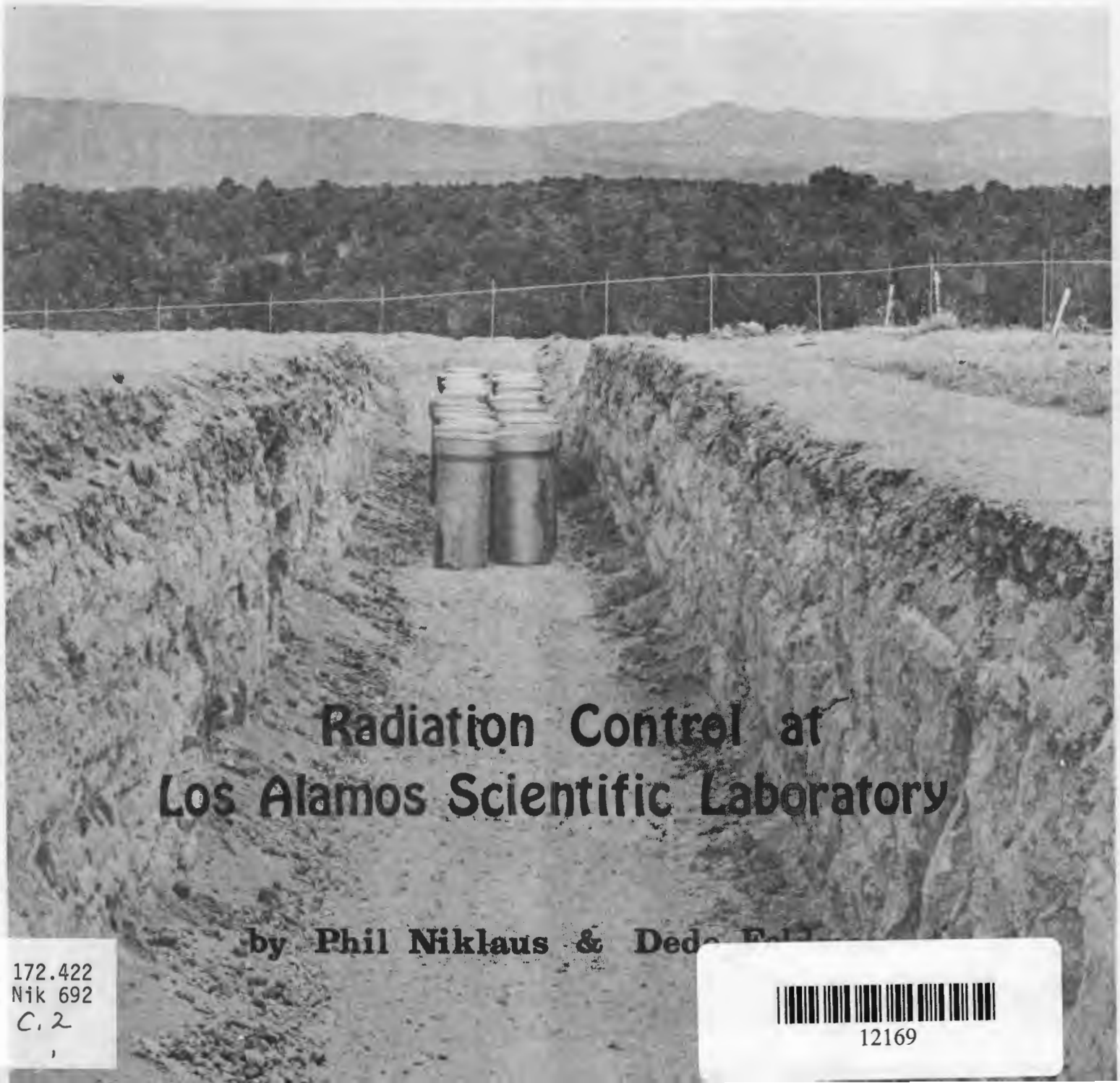
HOW SAFE IS NEW MEXICO'S ATOMIC CITY?



Radiation Control at Los Alamos Scientific Laboratory

by Phil Niklaus & Ded[illegible]

Research for this series of articles was assisted by a grant from the Fund for Investigative Journalism in Washington, D.C. Phil Niklaus and Dede Feldman are free-lance writers living in Albuquerque.

Phil Niklaus, who served as an Army public information officer in Vietnam from 1967 to 1968, holds a BA in Journalism from Ohio Wesleyan University, Delaware, Ohio and an MA in Journalism from American University, Washington, DC. For more than five years, Niklaus worked as environmental reporter and weekly columnist for the *Albuquerque Journal*, which published his series of articles on nuclear waste in booklet form in 1976. His first series of articles on the nuclear energy issue appeared in the *Frederick News-Post*, Frederick, MD in December, 1970.

Dede Feldman is a former high school teacher turned writer who has written for *The New York Times, Environmental Action Magazine,* and *The Albuquerque News.* She has a BA and MA in Political Science from the University of Pennsylvania. She is an owner-builder of a passive solar house in Albuquerque.

Cover photo

Nuclear waste stored in trenches at Los Alamos Scientific Laboratory, Los Alamos, N.M.
– Photo by Dede Feldman.

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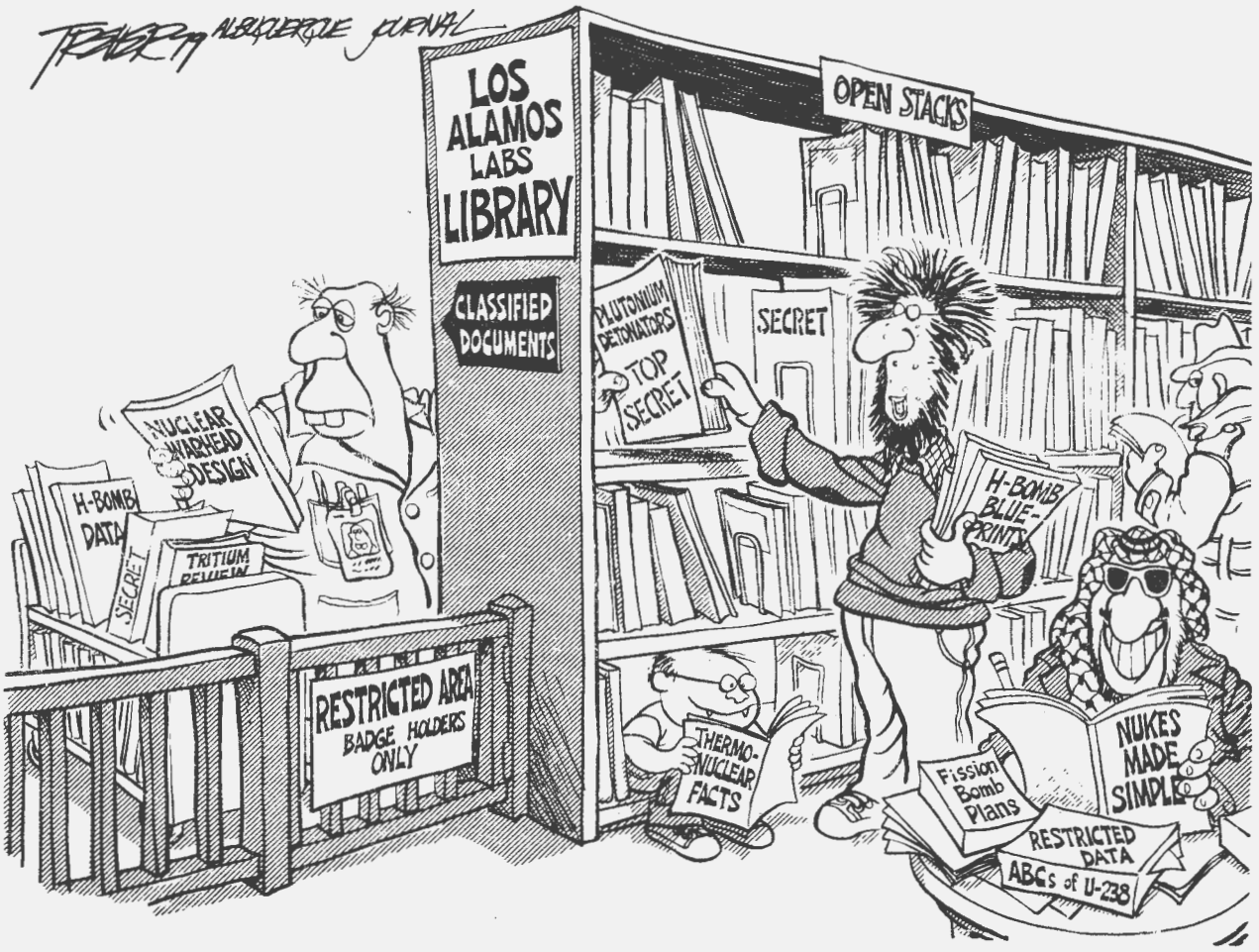


Editorial:

Public Must Be Convinced

Los Alamos Scientific Laboratory and the U.S. Department of Energy created – for themselves – a formidable problem in public relations and credibility with an abrupt decision to bar the public from the laboratory's library.

Regardless of the real validity and urgency of this precipitous action, the timing heaped a tremendous burden of proof on the laboratory and the department. It will be hard to convince the American public, for example, that the barn wasn't locked only after the horse made its exit; that the library wasn't declared "off limits" to impede the pending court appeal of the *Progressive* magazine, a Wisconsin publication, or that the action was not taken to forestall further embarrassment at the hands of precocious journalists.

The extraordinary zeal whereby the nation's nuclear laboratories and nuclear secrets have been kept secure – first by the wartime Manhattan Project, later by the Nuclear Energy Commission and more recently by the Department of Energy – makes it almost unbelievable that classified data could have been mixed in with public documents, inadvertently or otherwise.

The closing of the library might have been taken in stride by a trusting public if it had not come at a time when a researcher, in support of the *Progressive* magazine's court appeal, was striving to examine unclassified documents in the public section of the library.

The Wisconsin publication's announced intention to publish an article on how to make a hydrogen bomb was quashed by the order of a federal judge in Milwaukee. It was the magazine's thesis that information describing how the bomb could be built was readily available to the public. The unpublished article, in fact, was written from information made available to author Howard Morland, who disclaims any personal sophistication in nuclear know-how.

Any court deliberating the magazine's appeal from the Milwaukee gag order can determine if indeed there were unclassified documents in the library that could have expedited a personal H-bomb project. The fact is that untimely lowering of the curtain in the face of a researcher prepared to make that determination is an undue and arbitrary impediment to the quest for justice.

Albuquerque Journal, May 16, 1979.

PREFACE

This series of articles on radiation management practices at the Los Alamos Scientific Laboratory (LASL) in north central New Mexico appeared daily in the *Albuquerque Journal* Oct. 7-14, 1979. The articles, covering the lab's handling and disposal of nuclear waste, possible health effects and the whole area of radiation standards, have been updated for this booklet to include information contained in the final LASL Environmental Impact Statement, which was released in January, 1980.

The articles have evoked considerable controversy both in Los Alamos and the state as a whole. Following publication of the series, the *Journal* received letters-to-the editor both pro and con; some written by staunch nuclear supporters, others by residents of Los Alamos outraged to hear, for the first time, what is being dumped in their own backyard.

There was no official response to the articles from either LASL or the U.S. Department of Energy, though several of the lab scientists said they had advocated responding to them. One LASL scientist reported to us that the articles had "hit some nerves" at the lab. "They [the articles] have brought about some re-examination internally," he said.

As part of our investigation, we interviewed about 40 individuals, some several times, including present and former LASL scientists, state and federal health and environmental officials, state legislators, and Los Alamos area residents. In addition, we studied more than 50 LASL technical publications, which served as the basis for many of our interview questions. We were fortunate in that about one week after we had completed this phase of our research, the LASL library was abruptly closed to the public after a classified document, which had inadvertently been placed in the unclassified section, was found in the possession of a researcher for *The Progressive* magazine. Today, ten months later, portions of the library containing unclassified technical documents remain closed to the public, although LASL has scheduled its reopening in April, 1980. (It should be noted that without access to the LASL library, the series of articles in this booklet would not have been possible.)

Another event which affected our investigation was the accident at Three Mile Island, which occurred in March 1979, while we were in the process of questioning LASL officials on cancer rates, safety procedures and the adequacy of waste storage techniques. The accident, and the concurrent Kerr-McGee/Karen Silkwood trial, seemed to intensify the seige mentality that characterizes some LASL officials.

While most of the LASL scientists we interviewed were open, honest and generous with their time, officials in the solid waste division initially refused to see us or allow us to tour the lab's principal solid waste disposal site; representatives of the lab's Public Information Office were generally uncooperative, failing to provide us with a copy of the LASL budget and other, basic information. One retired liquid waste official told us we were going to starve in the dark.

We would like to extend special thanks to Dr. George Voelz, Dr. Lamar Johnson, Dr. Wayne Hansen, Dr. William Purtymun, Dr. Alan Stoker and Dr. Thomas Hakonson, who spent many hours with us putting into layman's terms some of the confusing terminology and technical concepts central to the nuclear issue.

Of perhaps equal concern as the impact of LASL operations on the surrounding population and environment is the question of the lab's public information policies and practices. We have come to believe that the people of New Mexico have been seriously deceived as to the nature and extent of the routine and accidental releases of radioactivity from the lab.

LASL, born in secrecy dictated by wartime conditions, has never been able to shake the habit. Information on lab activities, channeled through the New Mexico news media, continues to be seriously tainted by half-truths, routine down-playing of radiation accidents and, in some cases, outright falsehoods. As a result, the people of New Mexico have been lulled into complacency over the nuclear projects underway on "the Hill."

When Dr. Donald M. Kerr, Jr. was selected as the new LASL director last spring, he pledged that the lab would strive to provide more information on its activities to a wider spectrum of the public and to New Mexico officials. But just the opposite may be occuring.

Dick Behnke, a reporter for the Santa Fe *New Mexican*'s Los Alamos bureau, noted in a column which appeared March 9, 1980 the decline of substantive press releases from LASL since Kerr became director. "In the nine months since Kerr took over, the number and content of laboratory press releases has hit an all time low," Behnke wrote. "Local reporters, who once relished writing about the scientific doings at LASL, are now faced with a few brief press releases on such mundane things as speaking engagements, awards and new people in new jobs [a lot of those]. There has not been one item in the last nine months about what is going on at LASL in its main job – science."

Since publication of the series of articles on Los Alamos in the *Albuquerque Journal* last October, the U.S. Department of Energy has released the final Environmental Impact Statement on LASL operations. No public hearings on the massive document are planned, however, because of insufficient public interest. ("Public interest" has apparently been determined by DOE and LASL by the number of written comments received on the draft impact statement.)

Public hearings have been held on the environmental impact statements prepared on other nuclear facilities around the country – including the Lawrence Livermore Laboratory – and have provided a unique opportunity for members of the public to find out what is going on at those installations. The people of New Mexico will, it seems, be denied that right.

INTRODUCTION

"Our world faces crisis as yet unperceived by those possessing power to make great decisions for good or evil. The unleashed power of the atom has changed everything save our modes of thinking and we thus drift toward unparalleled catastrophe. We scientists who released this immense power have overwhelming responsibility in this world life and death struggle to harness the atom for the benefit of mankind and not for humanity's destruction."

