Memorial to Willard Frank Libby
1908–1980

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Willard Frank Libby died unexpectedly on September 8, 1980, of a bad back complicated by a pulmonary blood clot. Until the day of his death he was carrying on his researches at top speed as he always did. One week before, he had completed a seminal paper on the geometrical theory of catalysis of light hydrocarbon reactions important in oil refineries and on the role of electron tunneling therein. Furthermore, on the day of occurrence of the clot, he was working with Professor Keith Runcorn and me on our ongoing considerations of the possibility of superheavy elements in the early universe.

Few people know about all of his many careers. In his young years he discovered many radioisotopes, after building the first Geiger-Muller counters in the United States, at the Radiation Laboratories at Berkeley. At the same time he invented boron-trifluoride counters for neutron detection.

In the war years he and his group at Columbia University in the Manhatten District solved the exceedingly difficult problem of the barrier for the thermal diffusion method of separating uranium 235 from uranium 238. The patents for the barrier, which carry his name and that of Anthony Turkevich, have never been issued by the U.S. Patent Office and are still classified 35 years later, so have gone unrewarded despite the fact that the electric nuclear power industry in the United States and in many other countries has depended on this barrier for enrichment of uranium fuel for more than 30 years. The U.S. Government has grossed $6 billion and netted $3 billion from these patents.

After World War II came the tumultuous years in which he, with the help of his group at the University of Chicago, invented radiocarbon dating and so revolutionized our knowledge of the history of human development and archaeology for the past 50,000 years. Radiocarbon dating keeps expanding into ever-widening uses; e.g., determining ages of soils; age of ocean bottom water; rates of exchange of atmosphere between the stratosphere, troposphere, and hemispheres; and the rate of absorption of atmospheric carbon dioxide into the surface of the oceans, knowledge of which is essential to determine if CO_2 in the atmosphere will level off.

There are more than 140 radiocarbon laboratories worldwide; many of their personnel were trained by Bill Libby and by his students. As Athol Rafter of the Physical Research Laboratory of Wellington, New Zealand, wrote, "The sun never sets on Bill Libby's radiocarbon laboratories." The scientists of these laboratories attend international conferences every two years, the most recent being the Tenth International Radiocarbon Conference, held at Bern and Heidelberg in August 1980. The journal *Radiocarbon* publishes several bound volumes per year containing hundreds of radiocarbon dates and describing the dated materials and their provenances. Bill Libby's last message to the radiocarbon daters was to consider how to evaluate the history of world

climate using the several hundred thousand existing radiocarbon dates and measuring others as needed.

In his years as Atomic Energy Commissioner he took over John Von Neumann's initial work inventing and supporting computer development and thereby set the foundation for NASA to go to the Moon and to explore the planets. Further, he guided, funded, and encouraged the fledgling electric nuclear power industry.

He and his students at UCLA prepared many new compounds at high pressure and measured their properties. With others of his students he traced nuclear bomb-produced ^{14}C and tritium in the atmosphere, which then diffused into the troposphere and oceans and across the the equator into the Southern Hemisphere and measured the time for processes to occur. He measured fallout of fission products, and tritium in rain and snow, finding that rain makes three hops in crossing the United States. He measured ages of lake, river, and spring waters, initiating the new science of hydro-chronology. These measurements comprise a global experiment of unique value to our understanding of our oceans and atmospheres. His measurements of the replacement rates of human tissues showed that man's brain is only as old as his hair.

He founded the Meteoritical Society, bought meteorites wherever he could obtain them, and funded many groups to analyze these precious samples of material from space, especially to train the meteorite scientists to study and analyze the Moon rocks that would be brought back by the astronauts.

He established two professions: the health physicists to monitor and verify (or criticize) the Atomic Energy Commission, nuclear weapons testing, and the nuclear electric power industry; and the Doctors of Environmental Science and Engineering, unique professionals with breadth in seven sciences, able to diagnose and solve problems of the environment. Environment doctors are in great demand in federal and state agencies and in private industry. The curriculum that trains them at UCLA is unique in the United States and in the world.

He anticipated the development of major problems facing science and society, figured out methods with which to address them, and took measures to do so.

Lord William Penney wrote about Bill, "I shall remember him always as a man of courage and imagination, a loyal friend, and a worker whose place in science is forever secure."

Most recently he was turning his attention toward advising industry on technological problems and urging the investment in research to solve such problems. Always he gave time and energy to advising government agencies. And he gave time to talking to children and students at every level of education. Either an institution paid his speaking fee or else he did it free. Sometimes he flew four thousand miles to speak to a high school class without pay. He believed that education is our only hope and that science is basic to human success in overcoming the difficulties of existence in our physical world.

He was one of the truly great scientists. We celebrate him and miss him.

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