Prehistoric Maize in Southeastern Virginia

Abstract. *Five fossil maize-pollen grains were identified in a peat profile from Dismal Swamp. Extrapolation from the radiocarbon age of peat lower in the section suggests an age of 2200 years. The find suggests that a small clearing within the swamp was cultivated and thus supports the hypothesis that agriculture had diffused into coastal regions before the end of Early Woodland time.*

The most important plant cultivated by early inhabitants of the New World was maize. By the time of the first European contact with the Americas, culture of maize had spread from its original centers in Mesoamerica to the St. Lawrence River region (47°N) and Chile (43°S) (*1*). Yet relatively little was known until recently concerning the antiquity of maize culture and the pattern of its diffusion into North America. It has been proposed that wild maize, a "species" now extinct, occurred in Mexico at least as early as the last interglacial (*2*) and persisted there until 2000 years ago (*3*). Recent evidence from southern Mexico suggests that corn was first cultivated there between 7000 and 5000 years ago. It is thought that maize had spread into northern Mexico, New Mexico, and Arizona by about 4000 years ago (*3, 4*).

The earliest introduction of maize into the Mississippi basin has not been dated accurately, but it is assumed that the considerable development during the Early Woodland Adena culture (1000 B.C.–A.D. 200) was in part a function of the beginning of agriculture (*5*). Agriculture was certainly well established there by Middle Woodland time (*5, 6*). Much less is known regarding the antiquity of maize culture along the eastern seaboard, but it is generally thought to have been introduced at the end of Early Woodland time, perhaps close to A.D. 1 (*7*); the few dated remains appear to be considerably younger.

Pollen analysis of peat sections from Dismal Swamp has yielded an early record of maize in southeastern Virginia. Initially a single pollen grain of maize was identified from the 0.49-meter level of a core (DS-1) from beside Feeder Canal, just east of Lake Drummond (Fig. 1). A recheck of the slide and of others from the same level revealed four more grains.

The grains range in diameter from 77.7 to 84.1 μ (*8*); the axis:pore ratio [ratio of grain diameter (long axis) to pore diameter] varies from 5.2 to 6.1; the sculpture (Fig. 2) consists of distinct, symmetrically distributed microechinae; columella distribution corresponds to that of microechinae. These characteristics automatically exclude *Tripsacum* as a possibility, for its grains are significantly smaller ($\bar{X}$, 41.9 μ; range of variation, 33.4 to 56.6 μ), its ratios are generally lower, and its sculpture is distinctly verrucate (*9, 10*). Teosinte and maize are more difficult to separate: their sculpture is virtually identical, their ratios correspond almost perfectly, and they overlap somewhat in grain size (*9*). Nevertheless it is reasonably certain that the fossil grains are those of maize pollen; they are more than two standard deviations larger than the mean size of teosinte (63.6 ± 4.7 μ) (*9*), and teosinte from the United States is unknown.

A radiocarbon age of 3580 ± 100 years (sample Y-1321) was obtained from the 0.80-meter level of the same core. If one assumes a relatively uniform rate of peat formation (suggested by the homogeneity of the topmost meter of peat), an age of 2200 years can be assigned to the 0.49-meter level. The exact age is conjectural; one may need to allow for some compaction and for possible loss of surface peat by oxidation or fire. However, I think that 2000 to 2200 years is a reasonable approximation of the age of the maize pollen. There is no evidence of compaction in the sediment, and the generally good preservation of pollen in the higher levels suggests that little oxidation has occurred. The level of the material that yielded the radiocarbon date is too shallow to be affected by enrichment by humic acids and amino acids leached from the surface layers (*11*). If the age of this pollen find can be validated, it will be the oldest evidence of maize in the Middle Atlantic region and will substantiate the hypothesis that agriculture had diffused into the area before the end of Early Woodland time.

