References and Notes

1. R. G. Canti, J. O. W. Bland, D. S. Russell, *Research Publs. Assoc. Research Nervous Mental Disease* **16**, 1 (1937).
2. C. E. Lumsden and C. M. Pomerat, *J. Exptl. Cell Research* **2**, 103 (1951).
3. C. M. Pomerat, *J. Nervous Mental Disease* **114**, 430 (1951).
4. ———, *J. Neuropathol. Exptl. Neurol.* **14**, 28 (1955).
5. ———, *Biology of Neuroglia* (Thomas, Springfield, Ill., 1958), p. 162.
6. G. G. Rose, C. M. Pomerat, T. O. Shindler, J. B. Trunnell, *J. Biophys. Biochem. Cytol.* **4**, 761 (1958).
7. Grateful acknowledgement is made to Mrs. Walther Hild and Charles Raiborn for their aid with the preparation of the cultures and to George Lefeber for the photographic work. This investigation was aided by a research grant (PHS B-364 — C5) from the National Institute of Neurological Diseases and Blindness of the National Institutes of Health, U.S. Public Health Service.

7 August 1959

Age of Marginal Wisconsin Drift at Corry, Northwestern Pennsylvania

Abstract. Marl began to accumulate about 14,000 years ago, as determined by radiocarbon dating, in a pond in a kettle hole in Kent drift at Corry, Pa., 9 miles inside the Wisconsin drift margin. This radiocarbon age represents the minimum time since the disappearance of the ice from Corry and confirms an assignment of Cary age to the drift.

Samples of peat and marl from a bog in a kettle hole in the northwestern part of Corry, Pa., have been assayed for C^{14}. Corry, in southeastern Erie County, is 7 miles southeast of the southwestern corner of New York state.

The kettle hole is in a kame complex (*1*), the location of which is well shown on the *Glacial Map of the United States* (*2*), associated with the Kent till (*3*), which is the outermost Wisconsin till of the Grand River glacial lobe in northeastern Ohio and northwestern Pennsylvania. It has been earlier correlated as "early Cary" by White (*4*). The kettle hole is 9 miles northwest of the outer limit of Wisconsin (Kent) drift, which is marked by the prominent 4-mile-wide Kent moraine (*5*).

The kames at Corry are related to the disappearance of the marginal part of the ice sheet, but they may have been deposited at an ice edge which readvanced slightly to Corry after retreat from the Kent moraine. The age of the lowest part of the organic deposits establishes the minimum time since the kettle hole has been available for the accumulation of organic material.

The bog is being worked for peat for floriculture by Russell Graham and Earl Shade, who report that the peat in the center of the bog is as much as 30 ft thick and is everywhere underlain by marl. The section and samples for which data are given in Table 1 were secured in an auger boring; the dating of the samples was done in the radiocarbon laboratory of the U.S. Geological Survey. The apparent difference in age between the highest marl and the lowest peat may be real—that is, no material was deposited for almost 4000 years—or more probably it reflects contamination of the peat sample with peat from higher levels.

The age determination for the lowest marl is consistent with the interpretation of Cary age for the drift at Corry. This is the first determination of the age of drift of northwestern Pennsylvania to be made by means of radiocarbon analysis.

JOHN B. DROSTE
Department of Geology, Indiana University, Bloomington
MEYER RUBIN
United States Geological Survey, Washington, D.C.
GEORGE W. WHITE
Department of Geology, University of Illinois, Urbana

References and Notes

1. The field study of the glacial deposits of this part of northwestern Pennsylvania was made by J. B. Droste as part of the investigation of till composition of the Allegheny Plateau supported by National Science Foundation grants to G. W. White. Publication of this report has been authorized by the director of the U.S. Geological Survey.
2. R. F. Flint, R. B. Colton, R. P. Goldthwait, H. B. Willman, *Glacial Map of the United States* . . . , (Geological Society of America, New York, 1959).
3. G. W. White, J. B. Droste, R. F. Sitler, V. C. Shepps, *Bull. Geol. Soc. Am.* **68**, 1902 (1957); V. C. Shepps, G. W. White, J. B. Droste, R. F. Sitler, *Penn. Geol. Survey Bull. G. No. 32* (1959).
4. G. W. White, *Ohio Div. Water, Bull.* **26**, 37 (1953).
5. ———, *Bull. Geol. Soc. Am.* **68**, 1902 (1957).

28 July 1959

Table 1. Description and radiocarbon dates of samples from an auger boring.

Sample	Ft	In.
Peat, brown to greenish brown, with leaves, grasses, seeds, and wood. Sample W-347 from lowest 8 in., age 9,430 ± 300 years	9	9
Marl, light to medium gray, rich in plant material, highly calcareous, very fossiliferous, contains pelecypods, gastropods, and ostracods. Sample W-346 from top 8 in., age 13,000 ± 300 years; sample W-365 from bottom 8 in., age 14,000 ± 350 years	3	0
Clay, blue gray, silty, laminated, highly calcareous	9	0
Sand and fine gravel, gray, calcareous	1	6
Bottom of auger hole		

Tolerance of Mouse-Brain Tissue to High-Energy Deuterons

Abstract. A striking relationship between the size of the impact area of a deuteron beam and the threshold dose for a radiogenic lesion has been noted. The dose required to produce a threshold lesion in mouse brain increases from 30,000 rad with a beam 1000 μ in diameter to 1.1×10^6 rad with a beam 25 μ in diameter.

The experiments reported here are part of a program designed to investigate the biological effect of heavy cosmic ray primaries upon brain tissue by a simulated technique. This technique is based on the expectation that most of the biological effect of a cosmic ray primary would result from the dense cluster of secondary protons surrounding the path of the primary. It is estimated that such a cluster would create a core of ionization about 25 μ in diameter (*6*). Thus, a beam of protons or deuterons of a certain dose and about 25 μ in diameter should simulate to a certain extent the spatial pattern of ionization energy of the thindown of a heavy cosmic primary. On the other hand, by this technique one is unable to approximate the dose rate of a cosmic primary, which transfers its energy within a billionth of a second. However, preliminary studies indicate that, with a 25-μ beam, an increase in the dose rate from 15,000 to 400,000 rad/sec decreases the threshold dose for a radiogenic lesion only by approximately 10 to 20 percent. This suggests that the differences in dose rates between cosmic primaries and the simulating techniques may be of minor biological significance.

The phase of the study reported here is concerned only with the independent variable of beam size.

The irradiations were performed with a 22.5 Mev deuteron beam from the 60-in. cyclotron at the Brookhaven National Laboratory. After passing through a helium ionization chamber and 2 in. of air, the beam had a depth range in tissue of approximately 2.5 mm. Dosimetry was based on continuous recording of the current in the ionization chamber. The mean dose rate varied from 15,000 to 60,000 rad/sec. Density measurements on phantoms consisting of laminated photographic films distal to the apertures were used to calculate dose distributions. The dose in rad was calculated from the total number of deuterons absorbed per unit volume of tissue, and this calculation was confirmed, to a first approximation, by depth dose measurements with films. The ionization in tissue is quite uniform to a depth of 1.5 mm, and this was the only region considered, since beyond this depth the ionization density in-