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NEW TOOLS HELP SOLVE ANCIENT PUZZLES

Techniques and instruments originally developed by LRL chemists to follow the paths of nuclei are now helping UC archaeologists to solve the mystery of where ancient man traveled and what people he met.

In several recently published reports (UCRL 17937, UCRL 17968), nuclear chemists Isadore Perlman, Frank Asaro, Harry Bowman, and R. D. Giauque describe how two sophisticated nuclear techniques—X-ray fluorescence spectroscopy and neutron activation analysis—are being brought to bear on the kinds of questions that archaeologists have been wondering about for years.

One such intriguing question in archaeology has been the extent of communication between early human settlements. Were prehistoric people, separated from each other by hundreds of miles and by mountains and seas, aware of each other at all? How far did they wander from their villages, and why? How were technology and materials spread? Contact between two cultures has been inferred

PHOTO COURTESY R. H. LOWIE MUSEUM OF ANTHROPOLOGY

RIVERBOATS AND FLAMINGOS decorate pottery jar made by ancient Egyptians 5,000 years ago. This jar is typical of those being studied at LRL by neutron activation analysis techniques.

by comparing objects that people made and used, but such evidence can be inconclusive. An ancient pot that looks just like the ones made in a village 500 miles away could mean that trade took place—or it could be a case of coincidence. Then too, materials are often *fragmentary*.

A more decisive answer might be found in the detailed analysis of the raw materials, rather than the styles, of artifacts. If a material used in a particular village *does not* occur locally, it must have been imported—and a knowledge of the material's chemical content might allow us to pinpoint the source.

Until recently, however, the kind of comprehensive chemical analysis necessary to make such determinations was simply beyond the state of the art of chemistry. What has made such analysis possible now is the development, over the past few years, of highly sensitive silicon and germanium detectors. These detectors, with their associated electronics systems, have revolutionized the old techniques of X-ray fluorescence spectroscopy and neutron activation analysis, permitting both techniques to record a

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Laboratory's Role In Mop-Up Activity After Thule Crash

Eight LRL staff members and an instrument developed by the Hazards Control Department played a significant role in the search, recovery and cleanup operations which followed the crash of a nuclear weapons B-52 bomber near Thule Air Force Base, Greenland, on January 21.

The eight LRL'ers who served at different times as members of the recovery team at the crash site are now all back at Livermore—with a lasting appreciation of our California climate.

The men are Nate Benedict, Weapons engineer and representative of LRL's "Hot Spot" response team; Walt Bennett, head of Hazards Control Department; Jim Becker, Joe Tinney and Milan Knezevich of the Hazards Control staff; Don Knowles from the Electronics Engineering Department; and Duane Sewell and Jim Olsen of the Director's Office.

The nuclear search and recovery opera-

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ALL SUITED UP for a day on the job, a member of the nuclear clean-up crew peers warily at the world through his parka's "sight hole." Warm breath keeps small exposed area from freezing.

Laboratory's Role In Mop-Up Activity At Thule Site . . .

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tion, which was nicknamed "Operation Crested Ice" by the military, began on January 21, when a Strategic Air Command B-52 carrying four hydrogen bombs crashed on the ice of North Star Bay, about seven miles southwest of the airport runway at Thule base. The plane was approaching for an emergency landing because of a fire aboard the aircraft. One crew member was killed after exiting the aircraft, but the others all ejected and were recovered with only minor injuries.

There was no nuclear yield involved in the crash, but the high-explosives component of the four weapons did explode. This resulted in the scattering of the plutonium contained in the weapons over the surface of the ice. Within ten hours, General Hunziker had arrived at Thule, activated the Strategic Air Command Disaster Control Team, and started a massive effort to recover all contaminated debris before it could become a hazard to health, safety or security.

"FIDLER"

LRL involvement in the cleanup operation came about in a rather indirect fashion. The hydrogen bombs on the downed B-52 were not of LRL-Livermore design, and thus the Laboratory had no official responsibility in the early recovery efforts. However, LRL did have something that proved to be of importance to the operation — "FIDLER" (Field Instrument for Detection of Low Energy Radiation), a portable scintillation counter designed in the Hazards Control Department and field tested at the Nevada Test Site last year. The instrument is designed to rapidly survey large areas, through detection and measurement of low energy X-rays and gamma rays in the environment. LRL notified the Air Force (through JNACC—Joint Nuclear Accident and Coordination Committee) of FIDLER's availability, and an invitation to Thule was issued to "Hot-Spot" team chief Nate Benedict and physicist Joe Tinney. JNACC serves as the interface between the APC weapons laboratories and the military.

Hazards Control had been working on FIDLER for about two years, and an instrument had been built in anticipation of just such an emergency. The impetus in its development had been an earlier incident involving nuclear weapons—the one near Palomares, Spain, in 1966.

BACK HOME after their adventures on North Star Bay, participants in Operation Crested Ice get together for a group photo. L. to r. are Don Knowles, Milan (Slim) Knezevich, Walt Bennett, Jim Olsen, Jim Becker, Nate Benedict, and Joe Tinney.

The original development effort for this instrument was directed by Charlie Schmidt, who has since returned to UC Berkeley to work on his PhD, and later assumed by Joseph Tinney.

When Tinney and Benedict received their invitation to Thule on January 24, they were given only a few hours in which to prepare for departure and make the necessary modifications to the FIDLER enabling it to withstand the minus 40° temperatures to which it would be subjected at the site. Hazards Control technicians and shop personnel hurriedly assembled a thermal shield which, as it turned out, worked very well. They also devised a system which permitted the instrument's battery pack to be worn under the monitor's clothes, so that body heat could provide the warmth necessary for reasonable battery life.