The meaning of this occurrence of pollen is not clear. At first glance cultivation of maize within Dismal Swamp some 2000 years ago seems unlikely. By that time a vast cypress-

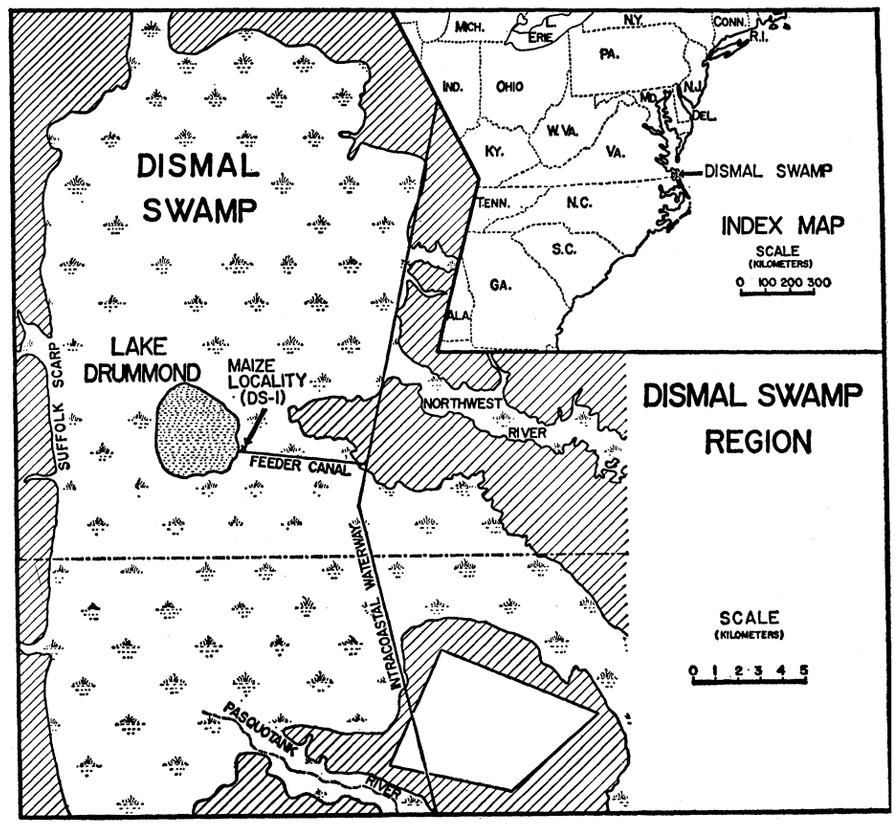

Fig. 1. Map of Dismal Swamp, showing the source of core DS-1.

gum swamp had developed; red maple and various swamp shrubs grew as subdominants. The entire surface of the swamp was mantled with forest peat, which was almost 2 meters thick at this site. Such a setting seems singularly improbable for maize culture. However, the depth of peat is made quite variable by the irregular surface of the underlying clay (*12*); for example, the clay breaks the surface 2.5 km northeast of the core site, and there are several slightly lower high points an equal distance south of the site. Such situations, with peat cover either thin or lacking, may have provided more favorable conditions for agriculture.

However, it is questionable whether maize pollen could have been transported from afar; the size of the grains precludes such transportation and, considering the presence of prolific pollen producers in the local vegetation, it is unlikely that such concentration of pollen grains could have resulted from long-distance transportation. It may be significant that no maize pollen was found in a core from Lake Drummond (sample LD-59, collected 2 km west of DS-1) although more than 1000 grains were counted from the critical levels. Thus it is quite possible that the maize pollen was locally derived.

The evidence suggests that there was a local clearing in the swamp in which maize could have been grown. In the levels embracing the maize find there are slight maxima of Gramineae (15 percent), *Corylus* (2 percent), and *Myrica* (4 percent), and occasional grains of *Artemisia*. Occurrence of these heliophytes in association with increasing percentages of *Ilex*, Ericaceae, and other swamp shrubs suggests the presence of a small clearing that was later overgrown by shrubs; such successions can be seen today in Dismal Swamp, especially in areas that have been subjected to deep peat burns. Such burns do not regenerate swamp forest immediately, but rather develop into "lights"—regions of dense, shrubby vegetation dominated by Ericaceae, *Smilax*, *Magnolia*, *Myrica*, and other shrubs.

Why the people of the Early to Middle Woodland cultures in this region should select forested swamp for farming is a mystery. Perhaps there was no conscious attempt to farm the swamp; perhaps the clearing was made by a spontaneous fire and was cultivated simply because it was available and required little further modification. Such destructive fires have been common in the swamp, especially during periods of low water level; charcoal fragments occur in many peat cores but not in the topmost meter of DS-1.

