carried out an independent check of our technique using Li_2SO_4 and benzoic acid. With a precise measurement of the neutron flux it was determined that 25 percent of all the tritons produced resulted in benzoic acid labeled in the ring hydrogens. An activity of 96 μc/g of benzoic acid was obtained with little radiation decomposition (*9*). This experiment demonstrates that the method is applicable to cyclic systems.

From this experimental evidence it would appear that heterogeneous recoil tagging should be generally useful for making tritium-labeled organic compounds of good specific activity. The type of system used in the experiments quoted—a powdered mixture—is by no means the only one that may be used. Presumably a slurry or emulsion containing an organic and a lithiated phase should work provided that the particle size was not much larger than the recoil range.

Although preparation of the labeled material is not difficult, its purification is complicated by radiation damage. Many of the molecules activated by the recoil tritons may be slightly altered by them to produce highly radioactive trace materials, chemically similar to the parent compound. In the purification process, useful quantities of these species may be separated.

An obvious limitation of the technique proposed here is that it cannot produce the very high specific activities obtainable by chemical synthesis or exchange with materials containing large percentages of radioactive atoms. A further and probably more serious drawback is that in general it will not be possible to produce compounds labeled at specific positions. As a first approximation it is to be expected that recoil tritons will produce random labeling. This will also result in some of the tritium being held as labile atoms. However all such loosely bound tracer can be washed out in the purification.

The practical limits of this technique have yet to be ascertained. Since larger molecules are usually more susceptible to damage by radiation, it is quite possible that with high-molecular-weight compounds only low specific activities will be obtainable. Further study is required for a better understanding of the mechanisms involved in these phenomena.

References and Notes

1. Research performed in part under the auspices of the U.S. Atomic Energy Commission. Part of this material has been presented before the 126th meeting of the American Chemical Society.
2. F. S. Rowland and W. F. Libby, *J. Chem. Phys.* **21**, 1495 (1953).
3. J. M. Miller, J. W. Gryder and R. W. Dodson, *ibid.* **18**, 579 (1950).
4. J. Willard, *Ann. Review Nuclear Sci.* **3**, 193 (1953).
5. G. Giacomello, *Ricerca sci.* **21**, 1211 (1951); Croatto, Giacomello and Maddock, *ibid.* **21**, 1598 (1951).
6. A. P. Wolf and R. C. Anderson, *J. Am. Chem. Soc.*, in press.
7. A. G. Schrodt and W. F. Libby, *ibid.* **76**, 3100 (1954).
8. Wilzbach, Kaplan, Brown, ANL 5056 (Argonne National Laboratory, 1953).
9. We are greatly indebted to L. Kaplan for permission to quote his interesting results.

Charles Manning Child

By his life and works Charles Manning Child added further distinction to the distinguished New England family name of Manning. He early showed a predilection for the philosophic aspects of biology. After completing the master's degree at Wesleyan University, he went to the University of Leipzig with the intention of studying under Wundt. However, he soon became dissatisfied with the type of study offered and transferred to the zoology department, where he was granted the doctor's degree under Leuckart in 1894. Surprisingly enough, his doctoral research was purely morphological and histological; it was concerned with certain sense organs of the Diptera.

Returning to the United States, Child became a prominent member of that brilliant group of American embryologists who devoted themselves in the 1890's to the subject of cell lineage and produced a series of imperishable articles. Here Child already revealed his trend toward organicism, for he rejected the implications of the mosaic theory of development that had been derived from cell-lineage studies and joined Whitman in his stand against cellular explanations of development.

About 1900 Child began the long series of experiments on the regeneration of coelenterates and flatworms that was to endure through much of his career. He constantly sought for some governing factor in regeneration. At first he believed that this factor was mechanical and ascribed morphogenetic control to such matters as tension, pressure, locomotory activity of the regenerating piece, and the like; reconstitution was believed to result from the attempt of a regenerating piece to function like the whole. On this basis Child published in 1910 a classical article, "The regulatory processes in organisms," in which he pointed out that the continuity of organic individuality is dependent on physiological correlation. This article was the prelude to the emergence of the gradient theory about 1911.

