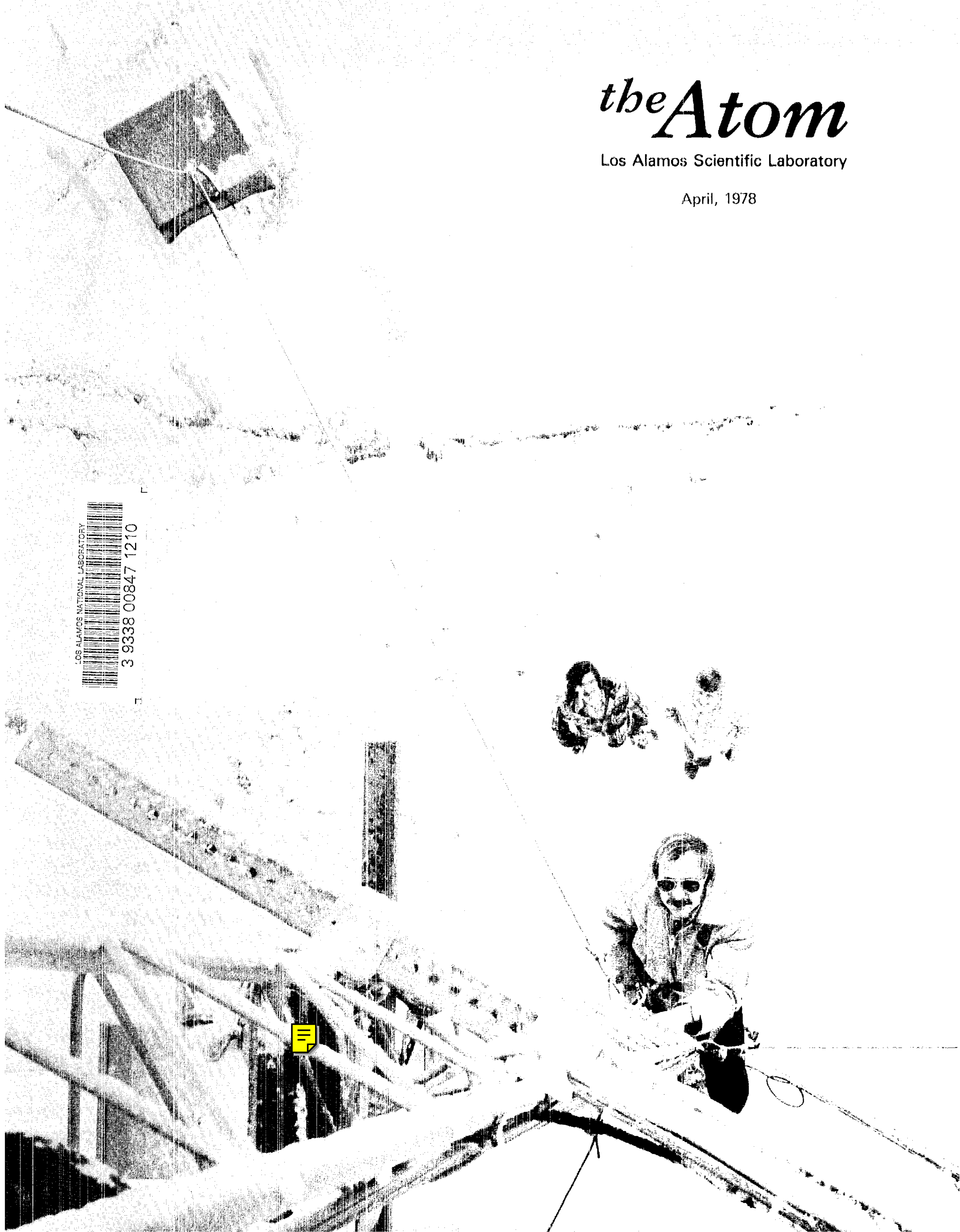
the Atom

Los Alamos Scientific Laboratory

April, 1978



theAtom

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REGULAR FEATURES

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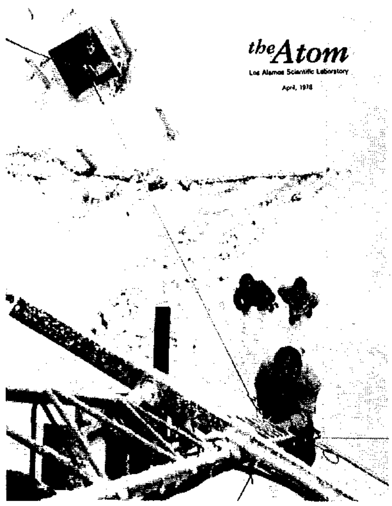
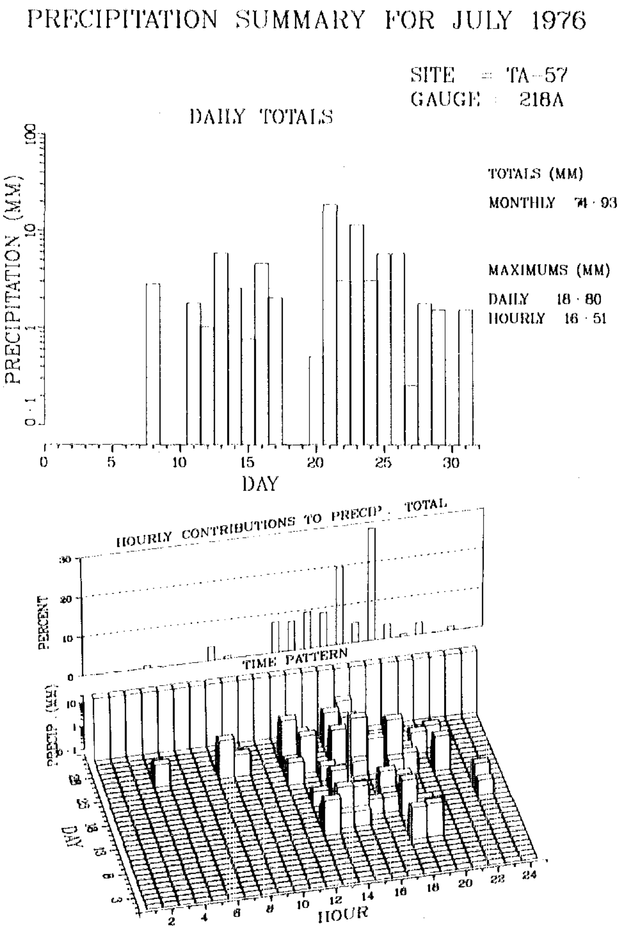
SPECIAL CREDITS

Our thanks to Win Headdy, ISD-7, for the photo of the Indian pottery in the archaeology article. ISD-3 produced the map for the Cosmos party, and EG&G provided the photographs taken in Canada where Cosmos scattered itself.



On his way to check sophisticated weather sensors, Don Van Etten climbs the 12-meter (40-foot) instrument tower at the waste disposal site. An extensive lightning protection system safeguards gear from thunderbolts, he recalls from an episode last summer. Watching at right below are Dave Phillips, also H-8, and Brad Woodworth, a student from New Mexico Mining and Technological Institute in Socorro, who is on a 6-month cooperative program at LASL.

How's The Weather? Glad You Asked . . .



This precipitation summary (July, 1976) may end up looking somewhat like the skyscraper district in a city, but it makes weather analysis easier for meteorologists. Precipitation is shown on an offset logarithmic scale so small amounts, a hundredth of an inch, for example, will be visible. At top, rainfall is shown per day. At center, it is shown as a percentage by the hour to the monthly total. Below, precipitation is marked per hour and per day. This can show that most July rains occur at unstable convections — higher temperatures. Thermal heat on the earth's surface starts a condensation pattern, and the resulting convection forces moisture-laden clouds to release part of their burden.

By Jeff Pederson

One of America's favorite discussion topics — the weather — is also the subject of scrutiny at LASL. To better understand air flows over complex terrain, and to judge response needs at atomic waste disposal sites, a sophisticated data acquisition system has been installed by the Environmental Surveillance Group of the Health Research Division (H-8).

"This system," says staff member Dave Dahl, "is one of the most advanced constructed to date. It promises to revolutionize the taking and processing of environmental field data."

Weather on the Pajarito Plateau remains largely unchanged by man's impact, but its cycles are becoming clearer. The newest generation of microcomputing equipment has been in use since January at the materials disposal site (TA-54), and it has replaced the first version which was installed in early summer, 1977. This "number-crunching" equipment can acquire and reduce the equivalent of thousands of pages of numerical data and translate them — with the aid of a computer — into color or black and white illustrations. Portable weather recording systems, especially if they incorporate H-8's extensive lightning protection devices, could eventually descend from LASL prototypes to be used in remote regions.

Don Van Etten of H-8 has his own story to prove the importance of the lightning protection on the 12-meter (40-foot) instrument tower at the waste disposal site. Los

Alamos, he notes, is one of the most lightning-prone regions of the United States.

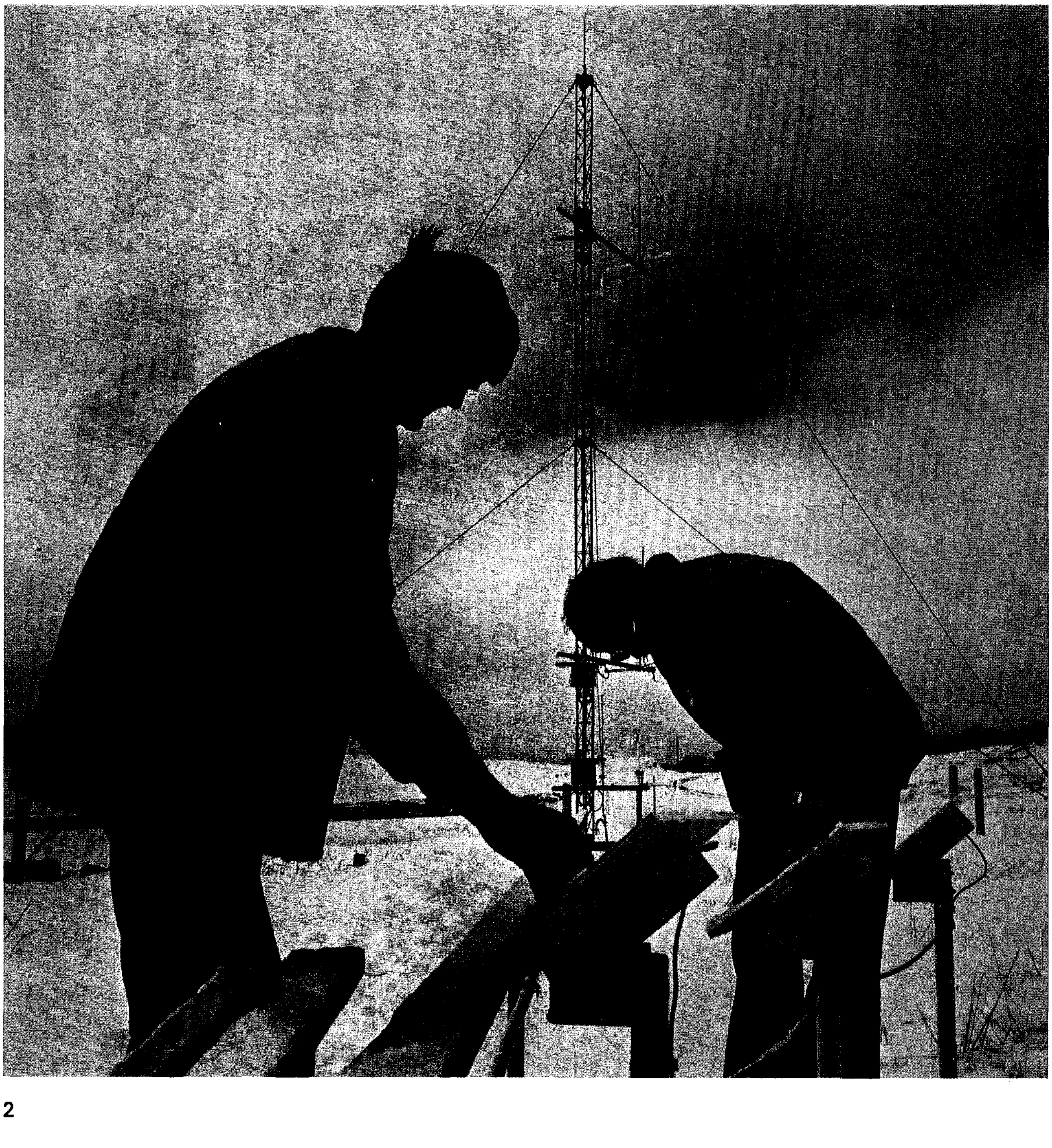
"I was in the instrument hut near the tower one afternoon last summer when a typical one-hour thunderstorm blew in," he recalls. "Most convective storms occur then, and we usually get quite a few cracks out of them.

