen identifications, participated in useful discussions, and reviewed the manuscript. We also thank Dr. Margaret Bender, Dr. John Kutzbach, and Dr. Wayne Wendland of the University of Wisconsin, Center for Climatic Research, for radiocarbon analysis.

REFERENCES CITED

Brush, Grace S., 1967, Pollen analyses of late-glacial and post-glacial sediments in Iowa; *in* Cushing, E. J., and Wright, H. E., Jr., *Quaternary paleoecology*. Yale Univ. Press, New Haven, pp. 99-115.

Davis, Margaret B., 1963, On the theory of pollen analysis: *Amer. Jour. Sci.*, v. 261, pp. 897-912.

Davis, Margaret B., 1974, Holocene migrations of ecotones: continuing northward migration of tree species throughout the Holocene caused changes in community composition and migrations of ecotones: *Amer. Quat. Assoc., Abs., 1974 mtg.*, pp. 18-21.

Dulian, James J., 1975, Paleoecology of the Brayton Local Biota, Late Wisconsinan of southwestern Iowa; unpublished Master's thesis, Dept. of Geology, University of Iowa, Iowa City, Iowa, 50 p.

Durkee, L. H., 1971, A pollen profile from Woden Bog in northcentral Iowa: *Ecology*, v. 52, pp. 837-844.

Faegri, Knut, and Iversen, Johs., 1964, *Textbook of Pollen Analysis*; Munksgaard, Copenhagen, 237 p.

Gray, Jane, 1965, Extraction techniques; *in* Kummel, Bernhard, and Raup, David, eds., *Handbook of Paleontological Techniques*, San Francisco, W. H. Freeman and Co., pp. 530-587.

Gruger, Johanna, 1973, Studies of the late Quaternary vegetation history of northeastern Kansas: *Geol. Soc. Amer. Bull.*, v. 84, pp. 239-250.

Hall, Stephen Austin, 1971, Paleoecological interpretation of *Bison*, mollusks, and pollen from the Hughes peat bed, Linn County, Iowa: unpublished Master's thesis, Dept. of Geology, University of Iowa, Iowa City, Iowa, 75 p.

Hallberg, George R., Hoyer, Bernard E., and Miller, Gerald A., 1974, The geology and paleopedology of the Cherokee Sewer Site: *Jour. of the Ia. Archaeological Soc.*, v. 21, chap. 2, pp. 17-50.

Jelgersma, Saskia, 1962, A late-glacial pollen diagram from Madelia, south-central Minnesota: *Amer. Jour. Sci.*, v. 260, pp. 522-529.

Kapp, Ronald O., 1969, *How to Know Pollen and Spores*; Wm. C. Brown, Dubuque, Iowa, 249 p.

Kleiss, Harold J., 1969, Hillslope evolution and soil formation in northeastern Iowa: unpublished Master's thesis, Dept. of Agronomy, Iowa State University, Ames, Iowa, 128 p.

Kleiss, Harold J., 1970, Hillslope sedimentation and soil formation in northeastern Iowa: *Soil Sci. Soc. Amer. Proc.*, v. 34, pp. 287-290.

Knox, James C., 1972, Valley alluviation in southwestern Wisconsin: *Annals of the Assoc. of Am. Geog.*, v. 62, no. 3, pp. 401-410.

Lane, George H., 1931, A preliminary pollen analysis of the East McCulloch peat bed: *Ohio Jour. Sci.*, v. 31, pp. 165-171.

Lichti-Federovich, Sigrid, and J. C. Ritchie, 1965, Contemporary pollen spectra in central Canada. II. The forest-grassland transition in Manitoba: *Pollen et Spores*, v. 7, pp. 63-87.

Lichti-Federovich, Sigrid, and J. C. Ritchie, 1968, Recent pollen assemblages from the western interior of Canada: *Rev. Palaeobotan. Palynol.*, v. 7, pp. 297-344.

McAndrews, J. H., 1967, Pollen analysis and vegetational history of the Itasca region Minnesota; *in* Cushing, E. J., and Wright, H. E., Jr., eds., *Quaternary Paleoecology*, Yale Univ. Press, pp. 219-236.

McAndrews, J.H., Berti, A. A., Norris, Geoffrey, 1973, Key to the Quaternary pollen and spores of the Great Lakes region: *Royal Ontario Museum, life science misc. publ.*, 61 p.

Mehringer, Peter J., Jr., 1967, Pollen analysis of the Tule Springs area, Nevada: *Nev. State Mus., Anthropol. Papers no. 13*, pp. 130-200.

Ruhe, R. V., 1969, *Quaternary Landscapes in Iowa*; Iowa State Univ. Press, Ames, Iowa, 255 p.

Ruhe, R. V., Dietz, W. P., Fenton, T. E., Hall, G. F., 1968, Iowan drift problem, northeastern Iowa: *Iowa Geol. Survey Rept. Inv. 7*, 40 p.

Walker, Patrick H., 1966, Post-glacial environments in relation to landscape and soils on the Cary Drift, Iowa: *Iowa State Univ., Agric. and Home Econ. Exp. Sta., Res. Bull. 549*, pp. 838-875.

Walker, P. H., and Brush, G. S., 1963, Observations on bog and pollen stratigraphy of the Des Moines glacial lobe, Iowa: *Proc. Iowa Acad. Sci.*, v. 70, pp. 253-260.

Watts, and Bright, R. C., 1968, Pollen, seed, and mollusk analysis of a sediment core from Pickerel Lake, northeastern South Dakota: *Geol. Soc. Amer. Bull.*, v. 79, pp. 855-876.

Wright, H. E., Jr., 1968, The roles of pine and spruce in the forest history of Minnesota and adjacent areas: *Ecology*, v. 49, pp. 937-955.

Wright, H. E., Winter, T. C., Patten, Harvey L., 1963, Two pollen diagrams from southeastern Minnesota: Problems in the regional late-glacial and post-glacial vegetational history: *Geol. Soc. Amer. Bull.*, v. 74, pp. 1371-1396.

Wright, A. E., Jr., and Watts, W. A., 1969, Glacial and vegetational history of northeastern Minnesota: *Minn. Geol. Survey Sp. Pub. ll*, 59 p.

H6618