Charles Stacy French
1907-1995

Charles Stacy French, the Director of the Department of Plant Biology from 1947 until 1973, died on October 13, 1995 after a brief period of hospitalization for pneumonia. French was born on December 13, 1907 in Lowell Massachusetts and received his B.S. degree in 1930 from Harvard University. French's doctoral thesis research concerned the effects of temperature on the rate of respiration of Chlorella. He often recalled how Pei-Sung Tang, then a postdoctoral fellow from China, helped him organize his mass of data into a suitable thesis. French's first scientific paper entitled "Oxygen-consumption in Chlorella" was published in 1933 in the Chinese Journal of Physiology with Tang as the senior author (Tang and French 1933). After receiving his Ph.D. degree in biology from Harvard in 1934 he worked with Robert
Emerson at the California Institute of Technology in Pasadena, California. In 1935 Emerson arranged for him to spend a year in Otto Warburg’s laboratory in Berlin. There intensive scientific effort, discipline and hard work were expected of all members (French 1979). French published a preliminary note in Science in 1936 describing measurements of hydrogen and carbon dioxide photoassimilation in purple bacteria and published his results in 1937 on measurements of quantum yields and action spectra in photosynthetic bacteria (French 1937a,b).

French spent three years working in Chicago with James Franck but did not interact well with Franck who, as a physicist, approached photosynthesis in a much more theoretical way. French was an inveterate experimentalist who wanted to measure as much as he could about photosynthesis and then attempt to explain the results with a theory. During his time at Chicago French associated with H. Gaffron, R. Clayton, R. Livingston and W. Butler and while there he measured in collaboration with M. Anson from the Rockefeller Institute the evolution of oxygen in isolated chloroplasts according to Robin Hill’s procedure and suggested the name "Hill Reaction" (Myers 1974, French 1979).

French accepted a position as assistant professor of botany in 1941 at the University of Minnesota, advanced to associate professor and remained there until 1947. While at Minnesota French’s only doctoral student, Stanley Holt, worked with him on the reduction of various organic dyes and inorganic salts by chloroplast preparations. In another study they showed, using isotopic oxygen, that in chloroplasts and intact photosynthetic cells, the oxygen evolved came from water (Holt and French 1948a,b). French enjoyed his time at Minnesota but the extremely cold winters were hard on him since he was susceptible to respiratory infections. When Vannevar Bush, the President of the Carnegie Institution of Washington, offered French the Directorship of Carnegie’s Department of Plant Biology at Stanford, he happily moved to California in July of 1947 to succeed Herman Spoehr.

The Department of Plant Biology at that time had essentially two research groups: Experimental Taxonomy with William Hiesey, David Keck, Jens Clausen and Malcolm Nobs, and Biochemical Investigations with James H.C. Smith, Harold Strain, Harold Milner and Herman Spoehr, the latter group working mainly on photosynthesis and photosynthetic pigments. French remained as the director of the Department for 26 years - a period of much innovative research in plant biology and, upon retirement in 1973, was succeeded by Winslow Briggs.

When French first arrived at Stanford, the Department consisted of a 3-story concrete building with a red-tile roof, still in active use today, as well as various out buildings, a large greenhouse and 10 acres of surrounding land that was leased from Stanford University. The basement of the building, except for one corner set aside for machine and wood shop facilities, was devoted entirely to various ingenious pieces of equipment that French and his postdoctoral fellows had set up to study photosynthesis. French encouraged all scientists and visiting post-doctoral fellows to use the shop and become proficient in using machine tools to make unique items needed for research measurements. He was himself a master at building ingenious instruments not available commercially that permitted him to investigate new and different aspects of photosynthesis. He was an early pioneer in combining the
methods of different branches of science. French had great enjoyment throughout his scientific life conceptualizing and developing such instruments.

Soon after arriving at Carnegie, French became interested in the forms of chlorophyll that occur in living plants and also in the formation of chlorophyll, a topic studied at the time by James H.C. Smith. In his studies of the forms of chlorophyll in vivo he needed to break unicellular algae and chloroplasts in order to separate them. He found that certain cells were notoriously difficult to break since their cell walls were tough and extremely resilient. To accomplish this task he pressurized samples in a thick, steel-walled cylinder mounted in a heavy metal frame by forcing a plunger into the cylinder with an automobile jack. By releasing the pressure suddenly through a needle valve the cells were forced out and broken by the resulting large shear forces (Milner et al. 1948, French and Milner 1951). This device is presently in wide use throughout the world and has since become known as the French pressure cell.