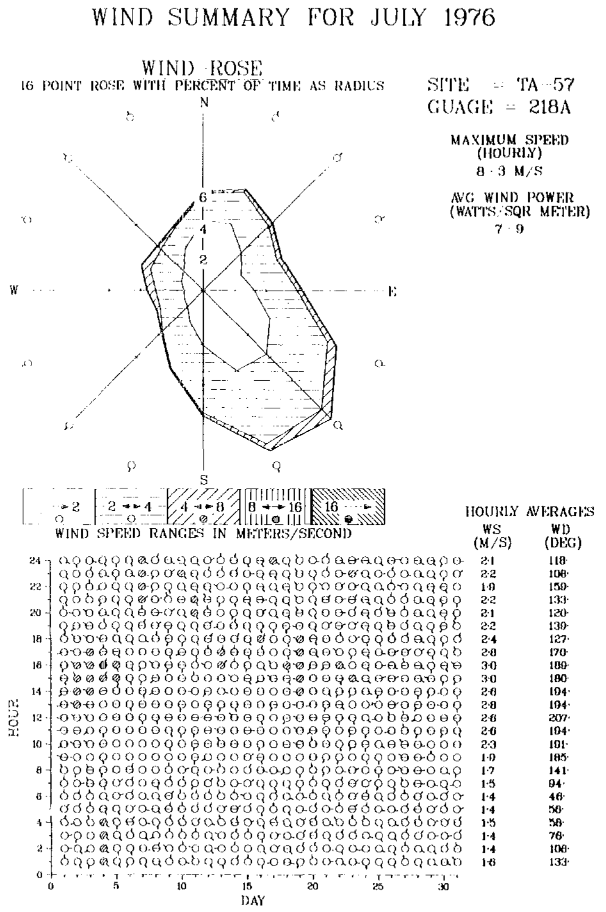
"It was hard to tell whether lightning hit the tower or the power line, but it was right there. There was no warning, just a flash and a boom, and then you could smell the discharge from it.

"It scared the pants off me. I checked the instruments, once I got over the surprise. It didn't knock anything out."

The steel tower's new protection system is a significant step toward environmentally-resistant field instrumentation. First, it is protected

After a March snowfall, Dave Phillips and Don Van Etten brush off solar panels that charge batteries used to run the data acquisition system. Portable equipment to analyze weather in remote regions not served by electricity or roads is one of their goals.





Wind can be shown in a "rose" pattern, so named because earlier graphic analysis presented winds with petal-like areas around the center of the graph. Below, the hourly readings for wind speed and direction are shown; statistical variations in the data are used to construct the rose pattern above. Wind direction is noted as being from the direction of flow, so in this rose the wind is mostly from the southeast for the month of July, 1976. Different sections of the rose show differing levels of wind speeds. On summer afternoons, wind is generally from the south and levels off at night. In the winter, westerly flows dominate.

by several lightning rods. Cables connect the rods to a large grid system which dissipates the energy of a lightning bolt. Weather sensors and electronic systems are also guarded by tritium-filled spark gaps and by high-speed zener diodes.

The spark gaps, mounted in plastic casings on the tower and on the instrument hut, protect equipment by their ability to conduct a 2,000 ampere current and divert most of the energy from a lightning strike to ground.

Inductors and high-speed diodes form another line of defense; special electronic devices in circuitry cards can handle a 1,000 volt pulse and respond in one trillionth (10^{-12}) of a second. The electronic pulse from a lightning bolt can be dropped to 50 volts by the spark gaps, and to 14 volts or less by the secondary protection cards.

The protection system worked to safeguard Van Etten — and LASL instruments — during his encounter. The data acquisition system, meanwhile, continued to scan sensors every 3 seconds and record both averages and standard deviations every 15 minutes.

Wind speeds and temperatures are measured at 3 levels on the tower. Humidity is monitored, and a weighing bucket rain gauge about 2 meters (6 feet) high stands nearby.

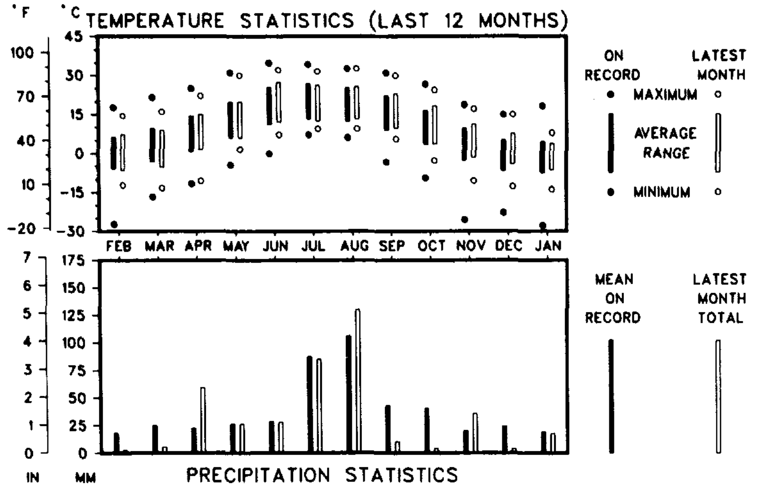
Eventually, solar radiation and soil temperatures will be recorded. LASL also plans to replace existing equipment, says Dahl, with new gear at the TA-50 tower, TA-33, the DP site, the Meson Physics Facility, and at the OHL Building. Studies of weather and the ecological communities at the geothermal well site in the Jemez Mountains are ongoing. The tower at the waste disposal site, says Dahl, "is the closest to where we consider we're going in terms of equipment."

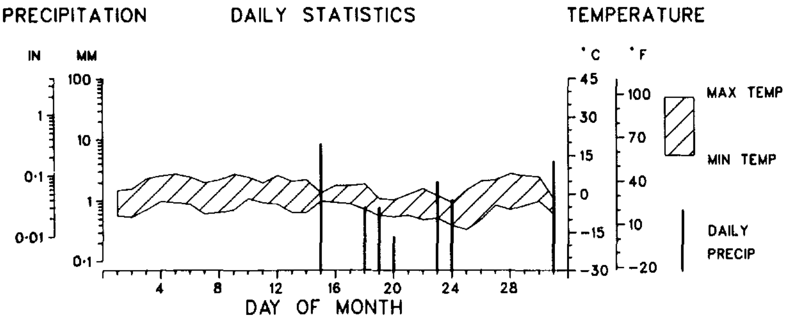
Small solar panels outside the instrument hut charge gel cell batteries, which power the data acquisition system inside. Aiming at eventual portability, H-8 personnel hope their system will prove operable at remote sites not served by electric lines or roads. The acquisition system could be run, however, on alternating current instead of the solar-charged batteries.

The system is now recording on 12 of 16 channels. Data signals move through an electronic translator unit that scales them to a 0-1 volt level for the microprocessor-based data acquisition system. The latter, in turn, outputs signals to a cassette tape, which can be interfaced with LASL's Central Computing Facility. Tape blips can be read there and transformed into 35 mm microfilm negatives for graphic display purposes.

A key part of the system is the C-MOS microprocessor, a joint venture of H-8 and the Computer Systems Group (E-5) of the Electronics Division. It was programmed and partially designed by Dave Phillips, and performs many analytical tasks before data goes onto

WEATHER SUMMARY – LOS ALAMOS, NM – JANUARY 1978





LATEST MONTH

	MAXIMUM C	F	TEMP WHEN	MINIMUM C	F	TEMP WHEN
MEAN	3·7	38·7		−6·5	20·4	
EXTREME	7·8	46·0	(1/5)	−13·9	7·0	(1/25)

DAYS WITH MAX OVER 32 C (90 F) 0
DAYS WITH MIN UNDER 0 C (32 F) 31
HEATING DEGREE DAYS (FROM 65 F) 1099

PRECIPITATION	MM	IN	WHEN
TOTAL	17·5	0·69	
MAXIMUM DAY	8·4	0·33	(1/15)
PRECIP SUM TO DATE	17·5	0·69	

DAYS WITH PRECIP OVER 2.5MM (0.1IN) 2

SNOWFALL	MM	IN	WHEN
TOTAL	152·4	6·00	
MAXIMUM DAY	50·8	2·00	(1/23)

ON RECORD (1951 – PRESENT)

	MAXIMUM C	F	TEMP WHEN	MINIMUM C	F	TEMP WHEN
MEAN	4·4	39·9		−7·5	18·5	
EXTREME	18·3	65·0	(1953)	−27·8	−18·0	(1963)

DAYS WITH MAX OVER 32 C (90 F) 0
DAYS WITH MIN UNDER 0 C (32 F) 30
HEATING DEGREE DAYS (FROM 65 F) 1121

PRECIPITATION	MM	IN	WHEN
MEAN	19·0	0·75	
MAXIMUM DAY	24·9	0·98	(1952)
PRECIP SUM TO DATE	19·0	0·75	

DAYS WITH PRECIP OVER 2.5MM (0.1IN) 2

SNOWFALL	MM	IN	WHEN
MEAN	225·2	8·87	
MAXIMUM DAY	355·6	14·00	(1974)

This version of a weather summary at Los Alamos was offered to employes for the first time in January, 1978. The computer program, written by Ken Rea, H-8, allows for a side-by-side comparison of the new graphics approach at left and a standard listing of figures at right. Temperature bars at left give averages for high and low readings over the past 12 months. The dark points show the historic average highs and lows, plus the independent extreme readings. The current months are shown as open bars and circles. Precipitation is given as averages on record next on the current monthly readings, over a one-year period. The lower graph can show interesting relationships between temperature and precipitation. Temperatures tend to drop as the leading edge of a front moves over Los Alamos, and readings tend to rise after precipitation.

tape in blip form.

"Otherwise," says Dahl, "it would take a man 17 years to put up a month's worth of high-resolution data." A cassette will hold 2 weeks' worth of recordings; the tape could run for a month if recordings were made only on the half hour.

Dahl wrote the computer codes for generating computer graphic displays from weather data; some examples accompany this story. The Area G analysis, page 5, is a day's worth of data from the TA-54 tower system. With this display, says Dahl, the analyst can determine periods of inversion, momentum mixdown, and diurnal (24-hour) wind patterns.

At the tower, wind is calculated as an average of orthogonal (right angle) speeds. A single wind direction vane, in contrast, would tend to give an inaccurate reading of 180 degrees when averaged over a long enough period of time because of the discontinuity on a 0-360 degree scale. The average of a 350 degree reading and a 10 degree reading, for example, is 180 degrees.