– Albert Einstein, 1946

One of the ironies in the history of Los Alamos Scientific Laboratory is that Albert Einstein, whose E=mc2 mass-energy equation provided the theoretical basis for nuclear weapons and who played a key role in the decision to proceed with the development of an atomic bomb, never visited the research facility tucked away in the mountains of northern New Mexico.

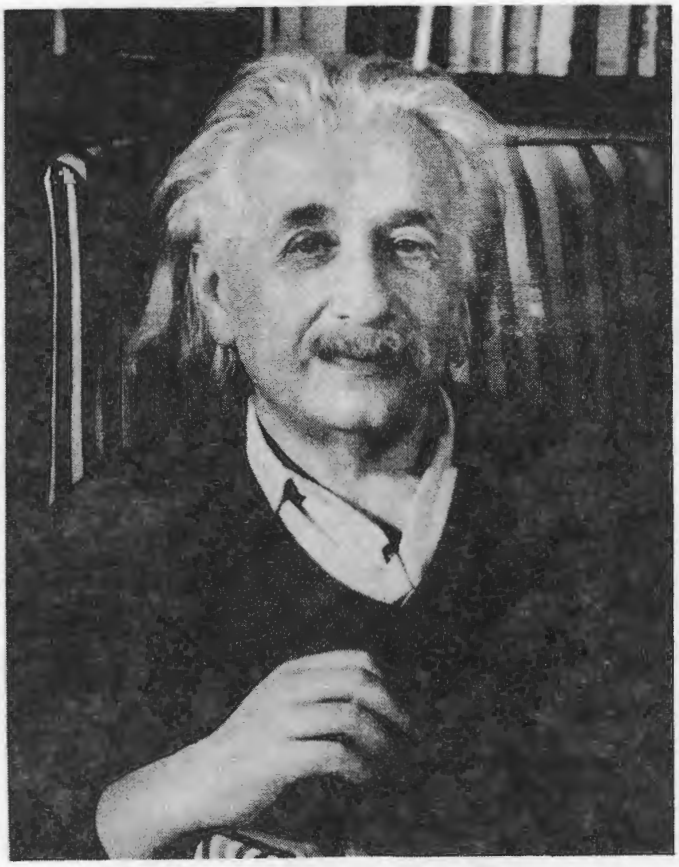
It was Einstein, the German physicist, who suggested that space and time were not what they seemed, who wrote the now-famous letter to President Roosevelt which laid the groundwork for the Manhattan Project and the establishment in January 1943 of the secret laboratory at Los Alamos. He told the President in the Aug. 2, 1939 letter that research work conducted since Otto Hahn first split the nucleus of the uranium atom in 1938 "leads me to expect that the element uranium may be turned into a new and important source of energy in the immediate future."

Einstein wrote: ". . . It may become possible to set up nuclear chain reactions in a large mass of uranium, by which vast amounts of power and large quantities of new radium-like elements would be generated. . . . This new phenomenon would also lead to the construction of bombs, and it is conceivable – though much less certain – that extremely powerful bombs of a new type may thus be constructed."

Einstein recommended that a single person be appointed to oversee a research and development effort exploring that possibility, to serve as coordinator between government agencies and the scientific community. That person was Dr. J. Robert Oppenheimer, LASL's first director who held that position until the end of the war.

The decision to lend his name to those urging a crash program to develop the atomic bomb did not come easily to Einstein, a lifelong pacifist and one of a number of Jewish physicists who sought refuge in the United States from the growing Nazi storm in the 1930s. His abhorance of war ultimately gave way, however, to what he considered the greater threat of Adolph Hitler.

Yet, while Einstein helped set the wheels in motion which led to the detonation of the world's first atomic bomb six years later, he was virtually excluded from all official knowledge of the work in progress at Los Alamos – the immigrant-pacifist could not be trusted in Washington, D.C. In a letter to American physicist Dr. Harold Urey, Vannevar Bush, director of the U.S. Office of Scientific Research and Development, spoke of the official reluctance to include Einstein in the atomic bomb program: "I wish very much that I could place the whole thing before him and take him fully into confidence, but this is utterly impossible in view of the attitude by people here in Washington who have studied his whole history," Bush admitted in the letter.



Albert Einstein. AP Newsfeatures Photo.

Ronald W. Clark, in his biography "Einstein: The Life and Times" (The World Publishing Co., 1971), writes: "The exclusion of Einstein from the inner counsels of the scientists who drove the Manhattan Project to its conclusion was to have one important result in 1945. For it effectively prevented him from using his enormous prestige when the future of the bomb was being discussed. By that time he was an outsider. . . . Thus the prophet of E=mc2 did not, in theory, know of the bomb's existence until it was dropped in anger."

Indeed, Einstein and other scientists who emerged from the Hiroshima-Nagasaki experience calling for strict control of this new, devastating form of warfare were largely ignored as the atomic weapons debate succumbed to the cold war arms race. Many of these scientists, some of whom had worked on the bomb project at Los Alamos, gradually returned to the universities and private industry.

Einstein and others continued to urge international regulation of nuclear weapons, through the Emergency Committee of Atomic Scientists, but it was those who insisted that national security dictated building bigger, better bombs who prevailed.

Among them was Dr. Edward Teller, one of the Manhattan Project physicists who ultimately left Los Alamos in the early 1950s because of dissatisfaction with the pace of nuclear weapons development at the lab. Teller was the aggressive advocate of pushing ahead with thermonuclear "superbombs," while Oppenheimer and his handpicked successor as LASL director, Dr. Norris Bradbury, were reluctant to proceed with H-bomb development after witnessing the horror at Hiroshima and Nagasaki.

Dr. Edward Teller, "father of the H-Bomb."
***Albuquerque Journal* File Photo.**

The philosophical schism between Teller and Oppenheimer characterized the debate within the scientific community during the post-war years; and the split between the two physicists widened further when Teller testified against Oppenheimer at the Atomic Energy Commission's "Gray Board" hearings in 1954, which resulted in the revocation of Oppenheimer's security clearance. Bradbury, who served as LASL Director from 1945 to 1970, has been quoted as calling those AEC hearings "a needless tragedy from start to finish."

When the brilliant physicist Hans Bethe, LASL's associate director under Bradbury, left Los Alamos to go to Cornell University, the lab's number two job went to Teller. Yet even after Teller and Stanislaw Ulam supervised the development of the hydrogen bomb at Los Alamos, Teller remained dissatisfied with the weapons program under Bradbury. "Edward felt we should run off in every direction at once to build the hydrogen bomb," Bradbury later recalled. "I don't think he was very happy about the way I was running the lab."

Eventually, Teller broke away from Los Alamos and was successful in gaining support for a second national weapons laboratory. The Lawrence Livermore Laboratory was established near Berkeley, CA in September, 1952, a product in large measure of Teller's driving ambition to escalate the U.S. nuclear capability at a time when no other nation even approached this country's atomic arms inventory. One of those who shared Teller's views and joined him at the new California weapons facility was Harold Brown, the present Secretary of Defense.

Dr. Harold Agnew, former LASL Director.
***Albuquerque Journal* File Photo.**

Among the scientists who remained at Los Alamos after the war was Dr. Harold Agnew, one of the young physicists who worked with Enrico Fermi on the first self-sustained fission reaction. Agnew, who went along on the Hiroshima mission as a scientific observer and generally agreed with Teller on the need to increase U.S. nuclear firepower, was appointed head of LASL's Weapons Physics Division in 1964. In 1970, he was named to succeed

Bradbury as the lab's director. He served in that position for nearly a decade, leaving last spring to take the job of president of General Atomic Corp. in San Diego, Cal. (As a parting gift, the U.S. Department of Energy bestowed on Agnew its highest accolade – the "Enrico Fermi Award for 1978" – which carries with it a Presidential citation, a gold medal and $25,000 cash.)

Before leaving Los Alamos, Agnew took a final shot at the University of California, which has administered both laboratories since their establishment. He cited a lack of advocacy for the total LASL program by the California Regents and "my frustration with what I consider to be a continuing inequitable distribution of defense funding by the Department of Energy between the LASL and Lawrence Livermore Laboratories." (In fiscal year 1978, Lawrence Livermore received $143 million in weapons research contracts, compared to $114.3 million for Los Alamos.)

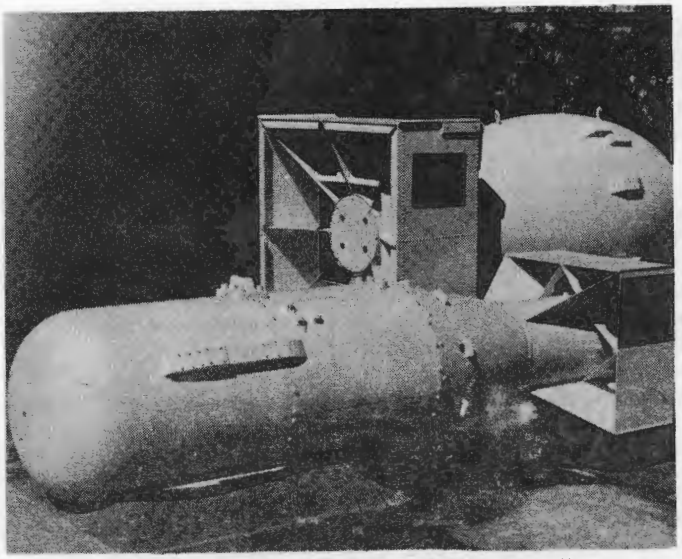
Lawrence Livermore, located at the site of an old Naval air station in California's southern Alameda County, achieved parity with the older, established laboratory at Los Alamos during the 1960s. The two facilities have been going head to head ever since in competition for the right to design this country's advanced weapons systems.

Since the explosion of the first A-bomb at Trinity Site on July 16, 1945, there have been more than 1200 nuclear tests worldwide, more than half of which have been carried out by the U.S. While precise figures are hard to come by, the Coalition for a New Foreign and Military Policy in Washington, D.C, reports that the U.S. arsenal contains at least 35,000 nuclear warheads – all of which have been designed either at Los Alamos or Livermore. The total world inventory is about twice that number, according to the Coalition.

The nuclear warheads that exist today in the U.S. stockpile make the Hiroshima and Nagasaki bombs look like pop-guns. While the atomic bombs which leveled the two Japanese cities had the explosive equivalent of 20,000 tons of TNT, the U.S. now has H-bombs with the explosive force about three times as great as all the bombs dropped by the U.S. during the entire Vietnam war.

This country's nuclear weapons policy in large measure has been guided over the past 35 years by a loosely-knit but influential alliance of scientists in the Teller-Agnew mold, military leaders and supportive U.S. Congressmen. The voices of moderation within the scientific community – Einstein, Oppenheimer and others – have been either ignored or officially black-listed.

Dr. Daniel Ellsberg, a former high-ranking government consultant intimately involved in the formulation of this country's strategic war plans during the 1960s, spoke of this nuclear power elite in a revealing interview in the February, 1980 issue of *Not Man Apart*, a publication of Friends of the Earth in San Francisco, CA. "We are seeing a pattern of behavior that has been around for a very long time – now simply implemented with nuclear weapons," said Ellsberg, a Harvard Ph.D. who also attended Cambridge University as a Woodrow Wilson Fellow. "The kinds of threats that were made before nuclear weapons are now still being made with nuclear weapons, as if they were just another kind of violent machinery to be fitted into the same pattern of behavior. Now that in itself represents very gross insensitivity and ignorance on the part of these



Replicas of "Little Boy" and "Fat Man," two of the original nuclear bombs developed at Los Alamos. Photo by Phil Niklaus.

men. They do not conceive the difference in violence and destructiveness in these weapons. They don't face up to it – just as the members of the public don't. But it is true, probably, that in the long-run, we won't be able to get away from the risks of these weapons until we attack and change this basic pattern of behavior."

Ellsberg, who turned the "Pentagon Papers" over to the U.S. Senate Foreign Relations Committee in 1969 and later to *The New York Times* for publication in 1971, served as an analyst for the RAND Corporation for 10 years. In that capacity, he helped formulate the structure and content of U.S. nuclear war strategy and in 1961, he was assigned the job of drafting the Kennedy Administration's top secret guidance to the Joint Chiefs of Staff for nuclear war plans.

Since his involvement in shaping this country's nuclear game plan, Ellsberg has turned anti-nuclear activist. Although he faces a possible jail sentence for civil disobedience for his part in a demonstration at the Rocky Flats, Colorado nuclear weapons plant, he remains committed to increasing public awareness of what he considers the present suicidal course mankind finds itself on with the continued proliferation of nuclear weaponry. "We're not talking about unilateral disarmament; the objective has to be global disarmament. Nothing other than that will protect the human species," he warned. "So it's a race, in which it's not at all guaranteed that the human species will be the winner. On the contrary, I think the odds favor that we will wipe ourselves out with the weapons that have already been produced, and with the behavior patterns that we have clung to so long."

There is little to indicate that the pattern of behavior Ellsberge spoke of is changing. To the contrary, the present crises in Iran, Afganistan and other areas have been used as justification by the shapers of U.S. foreign policy to further accelerate this country's nuclear arms production.

On Feb. 1, 1980, Edward Teller, now 72, returned to Los Alamos as a member of the University of California Special Research Projects Committee to receive a briefing

of the current projects underway at LASL. During his tour, Teller again was drumming up enthusiasm for increased nuclear production as well as the development of laser beam weapons on the grounds that the U.S. defense posture is vastly inferior to that of the Soviet Union. He suggested that the U.S. long ago lost the weapons race in terms of numbers to Russia. "To catch up quantitatively will be very difficult – in the short run, impossible," he was quoted as saying.

Considering the widespread instability today in the world, the presence of this ever-growing number of devastating nuclear weaponry brings the prospect of an atomic cataclysm from the realm of science fiction to the possible and even inevitable. That view, once shared by a fringe of American society, is now becoming apparent even to those most intimately associated with the U.S. nuclear evolution.

Dr. George Kistiakowsky, emeritus professor of chemistry at Harvard and science advisor to President Eisenhower, described the likelihood of a nuclear confrontation in the March 9, 1980 issue of *Parade* magazine. "Given the present geo-political trends and the quality of political leaders that burden mankind, it would be a miracle if no nuclear warheads were exploded in anger before the end of this century and only a bit smaller miracle if that did not lead to a nuclear holocaust," said Dr. Kistiakowsky, who served as head of the explosives division at Los Alamos during the Manhattan Project years and is considered one of the world's most knowledgeable scientists on nuclear weapons.

A global atomic war is of course the ultimate concern in the overall nuclear debate in this and other countries. But short of the very real threat of all-out nuclear warfare, the atomic age born in the New Mexico desert in 1945 has created the spectre of a planet slowly but steadily being contaminated with radioactive by-products from both the military and commercial sectors of the nuclear industry.

Since its origin as a super-secret military facility established for the sole purpose of constructing the world's first fission bomb, Los Alamos Scientific Laboratory has evolved into one of the nation's foremost energy research installations. With roughly 45 per cent of its budget devoted to nuclear energy programs and another 40 per cent to nuclear weapons, the lab has conducted considerable research on the control of radioactive materials and on their behavior when released to the environment.

Given the growing public uncertainty in the U.S. and elsewhere regarding the ability of the nuclear industry to

Underground nuclear blast of Nevada Test Site. LASL Photo.

effectively handle and contain radioactive materials, it was our view that an in-depth investigation of one of the country's premiere research laboratories would help define the "state of the art" in nuclear waste handling and disposal technologies. At Los Alamos, a unique liquid waste treatment facility has been constructed to process radioactive effluents generated by the various nuclear programs; a test incinerator to reduce the size of solid wastes is nearing completion; and radiation monitoring devices have been developed. As such, LASL is considered to be in the vanguard of this country's nuclear research and development efforts.

