Retiring This Year

Sterling H. Emerson

Sterling H. Emerson is a native of Lincoln, Nebraska, with a BS from Cornell University, and an AM and a PhD from the University of Michigan. His first position after he received his doctorate in 1928 was as an assistant professor of genetics at Caltech. Now, 43 years later, he has been named professor of genetics, emeritus, at the Institute. In the interim he has investigated and unraveled complex genetic phenomena in a number of organisms—the evening primrose, fruit flies, and fungi.

A major theme of Emerson's research has been to understand how genes recombine with one another to generate the seemingly endless diversity of types which characterize many living forms. In spite of the tremendous strides made in understanding the chemistry of genes, little is known about the actual events at the chemical level which go on when two like chromosomes, one from the father and one from the mother, come together and recombine with one another. This process, known as crossing over, is one of the major ways in which nature is able to generate a large number of new kinds of animals and plants from pre-existing hereditary variations.

Emerson began his studies on crossing over using the fruit fly, Drosophila. He and a number of other investigators at Caltech showed that properties of gene recombination, or crossing over, can be deduced by elaborate kinds of breeding experiments using multiply marked chromosomes. More recently, Emerson has turned to a study of genetic recombination in fungi where not only crossing over but another related process of gene recombination known as gene conversion occurs. Gene conversion is a process in which tiny bits of one gene molecule exchange with tiny bits from another gene according, again, to certain rules which Emerson has been elaborating. Emerson is building mathematical models to help explain the gene conversion patterns which he and others have studied in a number of fungi.

In another kind of investigation Emerson has been concerned with how organisms are able to build up a hereditary resistance to drugs or other toxic agents. For these studies he chose the bread mold, Neurospora—since its genetics is very well understood—and the drug sulfanilimide because it is toxic to Neurospora as well as to many microorganisms, especially bacteria. Emerson was able to breed a strain of Neurospora which was not only resistant to this drug but actually required it to survive. With Marko Zalokar, at that time a Gosney research fellow at Caltech, he then was able to work out why this was so: The sulfanilimide interferes with the action of an essential vitamin, p-aminobenzoic acid. When a strain of the mold developed a requirement for sulfanilimide before it would grow, Emerson was able to show that a new mutation had arisen which caused the mold strain to be inhibited by a metabolic product of p-aminobenzoic acid. In the absence of the drug, the mold was literally dying of too much of the vitamin. When the drug was added, it brought the level back down to normal levels so that the mold could again grow in a normal way.

These elegant experiments of Emerson's were some of the first to clarify the way in which living organisms are able to build up resistance to drugs or antibiotics. The practical significance of such work is immense, since in medicine a continual battle must be waged to control bacterial infection by developing new drugs to which the bacteria are not yet resistant. Emerson's work has contributed to the development of a multiple drug or multiple antibiotic attack, which has become an important mode of therapy in controlling infectious diseases.


Sterling Emerson

In 1951 Emerson received a Fulbright award and a Guggenheim fellowship that enabled him to spend an academic year studying at the Botany School of the University of Cambridge in England and a summer in the department of genetics at the University of Paris. From August 1955 to September 1957 he was on leave from Caltech to serve as geneticist in the biology branch of the Division of Biology and Medicine of the Atomic Energy Commission in Washington, D.C. He has represented the AEC at several international conferences on the genetic effects of radiation.

Emerson's favorite way of relaxing is walking, which gets less and less rewarding in southern California. That drawback plus the eastward pull of family ties—his son lives in Philadelphia and his daughter in England—have Emerson and his wife considering a move. Meanwhile, he is working up old data and trying to write about it, and he is pursuing his other hobbies—plant breeding and drawing.

A. J. Haagen-Smit

Caltech's pioneer crusader for clean air, Arie Jan Haagen-Smit, is one of a notable group of distinguished scientists who have left their laboratories to go to work in areas of public concern. After 34 years at Caltech—the last 22 of them at the beck and call of a growing environmental problem—he has now become professor of bio-organic chemistry, emeritus.

