we hear that

Stuart A. Rice has been appointed Dean of the University of Chicago's Division of Physical Sciences beginning July 1980. Rice is a professor in the departments of chemistry and biophysics and theoretical biology, the James Franck Institute and the College. He succeeds **Albert V. Crewe**, professor in the departments of physics and biophysics and theoretical biology, the Enrico Fermi Institute and the College, who returns to full-time teaching and research.

obituaries

Harold C. Urey

UREY

Harold Clayton Urey is best known for his discovery, with F. G. Brickwedde and G. M. Murphy, of deuterium, for which he was awarded the 1934 Nobel Prize in chemistry. The discovery of heavy hydrogen, however, represents only the tip of a scientific iceberg. The profusion and diversity of his achievements during a career that spanned six decades mark Urey as one of the giants of twentieth century science. He will also be remembered for his intense interest in the social responsibilities of scientists.

Urey was born in Walterton, Indiana, on 29 April 1893. After graduation from high school he taught in country schools for three years before attending Montana State University, where he majored in zoology with a minor in chemistry. Issac Newton said of his own career that he "stood on the shoulders of giants," and no less is true of Urey. He developed his mastery of thermodynamics under the influence of G. N. Lewis and his school in Berkeley, where he moved in 1921. Later, in 1923, he went to Copenhagen for a year and studied atomic physics with Niels Bohr. On his return to the US Urey became an instructor at Johns Hopkins and in 1929 moved to Columbia, where he was appointed associate professor of chemistry. While at Columbia he collaborated with A. E. Ruark to write *Atoms, Molecules and Quanta*, one of the earliest books on quantum mechanics. The deep understanding that Urey had acquired of thermodynamics and quantum mechanics, together with his interest in the regularities of nuclear structure and his skills in optical spectroscopy, culminated in his discovery, in 1931, of deuterium.

In the 1930's Urey became the leading authority in the new science of isotope chemistry. His research was partly concerned with the theoretical estimation of the chemical differences between isotopic atoms and molecules and with the chemical methods by which isotopes could be separated. His primary concern, however, was with the information that could be gleaned from the existence of isotopes and the ways in which separated isotopes could be used as tracers of chemical, biological and geological processes.

During the Second World War Urey put his knowledge of isotope chemistry to use in the national effort. As director of the program at Columbia for isotope separation, he, with his team, transformed the laboratory-scale apparatus of the previous decade into the vast industrial-scale plants used for the production of heavy water and for the separation of the uranium isotopes. The chemical and gaseous diffusion processes developed by Urey and his colleagues were an essential component in the success of the Manhattan Project.

After the war Urey accepted an appointment at the University of Chicago and in 1947 published what is probably his most cited paper, "The thermodynamic properties of isotopic substances." This paper laid out much of the underpinning of the infant discipline of isotope geochemistry by extending and expanding his work of the 1930's. In an ingenious application of these theoretical principles Urey used high-precision mass spectrometry to measure the variations in the oxygen isotope abundances within the carbonate shells of belemnites that lived in the Cretaceous ocean. From these

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obituaries

measurements and from theoretical knowledge of isotope fractionation he was able to calculate the ocean temperatures some 70 million years ago.

Although Urey had for many years been interested in astrophysics and the origins of the solar system, he first concentrated his efforts on these matters while he was at Chicago. His book *The Planets: Their Origin and Development* represents the first systematic and detailed chronology of the origin of the earth, the moon, the meterorites and the solar system. In 1958 Urey moved to the Scripps Institute of Oceanography and the new campus of the University of California at San Diego. There he continued his investigations of geochemistry, meteroritics, the history of the solar system and the origins of life. He was deeply involved in the space program and used his influence to ensure that as much good science was done as possible. The culmination of Urey's interest in these matters occurred with the return to earth of the lunar samples.

During the last decade of his life Urey increasingly concentrated on the social responsibility of scientists, with which he had become concerned very soon after the first atomic bomb, to whose construction his research had contributed. In fact, he was one of the rather few scientists who as early as the late 1940's warned that mass fabrication of nuclear bombs would result in a serious threat to the survival of all people. He did not share the naive belief of some of the people involved that by manufacturing a growing number of increasingly sophisticated bombs we could dominate the whole world. His early views have been fully confirmed by the political evolution of the following 30 years. Indeed, the main result of the arms race which the US has led is that our national security has steadily diminished and that we have become increasingly mistrusted by the rest of the world.

Urey also reacted against misuse of science. He turned his efforts away from the military application of science to nonmilitary problems. Further, during the last decade of his life he devoted much of his activity to the problems of the "peaceful" use of nuclear energy. He pointed out that nuclear reactors are no viable solution to the energy problem and that the spread of nuclear technology under the pretext of producing energy might mean a proliferation of nuclear bomb technology to all countries. He warned that this meant a destabilization of an already dangerously unstable world situation. He convinced many of his friends that his antinuclear views were the only possible conclusion that could be drawn from a deep analysis of the complex situation.

There are many of Urey's colleagues and former students who follow up his achievements in chemistry, and in doing so, are paying tribute to him. But another way of paying homage to his memory would be for all scientists to consider carefully his views on the social responsibility of scientists and to act vigorously with this as a background. In a time when there is increasing propaganda of hatred towards those who have a society which differs from ours, when the arms race is speeding up, and when political brinkmanship is decreasing the political stability in the world, we miss his clear and authoritative appeal to reason. We still need him to remind all scientists that in the present age much of our work is not for the good of humanity but for destruction. It is the misuse of science, for which quite a few scientists carry a heavy responsibility, that has caused the present threat of a nuclear holocaust. It is the duty of all scientists to save our culture from annihilation. Urey considered this to be a conclusion of his lifelong thinking.

While individuals may disagree with particular views that Urey held, none will deny that he arrived at his conclusions only after deep thought and painstaking analysis. In his view of life as well as in this science he was above all a man of honesty and integrity.

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Fritz Strassmann

Fritz Strassmann died in Mainz on 22 April 1980 at the age of 78.

Strassmann's name is indelibly linked with one of the most consequential scientific discoveries of the twenieth century: nuclear fission. In December 1938, he and Otto Hahn in their now classic radiochemical investigation unambiguously identified barium as a product of the reaction of slow neutrons with uranium. This was the culmination of four years of research on slow-neutron reactions with uranium in which the products had been misidentified as transuranium elements formed by β^- decay following neutron capture. All these earlier investigations had been carried out jointly with Lise Meitner, who, however, fled from Germany in the summer of 1938 to escape persecution and was therefore not present in Berlin at the