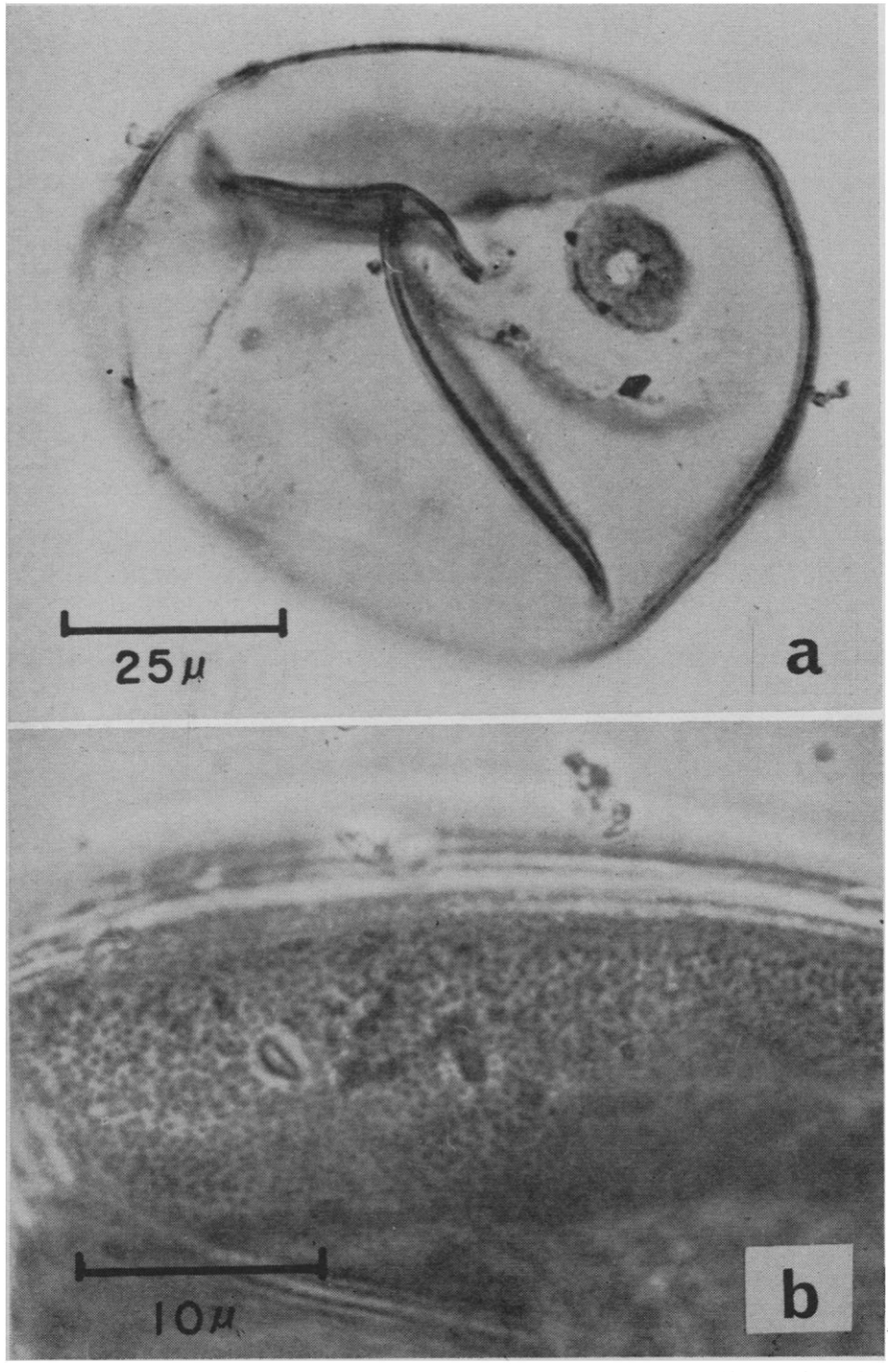

Fig. 2. (*a*) Fossil maize-pollen grain from core DS-1, Dismal Swamp. (*b*) Portion of *a* (by phase contrast); note sculpture.

