NUMBER 8 SUMMER 1983 NUCLEAR CHEMISTRY

Los Alamos Science

LOS ALAMOS NATIONAL LABORATORY

EDITOR'S NOTE

Nuclear chemistry is one of the lesser known and lesser publicized efforts at Los Alamos. At first glance the origin and fate of minute amounts of rare isotopes may seem much less exciting than big new laser projects or the novel abstractions of modern physics. But throw away your prejudice, gather some patience, and enter the fascinating world of isotopes and elements. Here meticulous care leads to determining the efficiency of nuclear explosions and discovering new elements in the debris. Tiny amounts of isotopes or elements provide unique signatures of events long past, such as the earth's collision with a large meteor that may have caused the dinosaurs' extinction, the existence of a natural nuclear reactor in the earth's crust, and the history of solar neutrino flux over billions of years. Here also the introduction of rare stable isotopes into complex systems provides a means for mapping the circulation patterns of the atmosphere and tracing the pathways of metabolism in living creatures.

The story of nuclear chemistry at Los Alamos began forty years ago when nuclear chemists fashioned highly radioactive, short-lived isotopes into gamma-ray sources to monitor the effectiveness of implosion weapons. Immediately after the Trinity test these scientists manned specially designed Sherman tanks to gather radioactive debris from the ground beneath the blast that would tell them the efficiency of the explosion. Jere Knight, nuclear chemist by profession and long-time ghost writer by natural talent and good will, has pooled his talent with Jim Sattizahn to present a fast-moving history of nuclear and radiochemistry at Los Alamos. It goes from weapons diagnostics for the Trinity and the Mike tests (the fabulously high neutron fluxes of the latter test produced two new elements) to the current panoply of research in biomedicine, geochemistry, nuclear waste storage, and basic nuclear science.

This history, rich in scientific detail, is followed by an article, written for the research scientists involved by Roger Eckhardt, on geochemical migration of radionuclides. Research in this area is providing a rational basis for decisions on underground storage of nuclear waste. For the past ten years Los Alamos scientists have done painstaking laboratory and field work to determine how water, the great mover of the earth's crust, may affect the migration of radionuclides in the tuffs at the Nevada Test Site. The question under study is: Should this site be chosen as a waste repository and, should a breach develop in the canisters containing the waste, will this site provide an adequate geologic barrier to migration?

There are at present over 10,000 tons of spent fuel at various places around the country waiting for a method and a site of storage to be chosen, and this number is expected to increase to 239,000 by the year 2000. The present plan is to characterize the geochemistry of three potential sites (tuff, basalt, and salt) by 1985 and have one operational by the mid 1990s. The responsibility involved in the final choice is awesome, so it is with interest and gratitude that we learn of the high-quality scientific effort being brought to bear on this decision.

The Los Alamos nuclear chemists are expert not only at tracing isotopes but also at separating both radioactive and stable isotopes and incorporating them into compounds for biomedical and environmental research. About ten years ago Nick Matwiyoff, leader of the stable isotopes program, realized that labeled compounds could be introduced into living systems and traced with nuclear magnetic resonance to monitor metabolic activity. In our cover story "Metabolism As It Happens" he and his coauthors describe the development of this emerging methodology and its potential as a tool for diagnosis or prevention of metabolic disorders. Great pains were taken to simplify this difficult subject, but the nonexpert may still need extra strength and patience to follow all the complexities of biochemistry. The reward is understanding the rich potential of a field still in its infancy.

Darleane Hoffman, highly respected as a scientist, is the first woman to become leader of a technical division at Los Alamos. She has for the last four years led and managed the diverse activities of the Isotope and Nuclear Chemistry Division. What is she like? How did she succeed in a man's world? In a short piece by Judy Lathrop we get a glimpse into the life of this remarkably clear-headed and attractive person. She is not only scientist, boss, wife, and mother, but also-as her colleagues quickly add—a trusted good friend. Her ability to make happen what she knows can happen without compromising the human gifts we most associate with the feminine side is an inspiration to those of us who sometimes wonder whether we can manage it all. ■

Necia Grant Cooper

Cover illustration by Rod Furan.
A nuclear magnetic resonance experiment with a perfused hamster liver—a marriage of physics and biology. The descending spiral around the liver describes the path of the induced magnetization vector. In these experiments the nuclear magnetic moments of stable isotopes make it possible to trace the biochemical pathways for resynthesis of glucose in the liver and to probe the regulation of the process. This new research technique, which promises to have widespread clinical uses, is described in the article *"Metabolism As It Happens."*

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Los Alamos Science is published by Los Alamos National Laboratory, an Equal Opportunity Employer operated by the University of California for the United States Department of Energy under contract W-7405-ENG-36.

Address mail to
Los Alamos Science
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