Yet despite these advances, LASL continues to experience major problems in the containment of radiation. In our six-month investigation, we found:

–The lab is dumping an average of 25,000 gallons a day of radioactive liquid waste into a series of deep canyons which intersect the LASL complex. As a result of past and present liquid waste disposal practices, radioactive "hot-spots" have been found on and around lab property. Some of these contaminated areas are located on nearby Indian land, others on county-owned land in the townsite and on land used by the public for outdoor recreational activities. A portion of the radioactivity disposed of in the canyons is slowly being carried by runoff to the Rio Grande. (article no. 3.)

–Tritium, or radioactive hydrogen, is routinely leaking from the lab's principal solid waste burial ground, as well as from other facilities where the element is handled. LASL officials say they are unable to prevent this "migration." (article no. 4.)

–A LASL report widely distributed to the New Mexico news media incorrectly stated that no radioactivity was leaking from the lab's primary solid waste disposal site. Under our questioning, one high-ranking LASL scientist admitted the report is "misleading" and will be revised to reflect the movement of radioactive tritium from the disposal trenches to the atmosphere. (article no. 5.)

–Accidental releases of radiation continue to regularly occur at Los Alamos, resulting in contamination and in some cases death among lab workers. The health impact of lab operations on the general public living around Los Alamos is difficult to guage, largely because of the absence of hard epidemiological studies. Previously unpublished statistical data from the New Mexico Tumor Registry show, however, breast and digestive tract cancer in the Los Alamos area to be more than twice the state and national averages. (article nos. 6 and 7.)

–The responsibility for monitoring radiation released from the lab rests primarily with LASL officials themselves, with only minimal state and federal oversight. One official with the U.S. Geological Survey in Albuquerque, which had been involved in a joint monitoring effort with the lab until until 1970, said his agency pulled out of the program because LASL allowed insufficient input by USGS in the interpretation of the collected data. He suggested that perhaps the monitoring should be conducted by an agency apart from LASL – an ethical point he said should be debated. (article no. 8.)

Based on our analysis of radiation containment procedures at LASL, it is apparent that despite technological improvements over the past 35 years, nuclear waste management today remains an imprecise, primitive art. Airborne and liquid effluents contaminated with various radioactive elements are routinely released from LASL facilities to the environment, where studies have shown elevated levels in plants, animals, soil and water in some cases hundreds and even thousands of times greater than is present from natural and fallout radiation combined. Meanwhile, the short and long-term health effects of this steady release of low-level radiation is poorly understood in the scientific and medical community.

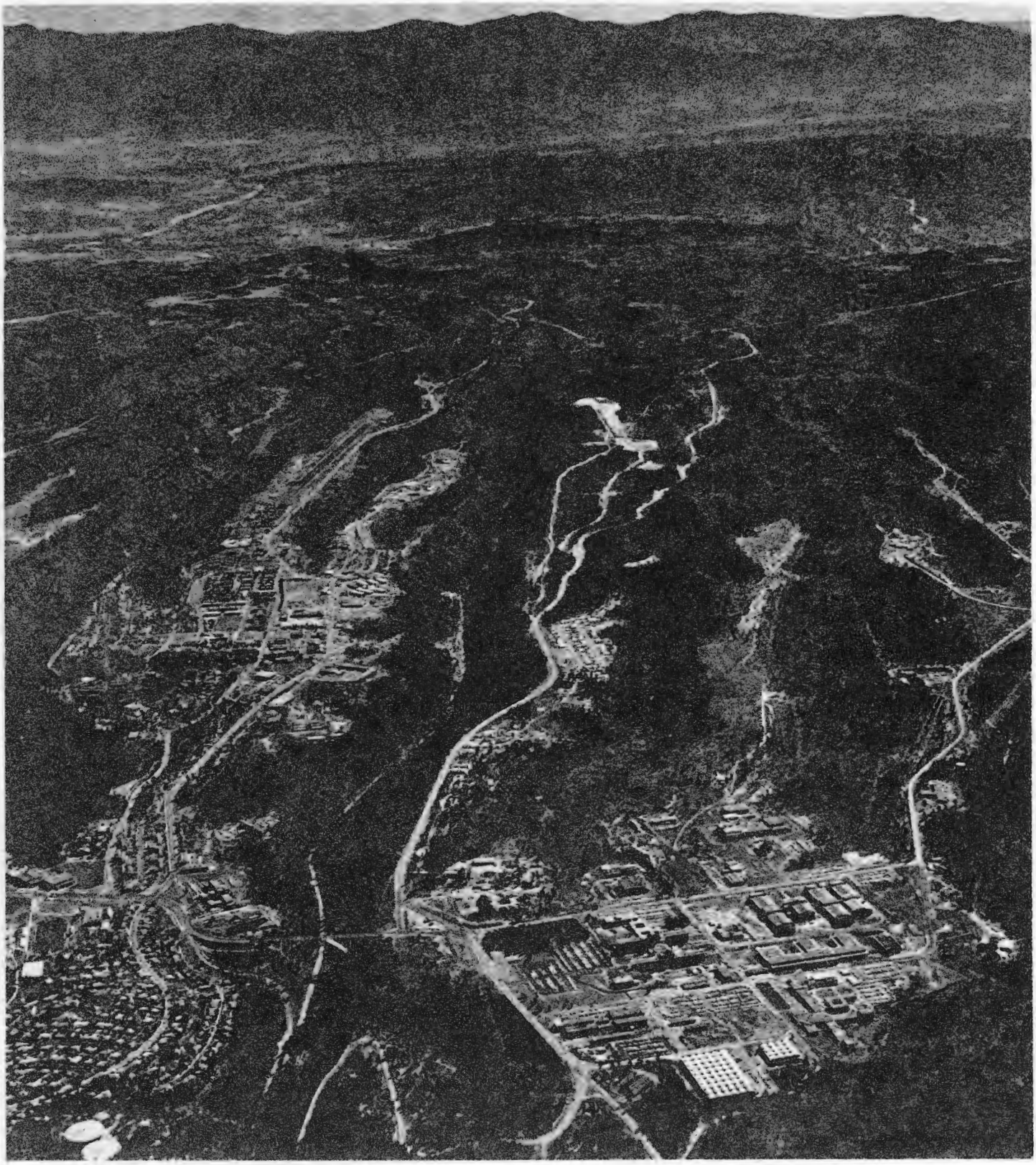
Los Alamos Scientific Laboratory is regarded as one of the leading nuclear research facilities in this country and probably the world, staffed by many of the nation's top physicists and with generous funding support from the Department of Energy. If the level of containment of radiation at LASL is indicative of the best the industry can do in terms of nuclear waste management, one begins to wonder what is happening at the other, less sophisticated nuclear installations throughout this country and the world.

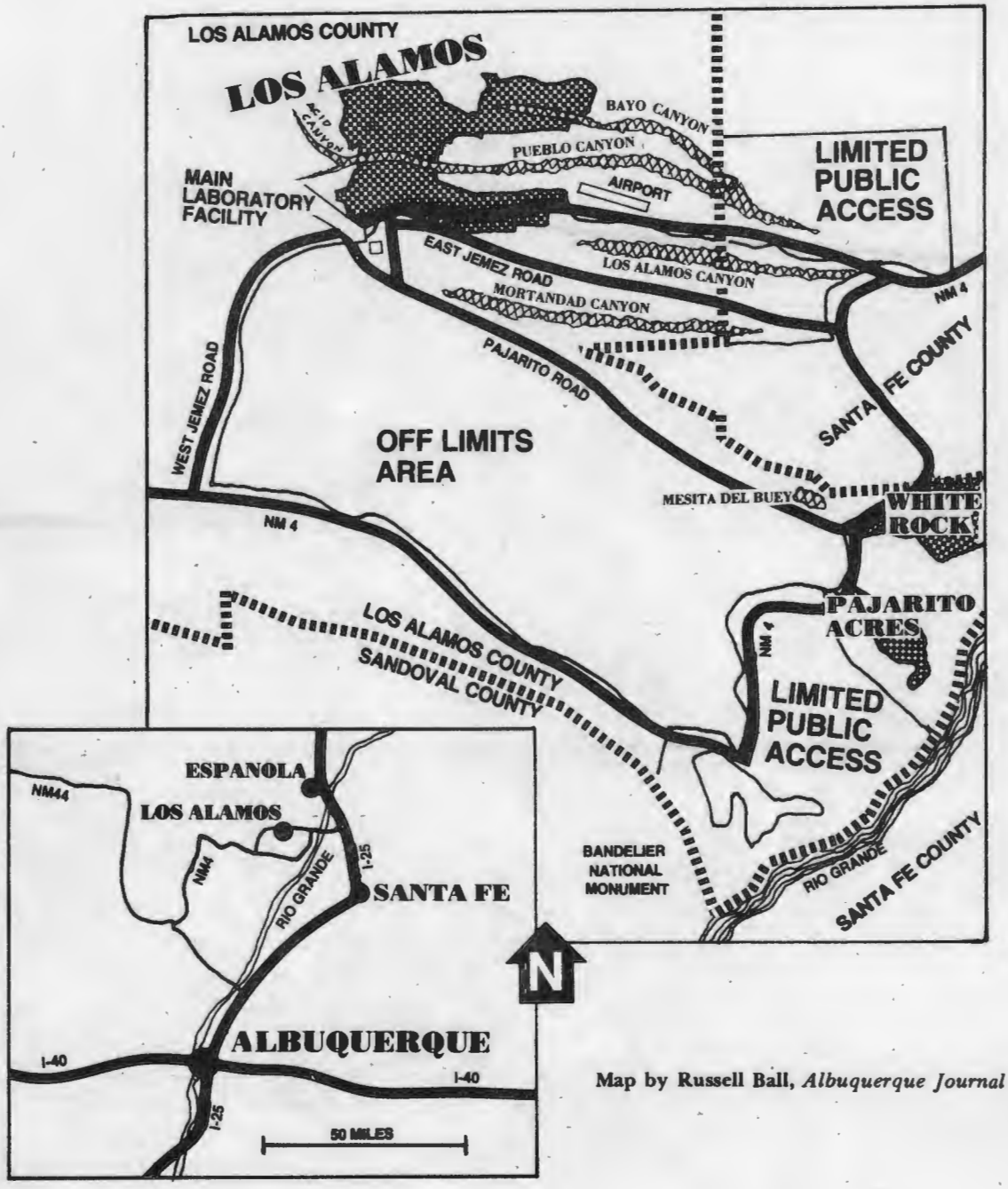
The inescapable conclusion is that the scientists, technicians and engineers given the power of the uranium atom are unable to control it. Radioactivity is leaking routinely and accidentally from all nuclear facilities – even the crown jewels of the industry such as Los Alamos Scientific Laboratory. Meanwhile, the world politicians are unable or unwilling to halt the inevitable spread of the nuclear weapons which now pose a threat to the very existence of the human race.

Nuclear bombs have been around for 35 years; the commercial nuclear power industry is about 10 years younger. But while the atomic age is still in its relative infancy, the record is not good and shows little indication of improving rapidly. The great promise of atomic energy has produced not electricity too cheap to meter, as predicted, but rather a filthy, hazardous fuel cycle, expensive nuclear reactors which are more of a threat to the communities they serve than a benefit, lethal waste products that will be around for hundreds of thousands of years and bombs big enough to destroy all life on this planet. Perhaps, most devastating for this country is that the nuclear issue is dividing the American people at a time when survival may depend on unity.

Dr. Ellsberg spoke of the challenge he considers preeminent for the people of the world: ". . . It is of far greater importance to disarm the world-states of nuclear weapons – even if everything else remains the same, with all the wars and the famines and everything else," he told the *Not Man Apart* editors. "It's simply a precondition for addressing any of those other problems. I can't really believe that life can persist very long with the level of nuclear weapons and the dispersal of them that we have not achieved. That has to change. . . ."

– Phil Niklaus and Dede Feldman
April, 1980





Map by Russell Ball, *Albuquerque Journal*

I

Radiation: How Much Is Too Much?

LOS ALAMOS — A lush mountain canyon intersecting Los Alamos Scientific Laboratory property, which is regularly visited by hikers and other outdoor enthusiasts, contains "hotspots" of radioactive contamination hundreds of times greater than has accumulated over the years from nuclear weapons fallout.

Acid-Pueblo Canyon, cut by an intermittently-flowing stream which feeds the Rio Grande, was used until 1964 as one of the original, long-term dumping areas for liquid radioactive wastes generated at the lab. Following a two-year cleanup operation involving the removal of about 600 dump truck loads of dirt and debris, LASL officials determined that the land had been decontaminated to non-hazardous levels and the canyon system was returned to Los Alamos County for public use in 1967.

Although the cleanup of Acid-Pueblo Canyon in 1967 was considered adequate at the time, more stringent federal guidelines covering radioactive contamination now dictate that additional cleanup work may be necessary.

Soil samples taken in the Acid-Pueblo stream bed showed what a LASL report terms "significant concentrations" of plutonium-239, a highly toxic and long-lived radioactive element.

LASL officials say the elevated amounts of plutonium and other radionuclides in Acid-Pueblo Canyon are not a cause of concern, as even the maximum concentrations are less than half the amount of radioactivity in soil allowed by federal radiation standards.

In recent years, however, government radiation standards have come under increasing attack and the question of low-level radiation has become the focus of heated scientific debate — one which could affect the future of nuclear power in this country.

The controversy centers on the relationship between small but steady doses of radiation and increased cancer rates and whether the present standards are adequate to protect public health.

The contamination found in Acid-Pueblo Canyon and other hotspots around Los Alamos — and what effect it might have on the general public — epitomizes the low-level radiation debate.

"I'm not too concerned about those levels (of radiation in the canyon) at this point because they're below any applicable standard," said Dr. Wayne Hansen, who heads the LASL Environmental Surveillance Group responsible for monitoring land in and around the lab's perimeter. He added, however, "If we were totally unconcerned (about radiation levels), my group would not exist."

Hansen, who worked for the U.S. Environmental Protection Agency (EPA) for four years prior to joining the LASL staff, acknowledged that persons hiking through Acid-Pueblo Canyon are not informed of the presence of above-fallout radioactivity, either by posted signs or other means. "There's no reason to inform them because it's not a hazard. It's quite well known locally," he said. "I would not hesitate taking my children walking through the area."

Acid-Pueblo, site of ancient Otowi Indian ruins, is one of three major canyon systems in the Los Alamos area that have been used over the years for the disposal of LASL's liquid radioactive wastes.

In 1976, 27,000 acres of land around Los Alamos was designated as a National Envirnonmental Research Park, one of four such areas surrounding nuclear installations in the U.S. set aside to enable the study of radioactivity in the environment. While studies by Hansen's group have helped identify the behavior of radioactive contamination in a natural setting, they have also revealed some elevated radionuclide concentrations in soils, plants and animals in the canyon ecosystems.

The final Environmental Impact Statement assessing the impact of LASL operations on the surrounding area, which was released in January, 1978, says of the canyon disposal areas: ". . . There are locations that have accumulated plutonium-238 and -239 and cesium-137 in sediments in significant concentrations above background." ("Background," as defined at Los Alamos, includes naturally occurring cosmic and terrestrial radiation, as well as the man-made radioactivity contributed from nuclear weapons fallout.)

