be readily observed, and expect to be taken seriously. I believe it may be literally true that never before in the history of corn culture has a corn parasite been exposed over a wide range to so uniform a host environment. Biologically, including of course its disease relations, we are transforming Indian corn from a freely cross-pollinated crop to a synthetic product.

Elsewhere I have pointed out a relation[9] which may indeed have been all but self-evident, namely, that among comparable crops there is a demonstrable difference as regards disease losses between open-pollinated crops produced from seed and similar self-pollinated crops, disease losses fluctuating more and being in general of greater importance in those plants which are largely self-pollinating.

In a field of open-pollinated corn, there is, I am told, even in the named varieties a wide range in genetic composition and, no doubt, also variation in susceptibility to many diseases. In such a field there is an observable variation in the time of silking and tasseling, and in the time at which plants reach a stage of susceptibility to infection by certain diseases. In contrast to this a field of "hybrid corn" is much more uniform in these respects.

To be sure, the corn now planted consists mostly of double crosses which are somewhat more variable in time of silking, etc., than single crosses. Certain careful growers also plant two crosses in a single field in order that they may still further reduce the hazards due to too great uniformity.

More important in relation to disease and disease-producing organisms is the fact that up until the last few years Indian corn apparently has been able to vary and adjust itself about as rapidly as the disease organisms themselves. Recent researches have shown that in general the common smut of corn, like most smut fungi, is parasitic only in the dicaryon stage, that is, it must cross to parasitize; that it is extremely heterozygous for many characters and consequently unstable; that variation is so common, even in unisexual lines, that from a single monosporidial line more than 150 distinct variants have been isolated; that different combinations of monosporidial lines differ greatly in their degree of pathogenicity and that some of them are so virulent as to kill the host outright.

No one supposes that this ability of the smut fungus or other fungi is recently acquired. It is very much more likely that the process has been going on for many centuries. It is hardly to be doubted that exceedingly virulent lines of smut may occasionally have appeared during these centuries, yet Indian corn survived and has been grown during recent years with a minimum of effective disease control, and apparently much less loss from disease than in the case of wheat.[10]

In corn we are dealing with a native plant, or at least one long cultivated in this area. In many of the places where we now grow corn, our Indian predecessors grew the same plant, which held its own against these same diseases when our ancestors were suffering from the black plague or arguing about the Post-Columbian pandemic of syphilis. All that is now changed and I believe permanently changed. Hybrid corn is here to stay. The increased yield, together with the ease with which seed is produced, makes its future all but certain. Almost equally certain seems to me the probability that we are changing the disease relations of this great crop.

By the wide use of hybrid corn we are depriving this important crop of its power of taking care of itself and by continued crossing and variation, continually adjusting itself to the equally variable parasites which attack it, and have substituted our own choice of parents for each field. In view of our none too brilliant record of success in so testing varieties of other grains as to insure them against loss from disease when planted over a wide acreage, it seems unlikely that we will have much greater success in dealing with corn. It seems much more probable that in spite of the best efforts of the breeders we will see for some years in hybrid corn a disease relation more nearly resembling that in wheat; that is, wider fluctuations in losses with some years very little damage and in others greater damage than has heretofore been observed. Eventually we may see lower average disease losses, but I sincerely believe that our corn breeders will be doing all that can reasonably be expected of them, if during the next ten years they keep the losses from disease in the new varieties, including losses in decay after harvesting, down to the general level of such losses in the old open-pollinated varieties.

OBITUARY

LAWRENCE JOSEPH HENDERSON

1878–1942

LAWRENCE JOSEPH HENDERSON, Abbot and James Lawrence professor of chemistry and chairman of the Society of Fellows in Harvard University, was born in Lynn, Massachusetts, on June 3, 1878. He died suddenly on February 10, 1942.

During the school years in Salem, his home contributed a code of behavior which persisted through life and an awareness of the learning of that day.

9 N. E. Stevens, SCIENCE, 89: 339–340, 1939.

10 N. E. Stevens, *Scientific Monthly*, 52: 364–366, 1941.

Through his father's business interests in the island of St. Pierre, he early established an affectionate and lasting intimacy with France. In school, mathematics, which in later years served both as a tool and for relaxation, was easy; the only teacher whom he remembered with satisfaction taught him physics.