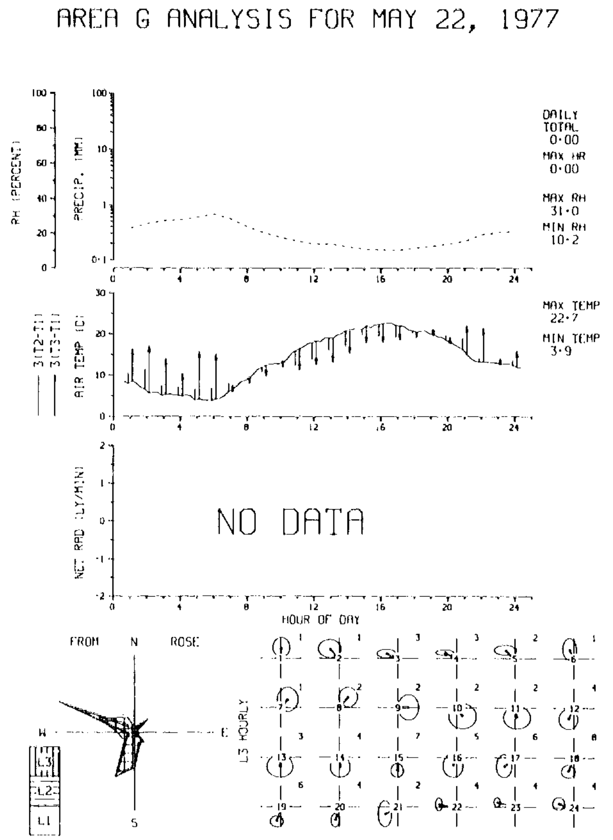
Drainage flows are also shown in the Area G analysis. At night, air tends to flow down the Rio Grande valley and down from the flanks of the Jemez Mountains toward the east, so the resulting flow is largely from the northwest. As the sunrise strikes the mountains above Los

Alamos, slopes are heated, and the Rio Grande flow reverses by 9 a.m. Upper level winds mix down later in the day to give a flow from the southwest. This results in a circular diurnal (24-hour) wind direction shift on certain days.

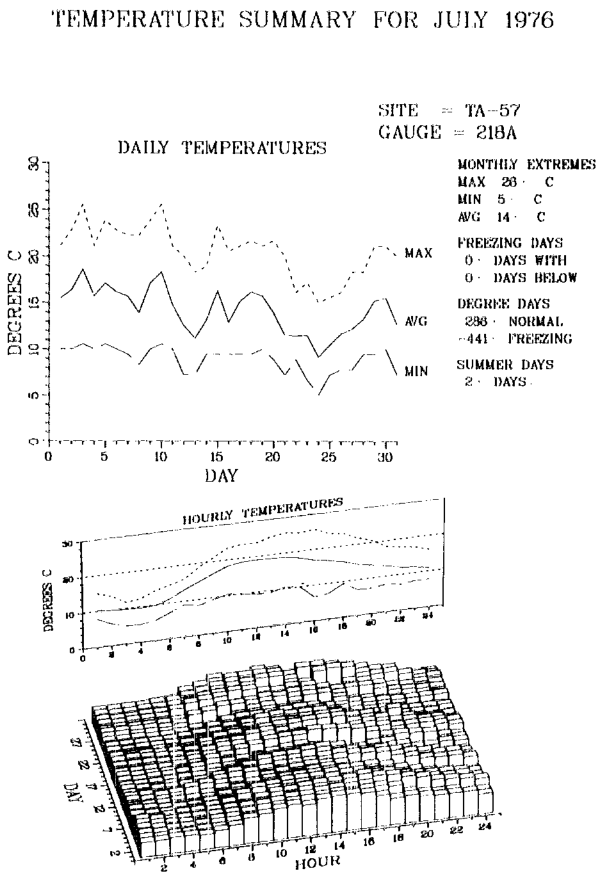
Other illustrations show how effective computer graphic displays can be for making monthly weather summaries, geared to recognizing weather patterns. General-use graphics packages in use and developed by Dahl include EASYPLT, EASY3D, and MAPPER.

Dahl says there are many instances where color-keyed graphics can show analyzed data in an easily-understood form, although H-8 typically uses black and white presentations for weather data. "Our generalized graphics codes have developed to meet the needs of users in H-8," he says, "and have found wide acceptance throughout the Laboratory."

Los Alamos receives about 460



Detailed analysis of Pajarito Plateau wind patterns comes from computer-generated displays. Readings are from the instrumentation tower operated by H-8. Air flow is largely from the northwest at night, but switches to a flow from the southwest during the day after sunshine strikes the flank of the Jemez Mountains. This results in a circular diurnal (24-hour) wind shift on some days.



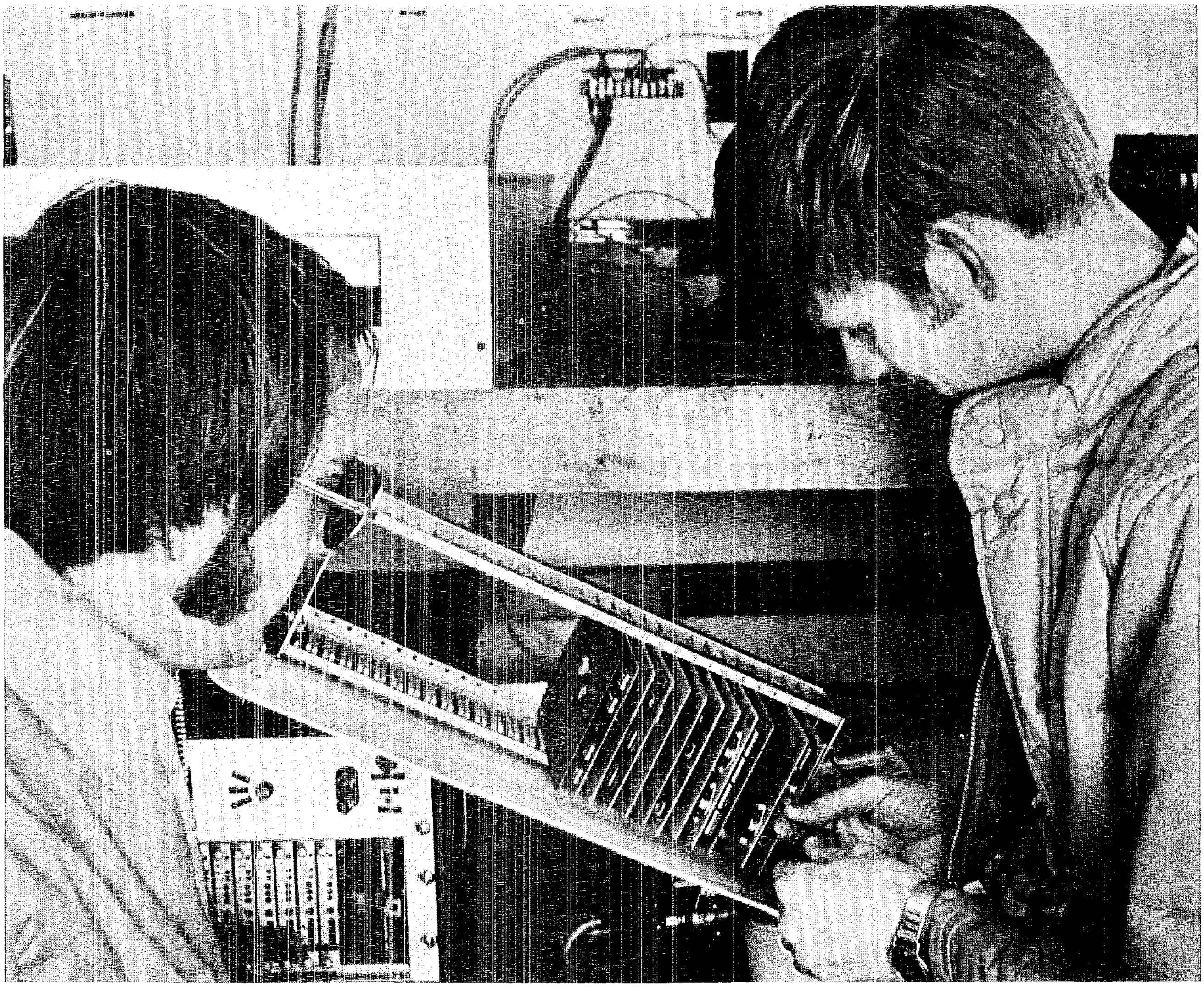
Temperature summaries like this one (July, 1976) can be of use to meteorologists who analyze data for significant patterns. This graphic display shows temperature averages by day, then by hourly average, then by 3-dimensional analysis for both days and hours. Temperature profiles, seen more easily this way than as a table of figures, can be correlated with precipitation readings.

mm (18 inches) of precipitation annually, and graphic displays from the computer -- like the monthly summary developed by Ken Rea -- can show at a glance which months are above or below average in moisture. Analysis from H-8 also shows that approximately 50 per cent of the yearly precipitation falls in July, August, and September. Night brings temperature inversions, and the complex terrain of the plateau causes rotor currents as air moves over canyons between the mesa tops.

Prototypes of weather recording systems are still being refined at H-8; Phillips says the continuing revolution in "chip" technology may lead to smaller, simpler systems within one year -- as opposed to the larger "suitcase" variety of microprocessor currently in use. "And we are looking toward developing small, inexpensive data systems as well as constructing several more weather towers," he adds.

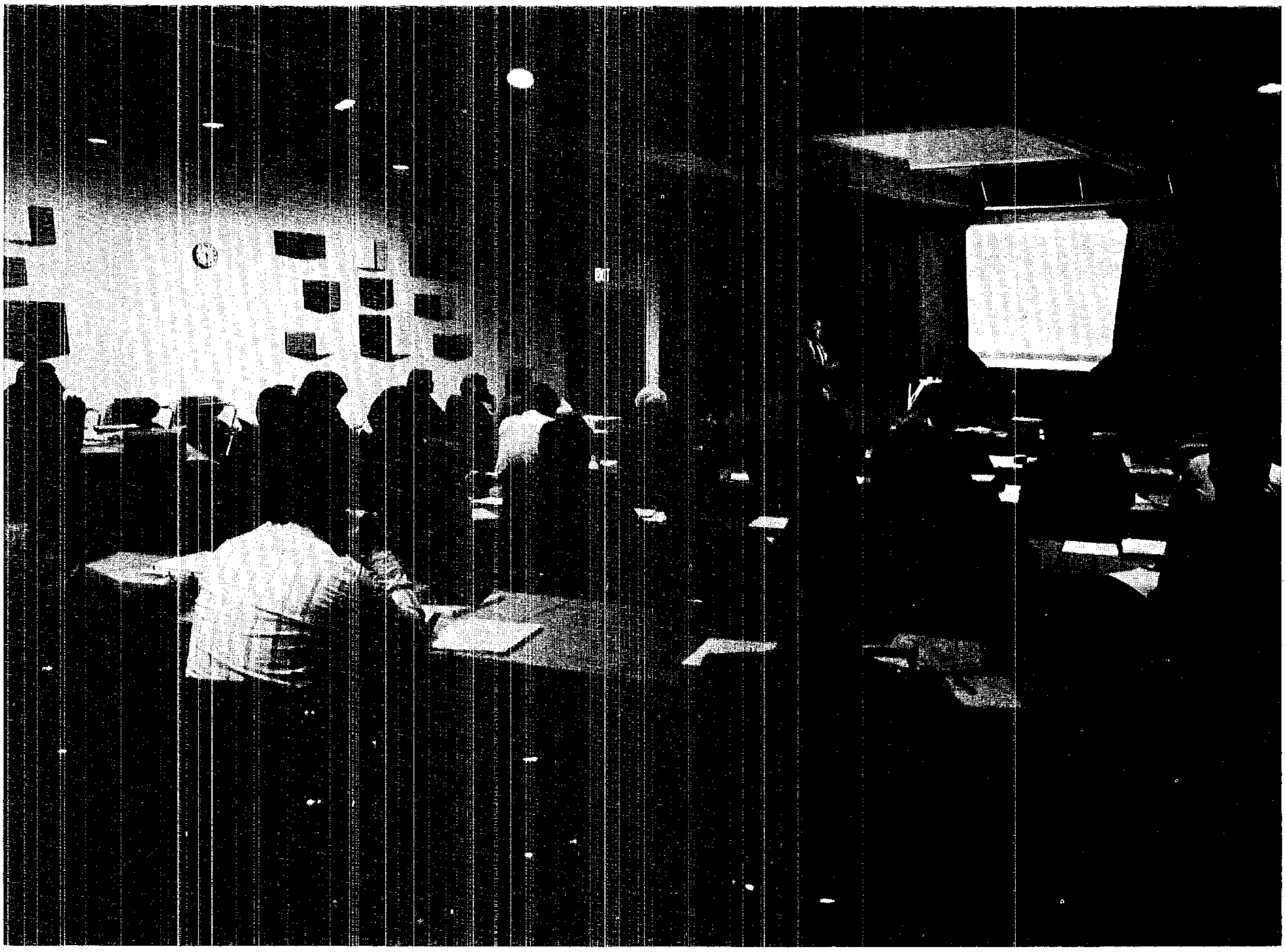
Talk about the weather, meanwhile, is also expected to continue -- as Don Van Etten can attest.

