States will sail for New York from Southampton on Saturday, July 27; if traveling by the Canadian route to San Francisco, they will sail for Montreal from Liverpool on July 26, or from Glasgow on July 27. The honorary local general secretary for this year's annual meeting is Dr. J. P. Major, Medical Society Hall, East Melbourne, Victoria.

THE trustees of the Surdna Foundation announce that Wesleyan University and ten welfare and religious institutions in Yonkers share in the first large distribution from the income from the fortune of the late John E. Andrus. The bequests amounted to $1,092,500, only a portion of the income of the foundation, which is said to be one of the most largely endowed charitable organizations in the world. Wesleyan University receives $300,000. Mr. Andrus, who died on December 26, at the age of ninety-three years, named the foundation by adopting the reversed spelling of his name.

THE National Zoological Park will receive an allotment of $680,000 from PWA funds. It is planned to build an addition to the bird house, a new elephant house and a house for small mammals, with special accommodations for apes. It is also planned to provide a machine shop.

THE private medical library of the late Dr. Bailey K. Ashford has been presented by his family to the School of Tropical Medicine at San Juan, Puerto Rico. This library contains a large collection of books, periodicals and pamphlets, together with valuable historical data on sprue, anemia and hookworm, in which fields Dr. Ashford had made notable contributions.

THE University of Cambridge has accepted an offer from the Department of Scientific and Industrial Research of the sum of £2,300 for building and equipping the extension to the Low Temperature Research Station on its southern side. It is to be used for scientific research and in the first instance for research in problems arising out of the preservation and handling of foodstuffs.

# DISCUSSION

## WHAT DO WE MEAN BY A BACTERIAL LIFE CYCLE?

BACTERIOLOGISTS have for some years been engaged in a vigorous, and sometimes slightly acrimonious, discussion of the question whether bacteria do or do not exhibit phenomena associated with a "life cycle." In a case of this kind, one always suspects that facts have been obscured by words. Arguments are generally concerned with words and ideas. Facts need not be argued about; they can be settled by observation.

In the present case, the facts are reasonably clear. Almost all bacteriologists will now acknowledge that many types of bacteria may at times exhibit morphological variants which differ rather widely from the forms most commonly observed in cultures. These variants may be swollen or branched or spherical, when the normal form is a regular rod. They may be larger than normal. Very frequently they are much smaller than normal. Furthermore, it is a well-established fact that some of these bizarre cells are not "involution forms"—if we mean by that term cells which are degenerating and necessarily doomed to perish. Many such abnormal cells, particularly the tiny coccoid forms of rod-shaped bacteria, have been shown to be viable and to reproduce the original type of organism. If by a life cycle we mean the occurrence of cells having a form different from that commonly observed in the species but capable of reproduction, then many bacteria have a life cycle. There is no essential difference between such a phenomenon and the familiar formation of endospores (except that the endospore has a special degree of resistance to unfavorable environmental conditions which many of the more recently described morphological variants lack).

Those who contend that bacteria lack a life cycle define the term more strictly. They consider that a "life cycle" must involve a certain inevitable and repetitive sequence of stages. In this sense they maintain that the bacteria do not possess a life cycle. If one transfers a culture in the phase of logarithmic growth to a fresh medium of the same kind, experience shows us that the form and size of the cells remain strikingly constant; and we have no reason to doubt that such a process can be continued indefinitely. A "cycle," according to Murray, means "a recurrent period (of events, phenomena, etc.)." Those who object to the life cycle theory may rightly maintain that such experiments exclude the existence of recurrent periods of varying morphology, due to some inherent tendency of the bacterial cells.