At the age of sixteen, he entered Harvard. Here it was possible for him to form habits of independence of thought and action which in college kept him from accepting the dicta of instructors or his fellows unthinkingly; in later years these habits were characteristic. An unorthodox performance of an experiment in physical chemistry produced unexpected results and persuaded Professor T. W. Richards to permit an investigation of their nature. As early as his sophomore year he had decided to enter biological chemistry, although no courses were offered in the college; and about this time he apparently began his thinking about the acid base equilibrium. Here he learned and mastered the generalizations of physical chemistry, then approaching its full vigor. As evidence for his understanding, he submitted an essay on Arrhenius' theory of electrolytic dissociation for a Bowdoin Prize Contest. Later, his knowledge bore much more valuable fruit.

Having received his A.B. degree in 1898, he took the generally accepted approach to biological chemistry and entered the Harvard Medical School, receiving his M.D. degree in 1902. But he never felt himself completely a medical student and lived in Cambridge, where began the friendships which were to lead for a time to an interest in philosophy. His medical studies were, however, by no means sterile. He learned the meaning of the Hippocratic teachings, acquired a thorough sense for biological phenomena, was initiated into problems which later deeply concerned him, and formed associations with physicians which he always treasured.

The years 1902–1904 were spent in Hofmeister's laboratory in Strassburg. And although they contributed little to his formal training, the associations with future leaders in physiology and biological chemistry did leave an impress and led to persistent friendships. There, too, his interest in hemoglobin began. He also observed a German university tradition already past its prime. And especially, he noticed certain German traits, among them an undiscriminating liking to obey authority, which later became generally offensive. Accentuated in Alsace-Lorraine, these traits produced a deep emotional impression upon him.

He returned to Harvard in 1904 as lecturer in biological chemistry, and soon decided that investigations of the acid base equilibrium were likely to prove more fruitful for him as a biological chemist than thermochemical studies chiefly concerned with the relation of heats of combustion to molecular structure. And so the next decade was devoted to studying the mechanisms involved in neutrality regulation in the animal organism and their explanation in quantitative physico-chemical terms, according to the theory of dissociation of weak acids. Meanwhile, his deeper curiosity, insight and a sense of order led him to perceive that "fitness is a reciprocal relation between an intricate pattern of properties of organisms . . . and an intricate pattern of properties of water, carbon, dioxide, and the compounds of the three elements, hydrogen, oxygen, and nitrogen."[1] This led to writing "The Fitness of the Environment," published in 1913. In 1917, influenced by the Royce Seminar, a more complete understanding of Willard Gibbs's study "On the Equilibrium of Heterogeneous Substances," and by his own habits of reflective contemplation and search for underlying uniformities, he completed "The Order of Nature." These books mark a turning point in his career, as he no longer felt constrained to concern himself only with the conventional application of physical to biological chemistry.

After a war-time digression into the physical chemistry of bread-making, he turned in 1919 to his important physiological studies. Already aware that numerous functional relationships existed in blood, he took advantage of the team spirit generated during war and led a group of investigators, already interested in the subject, simultaneously to investigate the variables involved. Before long it became possible to analyze the system in Gibbs's terms and to describe the simpler relations graphically with the aid of elementary mathematics. It was, however, necessary for him to learn and apply d'Ocagne's method of nomographic representation in order to reveal clearly the complex interrelationships. Although these studies continued until 1930, a synthesis was presented at Yale in the Silliman Lectures of 1928 and published as "Blood—A Study in General Physiology."