Haagen-Smit was born in Utrecht, Holland, in 1900. He received three degrees—his AB, AM, and PhD—from the university there and then joined its faculty. His work on the isolation and synthesis of plant hormones gave him an international reputation among other plant physiologists. It also brought him an invitation, in 1936, to lecture for a year at Harvard, and another invitation, from Caltech's famous geneticist Thomas Hunt Morgan, to join the Caltech biology division in 1937.

At Caltech Haagen-Smit continued his investigations of the structure, determination, and synthesis of naturally occurring compounds by returning to a project he had begun while working on his doctorate: the analysis of essential oils. From that work he moved to flavor studies, in the course of which he developed microanalytical techniques for separating compounds in order to obtain basic information about the chemical constituents of the flavor of food materials such as onion, pineapple, and grape. In 1950 he was given the Fritzsche Award of the American Chemical Society in recognition of his work on oils and flavors.

In 1948 Haagen-Smit decided to apply the techniques he had evolved in the flavor studies to finding out what was in the irritating air people were beginning to complain about. Starting with several hundred cubic feet of air (an equivalent of the amount a person breathes in one day), he collected a few ounces of condensed smog. This liquid was found to be mostly water containing a number of evil smelling chemicals—aldehydes, acids, and organic peroxides. Although these substances were known to be products of incomplete combustion and known to cause eye irritation, they had never before been reported as significant air pollutants. Their discovery in smog opened up a new field of investigation into the problem.

A. J. Haagen-Smit

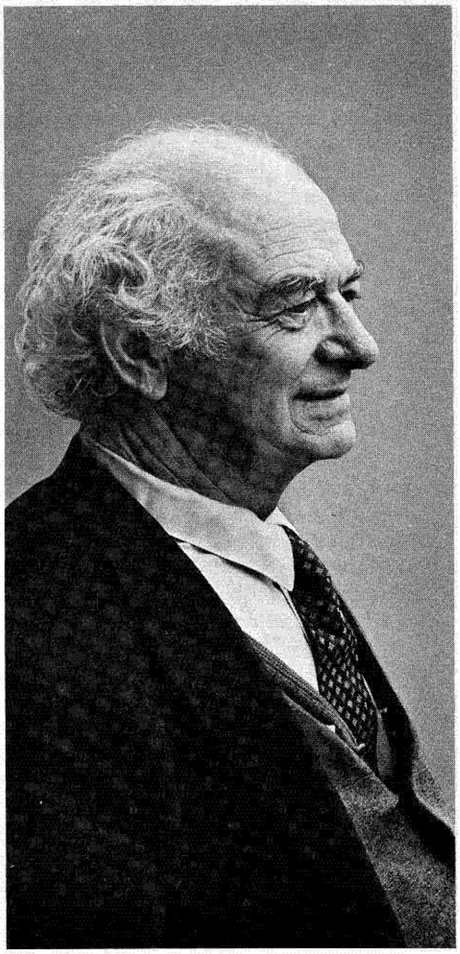
In 1949, Haagen-Smit published his conclusion that the organic material released into the air—mostly hydrocarbons—was oxidized through the combined actions of oxides of nitrogen and sunlight to become photochemical smog. He named the automobile and such industries as petroleum refineries, power plants, and steel factories as the major sources of air pollution. While the industries involved protested at first, eventually they cooperated in the effort to reduce smog. Today, in fact, California refineries are the best controlled in the world, and most of the automobile plants have impressive projects devoted to the study and control of auto exhaust.

Now, after years of serving on smog control bodies both for the state and the nation (and delivering innumerable speeches to interpret his findings), Haagen-Smit feels that pollution control will at best be only marginal as long as the public insists on all the goods and services it is accustomed to, and continues to regard such things as automobile emission inspections and curbs on electric power as inconvenient rather than imperative.

Haagen-Smit looks with some satisfaction on the accomplishments of the California State legislature and the Air Resources Board, of which he has been chairman for the past three years. California has set standards for the nation in air pollution control; the refineries have long since cleaned up their operations and, he believes, by the end of the 1970's the internal combustion engine will no longer be the number one smog producer.