In the instrument hut, Dave Phillips, right, shows some of the special circuitry cards in the C-MOS "suitcase" microprocessor he built and programmed. The analyzer scans weather sensors every 3 seconds, recording averages and standard deviations every 15 minutes. A man would need 17 years to compute a month's worth of high resolution data. A cassette tape records data blips and can be interfaced with a LASL computer to translate information into graphic displays. Don Van Etten looks on at left.



Solar Design Workshop For DOE People

LASL was host for the second annual workshop the last of February on solar design for personnel of Department of Energy facilities. Main topics of the workshop, which continued through March 3 in the National Security and Resources Study Center, were heating and cooling of buildings. Most of the participants were engineers and architects associated with DOE installations, and some participants also came from NASA, the U.S. Air Force, Brookhaven Laboratory, and private firms. About 40 persons took part in the workshop. A review of solar energy systems and a discussion of projects under way through the DOE Solar Demonstration Program were part of the meeting schedule. Also discussed were financial grants made available by the government to stimulate solar applications in new construction and in retrofitted buildings.



Los Alamos Scientists Earn Place In History

Twenty-five years ago, 3 young Los Alamos scientists unwittingly entered the history books as co-discoverers of 2 new elements. They were honored recently at a daylong symposium at Lawrence Berkeley Laboratory for their contributions to the discovery of elements 99 and 100 — einsteinium and fermium.

Few scientists are mentioned in history books, although all contribute in some measure to the body of scientific knowledge. Of those whose names stand out in scientific circles, even fewer gain recognition early in life, as did the Los Alamos researchers.

The 3 are still at LASL. Charles Browne is now associate director for administration, Rod Spence is with LASL's Geosciences Division, and Louise Smith is a staff member in CNC-11.

After the symposium, they looked back at the winter of 1952-53, and reminisced.

"Rod was group leader of J-11 (which became the present CNC-11)," Louise Smith recalled. "But Charles and I were new to Los Alamos — he came to the hill as a military staff member in September, 1952, and I had only been at the Laboratory a week — it was my first job after graduate school — when we realized we had discovered something unusual in the debris from the 'Mike' shot."

The Mike shot, which also is mentioned in history books, was the world's first thermonuclear explosion, set off on Enewetak Atoll in the Pacific in November, 1952.

With a week of professional experience under her belt, Louise Smith became one of 16 co-discoverers of the 2 transcalifornium elements that would be named for Albert Einstein and Enrico Fermi.

Spence was in the Pacific when the Mike shot went off. He was stationed on Kwajalein Atoll in the Marshall Islands, 300 miles from ground zero.

"We used planes to collect samples from atmospheric tests," Spence said. "They carried special filters attached to their wing tanks, and when the samples were retrieved they were placed in lead-lined containers for shipment to Los Alamos."

Spence recalled that the precious samples from the first thermonuclear explosion were divided into 2 shipments and flown in separate planes to ensure that at least one shipment would arrive safely, if a plane should go down.

The samples, from which Los Alamos researchers would determine the yield of the atomic blast, were transferred from Kirtland Air Force Base in Albuquerque to Los Alamos, and work began immediately.

"Typically, we dissolved the sample sheets in acid solutions, using techniques developed at Los Alamos," Spence said. "The Mike samples were contaminated with heavy amounts of coral, and we had problems with chemical reactions because of this — some samples were so (thermally) hot that they literally caught fire."

LASL's researchers provided Argonne National Laboratory and the University of California Radiation Laboratory (now Lawrence Berkeley Laboratory) with material from the Mike shot, and work was carried out simultaneously at all 3 laboratories.

"Almost immediately we trod new ground," Charles Browne recalled. "We were working to isolate the plutonium fraction from the samples, but we could not explain the beta activity we were receiving."

Most plutonium activity is in the form of alpha emissions.

"We thought our chemistry was wrong," Louise Smith said, "but it wasn't. We were seeing a new plutonium isotope, plutonium-246, which was characterized by beta, rather than alpha activity."

Argonne researchers corroborated the existence of the new isotope, and described a second new heavy plutonium isotope they had discovered in the sample — plutonium-244. The Argonne and LASL teams would later identify a third new isotope — plutonium-245.

These previously unknown heavy isotopes, in such high yield, pointed to the successive capture of many neutrons in the uranium in the Mike device. The discovery caused excitement, but it was only a preliminary to what was to come.

"Glenn Seaborg (head of the Berkeley team that discovered the 2 new elements) had predicted that the actinide series (heavy radioactive metallic elements of increasing atomic number, beginning with ((89)) actinium) would come off an ion exchange column in a precise order, as the rare earth elements did," Louise Smith said. "As it turned out, he was absolutely right."

Isotopes of various elements have the same chemical properties. An ion exchange column is a chemical method for selectively removing elements (as entities containing the various isotopes) from a sample.

By today's standards, Los Alamos researchers had very primitive equipment. They did not have a high-sensitivity mass spectrometer, as Argonne did, nor very much capability in pulse analytical techniques.

"Bob Penneman had a 10-channel pulse analyzer at DP-Site," Browne said. (Today's pulse analyzers have up to several thousand channels; in 1952, Lawrence Berkeley's team owned an instrument with 100 channels). "Our radiochemistry work was being done at the old TA-1, across the street from Ashley Pond. I remember spending Christmas Eve of 1952 ploughing through 2 feet of snow, back and forth between TA-1 and DP-Site, trying to get an accurate analysis of our samples with Penneman's pulse analyzer, which was so temperamental it acted like a concertina!"

Charles Browne, the Laboratory's associate director for administration, Louise Smith, CNC-11, and Rod Spence, G-DOT, were the 3 Los Alamos scientists involved in discovery of elements 99 and 100.

A well-mannered pulse analyzer will accurately measure the energy of individual radioactive events in a consistent manner, with predictable channel widths. DP-Site's analyzer played like an accordion, Browne said, requiring that counting activity must be frequently interrupted for appraisal and calibration of the equipment.

Still to come was what Louise Smith described as "mysterious alphas."

"Signals in a series usually start at 5.1-MeV and march up the scale to a drop-off point of, say, 8-point something, before they stop," she explained. "We were getting signals that did not do this. We were seeing mysterious alpha signals at 6.6-MeV and 7.1-MeV, and they were coming at the rate of about 1 signal every 6 minutes or so."

All the Los Alamos researchers knew at this point was that they were, as Rod Spence put it, "seeing something without chemical identification beyond proving that it was a transplutonium element."

"Charles called Lawrence Berkeley and alerted them," Louise recalled. "They began looking for transcalifornium (californium — atomic number 98 — was the heaviest element then known) elements in material from the same source, while we continued our experiments."

The Radiation Laboratory team at Berkeley and the Argonne National Laboratory team in Chicago were to prove conclusively that the 6.6-MeV alpha activity detected at Los Alamos was a new element, atomic number 99. Alpha activity at 7.1-MeV noted by the LASL team was later identified as element 100.

Acrimony marred, in some respects, the important scientific achievement.

"The accomplishment was a team effort, but writing a description of the sequence of events caused some problems," Charles Browne said. "A large file of correspondence exists, with the various factions contending this sequence. Los Alamos was not really a part of the problem, because we were claiming nothing, except for our contributions in providing the samples, helping identify the new isotopes, and alerting the teams with advanced equipment to the peculiar activity in the samples."

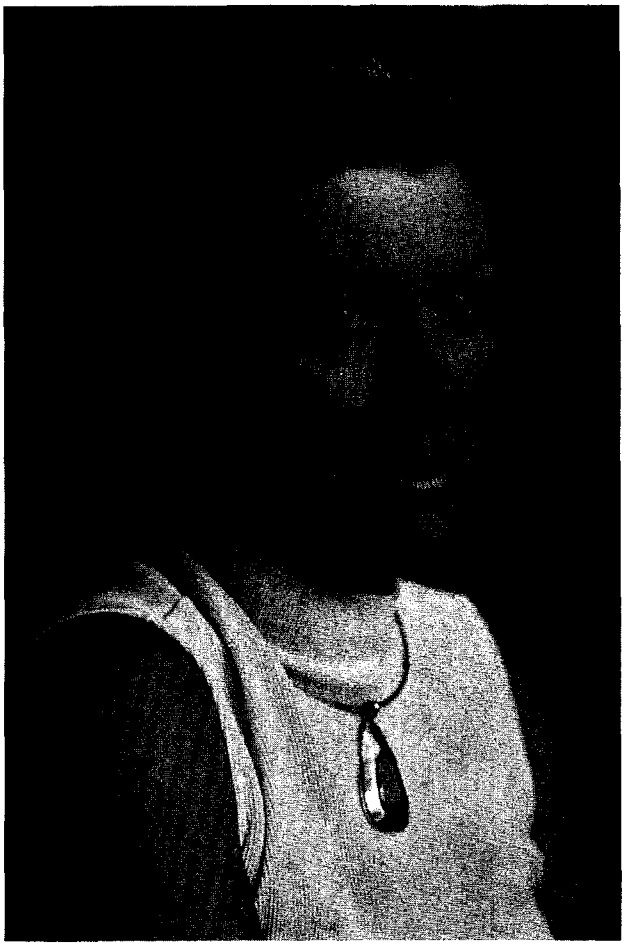
Browne wrote a description of the sequence of events, in the spring of 1953, that was eventually accepted by all of the parties involved. But it was not until August, 1955, that the true story of the discovery of the new elements was made public. Classification prohibited earlier announcement, and in fact the new elements were produced by conventional means, by slow neutron irradiation of plutonium in a reactor, and that announcement, carefully worded to imply that the experiment confirmed earlier work, was made public before the full story of the winter of 1952-53 could be told.

The official announcement of the names einsteinium and fermium (which set a trend for naming elements 101 through 105 for eminent scientists) was made at the Geneva Conference on the Peaceful Uses of Atomic Energy, just as The Physical Review published "New Elements Einsteinium and Fermium, Atomic Numbers 99 and 100," in its August 1, 1955, edition.

Listed as co-discoverers on The Physical Review paper were:

A. Ghiorso, S.G. Thompson,

Darleane Hoffman, associate group leader of CNC-11, narrowly missed becoming a fourth member of the LASL team that pioneered the discovery of elements 99 and 100.



G.H. Higgins. G.T. Seaborg, Radiation Laboratory and Department of Chemistry, University of California, Berkeley; M.H. Studier, P.R. Fields, S.M. Fried, H. Diamond, J.F. Mech, G.L. Pyle, J.R. Huizengan, A. Hirsch, and W.M. Manning Argonne National Laboratory; and C.I. Browne, H.L. Smith, and R.W. Spence, Los Alamos Scientific Laboratory.

The primary acknowledgment in The Physical Review is to the personnel of LASL for the design and construction of the thermonuclear (Mike) weapon, which gave rise to the extreme neutron flux required to produce the very heavy nuclides.

More than half of the discoverers were present for the Berkeley symposium in their honor. Eight scientific papers were presented, including an invited paper by Darleane C. Hoffman of LASL titled "Fission Properties of Einsteinium and Fermium." Darlene Hoffman might have been a member of the Los Alamos team that pioneered in the discovery of the 2 elements, if mislaid papers had not delayed her hiring date from December, 1952, to January, 1953.

Since coming to LASL, Darleane Hoffman has worked with samples from many atmospheric and underground nuclear tests in measuring the nuclear properties of heavy element isotopes. The fermium isotopes are of particular interest because a dramatic increase in total kinetic energy release and a change in the mass division from predominantly asymmetric to predominantly symmetric has been found to occur between Fm 256 and 258.