French constructed the first automatic recording fluorescence spectrophotometer that simultaneously measured and corrected fluorescence emission spectra. This was done with two homemade grating monochromators and a potentiometer positioned by a rotating plastic drum on which was inked a correction curve followed by a photocell. French had a good relationship with astronomer Ira Bowen of Carnegie Institution's Mt. Wilson/Palomar Observatories and he helped obtain large diffraction gratings and optical components needed to construct large monochromators. French used his fluorescence spectrophotometer to study fluorescence emission spectra in a number of marine algae. He also did some of the earliest studies demonstrating the highly efficient transfer of excitation energy from one photosynthetically-active pigment to another (French and Young 1952).

French fabricated an ingenious spectrophotometer that measured the first derivative of the absorption spectrum and allowed the detection of very minor components whose contribution to an absorption spectrum would otherwise go undetected. For this purpose he caused the slit of the monochromator to vibrate over a few nanometer wavelength interval. This spectrophotometer took several years to complete and towered imposingly above its tables. Most of its optical and electronic components were obtained from recently-available military surplus equipment. The message stenciled on one of its aluminum circuit boxes "do not remove from the airplane" invariably caught visitors' eyes.

French built an ingenious curve analyzer (French et al. 1954) that consisted of five separate vertically-moving tables on which were drawn Gaussian curves. These curves were followed by a photocell that tracked the curve as the table moved. Movement of the photocell positioned a potentiometer. This produced a voltage proportional to the Y-axis of the curve as the wavelength X-axis was driven along. This giant assemblage eventually produced a curve that was the approximate sum of the curves on the five tables. By varying the shapes and heights of the component curves French could obtain by trial and error an estimation of the various forms of chlorophyll that were necessary to produce a resulting curve resembling that obtained from the in vivo measurements. Many years later, with the advent of digital computing, he enjoyed doing curve analyses with much more ease and accuracy.
When Francis Haxo visited the Department he brought along the rate-measuring oxygen electrode that he and Lawrence Blinks had used to measure the action spectra for oxygen evolution in a number of marine algae in Pacific Grove at Stanford's Hopkins Marine Station. French took to the polarographic technique immediately since it allowed him to use very small samples and the electrode's response time was extremely rapid compared to the manometric technique that he had to use in Warburg's laboratory. French, along with Per Halldal, devised an apparatus that measured the action spectrum for oxygen evolution automatically. Much excitement existed at the laboratory at that time because the Emerson enhancement and Blinks chromatic transient effects suggested that two light reactions cooperate during photosynthesis of plants. Jack Myers and Stacy French measured the action spectra for enhancement and the Blinks effects and also showed that alternation of lights absorbed preferentially by system 1 and 2 even at intervals separated by up to 6 s could still produce enhancement showing that there were long-lasting intermediates produced by the two photosystems of photosynthesis (Myers and French 1960a,b).

Vannevar Bush began a fellowship program that brought postdoctoral fellows and visiting investigators to the laboratories of the Institution including the Department of Plant Biology for varying lengths of time (see list at end). These programs cultivated friendships and the exchange of scientific ideas and collaboration between Carnegie scientists and many scientists throughout the United States and the world. French felt that everyone's career in science depends largely on one's interactions with other people and that perhaps the easiest way to become a successful scientist was to cultivate the right people and then learn from them. For these reasons he greatly valued the postdoctoral fellowship program that Vannevar Bush had initiated and was always on the lookout for talented scientists to invite to work in California at the Department.

French was an easy going and friendly person who greatly enjoyed doing research. He thought it remarkable that the Institution would buy a scientist's time and then trust him to do innovative and significant scientific research. French always encouraged scientists to think and do research independently. He valued cooperation rather than competitiveness among scientists and established an atmosphere at the laboratory where frequent and friendly discussions could take place. Many people remember the good conversations and camaraderie they enjoyed while having lunch in the native plant garden in the comfort of the Adirondack chairs with birds nearby waiting for handouts of food.

French was given many honors during his life. He was elected a member of the U.S. National Academy of Sciences and the National Academy of Arts and Sciences in 1963 and a member of the Academie der Naturforschung Leopoldina in 1965, and was given the Reid Barnes life membership of the American Society of Plant Physiologists in 1971 and the Merit Award from the Botanical Society in 1973. He was awarded an honorary Ph.D. degree from the University of Göteborg, Sweden. For many years he also served on the Editorial Board of Photosynthesica.

Stacy French's death was a great loss to his family as well as to his many friends and colleagues around the world. He is survived by his widow, Lee Pennland French who
was married to Stacy in 1993 after Margaret French's death in 1992, and by his son Charles Ephraim French and daughter Mrs. Helena French Halperin. The field of photosynthesis has lost one of its great pioneers.


From his scientific papers the following ones are most important:


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