The gradient theory was based on the results of a long accumulation of experiments on the regeneration of planarians. These experiments led Child to abandon his theory of mechanical control of morphogenesis and to concentrate on a physiological gradation of processes as the controlling factor. The essence of the gradient theory is that a gradation of physiological processes forms the basis of polarity and symmetry and also controls the regenerative processes.

In 1915 Child published what I consider the most fruitful and outstanding of his books, a small volume entitled *Individuality in Organisms*. The essential thesis of this book is that the problem of the unity of the organism is the problem of correlation, and that correlation is achieved by anteroposterior dominance, which in turn is the expression of an anteroposterior gradation of physiological processes. In this book Child also developed the important concept of physiological isolation or escape from dominance, bringing forward a wealth of facts in support of these concepts.

The year 1915 also saw the publication of the important volume *Senescence and Rejuvenescence*. Later books, *The Origin and Development of the Nervous System* (1921) and *Physiological Foundations of Behavior* (1924), are of lesser value, in my opinion. Finally, in 1941, Child summed up his concepts and the experimental bases for them in the outstanding volume, *Patterns and Problems of Development,* which forms an essential guide to his philosophy of the organism.

Child spent most of his scientific career in a frontal attack on the fundamental biological problem: organization. He saw, as most of his zoological colleagues could not see, that the properties of the organism—its order, its unity, the correlative nature of its activities—cannot be explained by assigning powers to elementary particles, genes, or what not. Particulate theories fail to touch the essential problem, the characteristics of the organic individual, of which the chief one is integration. The problem of organismic integration is one of both pattern and material. Hereditary factors enter into the material, but the main pattern of organisms, the axiate pattern, is explicable as a gradient in the rate of physiological processes. Such axiate pattern is thought of as arising in the last analysis from the differential action of the external world on protoplasm, establishing a gradation.

Following his retirement in 1937 from the University of Chicago (to which he had come in 1895), Child continued, at Stanford University and its marine laboratory, his experimental work on the alteration of development by chemical means, a method he had long used as a means of analysis of the role of gradients in development. He was still pursuing this line of investigation at the time of his death.

Throughout his scientific career Child was notable for his whole-hearted devotion to fundamental problems of biology. He was entirely devoid of the personal ambition, the seeking for advancement, position, and fame, that mars the lives of many scientists. He ever adhered to the highest standards of scientific integrity and thereby won the respect of all who knew him. He was a great lover of the outdoors, especially of mountainous country, and throughout his life was wont to take the trail in the western mountains with his pack and photographic equipment, for he greatly enjoyed photographing scenes of natural beauty. He lived a good life, employing his mental faculties to their utmost in research and enriching himself by contact with unspoiled nature.

LIBBIE H. HYMAN
American Museum of Natural History, New York

News and Notes

Research on Semiconductors

Approximately 450 scientists from 20 countries met in Amsterdam, 29 June–3 July 1954, to discuss the latest results in semiconductor research. This second international conference on semiconductors (the first one was held at Reading, England, in June 1950) was organized by the Netherlands Physical Society and supported by the International Union of Pure and Applied Physics and UNESCO. The conference committee, headed by E. J. W. Verwey with H. J. Vink as secretary, was responsible for the extremely successful organization of the conference. A total of 65 papers was presented. The program was arranged to provide adequate time for formal and informal discussions and to give room for spontaneous reaction to the papers.

An introductory paper outlined the present scope of semiconductor research, and the conference closed with a lecture summarizing the papers presented. Although considerable interest was expressed in the various intermetallic semiconductors and the sulfides, selenides, and tellurides of lead and cadmium, the scope of the papers indicated continued emphasis on the elementary semiconductors, germanium and silicon.

The introductory lecture by H. B. G. Casimir (Eindhoven) gave a broad perspective of the problems in semiconductor research. The problems were classified into four main divisions: (i) stationary states, that is, energy band structure of the periodic crystal lattice, including surface and impurity states; (ii) transport phenomena, such as conduction, Hall effect, thermoelectric power; (iii) transition phenomena, which dealt with transitions between stationary states; and (iv) recombination phenomena, which dealt with problems conducted with carrier generation and recombination.

There were some papers that presented theoretical calculations with regard to the structure of energy bands. Among these was the paper of F. Hermann (R.C.A., Princeton, N. J.) on diamond and germanium which gave an interesting insight into the nature of the band structure in this type of lattice. Results, using cyclotron resonance, were reported by A. F.