The impact statement, prepared by LASL personnel for the U.S. Department of Energy, goes on to say, however, that because of the rugged, isolated nature of the canyons, a person walking through the areas of radioactive contamination "would likely be exposed for only short periods" and therefore would receive only an insignificant radiation dose.

The report concludes: "Thus, neither the direct atmospheric releases nor any possible pathways resulting from release of liquid effluents have any significant impact."

While Dr. Hansen and others at Los Alamos discount the potential adverse health effects of contamination

One of fifteen radioactive waste disposal sites at Los Alamos. Photo by Dede Feldman.

in the canyons, other federal officials have cautioned that increased vigilance of the surrounding ecosystem is advisable. In a letter commenting on the draft Environmental Impact Statement on LASL operations, Dr. William H. Foege, Assistant Surgeon General with the U.S. Public Health Service, stated: "This [draft EIS] acknowledges that low but measurable levels of long-lived radionuclides, such as strontium-90, plutonium-239 and americium-241, are being released from the Los Alamos facilities into neighboring terrestrial and aquatic environments. The Food and Drug Administration is concerned about the potential for such radionuclides to accumulate in aquatic and terrestrial plants and animals which become a part of the human food supply."

"Therefore, we recommend that the Department of Energy broaden the base of its monitoring program to include measurements of the above radionuclides in components of plants and animals located downstream and downwind from the research facilities, waste burial sites and other locations known to be used as human food sources."

The Department of Energy, which exercises regulatory authority over LASL, has ordered a reassessment of known areas of radioactive contamination around various nuclear installations in this country. One of the locations identified for further survey work is Acid-Pueblo Canyon.

Yet although radiation levels in soils, plants and animals have been found to be in some cases hundreds and even more than a thousand times higher than the contamination present from fallout accumulations, the public continues to be allowed unrestricted access to Acid-Pueblo Canyon.

"Well sure they walk in there," said Dr. Alan Stoker, another member of the lab's Environmental Surveillance Group. "Do you want the guidance number that EPA accepts as a safe level? EPA says that if it's less than 13 picocuries (of plutonium) per gram, forget it, it's okay, don't worry about it — eat it if you want." (A picocurie is a measurement of radioactivity).

The plutonium-239 measured in Acid-Pueblo revealed maximum concentrations of 5.62 picocuries per gram. Although that figure is more than 100 times higher than the level generally attributed to atomic fallout — about .05 picocuries per gram — it is still less than half the 13 picocuries allowed by EPA.

Dr. Hansen scoffed at the idea that radioactive contamination above fallout represents a possible exposure problem. "One hundred times (fallout) is a scare number as far as I'm concerned. It doesn't put any perspective on what the real hazard is. Compare it to the EPA standard — that's a good comparison," he said.

As part of its responsibility for radiation monitoring around Los Alamos, Hansen's group prepares an annual "Environmental Surveillance" report, which documents the findings of the previous year's studies. The most recent annual report covering 1978,

which was released last spring, concludes: "No significant exposure pathways are believed to exist for radioactivity released [to the canyons] in treated liquid waste effluents."

During an interview, however, Hansen admitted that the report's conclusion is not entirely accurate. "In the absolute sense, there is some exposure [to persons walking through the contaminated canyons]," he said.

The final LASL impact statement says that the average whole body dose of radiation attributed to the lab's nuclear programs is about .8 millirem a year in the Los Alamos townsite and about .1 millirem a year in White Rock, the neighboring bedroom community. The report states: "The added risk of injury by cancer is estimated as between zero and one in 12 million per year for the townsite and between zero and one in 100 million per year for White Rock due to LASL activities."

The story of radioactive waste disposal practices at Los Alamos begins during the initial years of the lab's existence during World War II.

Los Alamos Scientific Laboratory was established in January, 1943, its sole mission the development of a bomb using the vast energy released during the fission or splitting of the nucleus of the atom. A school for boys in the mountainous, north-central region of New Mexico was selected as the site for the bold undertaking — code-named Project Y of the U.S. War Department's Manhattan Engineering District — which two and a half years later brought this country and the world into the nuclear age.

Some of the most talented physicists and engineers from the Free World and around the U.S., together with promising young post-graduates from the country's top universities, were assembled under the direction of Dr. J. Robert Oppenheimer, a prominent nuclear physicist from the University of California at Berkeley who had been studying the theoretical possibilities of an atomic bomb. At Los Alamos, amidst the scenic backdrop of northern New Mexico, they worked against time, driven by a sense of pioneering scientific innovation and national urgency in what some felt was a race with Nazi Germany to produce the world's first fission bomb.

During the hectic early period of the lab's existence, the spartan, hastily-constructed military installation was veiled in super-secrecy – high fences and armed guards were stationed along its perimeters; the only mailing address was a Post Office box in Santa Fe; all personnel, including children, were required to show specially-issued identification cards before entering and leaving and the most well-known of the physicists were assigned code names to stifle speculation as to what was underway at Los Alamos.

New Mexico residents living nearby wondered at the mysterious comings and goings on "the Hill," but they were kept guessing until early one Sunday morning in the summer of 1945, when the tightly-held secret was blasted into the open in the desert northwest of Alamogordo.

The impact of that initial atomic test at Trinity Site was both immediate and far-reaching — and perhaps more than any other event of the 20th Century has irrevocably changed the course of world events. The detonation of "Fat Man" on July 16, 1945 signalled the beginning of the end of the Japanese war effort and thrust the U.S. at once into undisputed preeminence as the world's arms leader.

The ensuing debate over nuclear weapons, which helped fashion the direction of Los Alamos Scientific Laboratory in the post-war years, continues to rage. The current controversy in the U.S. Congress over the SALT II agreement between the U.S. and Russia typifies the extent to which opinions continue to differ on control of nuclear weapons — and nuclear energy in general.

During LASL's early years, the potential adverse effects of radioactive pollution, not surprisingly, took a decided back seat to the threat posed by Germany and Japan. The rush to fabricate a nuclear bomb was the over-riding concern during the war and even in the post-war years, only passing attention was given to the radioactive by-products generated at the lab.

Highly-contaminated liquid wastes were for the most part simply flushed, untreated, into the canyons which cut through the lab property; the solids were buried in pits dug in the Los Alamos mesas with little regard to their radioactive composition; and gases were vented to the atmosphere after only limited filtration. Those questionable waste management practices of the past resulted in some severe contamination around Los Alamos, as evidenced by the continuing decontamination problem facing lab officials in Acid-Pueblo Canyon and elsewhere.

Over the years, those initial haphazard disposal practices have been upgraded substantially, although the basic strategies employed to contain radioactive releases remain essentially the same.

Currently, the weapons work and other research programs are carried out at 30 technical areas throughout the LASL installation, virtually all of which produce varying quantities of liquid, solid and gaseous waste. Airborne radioactivity is released from about 90 stacks, located in 14 of the lab's principal technical areas.

Solid waste materials, ranging in size from test tubes and rubber gloves to massive "glove-boxes" and other laboratory equipment rendered useless by radioactive contamination, continue to be placed in huge trenches and shafts cut in the volcanic tuff at Los Alamos. While these solids were buried at random in the earlier years, today they are analyzed for isotopic composition and the longer-lived radionuclides are placed in retrievable storage to allow for future permanent disposal, presumably at a national nuclear waste disposal site such as the Waste Isolation Pilot Plant (WIPP) proposed near Carlsbad.

The radioactive liquid waste generated at the lab — at a rate of 25,000 gallons a day — now undergoes processing at two treatment plants, where the most hazardous concentrations of some radionuclides are separated as a sludge for burial in one of the lab's solid waste storage sites. The remaining, still-partially contaminated liquid effluent is then released into the Los Alamos canyons.

Radioactive gases and particulate matter for the most part are passed through elaborate, multi-stage filtration systems before being released to the atmosphere, which has significantly reduced the concentrations vented to the air from the comparatively primitive containment procedures of the past.

LASL is now widely viewed as one of the world's premiere scientific installations, a leader in the U.S. weapons and energy development effort. In the field of nuclear waste management, the lab's facilities and practices are regarded as among the most advanced and have been pointed to, in New Mexico and elsewhere, as proof that the hazardous by-products of the nuclear age can be successfully isolated from the biosphere.

Yet although the technical improvements made to harness radioactive waste have decreased the rates of radioactivity routinely dispersed from the lab, their overall effectiveness remains variable — some radionu-

Rock formations, caves line the sides of many local canyons. LASL photo.

clides are contained at a rate of better than 99 per cent, some are not controlled at all, according to LASL officials.

The section of the final LASL impact statement on "unavoidable adverse environmental effects" says: "The release of some [radioactive and chemical] pollutants in liquid and airborne form from LASL facilities and treatment plants is an unavoidable result of continued operation. Present knowledge derived from the routine environmental surveillance program and special ecology studies indicates these releases result in impacts that are neither large or significant."

The impact on human health in the Los Alamos area from radioactive pollution is difficult to gauge, however.

LASL officials like to point out that the daily radioactive releases from the lab add only a small fraction to the total dose received by area residents from naturally-occuring radiation and fallout.

But aside from the constant dispersion of low-level radiation from routine operations, there have been periodic accidental releases of relatively large amounts of radioactivity which pose the threat of a consideralbly larger dose to the general public in a brief period of time. There are also mechanisms in nature which tend to concentrate radioactive elements, which can result in possible inhalation or ingestion by persons coming in contact with those sources of contamination.

The airborne and liquid pollution regularly released from LASL furthermore include radionuclides which do not appear naturally in the environment and which, in some cases, are little understood, nuclear critics charge.

Dr. George Voelz, who heads the LASL Health Division, downplays the impact of radiation on people living in the Los Alamos vicinity. "I'm not saying it's (radiation) not a hazard," he said during an interview. "I'm saying as a risk, it's so low comparatively that people are going to forget about it and start studying other things that are not as well understood."

Voelz believes other hazards in our technological society are of far more concern than radiation — a view shared by many at LASL. He rejects the notion that the impact of the longer-lived transuranics such as plutonium are not well known.

"I'd say it's pretty darn good," he said of the current level of understanding of plutonium. "There aren't too many unknowns about it as compared with other things. I wouldn't say there are no unknowns — I wouldn't be that stupid. But I'm just saying I can give you 10,000 chemicals in which we just don't have any information comparable to plutonium."

Dr. John Gofman, a professor of medical physics at the University of California at Berkeley and a long time nuclear critic disagrees. Writing in the Journal of the American Medical Association in 1976, Gofman said: .."... It is my opinion that plutonium's carcinogenicity (cancer causing potential) has been very seriously underestimated. If one couples the corrected carcinogenicity with the probable degree of industrial containment of plutonium, it appears the commercalization of a plutonium-based energy economy is a not an acceptable option for society."

Gofman, a former associate director of the AEC's Lawrence Livermore Laboratory — LASL's sister nuclear research facility in Berkeley, Calif. — is currently chairman of the Committee for Nuclear Responsibility, an anti-nuclear group of scientists.

Dr. Robert Watt, a nuclear physicist now retired from LASL, believes that Los Alamos officials are reacting to the growing controvery over nuclear energy.

"Los Alamos has become more defensive in the past five years. People are afraid of radiation and we see that data has been covered up in the Nevada Test Site (where much of the nation's nuclear weapons testing is conducted) and elsewhere," Watt said. "At Los Alamos, they think nobody else understands radiation. They're not worried about it and they think that no one else should be either."

To allay fears about radiation, LASL scientists and members of various pro-nuclear groups have appeared on local television in New Mexico to tell the public that the dangers from nuclear

energy are small, relative to other energy sources. In newspaper letters-to-the editor, interviews and public hearings, they have urged a comparison of nuclear-generated radiation to natural radiation from sunlight, airplane travel and adobe and other masonry building materials.

A number of LASL officials, in fact, blame the news media for the public's growing fear of radiation.

In a Los Alamos colloquium held shortly after the accident at Three Mile Island nuclear power plant, Dr. William Stratton, a LASL physicist who serves as consultant for the National Advisory Committee on Reactor Safeguards, said the news media was irresponsible in its reporting of the incident. "The press could have been responsible for millions of dollars in damages and thousands of lives lost (by unnecessarily panicking those in the area)," he said.

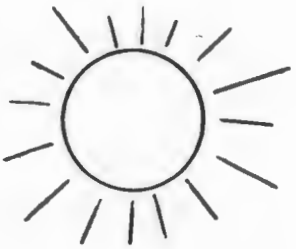
Stratton said the press always emphasizes the worst case and was in effect "screaming fire in a closed place" during the accident in Pennsylvania.

There are those, however, who throw the same charge of distortion back at LASL.

"The lab is expert at yellow sheet journalism. They exaggerate and minimize to exonerate themselves," said J.L. Kunkler, a geophysicist with the U.S. Geological Survey who participated in a cooperative monitoring program at the lab during the 1960s. "They were snobbish, arrogant — many felt they knew more than the AEC and other regulatory agencies."

One former LASL engineer, who moved to state government after 26 years at the lab, concurred with Kunkler's view. "They push their product," said Richard Neal, who now lives out of state. "This is natural, but I'm cynical about it. I wouldn't believe what they put out. They slant it. Information about accidents is very carefully screened."

LASL falls under regulatory control primarily of the federal Department of Energy, which is also the source of the lab's funding. Asked to assess LASL's performance in the field of radiation management, William Crismon, DOE branch chief of the Technical Division in Los Alamos, stated that there has never been an incident when DOE called LASL on anything. "LASL has been ultra-conservative —wearing a white hat—in terms of insults to the environment," he said.



One of several Indian ruins in Los Alamos canyons. LASL photo.

Lab Makes Los Alamos 'Elite Enclave'

Los Alamos, a county established more than 20 years ago to accommodate the transition from military to civilian control, is in many ways uniuque in predominantly Spanish northern New Mexico.

At the heart of the county, economically and socially, is Los Alamos Scientific Laboratory. The lab, born as a topsecret military base and raised under the tutelage of the now-defunct Atomic Energy Commission, is at present controled by the U.S. Department of Energy.

Although much of the land surrounding LASL was transferred to private and local ownership in the early 1960s, the federal presence remains pervasive.

In fiscal year 1976, the federal government provided direct assistance — involving $4.5 million — to the county government, schools, the town's water utility and fire and police forces. The payments, negotiated yearly, are made to offset the fact that the lab pays no property taxes.

Approximately 89 per cent of the county is federally-owned, with many of the roads maintained by the federal government.

DOE, through its funding of the lab, provides thousands of jobs to area residents. According to the LASL draft environmental impact statement issued last year, unemployment in Los Alamos County in 1976 was 4.8 percent, about half the average for northern New Mexico and less than one-fourth the rate in neighboring Rio Arriba County.

"If DOE operations in the area were to be discontinued, 8,650 jobs and $150 million in income would be lost to northern New Mexico directly," the impact statement says.

Median family income in Los Alamos in 1975 was $15,273 a year, about three times higher than the average in Rio Arriba and the highest in the state. In Los Alamos, only 2 per cent of the residents live below the poverty line, compared to 34 per cent in Rio Arriba.

The Los Alamos school system is the best in the state. Students from Los Alamos consistently achieve higher test scores than the statewide average and most attend college.

With what is considered the finest medical center in the state, Los Alamos County has patient-doctor ratio of 589:1, while in Rio Arriba the proportion is 1820:1.

In addition, Los Alamos can boast a low crime rate, water bills that are half those in Santa Fe, 33 parks, a light opera, a ski area and over 200 active clubs that cater to just about any personal interest from hiking to majong.

