Further, the chlamydospores from kernel infection in a hybrid of Chalco teosinte and maize show variation in spore shape, i.e., ovoid to spherical. Also their spines are slightly elongated and the diameter at the base is narrow compared to the spore spines of other teosinte smuts we have studied. The details of this investigation will be published elsewhere.

We are thankful to Dr. Walton C. Galinat, of the University of Massachusetts, Waltham Field Station, for kindly collecting the spores of teosinte smuts used in this investigation.

Umesh C. Banerjee
Elso S. Barghoorn

7. The oldest convincing archaeo-palynological evidence for natural introgression between Tripsacum and Zea.

Mangelsdorf and Reeves (1931, 1939) were the first to demonstrate that Zea and Tripsacum can be hybridized artificially. They also postulated that teosinte (Euchlaena mexicana) originated as a result of such natural hybridization between these two genera. Mangelsdorf (1961) further suggested that the South American races of maize may have inherited their tripsacoid characteristics through direct introgression with Tripsacum. But natural introgression between Zea and Tripsacum has not yet been demonstrated conclusively. Our recent palynological investigation with various genetic stocks, which were artificially produced by crossing Zea and Tripsacum, has revealed that such introgression could be predicted precisely using the pollen grain ektexine patterns at the micro-morphological level (Galinat, Barghoorn, and Banerjee, unpublished data). Our palynological data also indicate that teosinte is not a hybrid of Zea and Tripsacum as suggested earlier; we feel perhaps this genus may have evolved parallel with Zea, possibly from a common ancestor. The phenotypic patterns of the pollen grain ektexine of the "pure races" of Zea and Euchlaena are very similar, and are represented by the evenly distributed spinules, although Zea pollen is significantly larger in size both in archaeological and in modern populations. On the other hand, the phenotypic pattern of Tripsacum ektexine in diploid and tetraploid species shows a very distinct "negatively-reticuloid" spinule clumping. When different races of Zea and Euchlaena are hybridized with each other artificially or in the wild, the pollen grains

from hybrid derivatives (including the Type specimen of Zea cannina Wats., in the Gray Herbarium, Harvard University) show a pattern in which a few ektexine spinules are occasionally missing, giving rise to blank areas (Banerjee and Barghoorn, 1972a). This pattern occurs in most of the popcorn races from Mexico which overlap in flowering time with teosinte. Even the popcorn race "Confite Morocho" from Peru was found to exhibit this pattern and hence the presence of teosinte germ-plasm is indicated. However, the phenotypic Tripsacum ektexine pattern is dominant over the Zea and Euchlaena patterns, and the hybrid-derivatives retain some degree of spinule clumping. Our observations also suggest that this criterion could be used conclusively to show introgression of Tripsacum with both maize and teosinte. Recently, we have studied a prehistoric archaeological sample (tassel fragments) of Zea mays L. from the site near Huarmey, Peru, from level #4, dated approximately 2000 to 1600 B.C. (this date is estimated by the archaeologists, personal communication with Professor Mangelsdorf, and Mangelsdorf and Cámara-Hernández, 1967). The pollen grains from this site show a distinct spinule clumping and demonstrate the oldest convincing archaeo-palynological evidence of introgression of Tripsacum with maize. Moreover, we found that a collection of pollen grains of the extant race of Cuzco maize (Zea mays L.) also shows a distinct spinule clumping, and we may assume perhaps that this race of maize has likewise been derived through natural introgression with Tripsacum (Banerjee and Barghoorn, 1972b).

Literature cited:

Banerjee, U. C., and Barghoorn, E. S. (1972a). Fine structure of pollen grain ektexine of maize, teosinte and Tripsacum. in 30th Ann. Proc. Electron Microscopy Soc. Amer., Los Angeles, Calif., Ed. Arceneaux, C. J. (1972), pp. 226-227.

Banerjee, U. C., and Barghoorn, E. S. (1972b). Morphology and fine structure of the pollen grains of maize and its relatives. (Abstract) Presented at 5th Annual Meeting of the American Association of Stratigraphic Palynologists, Kingston, R.I., on October 25th-28th, 1972.

Mangelsdorf, P. C., and Reeves, R. G. (1931). Hybridization of maize, Tripsacum, and Euchlaena. J. Hered. 22:328-343.

Mangelsdorf, P. C., and Reeves, R. G. (1939). The origin of Indian corn and its relatives. Tex. Agric. Exp. Sta. Bull. #574.

Mangelsdorf, P. C. (1961). Introgression in maize. Euphytica 10:157-168.

Mangelsdorf, P. C., and Cámara-Hernández, J. (1967). Prehistoric maize from a site near Huarmey, Peru. Maize Genet. Coop. News Letter 41:47-48.

Umesh C. Banerjee
Elso S. Barghoorn

UNIVERSITY OF ILLINOIS
Urbana, Illinois
Department of Botany

1. Reaction of germinating maize pollen to Helminthosporium maydis pathotoxins.

Hooker et al. (Plant Disease Reptr. 54: 708-712, 1970) have shown that Helminthosporium maydis race T is virulent for maize plants which carry the Texas (T) male-sterile cytoplasm. Maize with nonsterile cytoplasm, as well as that with C or S male-sterile cytoplasm, is resistant to the race T pathotoxin. When germinating seeds are incubated in solutions of the race T pathotoxin, the elongation of primary roots of seedlings with T cytoplasm is inhibited. Root growth of seedlings with C, S or normal cytoplasm is not inhibited. The race O pathotoxin is not specific as to cytoplasm (Lim and Hooker, Genetics 69: 115-117, 1971). We have conducted studies to determine whether the race T pathotoxin has a similar differential effect on germinating maize pollen grains.

The technique of Cook and Walden (Can. J. Bot. 43: 779-786, 1965) for the in vitro germination of pollen was modified to incorporate toxin into the medium. As sources of race O and race T toxin, we have used both extracts of infected leaves and filtrates of Fries medium in which the fungus has grown. Pollen tubes were both fixed and stained with lactophenol aniline blue.

We have tested many lines and their different cytoplasmic versions, as well as the normal and T cytoplasm versions of some F_1's. Pollen germination of T and P cytoplasm plants is consistently inhibited in the presence of the race T toxin at concentrations which allow growth of