

Lawrence Berkeley National Laboratory

Lawrence Berkeley National Laboratory

Title

MICROPROCESSOR CONTROLLED ANODIC STRIPPING VOLTAMETER FOR
TRACE METALS ANALYSIS IN TAP WATER

Permalink

<https://escholarship.org/uc/item/7xh3273v>

Author

Clan, R.G.

Publication Date

1981-04-01

Peer reviewed

Conf-810813--17

Symposium on the 50th Anniversary of the Discovery of Deuterium:

(Dedicated to Harold C. Urey, 1893-1981)

Divisions of History of Chemistry, Geochemistry,
Nuclear and Physical ChemistryAnnual Meeting American Chemical Society,
26 August 1981 - Warwick Hotel

CONF-810813--17

DE83 000479

Opening Remarks - Jacob Bigeleisen

MASTER

Ladies and Gentlemen:

Good morning. I am Jacob Bigeleisen, chairman of this morning's program. This is the opening session of a Symposium on the occasion of the 50th Anniversary of the Discovery of Deuterium and this symposium is dedicated to the memory of Harold C. Urey. It was a privilege for me to have worked with Clyde Hutchison, who will preside over the afternoon session, in organizing this tribute to Harold Urey. The symposium is being jointly sponsored by the Divisions of the History of Chemistry, Geochemistry, Nuclear Chemistry and Physical Chemistry and is a mark of the breadth of Urey's interests and impact on chemistry. Participating in the symposium are a small number of Urey's many students and scientific associates. I know that I speak for all of Harold Urey's students and associates in acknowledging the profound influence he has had on each one of us both through the kind of science that he did and through his qualities as a person. In my own case it is rather improbable that I would have pursued a career in science were it not for Harold Urey.

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

MP
DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

I would like to say a few words about Harold Urey, the scientist, public servant, and the man.

As a scientist, Harold Urey considered the universe his laboratory. He focussed on the broad picture and chose problems which aroused his curiosity and opened new territories. His experiments were carefully planned and executed. All of his experimental results have stood the test of time. Each experiment added something to our understanding of nature. I will review briefly his discovery of deuterium.

In December 1931, Urey, Brickwedde and Murphy reported the discovery in nature of an isotope of hydrogen of mass 2^1 . This was not an accidental discovery, nor were Urey, Brickwedde and Murphy the first to look for a heavy isotope of hydrogen in nature. As early as 1919 no less a scientist than Otto Stern² reported negative results in the search for isotopes of hydrogen and oxygen. The natural abundance of deuterium in hydrogen was estimated by Stern and Vollmer to be less than 1 part in 10^5 . However, by mid 1931 there were compelling reasons to renew the search for a heavy isotope of hydrogen in nature.

Urey, among others, on the basis of studies of the regularities of atomic nuclei³⁻⁷, had predicted the existence of an isotope of hydrogen of mass 2. To reconcile the difference between the chemical and physical atomic weight scales and the atomic weight of hydrogen, Birge and Menzel suggested in late May 1931, that an isotope of hydrogen of mass 2 might be present to the

extent of 1 part in 4500 in natural hydrogen⁸. Urey set out to look for this heavy isotope of hydrogen in August 1931. It was not long before Urey and George Murphy observed weak satellites with a 0.27 % blue shift in the H_{α} , H_{β} , H_{γ} , and H_{δ} lines of atomic hydrogen. That these lines which had the proper wavelength for an atom with a nucleus of charge +1 and mass 2 belonged to 2H was confirmed by following their relative increase in intensity in samples successively concentrated in this isotope by Raleigh distillation of liquid hydrogen at 14° K. by F.G. Brickwedde at the National Bureau of Standards. Further confirmation of the assignment of the blue shifted lines was the fact that they were doublets. Professor W. Palmer, Chairman of the Nobel Committee for Chemistry of the Royal Swedish Academy of Sciences stated on Nobel Day, December 10, 1934, "Urey proved to be the man to tackle the question in a rational way and to solve it".

The objectives which Alfred Nobel set out in establishing prizes in chemistry, medicine and physics were fulfilled to a greater degree by Harold Urey than by most recipients of these prizes. The prizes were to be awarded annually for the most outstanding discoveries in the respective sciences in the preceding year. Each discovery was to be one capable of generating a major new field of investigation. It was Nobel's hope that the prize would go to a young man and that it would add to the independence of the recipient throughout his or her future career.

Urey received the Nobel prize at the age of 41, just three years after his discovery of deuterium. He was young by comparison

with most Nobel Laureates in chemistry and his recognition by the Swedish Academy came rather promptly after his discovery. He was the third American to receive the Nobel prize in chemistry; a total of 7 Nobel prizes in the sciences had been awarded to Americans before 1934. Urey was the first of the California school to receive a Nobel prize. New fields of study in biology, chemistry, geology and physics were opened up by the discovery of deuterium. Between December 1931 and December 1934, over 200 papers dealing with deuterium were published. By the time Alice Kimball prepared a bibliography of published research dealing with heavy hydrogen a decade later, the number of entries had grown by an order of magnitude. Deuterium has been used as an explosive and holds promise as the abundant energy source of the future. Current production of heavy water is measured in thousands of tons per year, requiring the processing of tens of thousands of tons of water per hour.

I would like to say a few words about Urey's independence of thought both in science and on the impact of science and technology on public affairs. I do not wish to imply that Urey would not have shown his fearless independence of thought without the Nobel prize; but I think that the Nobel prize may have encouraged him a little.

