Obituary

Frank Rattray Lillie
1870-1947

Frank Rattray Lillie was born June 27, 1870, in Toronto, Ontario, Canada, and died in Billings Hospital on the campus of The University of Chicago on November 5, 1947, after a second cerebral hemorrhage following one 5 months earlier. There was thus terminated a brilliant career of notable value to science in general and to the biological sciences in particular. It can probably be said correctly that no man of the present century has contributed more to the over-all advancement of science, for he has served admirably as contributor, originator, organizer, and administrator.

Coming from a background of Scottish clergy on both sides of the family, and with some earlier contemplation of entering into the work of the church, Lillie attended preliminary schools in Toronto. Later, at the University of Toronto, he developed a great interest in science from contacts with Prof. Ramsay Wright and Dr. A. B. Macallum. Upon graduation from Toronto with the B.A. degree in 1891, he attended the summer session of the Marine Laboratory at Woods Hole, Massachusetts, and also entered Clark University for advanced studies under the general supervision of Prof. Charles Otis Whitman, whom he accompanied to The University of Chicago on its opening in 1892; in the then-new institution Lillie became a Fellow. He received his Ph.D. degree from The University of Chicago in 1894, publishing in the next year his thesis on "The Embryology of the Unionidae: A Study in Cell-Lineage," of which his first published paper in 1893 had been a preliminary account. From the publication of his thesis in 1895 up to the year 1945 (10 years after retirement), only 6 years passed without the appearance of a publication under his name; more than 90 have appeared.

Lillie's contributions center in a general way around 6 particular lines of major interest, in all of which *development* is a principal consideration; *embryology* was therefore his main province of scientific interest. His graduate students played a conspicuous role in the development of his work, for it was characteristic that he opened general problems for investigation, set up broad governing principles, and left to them the development of details.

His first investigations centered on studies of cell organization, differentiation, cell-lineage, cleavage, and regeneration; these interests stand out prominently in the literature from 1893 to 1909. As did other investigators of this period, he made considerable use of the centrifuge as an instrument of investigation.

His second field of interest pertained to the embryology of birds, and he is probably most widely known from the publication in 1908 of *The development of the chick,* one of the earliest textbooks in embryology. This text and a manual for laboratory study of chick development, which with one major revision has been in current usage from 1906 to the present time, provided the prospective student of biology or medicine with directions for study and descriptive details of chick development. The text embodied much of the studies on the early development of the bird by Whitman's students at The University of Chicago (Harper, Blount, Patterson) and of his own experimental investigations on the chick in 1903–04. The text, with only one slight revision, has served continuously for 35 years as the best account available on bird development. It has been used by countless numbers of students in colleges and universities of this and foreign countries; after such excellent and long service, it is now undergoing extensive revision by a younger embryologist.

Lillie's third principal line of interest in biology was that of a study of *fertilization.* Following logically from his earlier studies on organization and development of the egg of marine invertebrates, the problems of fertilization received a great deal of his attention during the summer sessions at Woods Hole from 1910 to 1921, when his tenth study on fertilization problems was published. In this field his graduate students became more evident, since many contributions to the general problem came from their studies directed by Lillie.

The fourth major problem was introduced in 1916–17 in his excellent contribution to the problem of the freemartin. The conditions described and analyzed pertain to the interference in sexual differentiation of the female embryo of the cow when twinned with a male, and it introduced the problem of the role of embryonic sex hormones in sexual differentiation. This investigation, which is considered by some to be his greatest, has stimulated a tremendous amount of research in the United States and in most foreign countries where embryological studies have been carried out; the literature on the subject during the past 5 years carries several able contributions from foreign

laboratories. His own students have contributed greatly to the general problem, and work is currently being pursued in attempts to provide final clarification of the thesis introduced by him 30 years earlier.

The fifth interest in research fields again followed logically from the preceding and centered around studies leading to the isolation of sex hormones and a study of their physiological role in the organism in connection with sex and reproduction. Since this period was an especially busy one in his career, his personal contributions were mainly those of planning, organizing, guidance of students, and synthesizing. His introductory chapter in the first edition of *Sex and internal secretions,* edited by Edgar Allen in 1932 (Williams and Wilkins, Baltimore), under the title *General biological introduction* admirably expresses his mastery of these problems and his fundamental interest in the field. His long membership on the Committee for Research in Problems of Sex, National Research Council, permitted him to exert a pronounced influence in the developments in this subject.

Following his retirement from The University of Chicago, the sixth and final major line of investigation centered around the physiology of development of the feather, to which he contributed a striking series of analyses, aided frequently by the application of hormonal substances. Here, as in all other of his major fields of scientific interests, Lillie's masterful touch was evident; and his last paper in the series, published in 1944 (with Hsi Wang), was an experimental study of induction in the physiological development of the feather; it reveals that embryology was still as much a central part of his interests as it was during his first investigation, published in 1893. His last scientific paper was his concise account on the "Feather," appearing in the 1947 *Encyclopaedia Britannica.*

Lillie's career as teacher and leader in science is impressive. After graduation he taught for short periods at the University of Michigan and Vassar College, but he returned to The University of Chicago in 1900 as assistant professor of zoology. He attained his professorship in 1906. He became the second chairman of the Department of Zoology (1910–31) and exercised his leadership in the gradual building of a strong department. He was named Andrew MacLeish distinguished service professor of embryology in 1931—one of the earliest of the university faculty to be so honored—and was called into university administrative service, during a reorganization period, to serve as dean of the Division of Biological Sciences from 1931 until his retirement in 1935 as emeritus professor. His retirement provided time for the continuance of his research interests on feather development, which he pursued actively until 1944. In 1926 Dr. and Mrs. Lillie presented to The University of Chicago the Whitman Laboratory of Experimental Zoology, to serve as a much-needed extension of research facilities for his department; it was named for his old teacher and first chairman of the department.

