gangrene and of a number of bacteria and fungi causing plant diseases. The relationship of the soil to a variety of other diseases, such as hookworm and deep-seated actinomycetic infections, is likewise a matter of great importance. Some of these problems require further elucidation.

One could cite other illustrations of contributions of soil microbiology to human welfare, perhaps not so spectacular as the above, but important nevertheless. The dependence of various industrial fermentations upon soil-inhabiting microorganisms is well known. Others include the anaeobic bacteria producing butyl alcohol and acetone, the butylene glycol organisms of both the aerobic and anaerobic types, and many other organisms that produce various organic acids and alcohols. The citric-, fumaric-, gluconic- and itaconic-acid-producing fungi are also largely soil-inhabiting organisms; the very name of the fungus producing the last acid has the flavor of the soil (*Aspergillus terreus*). The industrialist interested in fungi and bacteria producing pectolytic enzymes, as well as proteolytic and amylolytic enzymes, usually goes to the soil in search for appropriate organisms. Some of the vitamin-producing microorganisms are of soil origin.

Although in all the above cases, the soil and its extensive microbiological population were given but little consideration, much benefit could frequently have been derived from a knowledge of the environment in which these organisms live and of their mode of life in the soil.

What Should a Training in Soil Microbiology Be?

On the basis of the above facts one may feel justified in postulating the type of training a prospective worker in soil microbiology should acquire. Soil microbiology as well as its mother science, microbiology, is dependent on general bacteriology and on mycology, as well as on physiology and biochemistry. Soil microbiology does not comprise merely the study of legumes and their utilization, of *Azotobacter* and its physiology, or of the cycle of nitrogen in the soil, as glorified by the time-honored terms of "ammonification," "nitrification" and "denitrification"; it does not comprise merely the enumeration of bacteria and fungi in the soil, or the isolation and identification of so many hundreds of species of these organisms—it is all that and much more. Soil microbiology, like microbiology or bacteriology, has a much broader concept and has acquired many ramifications. These comprise specific aspects of ecology, taxonomy, physiology, biochemistry and practical utilization. The soil microbiologist carries a certain taxonomic responsibility, since it is highly essential to know the exact nature of the organisms involved in a given reaction or group of reactions, and not merely to list these organisms as bacteria, molds or protozoa. The student who devotes himself to soil microbiology is, therefore, entitled to learn the various phases of this relatively new science.

Summary

It can now be definitely recognized that the soil microbiologist is in a position to make important contributions not only to our knowledge of soil processes and plant growth, but also to microbiology, especially microbial physiology, and to the utilization of microorganisms for various industrial, public health and other processes. The soil microbiologist is able to contribute in many ways to man's capacity to survive, by learning to control the activities of injurious microorganisms and by favoring the processes brought about by the beneficial organisms.

The reason why the broader concept "microbiology" rather than the narrower term "bacteriology" has been used throughout this discussion is that the soil microbiologist has often to pay as much attention to the fungi as to the bacteria, and occasionally also to the protozoa, the algae and even the nematodes and other worms, inhabiting the soil in large numbers. Only a recognition of all these lower forms of life and their many interrelationships can help to elucidate this complex and important science.

OBITUARY

FRANCIS BERTODY SUMNER[1]

August 1, 1874–September 6, 1945

Professor Sumner's interests were primarily those of a naturalist; he is best known scientifically for his experimental studies on the nature and inheritance of adaptive variations as the key to an understanding of the problem of organic evolution. These studies have been widely recognized as being of exceptional significance. To him biology is also indebted for the first experimental proof of the origin by mutation of new varieties in any wild species of mammal and the Mendelian inheritance of their characteristics. At the time of his death he had been connected with the Scripps Institution for Biological Research (later the Scripps Institution of Oceanography) of the University of California for thirty-two years, having reached the retiring age of seventy the preceding

[1] Contributions from the Scripps Institution of Oceanography of the University of California, New Series No. 264.

year. He is survived by his widow, two daughters and a son.