All of the papers delivered at the Berkeley symposium dealt with the production and properties of einsteinium and fermium, representing an enormous body of knowledge made possible by the atmospheric tests a quarter of a century ago.

Short Subjects

David Heimbach, group leader, and **Gilbert Ortiz**, alternate group leader of Group ISD-5, have been named Certificate Records Managers. They are 2 of the 3 certified records managers in New Mexico. The honor for records managers is the equivalent of the title of certified public accountant and is given by the Institute of Certified Records Managers.

* * *

Peter Carruthers, T-Division head, has been named to a new intergovernmental committee responsible for a cooperative physics program between the United States and the Soviet Union. The new committee is charged with development and oversight of the cooperative program in physics carried on under the auspices of the US-USSR Joint Commission on Scientific and Technical Cooperation as part of an intergovernmental agreement.

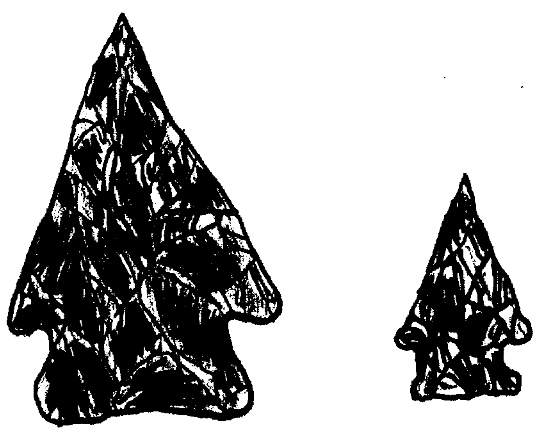
* * *

Michael D. Coburn, WX-2, has received the "Air Force Systems Command Technical Achievement Award" and a commemorative plaque for his part in co-authoring an award-winning technical paper. Coburn, working with 3 other researchers, produced a paper titled "New Energetic Binder Breakthrough for Solid Propellant and Explosive Formulations." The paper was one of 39 selected for Air Force-wide competition at a recent symposium. The joint research dealt with a chemical process that made a linked chemical chain (polymer) of a high molecular weight from separate molecules (monomers). The resultant plastic binder is explosive, hence the "energetic" description. A binder is a substance that binds the crystalline explosive particles together.

Tom Putnam, assistant MP-Division leader for safety, receives a 35-year award from Louis Rosen, left, MP-Division head.

Plateau Structures Studied

EDITOR'S NOTE: This is the third of several articles on the archaeological investigations of the Pajarito Plateau which will appear in *The Atom* during the next few months. This article will point out interesting features of various types of sites common to the Plateau. The first 2 articles appeared in the October 1977 and January-February 1978 issues of the magazine. The information in "Pajarito Plateau Archaeological Survey and Excavations," LASL 77-4, by Charlie R. Steen, archaeological consultant to LASL, serves as the basis for the series of articles.



The earliest structures on the Pajarito Plateau – small farmsteads of from 2 to 10 rooms, were almost always constructed of puddled adobe.

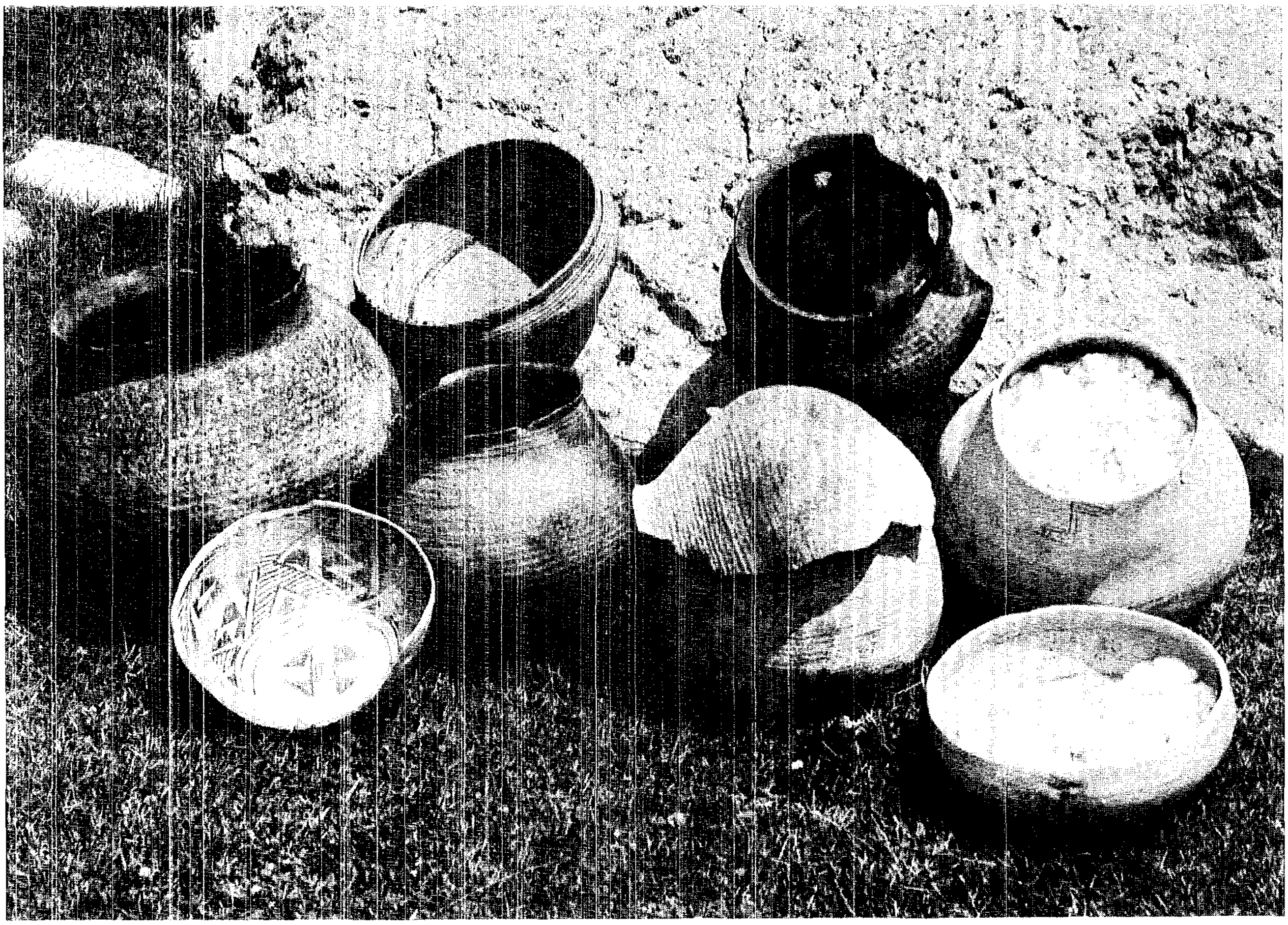
Rooms were aligned in 1 or 2 rows, and almost always were laid out in a north-south pattern. The dwelling rooms contained firepits, and a family typically used 2 to 4 rooms, one for living quarters, and the others for storage.

Ceremonial rooms, or kivas, are not always present at the small sites, and no true kiva has been reported in sites in the survey area at which Santa Fe Black on White pottery (dated A.D. 1225-1350) is predominant.

More commonly, one room, a little larger than the others and usually on the east side of the building, had a curved wall. Kiva features, such as ventilator, deflector, or extra large firepit, are common in excavations of these rooms. It probably is not accurate to apply the term kiva to the ceremonial rooms of these farmsteads.

Entrance to the rooms of the farmsteads must have been by ladder through a hatch in the roof. There is very little evidence of ground level doorways in these structures, even through partition walls.

In the walls are round openings – vents peculiar to the upper Rio Grande settlements – for which there are no good explanations for their purpose. The openings varied from 12 to 20 centimeters in diameter, and most were plugged



These pottery jars and bowls, some of which contain cotton several hundred years old, are types common to pre-historic Indian sites on the Pajarito Plateau.

with wads of mud or truncated cones of tuff. The vents were made at varying heights and positions in the walls.

Midden deposits at these sites are small. Trash was thrown anywhere in the vicinity of the house, and additions to the structure usually were built on the midden material. Trash deposits are most abundant on the east side of buildings, which indicates that that side, sheltered from the prevailing southwesterly winds, was where most of the family's work was done.

As the small sites expanded, most structures apparently still were only 1 story high. Also, at these larger sites, most construction seems to have been of stone laid with adobe mortar. Walls of shaped stone blocks appear for the first time, although adobe walls still were built. Walls of all 3 kinds of construction usually are found at these larger villages.

Investigations indicate that late in the 14th century the people of the Plateau began to gather in villages that consisted of clusters of house blocks with 1 dominant building, a 2- or 3-story structure built around a plaza.

A kiva was a feature of the plaza, and in nearly every such site a second kiva was dug east of the structure and south of the entry (on the east) to the plaza. The mounds that remain at this type of site measure 30 by 70 meters, and the site, again, is usually laid out north to south.

Most of the plaza site construction was done with masonry and shaped blocks of tuff, and pottery fragments indicate that these sites were contemporaneous with earlier stages of construction at large villages such as Tshirege.

How this kind of settlement fits into the late pre-Columbian construction pattern in the upper Rio Grande valley is not certain. Villages with kivas in central plazas and with eastern entries are fairly common. One such example is Tyuonyi in Frijoles Canyon. The compact plaza sites on the Pajarito Plateau are quite distinctive, although the sites in the valley, like Pueblo Pindi, are more extensive.

The cavate rooms carved into the Pajarito Plateau cliffs are a prominent feature of the area and apparently are all of the same period as the plaza sites and large sites like Tshirege. The rooms were dug into the soft tuff cliff faces and nearly always were the innermost rooms of blocks of masonry rooms built along the cliff bases. The outer rooms were dwellings, and were 2 or 3 stories high. The lower and back rooms were for storage of food and family utensils and equipment.

Some of the large cavate rooms have kiva features and are termed cave kivas. Other smaller, smoke-blackened rooms generally are considered dwellings, although some of them may have been small ceremonial chambers for a family, or an individual.

Three types of shrines have been recorded in the survey of the Plateau area. They are rough circles, open box shrines, and rock art shrines.

The circle shrines usually are found at the end of the long fingers of the mesas. They are composed of rocks pulled into a circle, and are places where men went to pray. The circles are 2-5 meters in diameter and usually are alone, although at some sites several contiguous circles are found. The shrine also may be simply an arc of stone laid on the ground.

Open box shrines were simple square structures made of stone work, and usually measured 1 to 2 meters on a side. The walls were 3 to 5 courses high, and apparently were not roofed. They served as places for prayer and meditation.

Rock art shrines of the pre-Columbian Pajaritans seems to have been inspired by religious thoughts or activities. Most of it is concentrated near ancient centers of population, particularly in and near kivas or ceremonial rooms. The survey of the Plateau revealed 2 pictograph sites in which rock art is the primary feature, with no dwellings nearby.

The nature of the tuff made easy work for the pictographic artist. The most common method of creating a figure was by pecking either the outline or the whole figure. Outlines of some figures were drawn by rubbing grooves into the rock face or by abrading the entire surface.

Crude human and animal shapes as well as various geometric shapes seem to have been made by all the artists.

Game pits, probably for capture of deer and eagles, were dug. They were very similar, varying only in locations chosen for them. The pits were dug into tuff, at places where it had no soil covering. They were about 2 meters long, 1 meter wide, and about 2 meters deep.

Deer pits were dug on low saddles between canyons and probably were hidden with a covering of light brush and given wing walls of juniper and pinon branches, so that a deer could be driven from a canyon up a slope to the saddle and forced to the pit where, it was hoped, it would step on the cover, fall through, and break a leg or its neck.

