Reference

1. J. A. Oliver, *The Natural History of North American Amphibians and Reptiles* (Van Nostrand, New York, 1955), pp. 42, 85, 89, 192, 292.

23 July 1959

Addendum. Since the foregoing report was submitted, there have been some other developments which should be included in this account. On the night of 25 August I noticed that the smaller of the two remaining animals was beginning to shed, with a roll back of its neck. However, this roll did not contain the typical bubble, and apparently the process was not going well. After watching for 1½ hours and seeing no further progress, I left. Next day the animal had the appearance of having shed completely. On 27 August it was found dead. There were no visible causes of death. It was opened at my request by Harry J. Bennett, who has had more experience with the internal organs of *Amphiuma* than anyone else here, because of having searched them for parasites. He thought that the intestine was smaller than usual. The cloaca contained the dark, watery feces noted before. Ovaries were present in a rather flaccid and undeveloped state, but small, yellow, individual ova could be discerned with the naked eye. (This leads to another hypothesis—namely, that the animal could have lived for a very long while on resorbed ovarian material.) The only sign of abnormality was the long urinary bladder greatly distended with liquid. This suggested that possibly the animal had succumbed to some osmoregulatory difficulty. For that reason the larger remaining *Amphiuma* was given a squirt of salt water from the laboratory sea-water system.

On 31 August the larger animal was also found dead. In this instance we have a better idea of the cause of death. Several times these *Amphiuma* had developed little punctate white spots all over the body, which felt hard and calcareous to the touch. They have never been examined microscopically, but we considered them to be fungi. They were controlled by unmeasured doses of potassium permanganate thrown into the water, or by shots of salt water which raised salinity of the aquarium water to 8 per mil; this apparently caused no difficulty to the amphibians. Brode had generally taken care of this matter, and during his absence I apparently let it go too long. The dead animal had a very large atypical swelling in the gill and gular region. It was preserved whole without autopsy. Thus, our observations have, temporarily at least, ended for lack of specimens.

The third development concerns some similar observations on another amphibian. Our colleague in summer teaching, H. T. Boschung, of the department of biology of the University of Alabama, recounted this matter to Everett L. Bishop, Jr., professor of biology at the University of Alabama, who stated that he had made similar observations on *Cryptobranchus,* the hellbender. In a letter to me dated 19 August Bishop stated that two animals were placed in a 75-gallon aquarium on 13 April; the three paragraphs that follow are quoted from his letter.

In the ensuing months I have placed about 50 live crawfish, ranging from an inch and a half to four inches in length, in the aquarium. Practically all of these have been eaten by the hellbenders. However, no significant increase in size has been noted. During the earlier weeks an almost constant laterally rolling motion took place in both specimens. A guess on my part was that this lateral rolling motion was a reflex associated with the respiratory function of the skin folds. . . .

Almost immediately (12 to 15 hours) after the specimens had been placed in water here a shedding of the skin was observed. Although a major portion peeled away from the head and then slipped off the body, there was some apparent random exfoliation. The shed skin had a distinct yellow-greenish appearance, highly suggestive of green algal pigmentation; although we talked about examining for the algae, we failed to do so. The major portion of the shed skin was 'peeled' off the head by a combination of head movements and rubbing against the bottom and sides of the tank. As this film of skin was rolled back below the pectoral limbs a surprisingly sharp flexion of the head permitted the animal to grasp the skin and peel it rapidly from the remainder of the body, engulfing the free part as it did so. The entire process took only about 10 minutes.

Several of us observed this being repeated four or five times since the original shedding. Unfortunately, no accurate records of observation have been kept. My impressions have been, however, that the sheddings have occurred at greater intervals. No one here can recall seeing this process occur since about the middle of June.

Bishop's observations raise the possibility that exfoliation or ecdysis may be present in other tailed amphibia, and also that it may be supplementary to regular feeding.

GORDON GUNTER

10 September 1959

Rhythmic Contraction of Schwann Cells

Abstract. By time-lapse cinematography it was found that Schwann cells in tissue cultures of dorsal root ganglia from newborn rats show a contraction rate of approximately 4 to 18 minutes. This activity is of the order of magnitude reported for oligodendroglia.

In 1937 Canti, Bland, and Russell (*1*) reported pulsatile activity of cells cultivated from an oligodendroglioma, as revealed by time-lapse cinematography. Employing similar methods, Lumsden and Pomerat (*2*) established that oligodendroglial cells from the corpus callosum of the rat exhibited a contraction-expansion cycle of approximately 5 minutes. These findings were extended to include such elements from presumably nonpathological human tissue obtained in the course of lobotomies (*3*) and from oligodendrocytes of neoplastic origin (*4*). Recent studies of oligodendroglia have been summarized (*5*).

Table 1. Rhythmic contraction of Schwann cells from dorsal root ganglia of newborn rats, in vitro.

Culture*	Days in vitro	No. of contractions	Period (min)	Av. rate (min)
1a†	5	8	70	8.75
1b‡	5	None	95	
1c†	5	8	70	8.75
1d†	6	13	230	17.69
2a†	13	16	151	9.43
2b‡	13	17	113	6.64
2c†	13	70	410	5.85
3a†	13	12	70	5.83
3b§	14	21	80	3.81
3c†	14	16	90	5.62
4a†	16	17	120	7.05
4b†	17	12	70	5.83
4c†	17	1	9	9.00

* Letters indicate sequences providing test cells. † Treatment: nutrient. ‡ Treatment: 50 μg of γ-aminobutyric acid per milliliter of nutrient. § Treatment: 100 μg of γ-aminobutyric acid per milliliter of nutrient.

This report is concerned with the behavior of Schwann cells in tissue culture. Dorsal root ganglia obtained from newborn rats were cultivated under dialysis membranes in Rose chambers (*6*); a fluid nutrient consisting of 50 percent Gey's balanced salt solution, 45 percent human ascitic fluid, and 5 percent horse serum, reinforced with a final concentration of glucose at 300 mg/100 ml, was employed.

Phase-contrast, time-lapse cinematographic film records were made of dorsal root ganglia of rats on four cultures incubated from 5 to 17 days at a rate of four frames per minute. Schwann cells exhibited rhythmic contractile activity closely resembling that of oligodendroglial cells derived from the central nervous system.

Since γ-aminobutyric acid was being employed in parallel studies, this substance was added to some cultures of dorsal root ganglia. Table 1 summarizes observations on the contraction rates of Schwann cells obtained in preliminary experiments. On the basis of this limited series, γ-aminobutyric acid is not believed to have exerted a significant effect on cells in this system, but the data establish the phenomenon of rhythmic pulsatile activity for Schwann cells at a rate approximating that reported for oligodendroglia (*7*).

CHARLES M. POMERAT

Tissue Culture Laboratory, Department of Anatomy, University of Texas Medical Branch, Galveston

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-