DONALD R. WHITEHEAD
Department of Biology,
Williams College,
Williamstown, Massachusetts

References and Notes

1. H. E. Driver and W. C. Massey, *Trans. Amer. Phil. Soc.* **47**, 167 (1957).
2. E.S Barghoorn, M. K. Wolfe, K. H. Clisby, *Botan. Museum Leafl. Harvard Univ.* **16**, 229 (1954).
3. P. C. Mangelsdorf, R. S. MacNeish, W. C. Galinat, *Science* **143**, 538 (1964).
4. P. S. Martin and J. Schoenwetter, *ibid.* **132**, 33 (1960).
5. J. B. Griffin, in *Prehistoric Man in the New World*, J. D. Jennings and E. Norbeck, Eds. (Univ. of Chicago Press, Chicago, 1964), pp. 223–58.
6. ———, *Wisconsin Archeol.* **41**, 21 (1960).
7. K. Schmitt, in *Archeology of the Eastern United States*, J. B. Griffin, Ed. (Univ. of Chicago Press, Chicago, 1952), pp. 59–70.
8. Fossil samples were prepared by treating peat with KOH, HF, and acetic acid; samples were mounted in silicone oil.

Measurement of other fossil grains in the sample indicated no aberration in size.
9. D. R. Whitehead and E. J. Langham, *Bull. Torrey Botan. Club* **92**, 7 (1965).
10. H. T. Irwin and E. S. Barghoorn, *Pollen Spores* **4**, 352 (1962); M. Tsukada, *ibid.* **6**, 393 (1964).
11. F. M. Swain, A. Blumentals, R. Millers, *Limnol. Oceanog.* **4**, 119 (1959).
12. R. Oaks, "Post-Miocene stratigraphy and morphology, outer coastal plain southeastern Virginia," dissertation, Yale Univ. (1964).
13. Supported by NSF grant G-17277. I thank J. B. Griffin and H. A. MacCord, Sr., for information on early agriculture in eastern North America; and Dr. Griffin for reading the manuscript.

17 September 1965

Andromeda Galaxy: Extension of the 610.5-Megacyle-per-Second Map

Abstract. *A radio map of the Andromeda galaxy, M 31, made with the 400-foot (122 m) radio telescope at the University of Illinois has been extended northward to cover the full optical extent of the galaxy. Several condensations of radio emission appear along the major axis of the galaxy, and other radio features are resolved.*

A recent map at 610.5 Mc/sec of the nearby galaxy M 31 by MacLeod (*1*) with the 400-foot (122 m) radio telescope at the Vermilion River Observatory (VRO) of the University of Illinois has been compared by Arp (*2, 3*) with optical studies of the spiral structure of that galaxy. Arp's comparison of the optical and radio studies revealed the curious fact that the three major concentrations of radio emission along the major axis of M 31 correspond to the successive position where one of the spiral arms crosses the axis. The original radio map covered a range in declination from 39.9° to 41.7°, and in order to investigate further correspondence of the spiral structure and radio emission we have extended the map northward to a declination of 43°. The completed map of the whole region is shown in Fig. 1.

The procedure for making the extension to the map was the same used for the original section (*1*). Three drift curves obtained at each declination, spaced at intervals of one-half the beamwidth across the region, were averaged for the extension of the final map. Several declination cuts on a given right ascension were made in order to insure that the baseline level remained consistent from declination to declination. The 400-foot (122 m) radio telescope has a circular beam with a half-power diameter of 16 minutes of arc. The receiver was a Dicke-type radiometer with an electron-beam parametric amplifier, loaned by the Zenith Radio Corporation. The noise fluctuations (root-mean-square, rms) of the system are equivalent to an antenna temperature of 0.18°K at the input of the receiver. The units on the map are expressed in terms of the antenna temperature. Each contour represents 0.15°K above an arbitrary zero near the right ascension of 1 hour.

The three concentrations of radio emission along the major axis are shown within the outline of the galaxy in Fig. 1. Arp (*3*) indicates that these concentrations correspond with the crossings of the major axis (N 2, S 3, and N 4) of one of the spiral arms. The next northward crossing of this same arm, N 6, occurs at about 00^h45^m and 42.2°; no increased radio emission is indicated at this point. There is, however, a slight increase in radio emission along the major axis of M 31 near $00^h43.5^m$ and 41.8°. This position is near Arp's (*2*) axis crossing N 5 of the other spiral arm of the galaxy. This may be coincidental, since large numbers of discrete sources appear in this part of the sky.