It is precisely, however, in this tacit assumption that a life cycle must be free from any environmental influence that there lies another dangerous pitfall of definition. If we allow that repetitive changes may directly result from environmental conditions and yet may constitute a life cycle, the balance of argument swings in favor of the "cyclists." If, instead of transferring a colon bacillus from one culture tube to another in the logarithmic phase of growth, we leave it

in the original medium for a longer period and then transfer it, a very definite series of repetitive events may be observed. The cells when first transferred to a new medium are small in size and exhibit certain quantitative physiological characteristics. Then for a certain period the cells become larger and physiologically far more active. The size may increase tenfold and the activity per cell fifty-fold. Later, both size and activity decrease again to their original figures. Under certain conditions, bizarre and coccoid and perhaps very minute or "filterable" forms may occur. On transfer to a fresh medium, the "cycle" repeats itself with perfect precision.

It must be freely granted that such a cycle is related to the effect of environment and not to any inevitable inherent tendency of a single cell; but I suspect that the same thing is true of all life cycles throughout the living world. The zoologist can cultivate protozoa, the botanist can cultivate molds, for an indefinite period by sufficiently rapid transfer to fresh substrates, without the appearance of cysts or spores or any other departure from the more usual morphological picture presented by the species. All that appears in such a case, if the medium be favorable, is the ordinary "life cycle" of binary fission. The phenomenon of endomixis does not present any real exception, since it does not alter the form or physiological properties of cells in any cyclical way. In the multicellular organism life cycles are apparently inherent simply because the organisms *are* multicellular and because the multicellular life produces a change in the environment of the individual cell more or less comparable to that produced in an old culture of bacteria. The germ cells exhibit no life cycles from generation to generation. It is true that in a metazoon there is a specialization of cell function associated with division and differentiation, but this is clearly degenerative rather than cyclical, since it is normally irreversible. Even specialized somatic cells when cultivated by Carrel *in vitro* show no life cycles after many years of observation.

May we not assume, then, that with all living cells, the "life cycle" so far as the individual cell is concerned—is a cycle of simple binary fission. Other phenomena involving change in cell morphology and physiology of a cyclical nature are responses to changing environmental conditions and not the result of any inherent time mechanism. If a unicellular organism shows a definite series of morphological and physiological alterations in response to certain changes in environment which are likely to occur with reasonable frequency in its natural life we may call it a "life cycle" if we wish or we may call it something else. In any case, this is the only kind of life cycle (other than binary fission) which can occur in unicellular and relatively simple multicellular forms. In this sense, the bacteria have life cycles. When we find a more complex and more regular life cycle in the higher plants and animals (relatively independent of external environment), it is because the interrelationships of the complex organism produce a cyclical change in the internal environment which is comparable with the change which takes place in a bacterial culture and which affects the individual body cell very much as the cultural environment affects the unicellular organism.

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## THE PRESS SERVICE AT THE PITTSBURGH MEETING

THE baffling problem of handling the paper winning the $1,000 prize appears at last to have been successfully solved. At Pittsburgh the announcement of the prize-winning paper was made at a conference of press representatives called for 9 A. M. at which a carefully prepared, clear and thoroughly intelligible résumé of the paper, and a biographical sketch of the author, were handed each one present, and arrangements were made for answering any questions that might be asked. The complete paper was also available. The release was for morning papers on the following day. Ample time was thus afforded the press representatives for studying the paper and for securing interviews on the subject-matter.

The proportion of the total number of papers sent in advance to the Press Service was slightly less than at the preceding Boston meeting. There were 1,806 papers (including demonstrations, etc.) listed in the program, of which 396 (20.2 per cent.) were received in advance.

If the 66 papers that were not received until after the meeting (partly because of having been mailed with insufficient postage) are added to the number sent in, and the 109 mathematical papers, which can not be handled successfully in the usual routine, are subtracted, there were 1,697 papers presented, of which 462 (23.5 per cent.) were received.

The number of papers listed and received, arranged by groups, was as shown in Table I.

This year each paper as soon as it was received was carded by author. By the use of this card catalogue the press representatives were able to find out at once whether or not a copy of any given paper was available, and all the essential information regarding the papers at hand. This card index proved to be exceedingly useful, and constant reference was made to it throughout the meeting.

For press purposes it is essential that information regarding the proceedings day by day shall be avail-