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LORANDE LOSS WOODRUFF

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A Biographical Memoir by
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Biographical Memoir

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H. H. Woodruff

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July 14, 1879–June 23, 1947

BY G. EVELYN HUTCHINSON

LORANDE LOSS WOODRUFF was born on July 14, 1879 in New York City, the son of Charles Albert and Eloise Clara (née Loss) Woodruff. His father and grandfather were clothing merchants; they came of a family of English descent that had settled near Farmington, Connecticut in 1641.

Woodruff was educated in public schools in New York and then at the College of the City of New York and at Columbia. He earned his B.A. at the latter institution in 1901, his M.A. in 1902, and his Ph.D. in 1905. His graduate work was done under Gary N. Calkins, partly *in absentia* as he obtained an assistantship at Williams College in 1903 and served as an instructor at that institution from 1904 to 1907. His great capacity as a teacher was recognized at Williams and was clearly a factor in his gaining an appointment as an instructor in biology at Yale in 1907. Though the College of the City of New York tried to lure him away in 1922, he remained at Yale for the rest of his life, apart from some service as a consulting physiologist in the Chemical Warfare Service during World War I and a sabbatical year spent with the National Research Council in 1928–1929. He became Assistant Professor in 1909 and Professor in 1915. In 1922 he was appointed Professor of Protozoology and in 1944 Colgate Professor of that subject; Colgate Professorships are primarily

given to senior members of the Yale Faculty who have shown outstanding ability as undergraduate teachers. He was designated a fellow of Branford College in Yale University in 1934. He was acting Chairman of the Department of Zoology in 1927-1928 when R. G. Harrison was on sabbatical leave and succeeded Harrison as Chairman and Director of the Osborn Zoological Laboratory in 1938. He continued in these positions till his death, though he was given a leave of absence during his last year, having suffered a complete breakdown after his wife's death in March 1946. He died on June 23, 1947. His marriage to Margaret Louise Mitchell, also of New York City, was a singularly happy one, and without his wife he appeared to his colleagues and friends to have lost all incentive for life. They had a son and a daughter.

Although he wrote a number of articles on the history of science and some on more general biological matters, Woodruff's original scientific investigations all concerned the ciliate Protozoa.

At the opening of the twentieth century when he began his work, it had been long recognized, and indeed was logically obvious, that the family lines of unicellular, or as some later would have it, acellular organisms, are potentially immortal, though of course in any line most descendants are destined to perish. The meaning of this immortality was, however, subject to debate. It was widely believed that the process of conjugation observed in a number of protistan groups had something to do with the capacity of cell lines to continue perpetuating themselves, though not all observations supported this belief.

In his earlier papers, from 1905 to 1914, at first working with a variety of ciliates but later concentrating on *Paramecium aurelia* and *P. caudatum*, Woodruff showed that the inevitable extinction of lines that did not conjugate could be prevented by appropriate conditions of culture and was in fact

almost certainly due to unidentified nutrient deficiencies. However, even under the best possible culture conditions, an irregularly rhythmical variation in division rate persisted. In a classical experiment involving an enormous tenacity of purpose over a period of eight years, he showed that more than 5,000 generations could be reared by cell division without the intervention of conjugation. Later under somewhat less rigorous control the culture was maintained for over 24,000 generations. The oscillations in division rate, however, persisted. In 1914 Woodruff and Rhoda Erdmann found that these variations were correlated with a process of nuclear reorganization which they termed *endomixis*, and which they realized had earlier been observed in a fragmentary way by Hertwig. In spite of the name that they used for the process, which etymologically would seem to imply fusion of gametes in a strictly internal process, Woodruff and Erdmann believed that the macronuclear replacement resulting from this process involved no such fusion. Later work, particularly by Diller in Woodruff's laboratory, showed, however, that in this they were mistaken. They had missed one micronuclear division and subsequent fusion, so that the reconstituted macronucleus was, as after conjugation, the result of a process that can, in the widest sense, be regarded as sexual. Such a process is now generally called *autogamy*. The result of the process that Woodruff and Erdmann discovered inevitably leads not merely to the replacement of the macronucleus, now known to be polyploid to a very high degree, but also to a continual reduction of the heterozygosity of any nuclei in the cell line, as Sonneborn soon demonstrated genetically. In this the internal reorganization process is in direct contrast to conjugation, which normally will lead to outcrossing and an increase in heterozygosity. These fundamental studies, though Woodruff at the time could not be fully aware of their implications, obviously played a great role in increasing our

understanding of the cell physiology of the ciliates. In addition, he was naturally much interested in cases in which the micronucleus appeared to be absent or where, even though it was present, no reorganization seemed to take place. He also published on the appearance of various ciliates in hay infusions allowed to mature in the laboratory, giving rise to a kind of ecological succession.

