DISCUSSION AND CORRESPONDENCE

RESEARCH IN MARINE BIOLOGY

TO THE EDITOR OF SCIENCE: Notices of the death of Dr. Alfred Goldsborough Mayor have referred to the lamentable possibility that the undertaking in marine biology which he directed might fail to be continued. Mr. Potts,[1] Professor Coe,[2] Dr. Davenport[3] and Dr. Schaeffer,[4] among others, have voiced or hinted at this fear, that a chief American instrument for research might be abandoned. Emphasis has been placed upon the unique opportunities until now provided by the Carnegie Institution Department of Marine Biology for investigations involving travel to more or less distant places, where material of unusually favorable type might (for a short time) be available to especially qualified students.

There is another side to this matter, and since there seems some likelihood of its being overlooked, I venture to comment upon it—for it is an aspect of marine research concerning which a continuous experience of several years as resident naturalist at the Bermuda Biological Station has given me strong convictions.

The "easy work" of zoology is to a large extent already done—although I have had expressed to me, by an eminent naturalist of the elder generation, the thought that "all the hard problems of zoology have been solved—you younger men need only to fill in the vacant spots." (Those "vacant spots"!) Research is costly. Adequate return for money and energy to be invested in biological investigation demands, and henceforth will increasingly necessitate, that the conditions attending investigative pursuits be the least unfavorable possible. Those whose varied experiences have provided an adequate background for judgment in this matter are unanimous in the conviction that the most suitable locations are to be found on the shores of tropical or semi-tropical seas. Supreme variety and abundance of animals, ease of access to them throughout the year, a comparative isolation conducive to their scholarly and productive treatment—these can be found in combination only in the warmer seas. There, some of the wasteful, merely mechanical, handicaps to fruitful research are eliminated.

It is not too much to take for granted, that studies of this nature are worth while. The financial support of numerous marine stations in America is sufficiently demonstrative. Yet if we examine the actual operation of these existing laboratories, we find that in general they are utilized for productive work during but a small portion of the year. The splendid material possessions of the Woods Hole Laboratory, to take an especially noteworthy instance, are as good as wasted, so far as research is concerned, during some eight to nine months of the year. The plain fact of the matter is that the existing American institutions for research in marine biology are either more or less unfortunately situated, with regard to climatic conditions or otherwise; or else overburdened in their potentially productive seasons by the requirements of elementary instruction—necessary work, and I speak of it only with respect; but it is not enough.

In Mayor's hands the Department of Marine Biology of the Carnegie Institution had before it two large tasks—the conduct of explorative expeditions, and the upkeep of a fixed laboratory serving as a central resort at favorable seasons. The workers at the Tortugas Laboratory being recruited from college and university staffs, and the possible season at Dry Tortugas brief at best, the actual time of the laboratory's session each year was necessarily short. The problems attackable under such conditions are limited in kinds. Some truly fundamental questions can not be faced at all without intimate knowledge of faunal conditions over extended periods of time. The notion, moreover, that "favorable material" for one kind of "problem" is to be found here in this place, for another kind there in that other place, is largely fallacious. Most naturalists acquainted with the subtropical marine fauna

[1] *Nature*, 110, 224.
[2] *Amer. Jour. Sci.*, Ser V, 4, 173.
[3] SCIENCE, N. S., 56, 134.
[4] SCIENCE, N. S., 56, 468.

have come into contact with it during only one part of the year, and are unaware of its seasonal fluctuations.

A permanent marine laboratory, adequately located, engaged actively in research during the whole year, I should suppose to be a cardinal necessity for biological development. As Mayor himself realized, the need is so obvious as to require frequent restatement; his reports, and letters from him, show that the realization of such a laboratory was for him a great hope.

In such a laboratory inquiries become possible which in other situations can hardly be undertaken at all. Temporary social isolation would perhaps have to be faced by resident investigators, and partial loss of contact with libraries; but there are compensations. Time to "sit still and think things over," on the ground, is of tremendous value in itself. The zoologist's business, I take it, is to provide an account of animals, in terms, ultimately, of the properties of materials and of their relations. An enormous segment of this task remains relatively unexplored. A truly scientific natural history of animals, prerequisite for the stability of biological theory, is still for the future. There is here a possibility of huge reward. To grasp it requires intensive work of a character which existing agencies for zoological inquiry do not make possible, for the work can not be done by means of visits to the seashore in summertime. A permanent laboratory in semitropical waters, moderately equipped, with a stationary staff, not cursed with a "program," could justify itself in this necessary work, and that without great expense.

That the only American institution for research in a position to fill this need may fail to do so, seems to me the most serious aspect of the case, rather than the possibility that another summer laboratory may be closed.

W. J. CROZIER

ZOOLOGICAL LABORATORY,
RUTGERS COLLEGE

ON TRANSLATING EINSTEIN

TO THE EDITOR OF SCIENCE: Generally I am well pleased with whatever Dr. W. J. Humphreys writes but I can't say I like so much his pleasantly written criticism in *Science* of November 24. He says that he very much dislikes my little article on relativity in *The Scientific Monthly* of November, 1922.

Because, giving the words used the only meanings recognized by layman and scientists alike, save a few specialists, several of the assertions are sheer nonsense. Certainly no system of equations, however clever, can prove to one of common sense, the existence of a real fourth dimension; that time and space are not wholly independent; that just because we and the Martians may be unable to synchronize our clocks there is no "now"; that time is "curved"; that a phenomenon may be seen before it happens; that the mere inclusion of gravitation in a more comprehensive expression eliminates it from nature; and so forth, and so on, through a long list of absurdities—absurd, that is, if their customary meanings be given to the words used.

It is my custom, whenever I get a new scientific book to pick out the most perplexing passage and try to put it into ordinary language. It is more fun, to my mind, than trying to solve the problem of three bodies on a billiard table and pays better. The book I had in hand was the English version of "Time—Space—Matter" by Weyl, the leading exponent of *Einsteinismus* in Germany. The paragraph I selected for translation into the vernacular was the following: (p. 274.)

Every world-point is the origin of the double-cone of the active future and the passive past. Whereas in the special theory of relativity these two portions are separated by an intervening region, it is certainly possible in the present case for the cone of the active future to overlap with that of the passive past; so that, in principle, it is possible to experience events now that will in part be an effect of my future resolves and actions. Moreover, it is not impossible for a world-line (in particular, that of my body), although it has a time-like direction at every point, to return to the neighborhood of a point which it has already once passed through. The result would be a spectral image of the world more fearful than anything the weird fantasy of E. T. A. Hoffman has ever conjured up. In actual fact the very considerable fluctuations of the g_{ik}'s that would be necessary to produce this effect do not occur in the region of world in which we live. Nevertheless there is a certain amount of interest in