But there are disadvantages as well to living in this nuclear Shangri-la.

In spite of the job opportunities afforded by the presence of Los Alamos Scientific Laboratory, women in the one-industry town are chronically unemployed.

A 1974 Los Alamos task force report on community health cited women with little more to do than volunteer work as a major mental health problem in the town, often leading to depression, marital problems, boredom and alcoholism. Another problem is the sense of isolation, which results not only from the community's geographical setting but also from the vast differences in income and cultural background that separate Los Alamos from the rest of northern New Mexico.

The most visible of these differences in racial — 81 percent of Los Alamos is Anglo, while in nearby Rio Arriba only about five percent of the population is Anglo.

"Los Alamos is an enclave for the very elite," said one woman who lived in the town for more than 20 years as the wife of a LASL physicist. She asked not to be identified.

"There's so much money and it's so isolated from the rest of the state," she noted. "There are a vast number of support people who work for the Zia Corp. (a construction and maintenance company servicing LASL), but many of them do not live in Los Alamos and there is very little mixing."

According to the LASL impact statement, about one-third of the LASL workers reside outside the town, including many Spanish and Indian employees who commute daily from Espanola, and the Santa Clara and San Ildefonso Reservations.

Dr. David Freiwald, a LASL spokeman, describes the double-edged relationship between Los Alamos and the surrounding areas this way: "There's some antagonism that mostly goes back to the economic thing — we're the highest paid per capita community in the state of New Mexico," noting, however, "If we weren't here, unemployment would be higher than it already is in places like Rio Arriba. We're doing in terms of work days of the year, a million dollars a day in research business and about 60 percent of that is payroll.

"They like us for that but they're also jealous because of the economic disparities."

II

Radiation Standards Causing Confusion

Government standards established through the years to protect the public and nuclear workers from excessive radiation exposure have been a source of increasing controversy and confusion, plagued by overlapping jurisdictions by federal agencies and conflicting interpretations of the health risks of low-level radiation.

"The standards are a mess, commented Dr. Wayne Hansen, who, as LASL's Environmental Surveillance Group leader, bears the responsibility for sorting out the sometimes conflicting radiation protection requirements imposed by the federal government. "You get some very strange mixtures of standards between agencies. We have one standard for this and one for that and they don't agree. You almost have to be a specialist to compare the standards.

"It's very unfortunate that we're in such a state, to be honest," he added.

Testifying during hearings on radiation protection before the House Committee on Government Operations, Dr. James Liverman, the Department of Energy's assistant secretary for the environment, stated: "The greatest obstacle of the success of the federal radiation protection program has been the absence of an authoritative voice within the federal government to stipulate standards as criteria which form the basis for agency and department programs."

Currently, the general public at Los Alamos is subject to two differing sets of radiation protection standards, one established by the Environmental Protection Agency for public exposure outside of lab property and one by the DOE and Nuclear Regulatory Commission for public exposure at the lab boundary and outlying areas.

Because of the layout of Los Alamos, there is in some cases little distinction between the area considered on-site and those classified as off-site. Public roads weave past LASL technical areas which routinely emit radioactive gases and there are "off-site" locations where members of the public do receive added doses simply by driving by.

The distinction lies in the regulations.

The most common measurement of human radiation exposure is the "rem," a unit referring to the actual amount of radiation absorbed by the body over a certain period of time. Because the rem is an inconveniently large measurement for radiation protection purposes, doses are more commonly expressed as millirem or one-thousandth of a rem.

The EPA standard adopted in 1977 for radiation dose limits to the public living near nuclear facilities is 25 millirem per year. The standard accepted by DOE and NRC for exposure to the general public is 170 millirem per year and 500 millirem for members of the public who may live adjacent to the fenceline of a nuclear installation.

The standards for public exposure allowed by the federal government are considerably lower than the maximum permissable radiation dose to nuclear workers, which is 5,000 millirem (five rem) per year.

Hansen, whose group is charged with determining compliance with the applicable standards, points out that LASL is bound only by the DOE-NRC standards, though he said the lab uses the more stringent EPA standard as a type of "self-evaluation" guide.

The 1978 LASL Environmental Surveillance Report states: "Some increments of radiation doses above natural and worldwide fallout background levels are received by Los Alamos County residents as a result of LASL operations."

How much of a dose depends, in large measure, on an individual's proximity to certain facilities known to be sources of routine radiactive releases, primarily gaseous. "If you live closer, you get more (of a radiation dose) than a guy that lives farther away," said Hansen.

But there are factors other than distance which come into play in determining radiation dose. The LASL final Environmental Impact Statement notes: "Specific persons will receive higher or lower doses depending upon their age, living habits, food preferences or recreational activities." But despite the wide range of variables, average dose estimates are determined on a strictly numerical basis.

The whole-body radiation dose received by the total Los Alamos population as well as residents of the surrounding area during 1978 from radioactive releases from the lab is calculated to be 10.5 man-rem, according to estimates contained in the Environmental Surveillance Report prepared by Hansen's group. The man-rem concept for calculating exposure is the cumulative total radiation dose received by an entire population. To determine individual dose estimates, that 10.5 man-rem figure was divided by the total population of 105,000 persons living within an 80-kilometer circle of Los Alamos. Based on the 10.5 man-rem LASL estimate, individuals within that radius receive an additional average dose of about one-tenth of a millirem per year from lab operations. The communities within this circle include Santa Fe, Espanola, Pojoaque, Jemez Springs and part of Bernalillo County. The maximum individual dose is calculated at four millirem, a figure arrived at by figuring possible exposure levels from routine emissions of radioactivity from three primary lab facilities — the research nuclear reactor at "Omega Site," the principal solid waste disposal area at Mesita del Buey and the Clinton P. Anderson Meson Physics Facility.

Dr. Hansen said, however, that he considers the man-rem system of esti-

mating average doses to the public "meaningless." He pointed out that the biological consequences of a single person receiving a radiation dose of 100 rem is far different than 100 persons each receiving one rem, although the two examples would equal 100 man-rem.

"It doesn't mean a cussed thing," he said.

Hansen added, though, that EPA, DOE and NRC all accept the man-rem concept. "I resist it whenever I can, but the crazy number is in the regulations, so you're almost forced to use it. Insanity, I think."

Despite his distaste for the present method of estimating individual doses, Hansen said he nonetheless believes that even the DOE-NRC standard of 500 millirem per year is adequate to protect public health. "That's the permissible limit — that doesn't mean you operate at that level. If you look at the doses at the separate (LASL) stations, you'll find most of the on-site (monitoring) stations fall well within 500 millirem per year."

Asked whether some members of the public in Los Alamos are exposed to radiation levels in excess of the 25 millirem per year EPA guidelines, Hansen replied: "I don't believe so."

Because radiation doses are cumulative, each additional increment of radiation is believed to increase the risk of biological damage. LASL scientists insist, however, that the small added radiation dose to the public from lab operations is not significant, especially when compared to other radiation sources. "I think that medical x-rays have not gotten the attention we need," Hansen suggested.

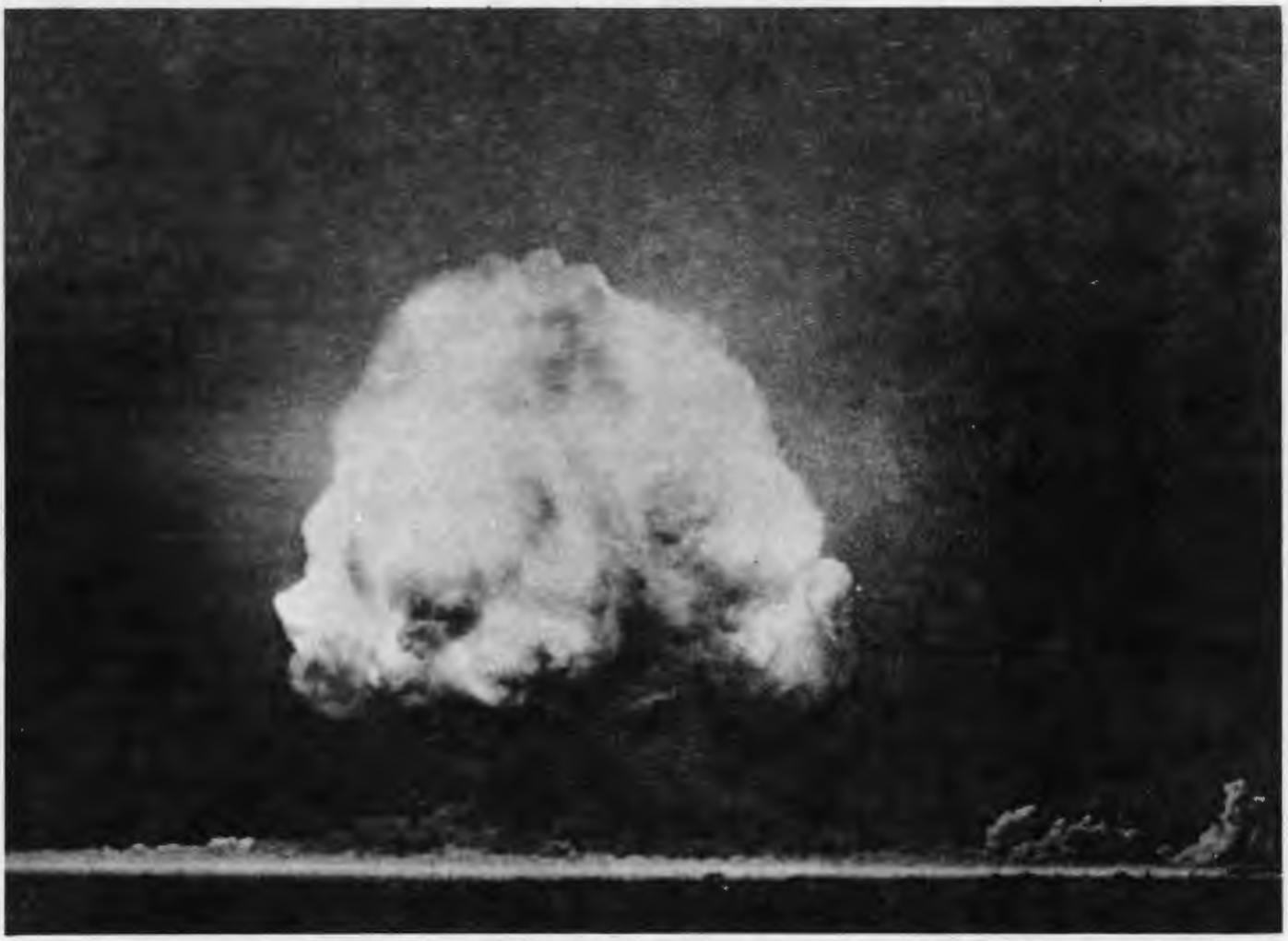
Within the scientific community, there is general agreement that large amounts of radiation are harmful. A whole body dose of 500 rems would probably cause death within about a month. An accident at Los Alamos in 1958, for example, delivered a dose of 12,000 rems, which took the life of a LASL lab technician within one day.

The health effects of lower levels of radiation are not so clearly understood, however.

The EPA policy on the relationship between radiation dose and health effect, published in the Federal Register on July 9, 1976, is based on the recommendations and findings of the United States Nations Scientific Committee on the Effects of Atomic Radiation, the National Academy of Sciences, the International Commission of Radiological Protection and the National Council on Radiation Protection.

The policy statement notes that "a great deal of uncertainty" exists in the attempts to identify the health consequences of low-level radiation. "These uncertainties in the relationships between dose received and effect produced are recognized to relate, among many factors, to differences in quality and type of radiation, total dose, dose distribution, dose rate and radiosensitivity, including repair distribution dose rate and mechanisms, sex, variation in age, organ and state of health."

The present EPA radiation policy



World's first atomic bomb exploded at Trinity Site, July 16, 1945. LASL photo.

accepts the "linear hypothesis" of dose-effect relationship, which assumes that there is some potential for adverse health consequences caused by any exposure to ionizing radiation and that the magnitude of the health effects is directly proportional to the amount of dose received.

Dr. Lamar Johnson, assistant LASL Health Division leader, explained: "The radiation standards and the philosophy in setting them up has been that any exposure to radiation causes some damage — the so-called linear hypothesis. So you'd have to have absolute zero (radiation exposure), to have no damage. So technically, if indeed that's true, any exposure, whether it be natural radiation or the Chinese bomb fallout, will cause some damage. What that is may be extremely difficult to measure — maybe it shortens somebody's life a day or two days."

He added: "There's much evidence in the biological literature to suggest that we have inherently in the biological systems the capacity to handle insults and recover from them. That's one of the reasons it's felt those are conservatively set standards. We can apparently accept so many millirems of radiation without any damage. In fact, you can even find reports in the literature that suggest biological systems' health is improved by certain low levels of radiation.

"How one would actually be able to connect that experience (exposure) with an end result somewhere downstream in time at low-level radiation is extremely difficult," Johnson allowed.

In 1934, workers using radioactive materials were allowed a dose of about 36 rems per year to the whole body, according to the guidelines established by the National Council of Radiation Protection. In 1950, the recommended dose was reduced to 15 rems per year and in 1957 the yearly dose was further cut to the present unit of 5 rem.

For members of the public, there has also been reduction of standards from 1.5 rem per year to any body organ recommended by the NCRP in 1952 to this year's EPA recommendation of 25 millirem per year — a reduction by a factor of 60.

Supporters of the nuclear industry say that the reduction in standards is the result of improvements in technology which have made such reduction practical, rather than because of new evidence of biological damage from low levels of radiation.

There are those who believe, thought, that the linear hypothesis may underestimate the risk of cancer from low-level radiation and they point to some recent, controversial studies as justification for their fears. These studies include:

- A 1977 study of Portsmouth, N.H. Naval Shipyard workers which showed that nuclear workers had nearly double the percentage of cancer deaths and roughly five times the leukemia deaths in comparison to either the general population or to non-nuclear workers at the same facility.

- A HEW Center for Disease Control study which found troops who participated in a 1957 atomic test called Smokey had twice the number of leukemia deaths as would be expected in the general population.

- A recent study of Utah residents downwind from the Nevada atomic test site undertaken by Dr. Joseph Lyons of the University of Utah which showed that the leukemia rate for children living in areas which received heavy fallout was two and a half times normal.

- An epidemiological study of cancer rates downwind from the Rocky Flats plant near Denver, Colo., by Dr. Carl Johnson of the Colorado Health Dept., which indicated that overall cancer rates among men were 24 percent greater and 10 percent higher in women living near the plutonium processing plant compared to unexposed populations in the Denver area.

- A study of about 35,000 workers at the Hanford nuclear reservation near Richland, Washington, conducted by Dr. Thomas Mancuso of the University of Pittsburg and later re-analyzed by Dr. Alice Stewart and Dr. George Kneale, two British epidemiologists, which suggested that ionizing radiation may induce bone marrow, pancreatic and lung cancer at levels well below (10 to 20 times) current federal occupational standards.

Dr. George Voelz, director of LASL's Health Division, calls the studies showing increased cancer rates from low-level radiation "preliminary" and charged that those people who liked the results had accepted them as fact without sufficient substantiating data. "We're getting lots of low-level radiation studies," he said, "I think they're fine but I think they're drawing conclusions too fast."

Voelz said the linear model in fact overestimates health effects at low levels of radiation and therefore has a built-in measure of conservatism. He called the present federal standards for protecting public health "about right."

