sponse rate. Similarly, the duration of the pause in both procedures is a direct function of the ratio requirement. The procedure provides a means of investigating other schedules of intermittent reinforcement by the removal of conditioned aversive stimulation (*7*).

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References and Notes

1. C. B. Ferster and B. F. Skinner, *Schedules of Reinforcement* (Appleton-Century-Crofts, New York, 1957).
2. V. M. Bechterev, *General Principles of Human Reflexology* (Jarrolds, London, 1933).
3. M. Kaplan, *J. Comp. and Physiol. Psychol.* **49**, 153 (1956).
4. T. Verhave, *Science* **129**, 959 (1959).
5. M. Sidman, *Tactics of Scientific Research* (Basic Books, New York, 1960).
6. ———, *Science* **118**, 157 (1953).
7. This investigation was supported in part by grants from the National Institute of Mental Health, the psychiatric training and research fund of the Illinois Department of Mental Health, and the National Science Foundation.

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Absence of Carbon-14 Activity in Dolomite from Florida Bay

Abstract. A sample of dolomite crystals concentrated from Recent carbonate sediments in Florida Bay gave a carbon-14 age greater than 35,000 years. Since Recent sedimentation in Florida Bay began less than 4000 years ago, the dolomite must be derived from older rocks, and Taft's hypothesis that dolomite is forming today is incorrect.

The occurrence of dolomite crystals in the Recent carbonate sediments in western Florida Bay was recently reported by W. H. Taft, who expressed the opinion, based on textural evidence, that the dolomite had been formed by Recent diagenesis (*1*). Because Taft also observed that the sediments contained quartz grains of approximately the same size as the dolomite crystals, there is the possibility that the dolomite, like the quartz, is clastic material derived from older rocks. Since the episode of Recent sedimentation in Florida Bay began about 3000 to 4000 years ago (*2*), it is possible to test whether the dolomite is of Recent origin by determining the carbon-14 content of the carbonate from the dolomite. The fact that dolomite separated from one sample of Florida Bay sediment showed no measurable carbon-14 activity indicates that the dolomite in this sample was of detrital origin.

A surface sample of about 3000 grams of carbonate sediment from Ox Foot Bank at the western end of Florida Bay (near latitude 25°00′ N, longitude 81°00′ W) was collected by Eugene Shinn. Dolomite crystals similar to those described by Taft were present in the sample. The sediment was separated into size fractions by wet sieving for the particles coarser than 44 μ and by repeated decantation for the finer sizes. Preliminary x-ray diffraction examination showed that the sample consisted mostly of aragonite and calcite with minor amounts of dolomite and quartz, and that the largest concentration of dolomite was in the 20- to 75-μ sizes. The 20- to 75-μ material was treated by adding dilute hydrochloric acid gradually, and x-ray diffraction runs were used to determine when the aragonite and calcite had been reduced to less than 1 percent of the amount of dolomite in the concentrate. During the acid treatment, the approximately constant ratios of x-ray peak heights between dolomite and quartz indicated that at least 90 percent of the dolomite present at the beginning was recovered. For the carbon-14 determination, the dolomite concentrate was treated with an excess of strong acid to evolve carbon dioxide, and the residual liquid was analyzed for calcium and magnesium by Versenate titration. The molar ratio of calicum to magnesium was 1 to 1.03, which indicates that, within the accuracy of analysis, the material dissolved for the carbon-14 measurement was composed entirely of dolomite. The amount of calcium and magnesium in the residual liquid showed that 6.7 g of dolomite were converted to carbon dioxide.

Carbon-14 counting, carried out 30 days after the sample preparation to allow a minor amount of radon activity to decay, showed that the dolomite contained no measurable carbon-14 activity. The count rate observed for the dolomite sample and background determinations made before and after agreed within the 2-percent error expected from the counting statistics. The age of the dolomite must be greater than 35,000 years, because a sample younger than this would have given a count rate different from the background rate by two standard deviations. Stated in another way, the carbon-14 determination was sufficiently sensitive to have detected a significant difference in count rate if as much as 2.4 percent of the sample had been as young as 4000 years.

Carbon-14 ages on the bulk carbonate sediment in the original sample gave 1750 ± 150 years, and the coarse shell fragments separated from the sample gave 1660 ± 130 years. If the dolomite crystals had grown in this environment during the last few thousand years, they would have had access only to carbonate that contained the usual amount of carbon-14 activity. Therefore it must be concluded that the dolomite crystals are derived from older rocks and mixed with the Recent sediment. Because the presence of carbon-14 activity would be a positive demonstration of the Recent origin of a carbonate material, it is suggested that the radiocarbon measurement used for the dolomite from the Bonneville salt flats by Graf *et al.* (*3*) is a much more reliable means of identifying a recently formed carbonate mineral than is the textural evidence used by Taft (*1*) and more recently used by Miller (*4*).

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References and Notes

1. W. H. Taft, *Science* **134**, 561 (1961).
2. A carbon-14 date of 3300 years from a peat layer near the base of the Recent carbonate deposits in Florida Bay has been reported by M. Rubin and H. E. Seuss [*Science* **121**, 481 (1955)].
3. D. L. Graf, A. J. Eardley, N. F. Shimp, *J. Geol.* **69**, 219 (1961).
4. D. N. Miller, *J. Sed. Petrol.* **31**, 473 (1961).

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Carbon Dioxide Fixation in Lobster Nerve

Abstract. Aspartic, glutamic, malic, and citric (isocitric) acids were isolated by chromatographic methods from lobster nerves incubated with Ringer's solution containing C^{14}-bicarbonate. All the compounds were labeled; the bulk of the radioactivity appeared in the aspartic acid. The findings suggest the operation in lobster nerves of the citric acid cycle including CO_2 fixation.

In nerve, carbon dioxide has long been regarded as a regulator of its internal *p*H; in addition, it produces an increased membrane potential (*1*). Recently, a significant carbon dioxide fixation, presumably via the citric acid cycle, has been demonstrated in vivo in the mammalian brain. Intracarotid infusion into cats of C^{14}-bicarbonate resulted in labeling of cerebral glutamic and aspartic acids and of glutamine (*2*).

This finding raised the question as to whether carbon dioxide fixation is a general metabolic property of nervous