During the thirties, Urey continued several lines of research outlined in his Nobel address. These included the work with Rittenberg and with Greiff on the theory and calculation of

the differences in the thermodynamic properties of isotopic compounds. With Thode, Hutchison and others he separated the isotopes of the light elements by chemical methods on a laboratory scale. Samples of enriched isotopes were used in further pioneering experiments carried out by Isidor Kirshenbaum on the differences in vapor pressures of isotopic compounds. Isotopes of oxygen were used by Roberts and by Cohn to study the mechanisms of chemical reactions. His scientific work was interrupted by World War II. During that period his group at the S.A.M. Laboratories of Columbia University developed industrial scale processes for the separation of ^2H , ^{10}B , and ^{235}U from natural mixtures. The processes developed at Columbia were successful and they are still in use today for the separation of these isotopes.

After the war, Urey was determined to disengage himself from classified work. His first task was to meet an obligation to deliver the Liversidge lecture to the Chemical Society in London. For this purpose he chose to update and expand earlier works with Rittenberg and Greiff on the thermodynamic properties of isotopic compounds. To facilitate this effort he had available new results which I had developed with Maria Goeppert Mayer on the statistical mechanical theory of isotopic molecules. Urey was able to predict new applications of isotope chemistry to geology. Together with Epstein, Lowenstam and others, Urey originated and developed the ^{18}O paleotemperature scale. He and his associates have created a whole new area of geology. Urey's interests shifted to other areas

of geology. He started to apply thermodynamics to rock and mineral formation and the composition of meteorites. These led him to develop theories about the origin of meteorites and the moon. He was interested in learning about the origin and development of the planets and the universe from studies of the chemical and isotopic composition of meteorites and the moon. Urey was a major proponent of the Appollo program to land a man on the moon and bring back moon rocks. Stanley Miller with guidance from Harold Urey isolated a number of amino acids from discharges in ammonia, methane, water mixtures. These pioneering experiments could provide some clues to the origin of organic matter and life itself in the universe.

Urey was a public man who spoke out fearlessly on public issues. He was deeply committed to democratic values. He spoke against the Spanish facists during the thirties; he alerted this country's scientific and political leaders to the dangers of fascism in Italy and nazism in Germany; he assisted scientists and their families to escape the oppression of these totalitarian regimes and to relocate in the United States. In the post war period he worked hard to shape a world free of the dangers and horrors of nuclear war. He made a thorough study of the evidence presented in the trial of the Rosenbergs. Although Urey lacked legal training, he raised a question still debated by legal experts "Did the U.S. Government establish beyond reasonable doubt the guilt of the Rosenbergs?" In his efforts to prevent the "Cold War"

and to see that justice be done in the case of the Rosenbergs, Urey was no more sympathetic to totalitarianism in the Soviet Union than he had been toward totalitarianism in Spain, Italy and Germany.

In the early thirties it was apparent to Urey that the development of the field of chemical physics would require a new journal. In 1933 he became the first Editor of the Journal of Chemical Physics, which has become the pre-eminent international journal in this inter-disciplinary area. Urey was a key person in the establishment of modern programs in teaching and research in chemistry and physics at Columbia University. The Society of Columbia Chemists will recognize Urey's achievements at Columbia this evening. After the war Urey moved to Chicago. The research institutes he helped found, now known as the Enrico Fermi and James Franck Institutes, are of world renown. No less than six Nobel prizes have been awarded for work done in these Institutes or to people trained there. In 1958, instead of retiring at the age of 65, he went to LaJolla as Professor at Large of the University of California. There he worked with Roger Revelle in changing Scripps Institute of Oceanography to one of the three major comprehensive campuses of the University of California.

Urey's outstanding mind and personal qualities attracted the association of many gifted individuals throughout his life. A number of them are here today and will speak on their current researches. This is the greatest tribute we can pay to Harold Urey.

With us today is a very special associate of Harold Urey, his wife Frieda Daum Urey. Frieda and Harold were married in 1926 and together they raised a family of three daughters, one of whom Professor Elizabeth Baranger is with us today, and one son. At Hopkins, Columbia, Chicago and LaJolla, Frieda and Harold opened their home to the world of scholars. They shared of themselves to promote the intellectual and social life of the campus. Frieda Urey, in particular welcomed new faculty, post-doctoral fellows, and graduate students and their families. She helped them adapt to a new environment. Harold relied on Frieda completely in such matters. His trust was well placed. I would like to recognize Frieda Urey at this time.

1. H.C. Urey, F.G. Brickwedde and G.M. Murphy,
Phys. Rev. 39, 164 (1931) [Communicated 5 Dec. 1931];
Phys. Rev. 40, 1 (1932).
2. O. Stern and M. Vollmer, Ann. d. Physik (4) 59,
225 (1919).
3. H.C. Urey, J. Amer. Chem. Soc. 53, 2872 (1931).
4. W.D. Harkins, Chem. Rev. 5, 371 (1928).
5. H.A. Barton, Phys. Rev. 35, 408 (1930).
6. W.M. Latimer, J. Am. Chem. Soc. 53, 981 (1931).
7. H.L. Johnston, J. Am. Chem. Soc. 53, 2806 (1931).
8. R.T. Birge and D.H. Menzel, Phy. Rev. 37, 1669 (1931).