Although he was born in Connecticut, his boyhood was spent first in Oakland, California, then in Colorado Springs and later in Minneapolis. He graduated from the University of Minnesota with the degree of B.S. at the age of twenty, in 1894. It was through his association with Minnesota's Professor Henry F. Nachtrieb that young Sumner was influenced to undertake zoology as a life career. His studies were interrupted by ill health for a year, after which they were resumed in the Graduate School of Columbia University. Here he had the guidance of three of the country's leading zoologists, Professors Edmund B. Wilson, Henry F. Osborn and Bashford Dean, although he states in his autobiography that his work with Professor James McKeen Cattell was even more inspiring. In the summer of 1899 Sumner joined an expedition sent to the Egyptian Sudan under the auspices of Columbia University in the hope of securing material for a study of the embryology of the lungfish *Polypterus,* then purported to be a possible ancestor of land-living vertebrates. The expedition was unsuccessful, however, and one of the members died.

For two years previous to receiving the Ph.D. degree from Columbia, in 1901, Sumner taught an undergraduate course in "natural history" at the College of the City of New York. In lieu of the offer of any position elsewhere, this to him irksome job was continued for an additional three years. This experience convinced him that he did not have the aptitude for undergraduate teaching and he decided that his best chance for a successful career lay in some field of biological research. He found such an opportunity in connection with his duties as director of the U. S. Fish Commission laboratory at Woods Hole, 1903 to 1911. Here he began his studies on the relations of heredity and environment in mice. These studies, with some interruptions, constituted his chief problem for twenty-seven years. Other work at Woods Hole, by himself and several associates, consisted of an extensive biological survey of the adjacent seas and seacoasts. Then during the two years 1911 to 1913 he served as naturalist on the U.S.F.C. Steamer *Albatross* in a survey of the physical and biological conditions of San Francisco Bay.

The welcome opportunity of resuming his experimental studies on mice was then offered at the Scripps Institution. To these studies he devoted seventeen years (1913–1930) of intensive effort. This involved the collection of differently colored geographic races or subspecies of the genus Peromyscus at many localities—from the humid and semi-desert regions of the Pacific coast, the mountains and inland deserts, the alluvial valleys and extending to the white sandy shores of the Gulf of Mexico. These different types were then placed in adjacent compartments under identical environmental conditions at La Jolla. They and their progeny were bred for four to twelve generations. About 2,300 individuals were analyzed in the greatest detail. At the present time it should be needless to add that the progeny showed no heritable deviations as the result of their changed environment. From these stocks, however, Sumner succeeded in obtaining evidence which proved for the first time in any wild species of mammal that spontaneous mutations of large extent as well as minute variations in color patterns were transmitted as single or multiple Mendelian factors. The evidence clearly indicated that this was the mechanism responsible for the origin of geographic races and presumably for specific differentiation and evolution.

The results of these studies were published in six papers covering 280 pages, including one of 106 pages in the Bibliographia Genetica (vol. 9, 1932). This substantial support to the theory of organic evolution brought Sumner much distinction, as witnessed by his election to the National Academy of Sciences, the American Philosophical Society and the Philadelphia Academy of Sciences.

Sumner's second most important contribution to biological theory was his ingenious experiments substantiating the reality of adaptive coloration in the selective survival of individuals and hence, by inference, in evolution. His more recent studies include morphological and chemical analyses of the changes in the pigmentation of fishes subjected to different conditions of lighting. Numerous other papers on the embryology and physiology of fishes show the same meticulous care in devising and executing his experiments and in the strictly impartial analysis and evaluation of the results obtained. Such work will not have to be repeated.

It may be of interest to note that Sumner began his studies on heredity in mice in the expectation of finding evidence in support of the Lamarckian doctrine, only to become finally convinced by the results that such an hypothesis is untenable. In addition to his strictly biological reports he published a considerable number of papers dealing with various sociological, psychological and philosophical problems, including preservation of natural wild-life areas, in which he always took a lively interest. Only a short time before his death he had the satisfaction of seeing in print the last of his writings. Among these was his autobiography entitled "The Life History of an American Naturalist" and a philosophical discussion of old age and death.