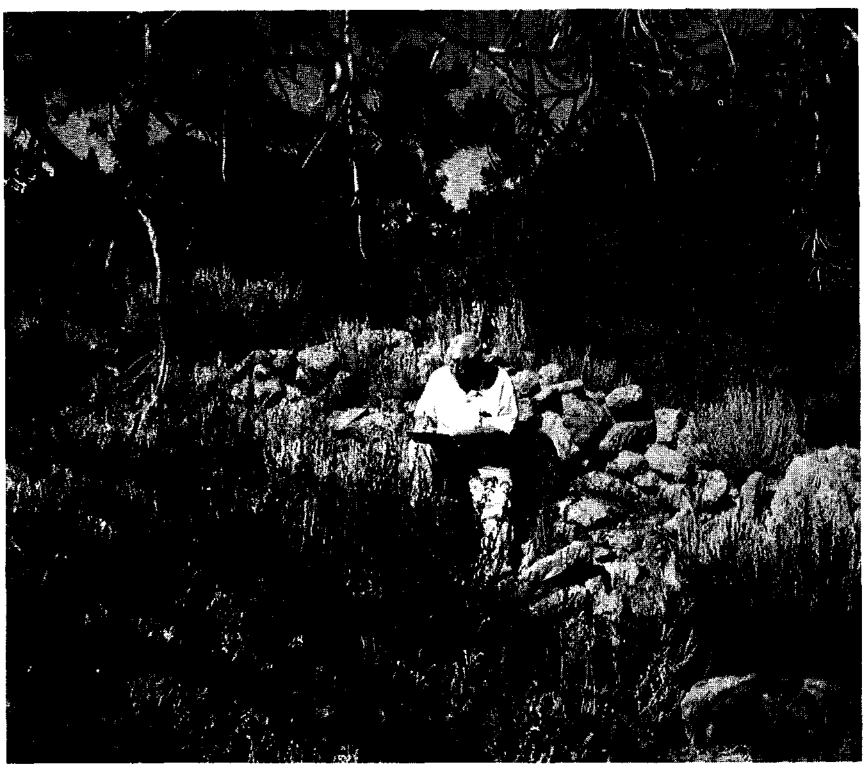
Scattered throughout the Pajarito Plateau are some pits that could not have been used for trapping deer. They are on the edges of high mesas or on very rugged points. With 2 men in the pit and a bait, like a rabbit, tied to the brush cover, the trap was set.

The men waited perhaps a day or more, and hoped an eagle would spot the bait, swoop to capture it, set its talons into the bait and remain long enough for the men to tie first its legs to the cover and then tie its wings.

Another prominent feature of the Pajarito Plateau sites are the many trails along faces of cliffs. The well-worn trails indicate the Indians walked constantly from tops of the mesas to the canyon bottoms and vice versa.

The survey of the Plateau revealed what apparently is a water-collecting device in Ancho Canyon. A curved drystone wall was constructed at the base of a cliff below a runoff channel. The basin probably held ceramic jars placed to catch water running from the cliff during rain storms.

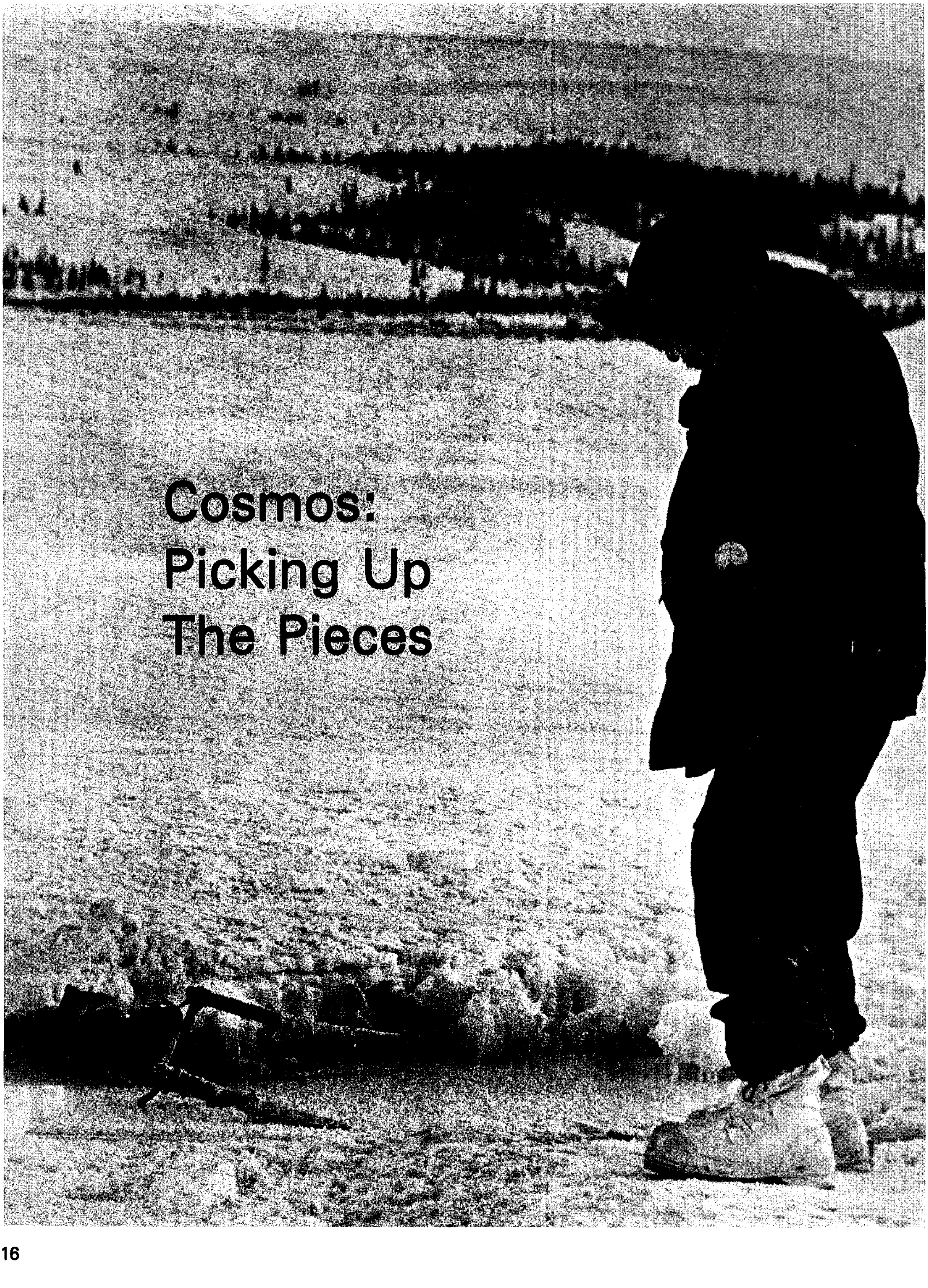
Charlie Steen at a Plateau site.

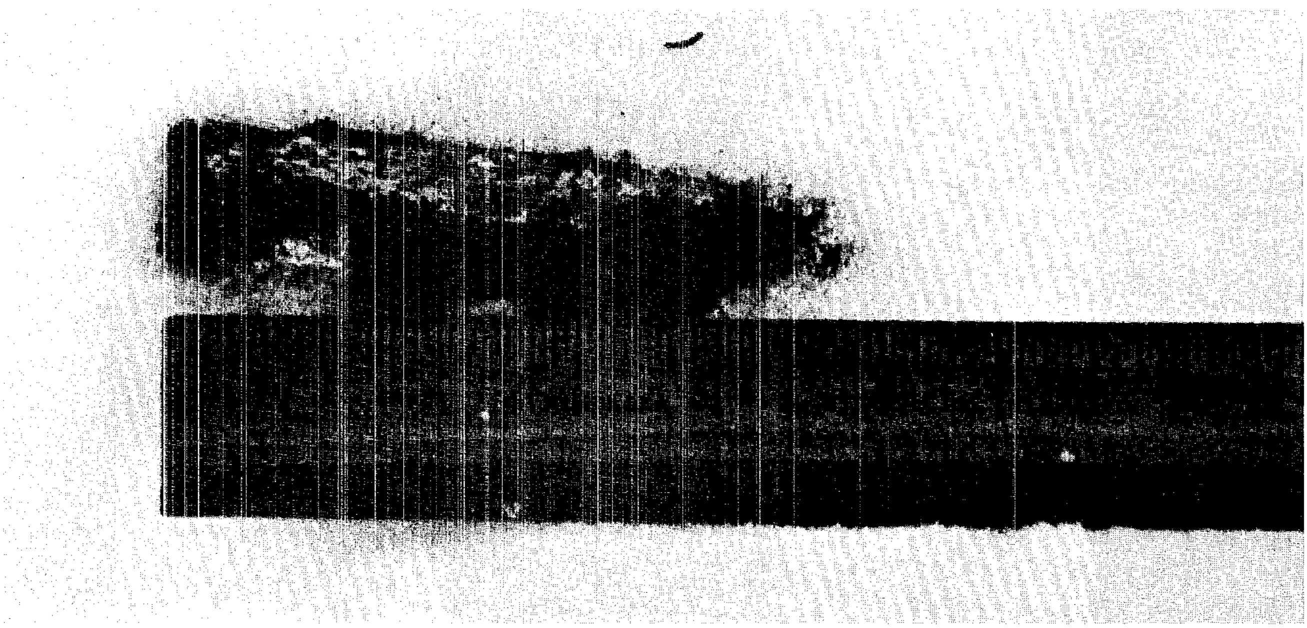


Among Our Guests

George Sawyer, alternate division leader of CTR-Division, briefs officials of the State Department's Foreign Service Institute on LASL's magnetic fusion program. The officials are members of an executive seminar in national and international affairs conducted by the State Department. While at LASL recently they were briefed on energy and weapons programs. Specific energy programs they studied, in addition to magnetic fusion, are laser isotope separation, solar heating and cooling, laser fusion, geothermal energy, and superconductivity.

LASL Director Harold Agnew recently hosted a meeting of officers of the Air Force Space and Missile Systems Organization (SAMSO). Attending the briefings on land-based ICBM programs were, left to right, MajGen John W. Hepfer, Deputy for ICBMs, LtGen Thomas W. Morgan, Commander of SAMSO, and BrigGen Pat Sheehan, mobilization assistant to General Morgan. Also attending were, in the background left to right, T.P. Seitz, Air Force ICBM system program manager for WPO at LASL, and J.M. Puckett, associate group leader of WPC-1.


Cosmos:
Picking Up
The Pieces



This fragment of what is thought to be part of the satellite's control rods is one of many such pieces of debris collected by U.S. and Canadian search teams.

By Barb Mulkin

Teams of LASL scientists have spent overlapping tours of duty in Canada since January, in response to the crash of a Russian satellite, but the work was "pretty normal stuff — mostly physics — and no 'SWAT team' effort," according to Sam Gardner, who coordinated the deployment of LASL team members under the direction of Robert N. Thorn, Associate Director for Weapons.

Gardner, one of many scientists who plotted the troubled satellite's decaying orbit in an effort to predict its impact area, said the Los Alamos experts were members of a U.S. Department of Energy (DOE) response team sent to Canada at the request of that nation's government. The overall U.S. contribution was headed by DOE's Nevada Operations Office, with much of the equipment and support personnel from EG&G Corporation, Las Vegas, Nevada, prime contractor for the nation's nuclear test site near that city.

The downed Cosmos 954 satellite, its instruments believed to be powered by a uranium-fueled reactor, plunged to earth January 24 near Great Slave Lake in a remote area of Canada.

LASL sent men and equipment to the Canadian Northwest Territories, 750 miles north of Edmonton, Alberta, to aid the search operation, which was code-named "Morning Light."

Bill Stratton and Larry Weintraub, TD-Division, spent several days in Canada, working in the areas of criticality, health physics, and radiation monitoring.

Stratton, whose career spans 3 decades of reactor research, said he believes most of the Cosmos power source burned up when the satellite entered the earth's atmosphere, and added, "Some people think the reactor is of the Romashka design, which the Russians displayed in 1964 at the Geneva Atoms for Peace Conference."

Weintraub and Stratton were the second LASL team to reach Canada. The first Los Alamos scientists to reach the Canadian Forces Base at Edmonton were Carl Henry, Q-2, and Dick Smale, H-1. They were later relieved by Q-2's Clyde Reed and H-1's Jerry Dummer.