Added to the scientific dispute over radiation standards is the economic consideration. "Current philosophy within the DOE, ERC, and EPA is to keep exposures as low as practica-

Dr. Wayne R. Hansen, LASL Environmental Surveillance Group Leader.
Photo by Phil Niklaus.

ble," explains Dr. Hansen, "That brought in the economic factor as well."

According to the Atomic Industrial Forum, a reduction of occupational exposures at nuclear plants would cost reactor operations about $507 million per year. The total cost between 1979 and the turn of the century would be between $23 billion and $53 billion, the AIF estimates.

U.S. standards for radioactive exposure are enforced through the use of "concentration guides" — the radiation levels in air and water in and around nuclear facilities deemed acceptable to protect the general public from adverse health effects. The concentration guides established for public areas outside a nuclear installation (uncontrolled) are considerably more stringent than those governing on-site or controlled areas.

"They're derived so that if someone continuously breathed air at those concentration guides or continuously drunk water at those concentration guides — 365 days a year — they would not receive any more dose to their body than is allowed by the federal radiation protection standards," said Dr. Alan Stoker, a scientist with LASL's Environmental Surveillance Group.

(The concentration guides, are expressed in curies per liter or curies per gram, depending on whether they apply to radiation levels in water or air. A curie is a unit of radiation measurement which is divided into smaller fractions — millicuries, one-thousanth of a curie; mico-curies, one-millionth of a curie; nanocuries, one-billionth of a curie; and picocuries, one-trillionth of a curie).

There are no concentration guides per se for radioacitivity in soils and sediments because, as Stoker put it, "damn few people eat much soil or sediment." They may, however, breath wind-blown radiactive particles and that possible exposure pathway is covered by an EPA "screening guide"

The World of Nuclear Energy

Even though nuclear energy is rapidly moving to center stage in the nation's growing debate over energy options, radiation is an issue that is confusing to most Americans. Even in New Mexico, the birthplace of the atomic bomb and the source of almost 50 percent of the nation's uranium, the properties and effects of radiation — that invisible, intangible and almost mysterious substance — are little understood.

One reason is the tongue-twisting, and intimidating, scientific terminology surrouding the nuclear issue. Words like transuranic, picocurie, strontium and millirem are sprinkled throughout articles and speeches of both nuclear opponents and proponents.

Another reason is that radiation comes in many forms. There are, for instance, alpha particles given off by plutonium; beta rays given off by tritium; gamma rays given off by all sorts of radioactive material.

Radiation sources are both natural, such as rock formations or sunlight, and man-made such as medical x-rays and nuclear waste from weapons research. And to compound the problem, different forms of radiation have different effects on the human body.

Gamma radiation, which can penetrate concrete, is especially damaging to human cells that reproduce constantly, such as bone marrow where blood cells are manufactured.

Alpha radiation does not penetrate like gamma radiation and in fact can be blocked by a single sheet of paper. But if inhaled or ingested, it can concentrate in the body's organs where it may cause chemical changes that later produce tumors.

Alpha, beta and gamma radiation are commonly referred to as "ionizing" radiation — radiation which ruptures the chemical bonds that join atoms together in molecules. Other types of radiation that fall into this category include x-rays and neutron radiation. The biological effects of this type of radiation are the subject of heated debate among scientists.

Most scientists agree, however, that ionizing radiation, which passes through human tissue, can prevent a cell from dividing, or it can damage the genetic material contained in the cell's nucleus, causing it to divide abnormally. The effects of this cell damage may show up later in the exposed person or in mutations in later generations.

Nuclear waste produced and stored at Los Alamos contains all these different types of radiation. The wastes are contaminated in varying degrees, thus emitting radiation at differing levels.

For management purposes, the wastes are classified as either high or low level, depending on their heat and radiation emission levels. The wastes are also classified by the length of time required before the radioactive elements in them have decayed to harmless levels.

All radioactive elements are unstable elements which decay over varying periods of time to stable elements. These decay rates are the "half-lives" of the elements. While some radioactive elements have extremely short half-lives, some only minutes, other remain radioactive for thousands and even hundreds of thousands of years. Approximately 10 half-lives are necessary before a radioactive element has decayed to insignificant levels.

Plutonium 239 for example, which has a radioactive half-life of 24,400 years, will remain radioactive for roughly 250,000 years.

At Los Alamos Scientific Laboratory, one of the major types of nuclear waste is "transuranic" or TRU waste. Composed mainly of debris contaminated with plutonium and associated elements, transuranic waste emits low level alpha radiation — — but because of the long half-life of plutonium, it is extremely long-lived.

What follows is a glossary of some of the common — — but mind boggling — terms in the growing nuclear debate.

BACKGROUND RADIATION — naturally-occuring radiation from radioactive elements present in the earth, atmosphere and even the human body. Atomic fallout is considered part of background radiation.

FALLOUT — minute particles of radioactive debris deposited in soils and bodies of water around the world. The debris, including the elements of plutonium, strontium and radioactive iodine, is the result of nuclear weapons tested in the atmosphere .

CURIE — a measurement used for radioactive elements, named after Madam Curie, the discoverer of radium. Curies are divided into smaller

which requires additional measurements and possible corrective action if radioactivity in soils and sediments are detected above certain concentrations (about 13-15 picocuries per gram of soil in the case of plutonium).

Although radio active concentrations on and around LASL property have been measured in some cases hundreds of times greater than fallout accumulations, lab scientists point out that for the most part these elevated levels are in areas not accessable to the public and therefore are not considered a potential health hazard. "LASL effluents are not adding a con siderable amount to fallout, in terms of exposure pathways to man," said Dr. Hansen . "You must take into consideration (exposure) routes to man."

Fallout, he said, is not an absolute number and in fact contains a "large statistical uncertainty" in concentrations from one area to another. "The mechanics of fallout levels are not very well understood," Hansen said.

Some scientists, however, contend that the nuclear industry is hiding behind fallout levels in order to downplay the impact of radioactive releases from nuclear facilities. "Without the cover of continued bomb testing, the nuclear industry could not continue," Dr. Ernest Sternglass, professor of radiation physics and radiological director in the department of radiology at the University of Pittsburgh, said during a speech in Albuquerque last summer.

Los Alamos Scientific Laboratory has been involved in nuclear testing since the first atomic detonation at Trinity Site on July 16, 1945. Although the U.S., along with Russia and England, abandoned the practice of testing nuclear weapons in the atmosphere with the signing of the Nuclear Test Ban Treaty in 1963, LASL continues to explode its bombs underground at the Nevada Test Site. Some countries,

Has a Language All Its Own

units — the most common of which is the picocurie — one trillionth of a curie.

CONCENTRATION GUIDES — levels of radioactivity permitted in air and water around nuclear facilities. These levels, set by the Environmental Protection Agency are usually expressed in picocuries per gram or per liter.

REM — a unit used to measure the amount of radiation absored by the human body over certain periods of time. Because the rem is too large a number for radiation protection purposes, doses are more commonly expressed as millirem or one thousanths of a rem. Present government standards allow nuclear workers to absorb 5 rems per year. Members of the public are limited to much less radiation each year, although government standards conflict on exactly how many rems are permitted.

MAN-REM — the cumulative radiation dose received by an entire population over a given period of time. The total radiation does from LASL to residents of the surrounding area, for example: is 10.5 man-rem. In order to determine individual doses, the man-rem figure must be divided by the number of people in the area.

HALF LIFE — the time necessary for one half of a radioactive element to decay. Once half of the substance is decayed, the same period of time is necessary for one half of the remainder to decay, and so on. Approximately ten half-lives are necessary before a radioactive element has decayed to a harmless level.

RADIONUCLIDE — a general term applicable to radioactive elements.

ISOTOPE — a series of atoms with the same atomic number but different weights. The isotopes of plutonium, for example are plutonium-238, plutonium-239, plutonium-240 and 241.

PLUTONIUM — a man-made radioactive element that emits alpha radiation for extremely long periods of time. Plutonium-239, the isotope of major concern, has a half-life of 24,400 years and can cause cancer if inhaled, ingested or absorbed through open wounds.

STRONTIUM-90 — a radioactive element produced by nuclear weapons and energy work and present in fallout. Strontium emits beta radiation and is similar to calcium in its chemical properties. Strontium from fallout is accumulated in milk, and like calcium it goes to the bone. Unlike calcium however, it can cause bone cancer or leukemia. Strontium's half-life is 28 years.

CESIUM 137 — a radioactive element produced by nuclear weapons and energy research. Cesium is both a beta and gamma emitter that can concentrate in human and animal muscles and produce external radiation exposure as well. Cesium has a half-life of 30 years.

TRITIUM — a radioactive element related to hydrogen. Tritium is a low energy beta emitter most commonly found as a gas or as water. "Tritiated" water or gas can be absorbed through the skin, inhaled or ingested. Tritium has a half-life of 12.26 years.

IODINE 131 — a beta and gamma emitter produced by nuclear reactions and present in fallout, Iodine 131, or "radioiodine," concentrates in the human thyroid and has an eight-day half-life.

URANIUM — a naturally occuring ore which in nature consists of about 99.3 percent uranium 238 and .7 percent uranium 235. Uranium is also a by-product of weapons testing. as uranium decays to lead, it creates several radioactive elements including radium and thorium.

LINEAR HYPOTHESIS — the basis of current radiation standards and at the heart of the current controversy over the effects of low-level radiation. In the early days of atomic energy, before the linear hypothesis was accepted, scientists believed that there was a threshold below which radiation had no ill effects. The linear hypothesis however is based on the assumption that the incidence of cancer at low dose is directly proportional to the response at high doses. In this hypothesis, in other words, any amount of radiation carries some risk.

IONIZING RADIATION — a term which includes x-rays, alpha, beta, gamma and neutron radiation. "Ionizing" describes the chemical effect of this type of radiation on surrounding objects, which can be highly destructive.

TRANSURANIC — a type of low-level, long-lasting radioactive waste, composed mainly of plutonium — contaminated debris from weapons work.

CRITICALITY — the state of a nuclear reactor, or other operation when it is sustaining a chain reaction.

Dr. Lamar Johnson, Assistant Health Division Leader at LASL.
Photo by Dede Feldman.

most notably China, have not agreed to halt atmospheric testing.

In monitoring the fallout from the continuing above-ground tests, LASL scientists measure the resulting concentrations of iodine-131, which because of its rapid decay rate, is more easily detectable than the longer-lived, lower-activity radionuclides such as plutonium-239. Aside from radioiodine, the radioactive isotopes of primary concern in fallout are plutonium-238 and 239 and strontium-90.

Although there are variations in the amount of fallout which can be measured on the ground, depending on the elevation of an area, average annual rainfall and other climatological factors, for the most part fallout levels in soils and water are relatively uniform, according to LASL scientists. "There is a variation on an annual cycle on the amount of fallout in the air from the spring mixing of the atmosphere and stuff like that, and peaks from the Chinese tests," Dr. Stoker noted. "But what's on the ground is what's been accumulating there over the years ever since the first atmosphere test, so that by natural processes it has been averaged out and is reasonably uniform and doesn't vary that much by area or by time of year."

The major contributions of radioactive contaminants from fallout occured during the early 1960s, when Russia and the U.S. were trying to outdo each other in terms of atomic performance. One Soviet test during that period was calibrated at 83,000 kilotons equivalent TNT, a bomb more than 4,000 times more powerful than the one dropped on Hiroshima.

"Yes, we're getting a very slow buildup," Hansen acknowleged. "We saw the major input (of fallout contamination) from the early 1960s testing in 1970. The main buildup is over with but there is still an inventory in the stratosphere."

Hansen, considered one of the experts on atomic fallout at Los Alamos, said current, admittedly rough estimates put the amount of plutonium dispersed throughout the Earth from atmospheric testing through the years at 350,000 curies. "It's a large number but it's spread over a very large area (the Earth)," he said, suggesting that concentrations amount up to about one to three millicuries per square kilometer throughout the world.

It is further estimated that 5 to 15 percent of the background radiation in the Los Alamos area is the result of fallout.

LASL scientists tend to regard the chances of adverse health effects from fallout as minimal. "Fallout increases the risk a very, very small fraction," said Dr. Hansen, adding, however, "the whole thing is a statistical response, unfortunately. So one has to resort to probabalistic statements about risk."

While the health impacts of exposure to low-level, radiation is a subject of escalating controversy, the presence of radionuclides in the food chain as a result of fallout is a matter of record.

An EPA report, based on the results of monitoring following a Chinese nuclear explosion on Sept. 26, 1976, states that elevated levels of iodine-131 were detected in milk samples in a number of states following the atmospheric test. The effects of that test explosion, rated a "low-yield nuclear device," were analyzed by EPA's nationwide Environmental Radiatiom-bient Monitoring System.

The ERAMS monitoring network, established in 1973, collected 293 pasteurized milk samples, 1124 air particulate samples and 95 precipitation samples. The EPA report released in August, 1977, states: "Rainstorms in parts of the eastern United States following the September test results in radioiodine levels on pasture grass and in cow's milk which were easily detectable and higher than expected.

While the inhalation of radioactive particles and the consumption of contaminated water are regarded as potential human exposure pathways, the primary concern is the ingestion of food, especially milk, which may contain radioactivity from fallout.

Cows consume large quantities of grass and some of the radioactive materials deposited on the grass are transferred within a day or two to the cow's milk. This pathway is especially serious, as infants are the most sus-

ceptable to radioactive contamination.

The final Environmental Impact Statement on LASL operations describes the danger from milk contaminated with iodine-131 from fallout: "Iodine concentrates in the thyroid. Thus, if the primary food source is containment with iodine-131, that concentrates in the relatively small thyroid of an infant, the dose to the infant thyroid can be substantial compared to the dose of an adult thyroid from the same iodine release."

The highest concentration of iodine-131, which, with a half-life of eight days, remains radioactive for approximately three months, was found in a milk sample collected in Baltimore, Md., on Oct. 8, about two weeks after the Chinese detonation.

The EPA noted that several state agencies in the ERAMS network reported radioactivity in raw milk samples as high as 1,000 picocuries per liter. In Connecticut and Massachusetts, where some of the highest concentrations were reported, the state health agencies were sufficiently concerned to order all dairy herds switched to stored feed only, rather than grazing in outdoor pastures susceptible to fallout contamination.

The thyroid dose to the American population from the September bomb test in China was calculated by the EPA, which concluded in its report: "Using EPA's best estimate for health effects, this population dose translates into an estimate of 4.3 excess thyroid cancers which could potentially occur in the 45 years following this event."

On Dec. 14, 1978, the People's Republic of China detonated an atomic bomb at the Lop Nor testing site in the southwestern part of the country which had an explosive equivalent of about 20,000 tons of TNT, the same size blast as leveled Hiroshima.

The ensuing radioactive fallout from the Chinese atmospheric test, measured over the following two-week period by air monitoring devices at Los Alamos Scientific Laboratory, results in radioactive concentrations in the air 500 times lower than the existing U.S. radiation standards for protecting public health.

Does that mean, then, that had China simultaneously exploded 500 atomic bombs the same size, under the same climatic conditions, the resulting fallout would still not have exceeded the U.S. health standards for radioactive contamination in the air?

"The statement you made is true," responded Dr. Johnson.

Dr. Johnson said that while it is statistically true, based on measurements of the most recent Chinese atmospheric test last Dec. 14, that the resulting fallout could be increased 500 times and still not surpass the levels allowed by the concentration guides, he believes the existing standards are more than adequate to protect public health from radiation injury.