Woodruff wrote a dozen notes and papers on the history of biology, of which the most important was on Sir John Hill, the pre-Linnaean author of the name *Paramecium*. Woodruff had an admirable collection of the works of this versatile Figaroesque Englishman, pharmacist, physician, actor, dramatist, botanist, zoologist, editor, and man-about-town. This part of his extensive collection of historic scientific books was fortunately not dispersed at his death and is now in the George Peabody Department of the Enoch Pratt Free Library in Baltimore. Woodruff could have resembled none of his predecessors less than Hill. No one would have supposed that had Woodruff not been elected to the National Academy of Sciences, as he was in 1924, he would have retaliated with an entertaining if mildly erotic parody of the scientific activities of our august body. Nevertheless, in private Woodruff could enjoy Hill's *Lucina Sine Concubitu*, directed at the Royal Society of London, which would not increase the prestige and wealth of its author by electing him and so making it possible for F.R.S. to follow his name on the title pages of his writings, an embellishment greatly desired by Hill's publishers.

From 1909 onward, Woodruff gave a very successful graduate course on the history of biology, which often attracted students from outside his own department and was for many years the only instruction in the history of science given in Yale.

Though Woodruff's influence as a protozoologist was great and his contribution enduring, it is possible that his real

significance was as a teacher. Beginning in the academic year 1909–1910 he had charge of the introductory biology course at Yale which he built up until about 500 students were enrolled in 1927. His textbook, *Foundations of Biology*, was very widely used throughout the 1920's and 1930's and is said in an examination at another New England college to have been attributed, when the author's name was asked, mainly to Woodruff, but by more than one student apiece to Aristotle, Theophrastus, Vesalius, Hales, Buffon, Lamarck, and Wordsworth. Actually since the author was a very literate man, all of these putative authors had had some share in making the book.

As an example of Woodruff the teacher in action, the following reminiscences of Professor Daniel Merriman are of interest.

One of the requirements for Woodruff's graduate course in Protozoology was to collect in the wild and identify 50 species. On culture, a collection from the outskirts of New Haven yielded me an hypotrichous ciliate that defied identification, and after examining innumerable specimens both living and stained Woodruff agreed that it was a new species. Then came the task of drawing it and writing it up for publication. This was my first real lesson in *looking*. In the best manner of Louis Agassiz, Woodruff rejected sketch after sketch until finally I produced one that met his standard with respect to the number and position of the cirri and cilia. The species was named *Urostyla polymicronucleata* and its description was published in the *Archiv für Protistenkunde* [88,3(1937):427–430].

I also had the good fortune to take Woodruff's course on the History of Biology. This resulted in my first paper in the field ["Peter Artedi—Systematist and Ichthyologist," *Copeia*, 1(1938):33–39] and, more importantly, led to a life-long interest in the history of science that has been reflected both in my teaching and in the publication of a number of contributions on oceanography in the 19th century. The background and methodology from Woodruff's course were invaluable. His teaching, perhaps combined with a certain parental influence, clearly provided the stimulus for a highly rewarding field of endeavor.

Though in his later years rather reserved in manner, he

was an essentially friendly man, capable of great kindness. A few letters preserved in the departmental files in the Yale Archives testify to the trouble that he would take in answering questions from amateurs and high school students puzzled about biological matters. Essentially conservative by disposition, he was ultimately always in favor of any change promoting higher standards, and is said for a time to have been a member of an informal group of Young Turks who met for lunch in the Graduates Club on New Haven Green and discussed what was wrong with Yale and what should be done about it.

Outside Yale, Woodruff had an enduring interest in the Marine Biological Laboratory (MBL) at Woods Hole. He was an instructor in the invertebrate course from 1905 to 1909 and then joined the staff of the embryology course in which he taught until 1914. Later he took over the course in protozoology for the season of 1927 in the absence of his old teacher and friend Dr. Calkins. He had been a member of the Corporation of the MBL since 1905, was elected to the Board of Trustees, and in 1930–1932 served on the Executive Committee. The Woodruffs had a summer cottage at Woods Hole, and their hospitality is remembered by many of those who survive from the generations that were students and young investigators forty or fifty years ago. He also occasionally visited the Mountain Lake Laboratory of the University of Virginia where he had several close friends, and he lectured on protozoology at four summer sessions there.

In retrospect, Woodruff's career seems unspectacular but extremely useful. A true servant of science and education, his contributions are built solidly into the fabric of our culture but can now be identified only by those with long memories or an exceptional interest in the past. Yet in the 1920's he was one of the American biologists best known in Europe. The ciliates at that time seemed more primitive than we now be-

lieve them to be, and the processes by which they maintain the integrity of what is essentially a complicated mass of somatic chromatin dividing in a way that is likely to be rather untidy, appears less fundamental than it did in 1914. There was at times almost a feeling that Maupas, having overemphasized the life-giving properties of sexuality, was being appropriately corrected in puritan New England. Nevertheless, the patient and skillful work that Woodruff did has made possible all the later research in his chosen area, and some of this later work has been very important indeed. He belongs to history, which is what he would have wanted.

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