As an organizer and administrator, Lillie has played a leading role in the advancement of science throughout the present century. His greatest monument, perhaps, is the Marine Biological Laboratory at Woods Hole, Massachusetts, a unique experiment in a democratic organization, owned and operated by its members, who represent colleges and universities throughout the United States as well as many foreign institutions. When he first attended the Laboratory in 1891, it was a small and insecurely financed institution, operating upon an ideal and accommodating a very few interested biologists. Its first director, Prof. C. O. Whitman, had fostered as an ideal a democratic, friendly, cooperative organization of biologists owned and administered by its own membership. Its stormy, uncertain period of existence is well chronicled by Lillie's history of the laboratory, written in 1944 as one of the last of his contributions (*The Woods Hole Marine Biological Laboratory,* University of Chicago Press).

A half-century after his introduction to it, the Laboratory was the leading institution of marine biology in the world, possessed magnificent equipment, abundant space for large numbers of investigators from all lands, a leading reference library, and a large endowment; but it still fostered the same democratic spirit in its operations, its teaching program, and all its other functions of service to the advancement of science. To Frank R. Lillie more than to any other person must go the credit for this phenomenal accomplishment.

In the first year of Lillie's connection with the Laboratory, he was an investigator receiving instruction. Shortly, he became a member of the teaching staff in Zoology and very soon was placed in charge of Embryology. He served as assistant director from 1900 to 1908, becoming the second director upon the retirement of Whitman. During his directorship from 1908 to 1926, the Laboratory saw its greatest growth and consolidation, due very largely to his stimulating leadership and effective administration. From 1925 to 1942, he was president of the Corporation and the Board of Trustees and was president emeritus until his death. From 1891 until his illness confined him in June 1947, Dr. Lillie had never missed a summer session at the Laboratory.

This remarkable succession of many years of service in no measure expresses his real contribution to the

Laboratory. With his continuous interest in, and attention to, details and larger plans for the institution, Lillie epitomized the finest aspects of a sociological experiment. In the words of the then director, Dr. M. H. Jacobs, on the occasion of a celebration of Lillie's 60th birthday at the Laboratory on June 27, 1930:

> To Dr. Lillie more than anyone else, the laboratory owes its freedom from certain features of our American system of institutional management which are particularly irritating to scientists. To have preserved during the critical period of its enormous material expansion the atmosphere of freedom and informality which characterized its earlier days and to have kept alive the spirit of healthy cooperation which makes it possible for the group of scientists who compose the Corporation and the Board of Trustees to manage the affairs of their own institution without a cumbersome administrative machinery, without the services of efficiency experts, and with an almost unbelievable absence of friction of any sort, is a contribution of outstanding importance, not merely to the Marine Biological Laboratory but to Science and Education generally (Anniversary Supplement in Honor of Professor Frank R. Lillie, *The Collecting Net*, June 28, 1930).

Renowned as is that portion of his career so assiduously devoted to the developments of the Marine Biological Laboratory, Lillie's services and influence reached out at the same time to additional spheres of planning and development. From 1935 to 1939 he was president of the National Academy of Sciences and in 1935–36 was chairman of the National Research Council. This combination of duties brought his organizing genius to bear upon the problem of coordination of the activities of these two national organizations. He is the only man ever to have held the leadership in the two organizations at the same time. In addition, he was appointed chairman of a committee of the National Academy of Sciences to study the problem of organization, location, financing, and construction of an Institute of Oceanography. The efforts of this committee can now be appreciated when one becomes acquainted with the fine Oceanographic Institute, also located in Woods Hole, immediately next to the Marine Biological Laboratory. Lillie served as president of the Oceanographic Institute from 1930 to 1939.

Honor has been bestowed upon him by membership in many societies and organizations in this country and abroad. He was managing editor of *Biological Bulletin* from 1902 to 1926 and was a member of the editorial boards of four or more journals as death overtook him. He has received honorary degrees from the University of Toronto and from Yale, Harvard, and Johns Hopkins Universities.

His last physical remains were sent to Woods Hole for interment in the churchyard of the Episcopal church, overlooking Little Harbor. Here he joins such other famous biologists as C. O. Whitman, Jacques Loeb, E. B. Wilson, Gary N. Calkins, C. E. McClung, and L. L. Woodruff, with whom he had worked for so many years. It is a fitting tribute to his love, devotion, and labors on behalf of an institutional ideal in science that so firmly bears the imprint of his genius, and so thoroughly casts its influence over the world, that he should thus be laid at rest nearby.

CARL R. MOORE

The University of Chicago