"I don't have any problem with it personally because I think the health standards have been set so conservatively that I wouldn't expect to have any problem with it," he said. "I think there are so many other problems more significant than that. If I had any control over it [fallout], I would just as soon not have it because I don't know what it does, nor does anyone else. You can't predict it."

Johnson continued: "They've got to have some standard if you're going to work with radioactive materials and get the benefit of it [atomic energy]. They [the standards] were set so you could have safe use of them."

Asked about the indications of possible increased cancer rates from the atmospheric testing in Nevada and Utah prior to the ban on above-ground nuclear detonations in this country, Johnson replied: "The returns aren't in, as far as the Utah and Nevada things are concerned. And now the Japanese work is primarily with people who had direct high-level exposure [from the Hiroshima and Nagasaki bombs] and that's quite different."

"I do think we need to be constantly alert and looking [for possible effects of low-level radiation]," he stated.

Dr. Hansen struck a philosophical note in discussing risk assessments from nuclear activities: "We were our own worst enemies – we built so much conservatism into risk, we've scared the hell out of everybody," he observed. "It's unfortunate people have this fear of radiation. They should have a respect, not a fear."

III

Liquid Wastes Slowly Infiltrating Environment

LOS ALAMOS — Liquid radioactive wastes dumped into a series of deep, intermittently-flowing canyons which intersect the Los Alamos Scientific Laboratory property are periodically carried to the Rio Grande by snowmelt and storm runoff, but lab officials say the relatively small quantities of radionuclides which do reach the river become rapidly diluted and pose no danger to public health.

Meanwhile, however, LASL samples of soil particles or sediments taken on San Ildefonso Pueblo land, which lies to the east between the lab and the Rio Grande, have revealed plutonium levels 10 times higher than the concentration attributed to fallout from all worldwide detonations of nuclear bombs. Furthermore, one soil sample collected last year on San Ildefonso land south of Otowi Bridge — at the point where runoff from one waste-receiving canyon centers the Rio Grande — showed plutonium-239 concentrations three times greater than existing fallout levels and cesium-137 about six times fallout.

The final Environmental Impact Statement released in January of this year on LASL operations notes: "It is known that small amounts of plutonium-238 and -239 and cesium-137 have been transported off-site in [soil] sediments. Also, there are locations that have accumulated plutonium-238 and -239 and cesium-237 in sediments in significant concentrations above background. These locations are stream channels that formerly received liquid waste effluent from laboratory operations."

LASL officials say they do not know as yet why the relatively high plutonium and cesium values were discovered in 1978 in the soil near Otowi, about six miles outside the lab complex. "It's a one-time sample for one year," said Dr. Wayne R. Hansen, who heads the Environmental Surveillance Group in LASL's Health Division. "We are not sure what its significance is."

Hansen suggested a number of possible explanations for the elevated radionuclide levels recorded during routine monitoring in 1978: they could have been caused by "cross-contamination," whereby the sample may have been inadvertently exposed to further contamination in the laboratory through an error in the soil analysis procedure; they may simply be an "out-lier" or extreme value in the overall monitoring statistics; or, he allowed. they could in fact be an indication of an increase in the amount of radioactivity moving away from the LASL installation.

"I'd like to point out that soil-sampling statistics have a wide band of uncertainty. And particularly in soil sampling, you can expect to have wide variance between samples, even for fallout which is remarkably uniform really," Hansen noted. "Soil sampling is really designed to look at trends — long-term trends, rather than instantaneous changes. So we don't normally get too upset unless it's really a large out-lier I wouldn't call this a large out-lier — it's (the plutonium levels) three times the average (from fallout) but it's not enough to be concerned about."

He added, however, "If it persists, then something is going on. If it appears again this year (in the monitoring data), then we'll have to go to a more intensive sampling network."

The residential community and scientific laboratory at Los Alamos are located about 25 miles northwest of Santa Fe on the remote Pajarito Plateau, a volcanic shelf jutting from the eastern slope of the Jemez Mountains.

The Pajarito ("little bird") Plateau represents a high point along the Rio Grande depression, a massive fault extending from southern Colorado, through central New Mexico and into northern Mexico. About 12 million years ago, a series of volcanic eruptions southwest of the present Los Alamos site began the geologic construction of the Jemez Mountains, climaxing a million years ago with two major explosions that spewed a hundred miles of volcanic tuff (ashfall and ashflow) and pumice around the surrounding mountain flanks.

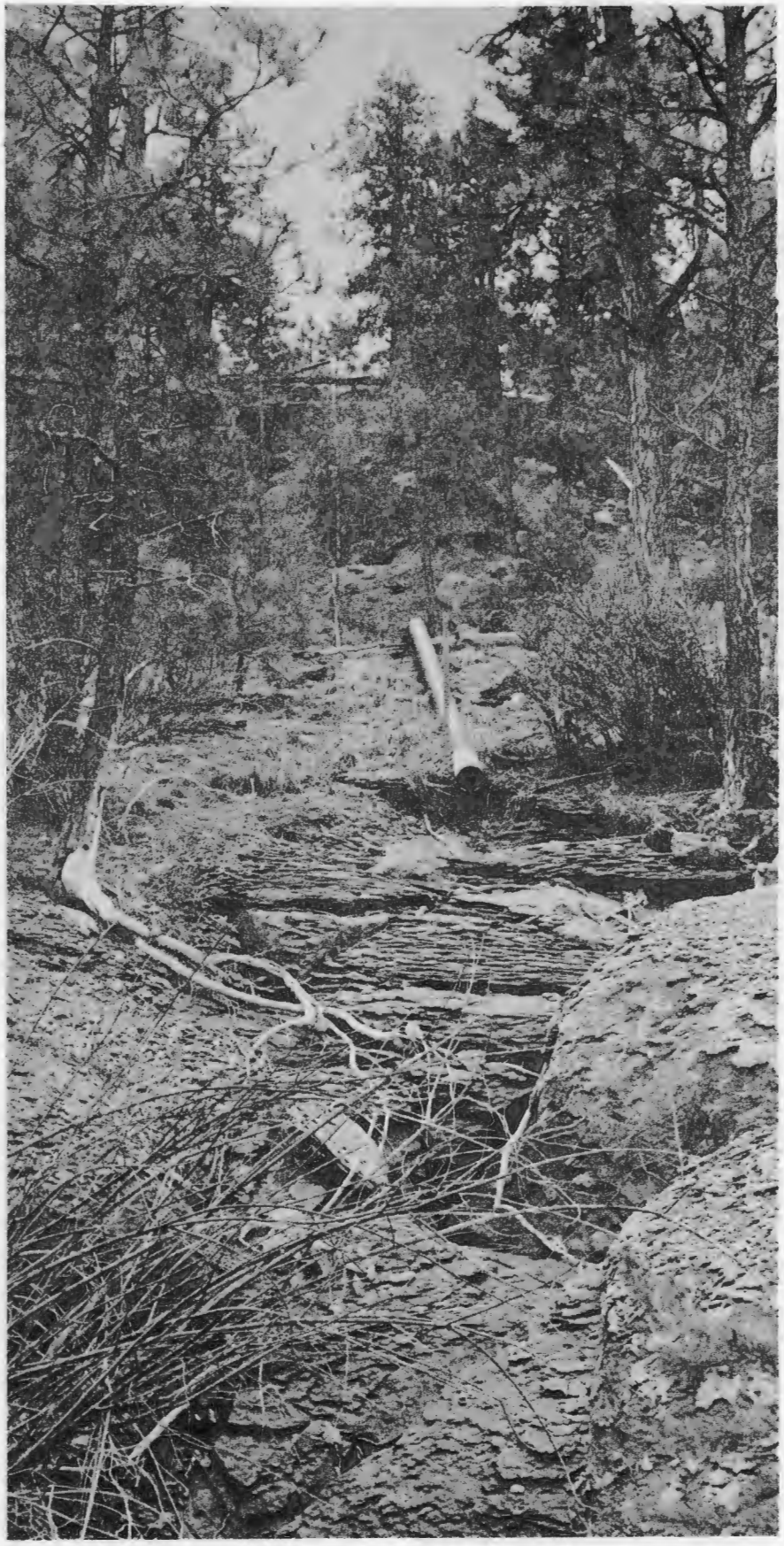
Over geologic time, the tuff deposited by the volcanoes, which makes up the top several hundred feet of the Pajarito Plateau, has been cut by intermittently-flowing streams fed by runoff from the mountains above. Natural erosion has sliced the plateau into a series of about 15 finger-like mesas separated by steep, meandering canyons, many hundreds of feet deep.

It is into several of these canyons, two of which transport surface water and sediments to the Rio Grande, that radioactive liquid wastes have been dumped since the 1940s.

Currently, an estimated 10 million gallons a year of liquid nuclear waste, laced with plutonium-238 and 239, cesium-137, strontium-89 and 90, uranium-235, americium-241 and tritium, are pumped through pipelines from laboratories and research facilities throughout the LASL installation to two treatment plants for processing.

After the liquid waste stream undergoes chemical and ion-exchange treatment to reduce toxic concentrations, the separated radioactive waste products, in the form of a sludge or wet clay, are either packaged in 55-gallon steel drums for placement in retrievable storage at the lab's principal solid waste disposal site or pumped directly into 60-foot-deep, asphalt-lined shafts for permanent burial. The remaining liquid effluent, which still contains measurable quantities of chemical and radioactive contiminats, is flushed out into two canyon systems — Mortandad and DP-Los Alamos Canyons — at a rate of about 27,500 gallons a day.

Mortandad Canyon has been a liquid waste disposal area since 1963 and DP-Los Alamos since 1952. Acid-Pueblo Canyon, the third major contaminated canyon system at Los Alamos, re-



Pipeline carries liquid radioactive waste into Mortandad Canyon.
Photo by Dede Feldman.

ceived untreated liquid wastes during the lab's early years and later treated wastes, but has not been used as a liquid waste disposal site since 1964.

The final LASL impact statement notes: "The three canyon areas into which wastes have been discharged are the subjects of continuing studies on the chemical and radiochemical quality of water and sediments. . . . The canyons will continue to receive low levels of contamination. These levels of contamination are not deleterious to health."

A LASL study on the uptake of Plutonium and Cesium in the three canyons, reported in May, 1975 at the National Symposium on Radioecology at Oregon State University, says: "Stream channel sediments were identified as the major reservoir of waste radioactivity based on the relatively high radionuclide concentrations measured in this component. Hydrological sediment transport processes in the respective canyons play a major role in the downstream movement of radioactivity."

In all three major canyon systems, maximum concentrations of plutonium-238 and 239, cesium-137, tritium and gross beta activity in soils have been routinely measured considerably above fallout levels. The contamination found in sediments, which characteristically are higher than that found in compacted soil, is also above fallout for plutonium-238 and 239, cesium-137, strontium-90 and americium-241.

In 1978, for example, sediment samples taken within the canyons on lab property revealed concentrations of cesium-137 more than 1,000 times larger than the baseline measurements blamed on fallout. Plutonium-239 was found in one sediment sample to be 200 times fallout and plutonium-238 was recorded in one case 1,300 times fallout, according to the LASL Environmental Surveillance Report for 1978.

As would be expected, the maximum concentrations in soils were lower than those found in the loose-bound sediments, but those too were considerably elevated above fallout — five times higher in the case of cesium-137, 47 times higher for plutonium-238 and 97 times higher for plutonium-239.

While a portion of the radionuclides in DP-Los Alamos Canyon and the no-longer-used Acid-Pueblo Canyon continues to periodically wash to the Rio Grande, the liquid effluent released to Mortandad Canyon is absorbed "sponge-like" in the stream bed and banks and does not flow to the river,

according to LASL officials.

Because no records were kept during the lab's early years, just how much radioactivity has been placed in the canyons and the amount that has left the lab property is unknown.

"We know that storm runoff transports sediments down a canyon, but we're not able to characterize that process quantitatively," remarked Dr. Thomas Hakonson, a member of the Environmental Surveillance Group in the field of radioecology. "We know very little — and when I say we, I mean anybody in the country, USGS all of them, know very little about particle transport in intermittent streams. This is an area where information would be extremely useful for assessing energy development wastes — uranium mill tailings, coal ash, the wastes we have here at the lab and so forth."

One LASL study concluded that as much as 90 per cent of the radioactivity in the canyons may be transported off-site, but by one high-ranking lab spokesman said the figure probably should be more like 50 percent.

"We can only speculate on it (the amount leaving the canyon areas) and we've made several speculations and my rememberance of the latest speculations is more like half of it," said Dr. Lamar J. Johnson, the acting head of nuclear waste management in the LASL Director's Office. "The reason we're speculating is we really don't know the original source term or how much has been actually placed there (in the canyons) because there weren't any measurements about what went out in the very early years. When they began, the measurement wouldn't differentiate between plutonium or uranium or whatever else. It was just a gross radioactive measurement."

Johnson emphasized, however, that while some radioactivity does in fact reach the Rio Grande during runoff periods, the quantities do not significantly add to the levels already present in the river from atomic fallout. "We inject a measureable — small but measureable — amount of material, whether its radioactive or non-radioactive, into the thing (the Rio Grande). By the natural process of runoff and dispersion, it's going to be diluted and at some point it will reach worldwide fallout levels or be so dispersed and so diluted we can't differentiate the atom of laboratory plutonium or whatever it was in this case, from something that came from somewhere else."

One official with the U.S. Geological Survey, who has participated in environmental monitoring at Los Alamos, warned against the outright dismissal of the impact on the Rio Grande as a result of radioactive releases from LASL. "Just because it's barely detectable doesn't mean it isn't there," said J.L. Kunkler, a geophysicist with USGS in Santa Fe.

Essentially all downstream water flow in the region passes through Cochiti Lake, a reservoir created by an earthen dam on the Rio Grande completed in 1976. The lake filled for the first time this year, with the heavy spring runoff from melting snow accumulations in the mountains of New Mexico and Colorado.

Cochiti Dam was designed to provided flood control, recreation and fisheries, but its primary function is to capture sediments washed down the Rio Grande channel. Because the dam is located about 18 miles from the point where the waste receiving canyons discharge into the river. LASL scientists suggest that most of the contaminated sediment particles will eventually become trapped behind the retention dam.

They do add, though, that during years of heavy water flow in the Rio Grande, such as occured this spring, a portion of the sediment load will continue further downstream with water released from the dam.

Despite the sediment-trapping function of Cochiti Dam, environmental officials at the lab point out that samples collected from the lake show no measureable buildup of radioactivity that can be traced to the routine releases from Los Alamos. The final EIS states: "Transport of radioactivity on sediments from Los Alamos Canyon into the Rio Grande is not resulting in any doses statistically higher than those due to worldwide fallout. This is confirmed by the measurements of water, sediment and fish from the Rio Grande downstream from the confluence with Los Alamos Canyon. . . ."

Although the primary reservoir of radionuclides piped into the canyons are the soils and sediments in the stream beds and banks, investigations by LASL enviromental scientists of the behavior or radionuclides in the enviroment have revealed some high concentrations in vegetation and wildlife native to the area.

LASL scientists who have studied the three canyons note that while some high levels of radioactive contamination have been detected in soils, plants and animals, those concentrations for the most part remain in the canyon ecosystem on fenced lab property and therefore do not represent a significant exposure pathway to the general public.

LASL officals report that the maximum concentration of plutonium in sediments transported beyond the lab boundary is 10 times higher than worldwide atomic fallout levels.