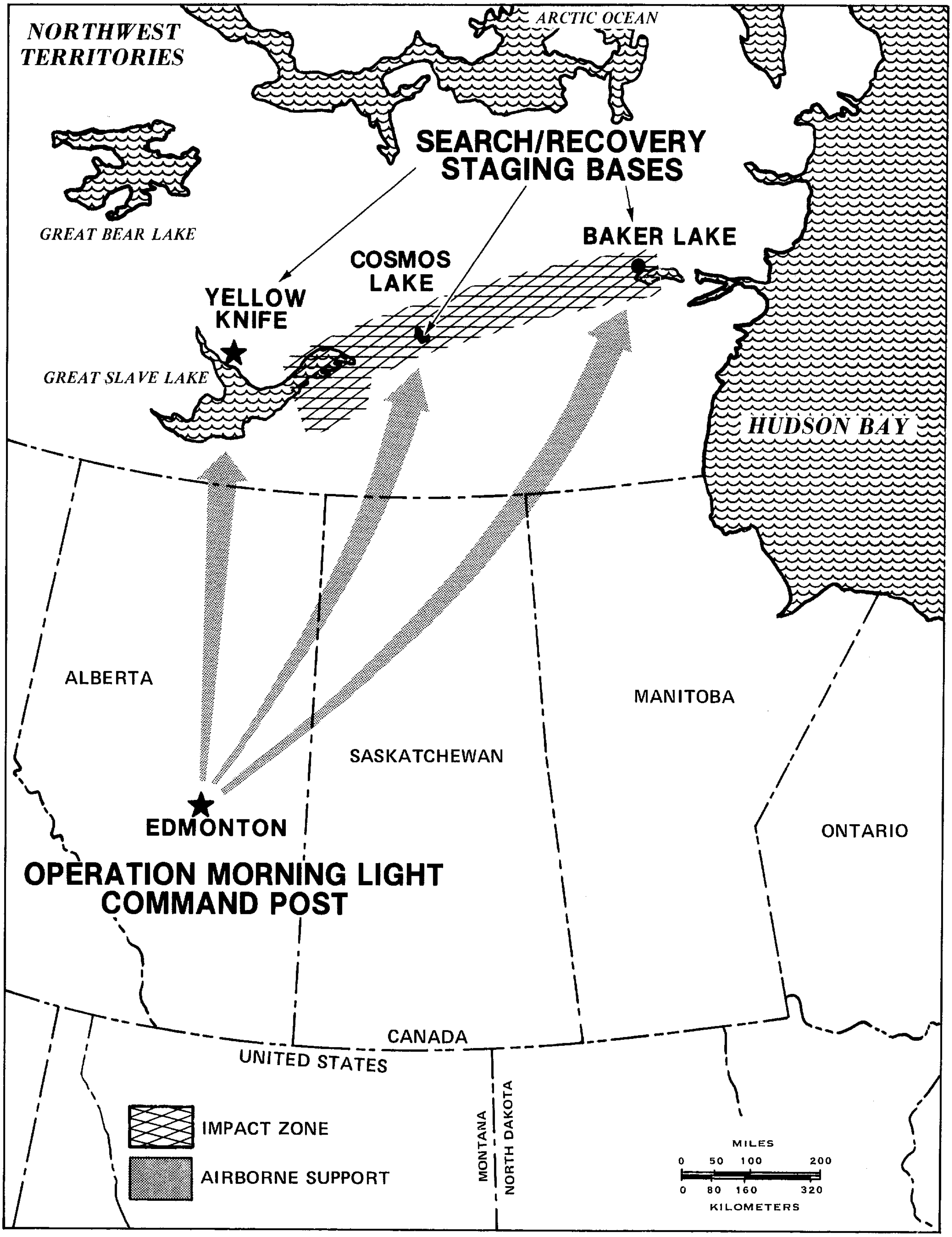
The doomed satellite was within 3 days of plunging to earth when Smale and Henry left Los Alamos for Las Vegas. But at that time, the point of impact was not known. Experts were using computers to plot fresh sequences of possible impact points, as Cosmos wobbled erratically through its final series of 90-minute earth orbits.

Within hours after the spacecraft made its final orbit and the Canadian government formally requested American help, the Los Alamos scientists boarded U.S. Air Force C-141s en route to Edmonton.

Smale, whose specialty is radiation safety and decontamination procedures, remained based in Edmonton for most of his tour. He lectured on his special interest fields to members of the Canadian

Photo, opposite page:

Paul Mudra of the Department of Energy's Nevada Operations Office inspects the area where a piece of the Soviet satellite Cosmos crashed to earth recently in the Canadian wilderness.


NORTHWEST TERRITORIES
ARCTIC OCEAN
SEARCH/RECOVERY STAGING BASES
GREAT BEAR LAKE
BAKER LAKE
COSMOS LAKE
YELLOW KNIFE
GREAT SLAVE LAKE
HUDSON BAY
ALBERTA
MANITOBA
SASKATCHEWAN
ONTARIO
EDMONTON
OPERATION MORNING LIGHT COMMAND POST
CANADA
UNITED STATES
MONTANA
NORTH DAKOTA
IMPACT ZONE
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KILOMETERS

Nuclear Accident Search Team at Yellowknife, capital of the Northwest Territories and a city of 12,000 on the north arm of Great Slave Lake, and flew several missions across the vast search area.

"The Canadian forces have not had a nuclear incident for many years and had little recent experience in radiation monitoring and personnel control," Smale commented, "and we were glad to share our expertise with them."

Smale said the first search planes carried health physics specialists to document the health and safety of the flight crew and the monitoring personnel aboard the craft.

"By January 28 it was decided that this was not necessary, in spite of the fact that the planes were flying extremely low across the search area -- as low as 500 feet above the ground much of the time," Smale said. "After 3 flights I remained in Edmonton and concentrated on calculating radiation shielding parameters and on helping design a radioactive storage facility at the Edmonton Armed Forces Base."

By contrast, Carl Henry, group leader of LASL's Detection, Surveillance, Verification and Recovery Group, was sent almost immediately to Baker Lake, some 600 miles east of Yellowknife, to investigate the region where the largest piece of debris from the Russian satellite was found.

Two men on a wilderness trip stumbled across the twisted piece of metal embedded in the ice of the Thelon River, about 250 miles west of Baker Lake, and reported the find to Canadian authorities. Carl Henry, who was acting as chief scientist of a 5-member crew based at Baker Lake, coordinated the effort to remove the radioactive debris from the ice.

"Consideration was given to whether or not the reactor, or parts of it, might be under the ice," Henry commented. "It was not; but nevertheless the metal was radioactive as a result of the reactor operation."

Searchers collected debris from the satellite by shoveling snow in suspected impact areas and monitored each slice of snow for radiation, which would indicate that a piece of the satellite might be beneath the surface.

Using hand tools — a gas-powered ice auger failed to work in the cold — Henry's team managed to chip the metal fragment loose and load it, first into a garbage can, later into a lead-lined container.

Henry described the enormity of the job of finding satellite debris because of the vastness of the Canadian wilderness. The search area stretches about 600 miles east from Yellowknife to an area east of Baker Lake, and is about 30 miles wide.

Canadian Armed Forces C-130 cargo planes flew around the clock at extremely low altitude so that scientists could search for telltale radiation. Chinook and Huey helicopters and twin-engine Otter planes fitted with skis crisscrossed suspected "hit" areas (where parts of the satellite fell to earth), landing people and materials to examine the terrain.

More than 100 hits had been recorded by the first week in March, with most of the low-level debris being found south and east of Yellowknife, near Snowdrift, and larger, or more heavily contaminated pieces being detected east and north of Snowdrift in an ascending pattern that marked the trajectory of the dying satellite.

Deadly cold and scant hours of daylight hampered the search.

Henry recalled it took 2½ hours for a Chinook helicopter to fly from Baker Lake, an Eskimo community of 1100, to the Thelon River (Cosmos Lake) where the large metal fragment of the Russian spaceship had left a crater.

This piece of the satellite, resembling antlers, is thought to be part of the ship's antenna system.

Planes and helicopters could not shut down their engines, or they would not start again in temperatures that sometimes registered a wind-chill factor of minus 70°F. A Chinook, in which Henry and his team members (personnel from DOE, Lawrence Livermore Laboratory, and EG&G) rode, broke down on the Thelon River and forced an overnight stay.

"We fared well. There was a Canadian Forces survival expert and a Royal Canadian Mountie at the site," Henry commented wryly. "We boiled 15 cans of frozen food to a point where we could use a can opener on them, then put them in a big pot and had a rather strange stew . . ."

Eventually it was decided to construct a base camp at this wilderness site, dubbed Cosmos Lake by the search team. Bill Stratton described trips aboard the enormous Canadian cargo planes as they landed supplies:

"The C-130 would swoop across the frozen (Thelon) River at 5 feet or less. The bay doors would open and a primary parachute would deploy, then a series of smaller parachutes would fly backwards, literally dragging the cargo attached to them out of the belly of the plane and on to the ice. They landed everything, including huge tractors to blade a landing field on the ice."

Much of the man-portable search equipment deployed through EG&G, Las Vegas, was designed at Los Alamos, as part of the Department of Energy's response capability for all types of emergencies.

Q-2's basic responsibility involves design and use of compact, portable equipment for response to nuclear emergencies.

Sam Gardner said the Cosmos

incident was unusual — it is the first of its kind, and DOE was responsible for aiding the Canadians because "the Department of Energy has access to a pool of equipment and expertise that could offer the most help."

The Los Alamos expertise on which DOE called demanded long hard days of work under difficult conditions for the scientists involved.

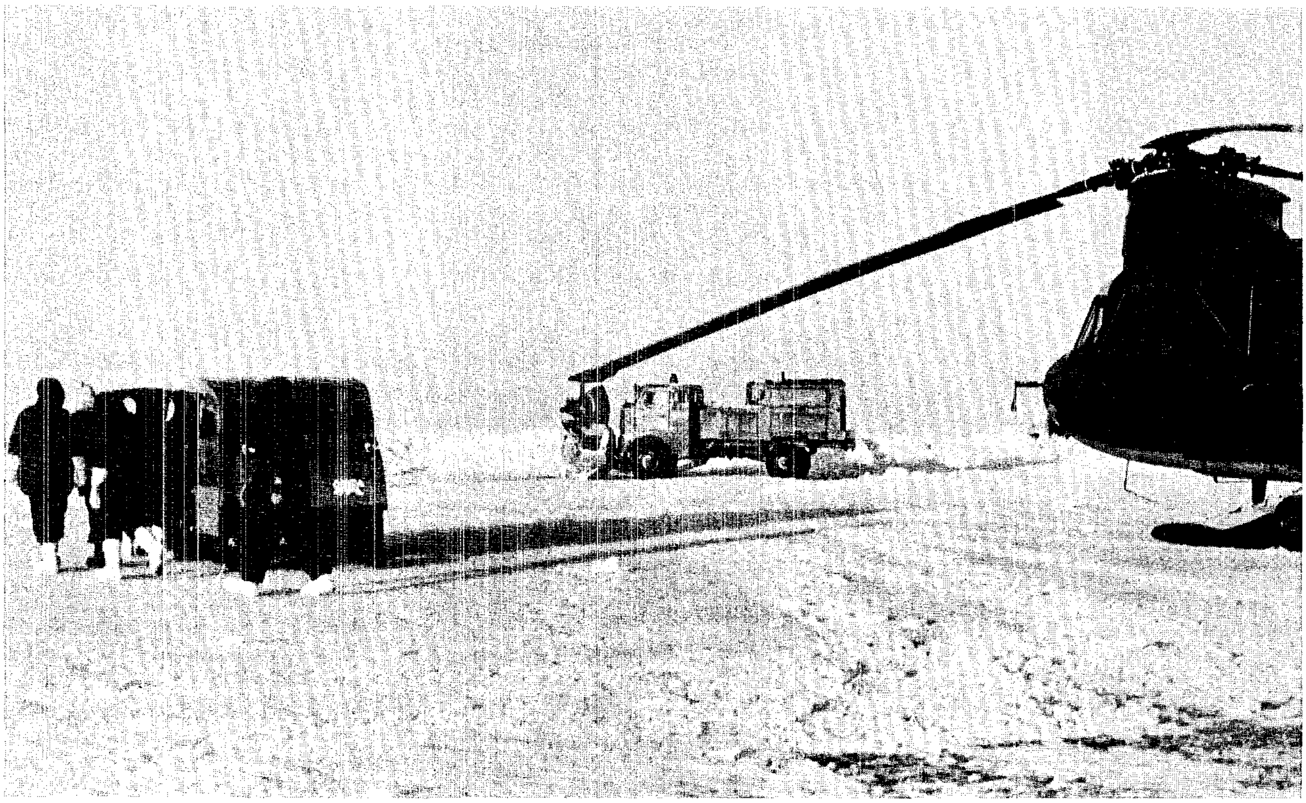
Clyde Reed, Q-2, spent his tour of duty at the Canadian Forces Base at Edmonton "wearing out a calculator to help the Canadians delineate the search areas."