Dog-Food Airlift

On the flight from SAC Headquarters in Omaha, Nebraska, to Greenland, Benedict and Tinney shared their KC-135 aircraft with 1500 lbs. of raw horsemeat, being rushed to the site as food for the sled dogs serving in the operation. Ordinarily, the sled dogs eat game that is killed for them by their Eskimo owners, but the local people—hired to provide transportation between the air base and the crash site—were too busy to hunt that week.

After their arrival in Thule, Benedict and Tinney donned their arctic gear (which had been issued to them along with their orders and their innoculations during a hectic 45-minute stop in Omaha) and hurried out to the crash site. The situation, as Tinney describes it, was depressing, to say the least. The site was in darkness except for the bobbing lights of Coleman lanterns carried by searchers out on the ice. The support facilities consisted of one wooden shack, also lighted by a Coleman lantern.

In later weeks of the operation conditions improved considerably. Generators were hauled out to the site, the crash area was floodlit, and a number of insulated structures were built. Nature also helped out by providing a little bit of daylight.

Iron Pants and Parka

Standard clothing for the job was effective, but rather annoyingly bulky and constricting. A typical day's outfit might consist of long thermal underwear, padded overalls, and "iron pants" (very heavily padded overalls), an arctic parka with animal fur hood and wool pullover head mask with eye holes—all covered, if you happened to be working within the "hot" area, by a standard radiation protection coverall. Uncomfortable as the clothing might be, no one was tempted to take any of it off. The average temperature and "chill factor" (a combination of temperature, humidity and wind speed) was such that human flesh would freeze in minutes, if exposed.

The LRL men's assignment was to survey the impact area with the FIDLER detector and prepare plots showing the distribution of contamination. The instrument performed admirably, and the early measurements made by Benedict and Tinney indicated that the FIDLER could be used to take the data which formed the basis for all subsequent cleanup and decontamination plans at the site, as well as for the diplomatic negotiations with the Danish Government.

CONTAMINATED SNOW is packed into surplus fuel tanks for later processing and disposal. In the background is one of the plywood structures used for shelter.

The men, joined a little later by electronics technician Don Knowles, also found time to devise and build out of the components on hand several other badly needed instruments, including a small ice-core scanner and a device for measuring possible contamination of wounds or cuts.

Decontamination

By the time their initial assignment was completed, the LRL team had proved itself so useful that General Richard Hunziker, the officer in charge of the operation, requested replacements from the Laboratory. Benedict left Thule on February 1, but very shortly Walt Bennett, head of the Hazards Control Department, and Jim Becker headed for the site. At later times Milan Knezevich, Duane Sewell and Jim Olsen arrived in Thule. The contribution made by the LRL team was recognized in a recent message from General Hunziker to Dr. Michael May, Director of the Livermore Laboratory: 'Please express my appreciation to the LRL team for their invaluable assistance to the Strategic Air Command Disaster Control Team during project Crested Ice. These highly capable gentlemen devoted long hours and worked in an adverse arctic climate in connection with our scientific operations. Your organization was splendidly represented by this fine group, and I am deeply grateful to these scientists and to your organization for your very real help during this difficult project."

Decontamination of the "hot spot" turned out to be a relatively routine matter of removing the contaminated ice and snow. The aircraft debris and the snow was placed in large surplus fuel tanks to await later processing and/or disposal. That phase of operation Crested Ice has now been completed and, though mop-up details will continue for some time, the operation may be said to have reached a successful conclusion.

ESKIMOS HELPED OUT by building 14 igloos which were used as temporary shelters by the early arrivals. Those who tried the igloos say they're warm and comfortable.

BLOOD DRIVE

Berkeley's Semi-Annual Blood Drive, held May 21, netted 74 units of blood for the LRL Blood Bank. Chairman Dick Falk reported, however, that 95 units were needed soon after the drive, depleting the new supply. Remember—donations may be made in the Lab's name at any time at the Blood Bank at 6230 Claremont Avenue in Oakland, phone 654-2924.

SPACE REACTOR PROGRAM ENDED AT LIVERMORE

LRL's Livermore Laboratory was notified by the AEC last month to begin immediate phase-out plans for the laboratory's space nuclear power program.

In its FY 1969 authorization report, the Joint Committee on Atomic Energy recommended that the LRL program be terminated, and that the 2.5 million dollars requested to continue the project at Livermore be deleted from the AEC appropriation. The House and the Senate have approved the AEC's FY 1969 authorization bill as recommended by JCAE.

Budgetary Pressures

"Members of the Joint Committee made it clear that they thought highly of the work done at the Laboratory," said Livermore Director Michael May, "but they also emphasized that budgetary pressures were extremely high this year, and that they had to cut out a number of projects aimed at long-range goals, including our space reactor effort."

The space power program was initiated at Livermore in January, 1966, as a long-term project to develop a liquid-metal cooled reactor system for the generation of power in space. The programmatic goal was the design of a reactor of minimum weight, to provide power in the mega-watt range over an extended period of time in a space environment.

Reassignment of Personnel

Of Livermore's 5,600 employees, approximately 80 were involved in the space power program. The majority of the employees in the program are of immediate usefulness to other Laboratory projects, and they are being reassigned as they become available. In some cases, however, where employees with specialized skills cannot be placed at Livermore, the Laboratory's Personnel Department is assisting them in finding other positions as rapidly as possible.

The most likely application for electric power in the megawatt range is thought to be electric rocket propulsion a scheme that has received serious attention (in competition with chemical and nuclear heat-transfer rockets) for future interplanetary exploration.

LRL's work in the space reactor program did not involve the actual construction or testing of a reactor. Instead the effort emphasized basic reactor research, with strong attention to advanced materials technology.