In addition to the scientific societies already men-

tioned, Sumner was a member of many local and national societies devoted to the various subdivisions of biology. Personally he was a man of distinctly superior intellect, kindly and unostentatious on all occasions but fearlessly honest and always ready to champion the cause of the minority. Those who knew him will miss a friendly and always intellectually stimulating association.

WESLEY R. COE

RECENT DEATHS

DR. JOSEPH MCFARLAND, professor emeritus of pathology of the University of Pennsylvania, died on September 22 at the age of seventy-seven years.

ANNIE W. FLEMING, assistant professor of mathematics at Iowa State College, died on September 19. She had been a member of the department of mathematics since 1900.

FRANK W. GARRAN, dean of the Thayer School of Engineering of Dartmouth College, died on September 19 at the age of fifty-one years.

DR. SMITH ELY JELLIFFE, the neuropsychiatrist, died on September 25. He was seventy-eight years old.

CHARLES W. GILMORE, curator of vertebrate paleontology at the U. S. National Museum, died on September 27 at the age of seventy-one years.

EUGENE J. CARPENTER, of Portland, Ore., soil conservationist in the U. S. Soil Conservation Service, Pacific Coast Region, died on September 11.

E. LANCASTER-JONES, since 1938 keeper of the Science Museum Library, South Kensington, England, died on September 9 at the age of fifty-four years.

SCIENTIFIC EVENTS

JOINT HEARINGS IN THE CONGRESS ON SCIENCE BILLS

IN response to President Truman's message to Congress urging the early establishment of a single Federal Research Agency as one of the legislative measures needed for the future welfare and security of the nation, Senator Harley M. Kilgore (D., W. Va.), and Senator Warren G. Magnuson (D., Wash.), announced on September 25 that joint hearings on several science bills now before the Senate would begin on October 8. Because of the similarity of purpose and related character of the bills which have been referred to the Senate Military Affairs Committee and to the Senate Commerce Committee, Senators Kilgore, Magnuson and Pepper, heading subcommittees which are to consider S. 1297 (Kilgore-Johnson-Pepper), S. 1285 (Magnuson) and S. 1248 (Fulbright) have arranged joint hearings on these measures. Senator Pepper is in Europe and is expected to participate actively in these joint hearings upon his return.

All three bills provide for increased Government support of scientific research but have different detail as to the scope of research and methods of administration. The hearings are designed to summarize expert public opinion and to develop a legislative program with respect to Federal support for research for national security, a rising standard of public health and the general welfare.

Senators Kilgore and Magnuson stated:

> We are in full accord with the President's plea for early adoption of legislation to establish a central scientific agency of the government with sufficient funds to encourage and support scientific research for the national interest. In order to expedite such legislation we have agreed to hold joint hearings on the various science bills referred to our individual subcommittees.
>
> We also support wholeheartedly the President's decision that until such an agency can be established on a full operating basis, the Office of Scientific Research and Development and the Research Board for National Security should continue. There must be no gap between wartime and peacetime program of research if the Nation is to derive full profit in the future from what we have learned in the past.
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> The atomic bomb has demonstrated, perhaps more vividly than any other single happening in history, the overwhelming importance of science in our national life. The same skill and scientific know-how which helped to bring rapid and decisive victory on the war fronts must now be used for the purpose of peace and national security. By continuing to promote the progress of science and the useful arts, as the Founding Fathers so wisely ordered, we shall be able to make large strides in improving our national health, in making secure our national defense, and in promoting prosperity and full employment.

In his message to the Congress, President Truman specifically called for a single Federal research agency which would perform the following functions:

1. Promote and support fundamental research and development projects in all matters pertaining to the defense and security of the Nation.
2. Promote and support research in the basic sciences and in the social sciences.
3. Promote and support research in medicine, public health and allied fields.
4. Provide financial assistance in the form of scholarships and grants for young men and women of proved scientific ability.
5. Coordinate and control diverse scientific activities