Reed calculated the numerous airborne search parameters and developed grid patterns for the search planes — an unglamorous, little-heralded task that was essential to the total effort.

Jerry Drummer, H-1, flew reconnaissance missions, picked up samples for delivery in Edmonton, and worked in health physics at the Canadian base there.

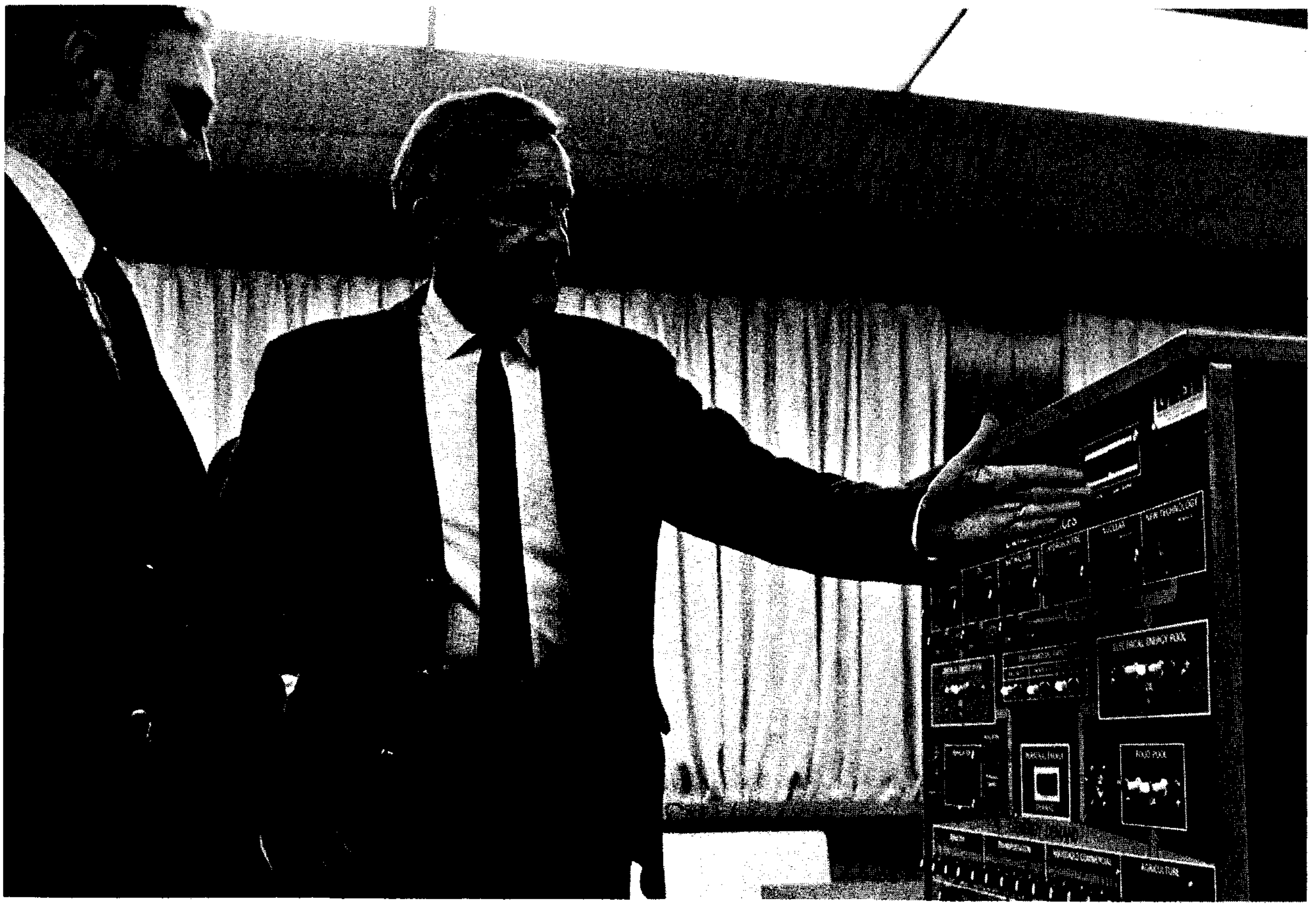
All of the LASL scientists who went to Canada contributed to a cooperative effort that basically might be called "mostly physics — pretty normal stuff." Out of the effort came reasonable assurance that the unlikely Cosmos incident caused no lasting harm to the people and the terrain in Canada's great Northwest.

LASL Expertise Aided Recovery Efforts



Helicopters, snow plows, and specially adapted ground vehicles were used to move people and supplies along the frozen rivers and lakes of the wilderness area where the satellite crashed.

Photo Shorts



P.W. Keaton, E-Division head, and LASL Director Harold Agnew discuss the capabilities of the energy environmental simulator, one of about 100 such machines in use throughout the U.S. The simulator, originally conceived by the Atomic Energy Commission, was built by Oak Ridge National Laboratory and the University of Wyoming. LASL's involvement has been to replace the analog circuitry of the original machines with micro processors. Keaton presented this simulator to Agnew, and it is on exhibit in the museum. The purpose of the simulators, which are demonstrated at public gatherings, is to impress on the layman that there is an energy problem in the U.S. and that the problem is of crisis proportions.

Colonel Graham D. Vernon of the National Defense University spoke on "Soviet Society and the Soviet Military" at a March colloquium at LASL. Vernon emphasized that the military in the Soviet Union is considered an extremely important part of life. Military members are praised and enjoy elevated positions in the society's structure.

10 Years Ago

Compiled from the April, 1968 *Atom* and the *Los Alamos Monitor* by Robert Y. Porton

OPEN HOUSE

The Los Alamos High School Instructional Materials Center will have an open house on Sunday. Complete with excellent library facilities, future plans call for the center to have the finest in audio-visual equipment plus copying and duplicating machines. With its Social Studies and English Resource Centers, team teaching will be used to provide more flexibility of schedules and provision for independent study, according to local school officials.

NEW DIVISION

A new technical division at the Los Alamos Scientific Laboratory — called the Computer Science and Services Division — has been formed. The purpose of establishing C-Division is to increase the long term efficiency and capability of LASL's computing facilities in support of all Laboratory programs.

OOPS!

Wouldn't you know it. Officers of the Los Alamos Police Department made the changeover to summer uniforms this week. The appearance of the short sleeved lightweight uniforms was accompanied by blowing snow and cold winds with temperatures as low as 27 degrees. The summer uniforms are still being worn — with heavy winter jackets.

REPORT

Several LASL physicists have co-authored a report in the current issue of "Physical Review Letters," a publication of the American Physical Society. The report is on new particles detected in the solar wind by instruments on Vela Satellites. The observations made by the 4 men are expected to aid solar theory and to provide a better understanding of some kinds of radio interference and the aurora through direct measurements of particles in the solar wind. Among the authors are Samuel J. Bame, John R. Asbridge and Ian B. Strong.

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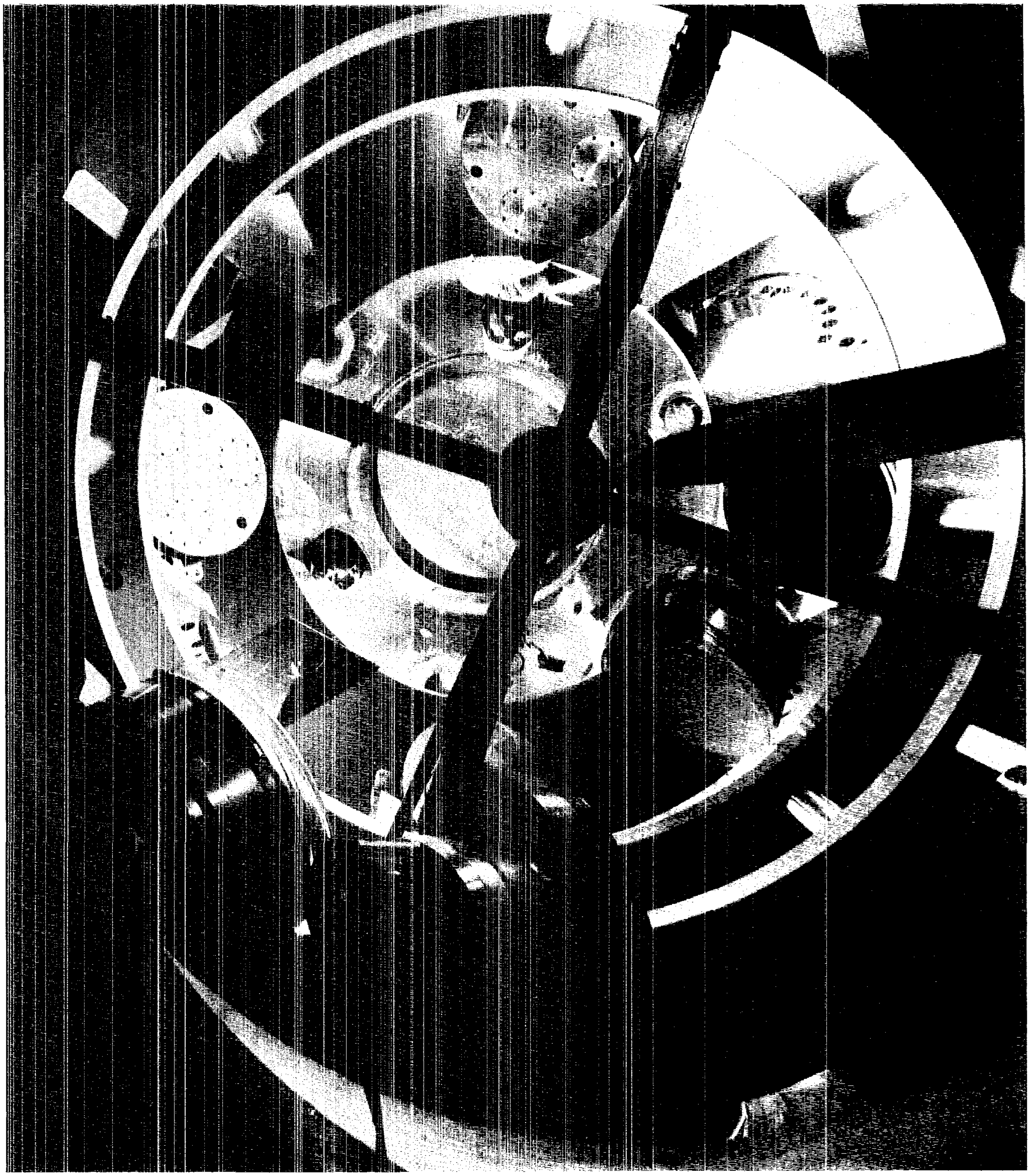

Ed Jolly and Ben Maestas, both L-1, pose for photographer Johnnie Martinez inside the target area of the 8-beam system, the center of L-Division's gas laser research.

The Los Alamos Meson Physics Facility at LASL is an impressive adornment to the terrain of the Pajarito Plateau. The facility conducts research in medium energy physics and biomedical research including treatment of cancer.