Other radio maps of M 31 by Large, Mathewson, and Haslam (*4*) at 408 Mc/sec and by Kraus (*5*) at 1415 Mc/sec show a general outline for the galaxy which is similar to that on the map resulting from our present observations. However, the map by Kraus in particular shows a narrow spur of emission extending northward from the general disk component of the emission at a right ascension of about 00^h42^m. This spur does not appear on the present

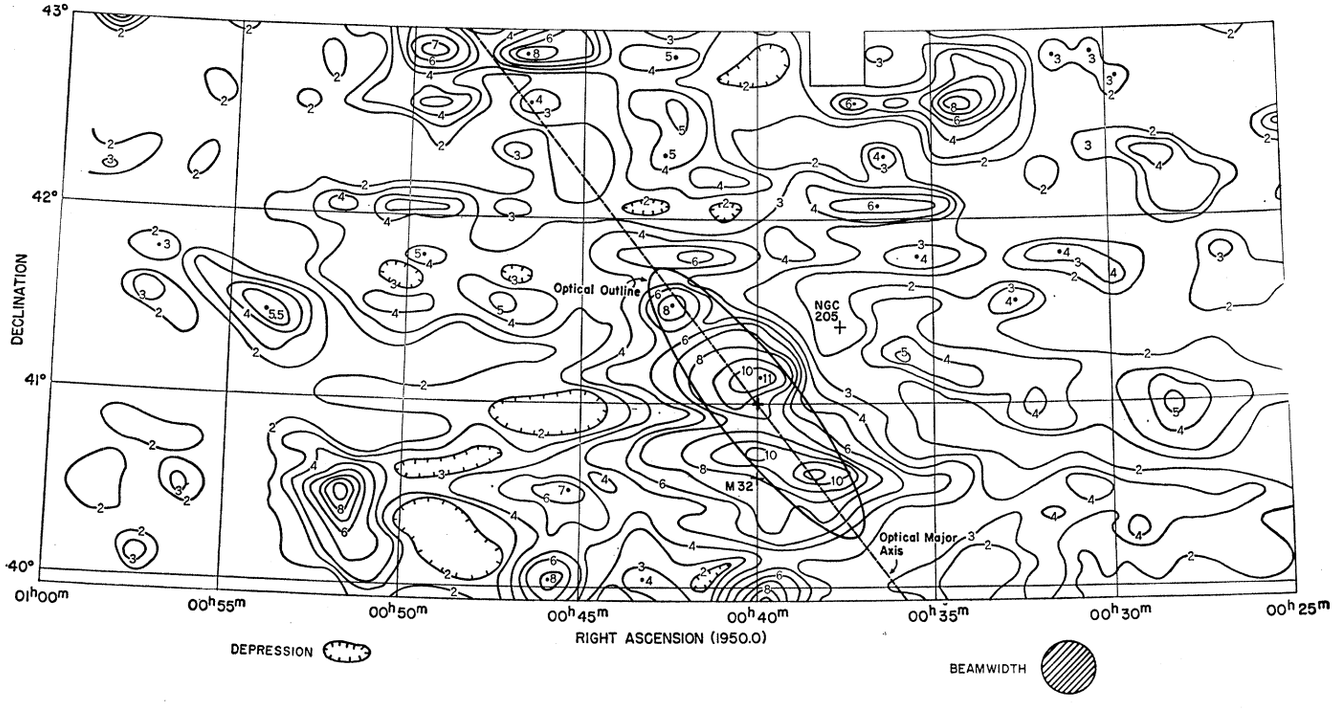

Fig. 1. A radio contour map of the galaxy M 31 at 610.5 Mc/sec made with the 400-foot radio telescope at the Vermilion River Observatory of the University of Illinois. The units on the map are expressed in terms of the antenna temperature. Each contour represents 0.15°K. The optical outline of the galaxy is also indicated with a dark cross at the center. The positions of the dwarf galaxies M 32 and NGC 205 are shown also.