Retirement will still mean a full speaking schedule for Haagen-Smit, and continuing activity on a variety of committees. He acts, for example, in an advisory capacity to the Atomic Energy Commission; the Department of Health, Education and Welfare; various California state organizations; the Los Angeles County Air Pollution Control District; and the County Tuberculosis Association. He is a member of the editorial boards of two air pollution journals, and—most pleasurable of all—he is a member of the board of trustees of the Los Angeles County Arboretum Foundation. Even with all this, as a dedicated gardener he is looking forward to a little more time for growing orchids and fighting crab grass.

Linus Pauling



Linus Pauling

Caltech's only winner of two Nobel Prizes, Linus Pauling, has now been named professor of chemistry, emeritus. Winner of the Nobel Prize in chemistry in 1954 and the Peace Prize in 1962—and recipient of nearly countless other awards, medals, and honorary degrees—Pauling has been on either the student or the faculty rosters at the Institute almost continuously since 1922.

Pauling was born in Portland, Oregon, in 1901 and, after receiving his BS in chemical engineering from Oregon State College in 1922, came to Caltech to do graduate work under Arthur Amos Noyes. He received his PhD in 1925, and then spent a year and a half in Europe doing research on the application of quantum mechanics to the problems of the structure of molecules and crystals He returned to Caltech in 1927 as assistant professor of chemistry. In 1931 at the age of 30 he became full professor; and in that same year he was named the first winner of the American Chemical Society's Award in Pure Chemistry, given for the most distinguished research of the year by a young man not over 30.

After the death of Noyes in 1937, Pauling succeeded him as chairman of Caltech's Division of Chemistry and Chemical Engineering and director of the Gates and Crellin Laboratories—positions he held until 1958. He continued his research and teaching at Caltech until 1964, when he became Research Associate in Chemistry. Since then he has also held positions as a member of the staff of the Center for Democratic Institutions in Santa Barbara and as professor of chemistry, first at the University of California at San Diego and then at Stanford.

Pauling's fields of interest have covered all branches of chemistry—extending into experimental and theoretical physics in one direction, and into biology and medicine in the other. Up to 1933 his experimental work comprised the determination of the structures of crystals and of gas molecules by the diffraction of X rays and electrons, respectively, and his theoretical work included the discovery of basic principles concerning the nature of the chemical bond and the structure of molecules. (His book *The Nature of the Chemical Bond,* published in 1939, is a classic and still a standard reference in the field.)

After 1933, Pauling applied himself to the problem of the structure of proteins. Instead of trying to study proteins directly, he and his co-workers studied the structure of the amino acids of simple peptides, and of other simple substances related to proteins. By using the information obtained in this way, they were able to predict the detailed structure of several proteins, including those found in bone, muscle, and red blood cells. One of the outcomes was that he and his associates were the first to demonstrate that sickle cell anemia is a molecular disease.

At least as important as his experimental work in biological chemistry was the style of thinking he brought to the field. For the most part, scientists had been inclined to think of the large molecules of biology—such as enzymes, other proteins, and nucleic acids—as amorphous blobs of matter. Pauling realized the value of thinking of them as structural atomic systems, and he expressed those thoughts in terms of the topological complementarity between molecules in biochemical reactions and the helical structure of many proteins.

Pauling is the author or co-author of a number of textbooks in chemistry, several hundred scientific papers, and of *No More War!*—a vigorous statement of his stance in regard to nuclear testing, published in 1958. In December 1970 he published *Vitamin C and the Common Cold.*

At present, during the academic year, home for Pauling and his wife is Portola Valley, near Palo Alto and the Stanford campus; for vacations they have a ranch in the Big Sur area. The four Pauling children—and 14 grandchildren—are scattered across half the globe: Linus Jr is a psychiatrist in Honolulu; Peter is professor of chemistry at the University College in London; Crellin is associate professor of biology at U.C. Riverside; and Linda is Mrs. Barclay Kamb of Pasadena. Kamb, professor of geology and geophysics at Caltech, is responsible for one further honor for Pauling: In 1960 he discovered a new mineral—one with the largest known basic structural unit of any inorganic material (nearly 3,000 atoms)—and named it after his father-in-law, "Paulingite."