But several years before, about 1926, William Morton Wheeler had brought the Italian economist and sociologist, Pareto, to his attention. The "Traité de Sociologie Generale" had impressed Henderson as an accurate qualitative description and a workable classification of the uniformities found in all observed social systems. Once aware of its importance, he was impelled to master it by eager study, to lead others to an understanding of its implications and to test its validity. After 1930 his efforts wholeheartedly served these ends. By 1935 his last published book, "Pareto's General Sociology—A Physiologist's Interpretation," had appeared. A collection of privately distributed lectures and excerpts for use in the course, "Sociology 23—Concrete Sociology," indicates the intensity and

[1] L. J. Henderson, unpublished "Memories."

extraordinary range of his reading and observation. Although the analogy of social systems to Gibbs's systems did not escape him, he realized that the time for quantitative treatment was not yet at hand. Without it, he was able to explain many phenomena observed in everyday relations between two or more persons, or between groups of individuals, in terms of the persistent uniformities which are the manifestations of sentiments. He increasingly stressed the study of man through concrete cases, and in 1941 appropriately emphasized this point of view in a course given to first-year students at the Harvard Medical School.

Next to his intellectual pursuits, his relations to Harvard University were his most important interest for three quarters of his life. Eight years a student, he served it devotedly in the usual sequence of academic posts for thirty-nine years. He gave formal instruction in three subjects: biological chemistry, 1904–1939; history of science, 1911–1942; and sociology, from 1932–1942. All his courses had one common characteristic—they reflected the progress of his thinking. For example, in 1912 he read a large part of "The Fitness" to his class in Chemistry 15 before he had finished the book. Thus he managed to preserve vigor and freshness in each of these courses over extended periods, and because of the unusual breadth of his learning, students gained not only special knowledge, but also were given an insight into the cultural meaning of science.

With graduate students he practiced a policy that amounted almost to *laissez-faire*. An enrichment of their ideas was inescapable, as informally he generously and sympathetically applied the "eager clarity of his mind" to the innumerable intellectual and personal problems presented by curious young men. And he ever strove to induce them to develop the best in themselves.

His leadership was recognized in that he was enabled to establish the Laboratory of Physical Chemistry at the Medical School in 1920 and the Fatigue Laboratory at the Business School in 1927. Convinced that investigators should ordinarily master their own destinies, he gradually withdrew from the active direction of both laboratories. He did, however, continue his direct association with the Fatigue Laboratory to the end.

For a number of years President Lowell and Henderson had discussed means of aiding the development of original scholars. Consequently, the Society of Fellows was founded in 1933 with Henderson as its first chairman. It came to reflect many of his beliefs. Here a group of most promising young men, stimulated by interaction with each other and with a few of the university's most distinguished professors, learned of dignity and breadth in scholarship, became aware that human relationships were important, and were given a period of freedom from academic and financial pressure so that some might, through reflective thought, experiment or writing, fulfil the promise of productive scholarship.

It was inevitable that his contributions to knowledge and his own increasing wisdom should receive recognition; the former by honorary degrees, lectureships, and memberships in learned societies, and the latter by appointment to important committees. The latter responsibilities he undertook with energy and with characteristic persistence, if at all. As Foreign Secretary of the National Academy of Sciences, he had, with the Foreign Secretary of the Royal Society, arranged the Pilgrim Trust Lectureship before war broke out; recently he was actively concerned with Inter-American relations.

But it was at his camp in Morgan Center, Vermont, that the many facets of his personality shone most clearly. His love of symmetry appeared in the buildings he had designed; his love of beauty in nature as he sat on the porch gazing at the gentle scene before him. Here his essential kindness and human interest were manifest not only to invited friends but to neighbors of the countryside. This place he loved. Here he thought, worked and contemplated the world in serene inquiry.

Altogether, his life, which he had made so rich, satisfactory and stimulating, exemplifies the concept of the complex interactions of organism and environment to which his experimental studies, continued observations, unusually wide reading and contemplation had led him. Although he undoubtedly would have minimized the magnitude of his influence on the environment, it is apparent in the importance of his publications, through his formal teaching, and less apparent, but probably even more important, in his human relations, especially with young men, his leadership in institutions and the deep and abiding affection of those who had come to know him well.

Ronald M. Ferry

RECENT DEATHS

Dr. C. Hart Merriam, founder in 1885 and until 1910 chief of the United States Bureau of Biological Survey, now known as the Fish and Wild Life Service, until three years ago research associate of the Smithsonian Institution, died on March 19 at the age of eighty-six years.

Professor Adam C. Davis, Jr., head of the department of experimental engineering at Sibley College, Cornell University, died on March 17 at the age of fifty-two years.