Asked to identify the specific location of the plutonium levels measuring 10 times fallout, Dr. Johnson replied: "This must be sampling on the (San Ildefonso) Indian land, I guess, because we have been unable to measure it once we get to the river above worldwide fallout."

"We've got an agreement with the Indians to let us on there (to take samples)," he said, adding, "some of the land around here has been declared sacred land so we try to be circumspect in our relationship to it."

One member of the San Ildefonso tribal council suggested, however, that the lab has been "circumspect" not so much toward the Indian land as with the tribe itself. The councilman, who asked not to be identified, said LASL officials have never communicated the nature or extent of the contamination on Indian land as a result of lab waste disposal operations. "What can we do? We have no say up there," he said.

Dr. Johnson responded to the charge by saying, "We provide them reports (describing the results of the LASL sampling program). We don't specifically sit down with them (to explain the reports) on our own initiative. If they wanted to, we would."

Johnson pointed out that while the plutonium levels detected on San Ildefonso land is indeed elevated above fallout, the measurements are well within the concentration guides established to protect public health. "That's (the levels 10 times above fallout) well below the standard or the suggestion of a standard by the federal government or an international (radiation) body."

During the lab's earlier years, the liquid waste with relatively lower radioactive concentrations were simply dumped untreated into Acid-Pueblo Canyon, which accounts for the majority of the contamination still present in that now-defunct canyon disposal area. The liquid wastes with the highest levels of contamination were placed in a series of four sorption beds, which are pits 120 feet long, 20 feet wide and six feet deep filled with boulders, gravel and sand to retain the radioactive particles while allowing the liquids to seep out.

The sorption beds were used between 1944 and 1952 to dispose of 2-3

million gallons per year of highly-contaminated liquid waste. The pits were not used between 1952 and 1964, but from 1965 to 1967 they were reopened and received about 74,000 gallons a month of treated liquid wastes from one of the lab's liquid waste facilities.

LASL officials agree that the use of the sorption beds for untreated liquid wastes was decidely not a good idea. In 1975, a core sampling of the pits revealed that plutonium had moved through fractures in the sand to a depth of 28 feet below the bottom of the trenches.

But those questionable practices of the past have either been abandoned or mourned and LASL officials point with some pride to the advances in liquid waste management over the past decades.

Approximately 90 percent of the radioactive liquids generated by LASL today are now channeled to the Central Waste Treatment Plant, a processing plant completed in 1967, with the remainder going to the smaller treatment facility at LASL's old plutonium plant.

The Central Waste Treatment Plant is a LASL showpiece in the field of nuclear waste management and lab officials view it as something of a symbol of the advances which have occured since the days when radioactive liquids were flushed into the canyons or sorption beds. Currently, the plant is capable of removing 99.9 percent of the transuranic elements — plutonium uranium and americium — and roughly 90 percent of the stronium from the daily flow of waste liquids. The new treatment process, like that at the old plants, is unable to capture either cesium or tritium, but LASL officials point out that there are relatively small amounts of those elements in the liquid waste stream.

Even with the improved processing capability of that modernized facility, concentrations of radionuclides measured in the present Mortandad Canyon disposal area are still considerably above "normal."

Sampling of soils and sediments last year in Mortandad showed a maximum concentration of plutonium-239 in sediments of 11.6 picocuries per gram — more than 200 times greater than the levels considered to be present from fallout. The maximum plutonium concentration in soils was measured at 2.52 picocuries per gram or nearly 100 times fallout. In addition, one sediment sample showed cesium-137 concentrations as high as 1,260 picocuries per gram, more than 1,000 times the cesium levels attributed to fallout.

Aside from the on-going situation of radioactive liquids released to the canyons, the present liquid waste processing system as now operating has not been without flaws.

In July 1974, about 12 years after the installation of the pipeline collection system to transport the liquid wastes to the Central Waste Treatment Plant, a leak was detected in a section of the 8-inch pipes. The leak, caused by plant roots clogging and cracking the pipe, spilled 260,000 gallons of liquids containing about 200 micro-curies of plutonium-238. An excavation effort, involving the removal of 155 truck loads of contaminated soil to the solid waste disposal site, was undertaken to bring the gross-alpha concentrations in the vicinity of the spill to levels deemed acceptable.

Because the integrity of the entire pipelines was now in question, it was decided to proceed with only a "limited" cleanup in order to permit the installation of a new section of pipe. By the end of August, the replacement line had been installed.

But Sept. 3, 1974, during the initial pumping test on the new section of a pipeline, the flow capacity was inadvertently exceeded, causing the liquid waste stream to back up and flow out of a manhole and onto Diamond Drive, one of the main thorough-fares at Los Alamos.

"Leak two contaminated a portion of a street and a parking lot, and storm drain leading to a nearby canyon (Mortandad)," explained a 1977 LASL report titled "Experience in the Cleanup of Plutonium-Contaminated Land." Within the day, the contamination on paved areas was fixed by applying a layer of asphalt and the canyon flow was blocked by an earthen dam. A small area around the manhole was excavated, backfilled with clean soil and surrounded with an earthern berm as a precaution against subsequent overflows."

LASL officials report that the "bulk" of the contamination resulting from the two spills was removed. Meanwhile, two monitoring stations in Water Canyon, a tributary to Mortandad, show slightly elevated cesium-137 levels and plutonium-238 levels about twice "normal."

According to lab officials, the cleanup operations employed following the 1974 mishap, "provided assurance that the area can be restored for uncontrolled public release without significant radiation exposure to the public or workers."

Dr. Gerald Buchholz, who has been in charge of the Central Waste Treatment Plant since 1975, said that while the entire pipeline network is "suspect," he doesn't know whether there have been further breaks in the system.

Buchholz, a lab employee since 1965, said the entire four miles of pipeline leading to the treatment plant are scheduled for replacement this year at a cost of $12.5 million.

He noted further that the new line will be equiped with a computerized system to monitor the quantities, types and concentrations of liquid wastes entering the processing plant. "At present we can only calculate what's leaving the technical areas (where the liquid waste is generated) and what's arriving (at the Central Waste Treatment Plant). We have no way of conclusively proving what's arriving here," he said.

When the liquid waste reaches the Central Waste Treatment Plant, it is temporarily held in two underground holding tanks, with a combined capacity of 100,000 gallons. After the liquid stream undergoes treatment to reduce the levels of toxicity, the resulting sludge is drained into a separate 12,000 gallon holding tank to await packaging in steel drums for ultimate storage or disposal at the solid waste burial site.

The liquids which remain following the treatment process are pumped into two effluent holding tanks, with a capacity of 110,000 gallons, before being transported through the pipeline which drains into Mortandad Canyon.

During a tour of the Central Waste Treatment Plant, Dr. Buchholz described the facility as a considerable improvement over the earlier liquid waste treatment facilities but added he would like to see the liquid radioactive releases reduced to zero. "There's been an awareness and a greater administrative attempt to keep radioactive waste released to the environment to a minimum. We don't feel right about discharging anything to the canyons here," he said.

Buchholz said that about $8 million to eliminate the effluent release from the liquid waste waste plant, perhaps through the use of solar evaporation ponds, is to be requested in fiscal year 1982. "The exact way to achieve zero discharge has not been identified. But it's our goal to essentially eliminate all uncontrolled discharges," he said.

Just how realistic is it to expect the

zero discharge goal to be achieved?

"I guess I would have to say it's impossible," commented Dr. Johnson. "It's a goal to which you can point. In reality, it will be virtually impossible to achieve."

He noted that economic practicality must be a consideration in determining what levels of controls should be implemented to minimize environmental contamination. "The return on the investment has to diminish as you invest more and more dollars and effort into it," he said.

Despite Dr. Johnson's assertion that zero discharge will not be possible, the final LASL environmental impact statement notes that funding for the solar evaporation ponds has been proposed for fiscal year 1982 and concludes: "Thus it is expected that release of effluents will continue at about present levels for another four to six years, after which time there will be no further discharge."

Run-off water contaminated with radioactive waste enters Rio Grande below Ottowi crossing. Photo by Dede Feldman.

LASL Scientists Keep Eye on Radiation's Spread

Over the past decade, scientists at Los Alamos Scientific Laboratory have stepped up their efforts to gauge the behavior and impact of radioactivity released to the surrounding environment from the various nuclear programs at the lab.

Studies by the LASL Environmental Surveillance Group have focused on radionuclides in water, soils, plants and animals in three major canyon areas intersecting the lab property, which have been used throughout the lab's 37-year history for disposal for radioactive liquid waste.

Although the highest concentrations of radionuclides appear in sediments in the stream channels and banks, other parts of the ecosystem have also demonstrated on affinity for absorbing radioactive contamination. A 1973 LASL paper describing the distribution of plutonium in the Mortandad Canyon liquid waste disposal area states: "There is some evidence...that plutonium does migrate downward in soils after extended exposure to the natural environment and may become more available to vegetation with time because of an enhanced root contact with the isotope."

One study reported in 1973 to a meeting of the International Radiation Pro tection Association in Washington, D.C., noted that plutonium-238 and 239 concentrations in the lung and hide of rodents sampled in one Los Alamos canyon suggested that windblown soil particles may be a prime contamination mechanism. A followup study, completed in 1976, said the accumulation of cesium-137 on soil in DP Canyon increased the average radiation exposure of small ground-dwelling rodents in the area by as much as 50 times.

Cesium-137 was also discovered to be elevated in mule deer inhabiting the canyon areas, with one deer exhibiting concentrations of the radionuclide in muscle about 35 times higher than deer in non-contaminated areas.

"This does represent a potential pathway for cesium-137 to humans, although calculations readily show that its importance from a radiation dose aspect is extremely minor," the LASL report on the study concludes.

Elevated tritium concentrations two to five times normal were also observed in mule deer, ravens and stellar jays collected from the canyon area.

The presence of bee colonies in the Los Alamos area presented LASL environmental scientists with a natural opportunity to assess the effects of radionuclides from the liquid waste disposal operations. The study was started in June, 1972 with the placement of hives near the point where the liquid effluents are discharged into Mortandad, Acid-Pueblo and DP-Los Alamos Canyons.

Worker bees, which forage for food and water, and hive bees were collected in a battery-powered vacuum sweeper over a six-month period for analysis at the lab. LASL scientists also collected freshly-produced honey and portions of the wax comb, as well as water samples from the stream channels.

Although the analyses did show some minor uptake of plutonium-238 and 239 and cesium-137 by the honeybee, it was tritium that was found to be the greatest source of contamination. Tritium concentrations in the worker bees increased from less than one picocurie per gram measured in pre-experiment sample bees to a maximum 9,600 picocuries per gram within 75 days.

Aside from the "dramatic increase" in tritium levels among the forager bees, the study further noted: "The data indicate that the transfer of tritium from worker bees to the hive bees to the honey was apparently very rapid....It was concluded that the wide-ranging foraging habits of the bee make it an integrator and accumulator of tritium over a wide area. The bees, through the production of honey, also serve as a vector in the transport of tritium to man."

A later study, completed in 1975, revealed even higher tritium concentrations in the bee colonies studied. The levels measured in the bees in Mortandad Canyon showed that the maximum concentrations had increased by a factor of 32,000 within 75 days.

Because the concentrations of tritium were so high, LASL researchers concluded that the source of contamination could not have been the radioactive liquid effluents alone. They postulate that some of the bees ingested tritium not only from the irradiated water in the canyon streams but also from the nectar of plants growing above a LASL solid waste disposal site.

Dr. Thomas E. Hakonson, one of the Environmental Surveillance Group involved in the honeybee studies, explained: "They obviously got it (the tritium contamination) in some water source, right? Well, they drink water but they also collect nectar from plants, which is essentially water. So the source could be either one of those.

"The periods where they reach peaks of tritium, it had to come from a waste burial source because the concentrations in water that are down in the canyon are not sufficient," he said.

Hakonson noted that concentrations of tritium, unlike some radionuclides, do not increase as the contamination passes from one level of an ecosystem to another. "The maximum (concentration) that occurs in honeybees is the maximum that occurs in the source that they get it from," he said.

Despite the high tritium levels found in the Los Alamos honeybee investigation, LASL officials note the contaminated honey is produced on fenced lab property and therefore is not available for human consumption and regard-

less would result in no adverse health effects even if eaten.

In order to determine whether radioactive releases from LASL facilities are affecting food sources to man, fish, fruit and vegetable, samples were collected during the fall of 1978 in the Los Alamos area and in the Rio Grande Valley below the point where the waste receiving canyons feed the river.

The fruit and vegetable study did reveal some radioactive contamination in the sample batches analyzed, though lab scientists say the concentrations are insignificant with the exception of leaf samples from a peach tree growing near the stack at LASL's Nuclear Safeguards Research and Development Laboratory. The analysis of the leaves from the peach tree was found to contain elevated levels of tritium, as well as higher than normal amounts of uranium and strontium-90. (The study team was only able to analyze the leaves from the tree because the peach crop itself had mysteriously disappeared before samples could be collected. LASL officials say they do not know what happened to the peaches, but note, however, that because the general public is barred from that particular area, the person or persons who may have collected the fruit must have been employed at the lab. Another possible explanation, they say, is that the peaches were eaten by wildlife.)

"The few peaches do not represent a significiant pathway to man because they are within a laboratory fence, represent a very small volume of ingestible water and have considerably less tritium than the uncontrolled area Concentration Guide for water (3,000 picocuries per milliliter), the 1978 LASL Environmental Surveillance Report states.

Of the vegetable samples collected in Los Alamos County, lettuce had the highest uranium and plutonium concentrations, but that contamination is "likely" due to nuclear fallout, according to the LASL report.

Meanwhile, "no significant differences" in fish samples collected at three locations at Cochiti Reservoir, below the point where the waste-receiving channels empty into the Rio Grande, were found when compared with samples collected from Heron and Costilla Lakes in northern New Mexico.

Dr. Thomas Hakonson, Radiologist at LASL. Photo by Phil Niklaus.

IV

Tritium Control Vexes Experts

LOS ALAMOS — Tritium, a radioactive isotope of hydrogen which appears most commonly as either as gas or as water vapor, is probably the most vexing radionuclide facing waste management officials at Los Alamos Scientific Laboratory. Although tritium has a relatively short radioactive half-life (about 12 years), it can be incorporated into any of the organic molecules found in the human body or in nature.

LASL officials admit the best they can do is delay the release of tritium to the environment.

"It's virtually impossible to clean that up because it acts just like one of the hydrogen atoms when it is oxidized (combined with oxygen) and we can't really treat it. So it will move wherever water moves — in the case of water vapor, whereever the atmospheric air moves," commented Dr. Lamar Johnson, the acting head of nuclear waste management in the LASL Director's Office.

Even underground burial of the elusive isotope, a key ingredient in the manufacture of hydrogen bombs, has failed to halt its eventual release to the atmosphere.

In fact, a major source of tritium contamination in the Los Alamos area is the lab's principal solid waste disposal site. The release of the radionuclide from the solid waste burial ground is caused by "evapotranspiration," a natural process whereby tritium contamination present in the disposal trenches moves through the volcanic tuff to the atmosphere as tritiated water vapor.

Elaborate efforts to control the "migration" of tritium from the disposal site, most recently involving double containment of the waste material, have proved only marginally successful. The tritium-contaminated waste is now placed first in a 30-gallon steel drum coated with tar, with that primary container then placed in a 55-gallon drum, which is in turn coated with asphalt.

Samples of tritium in plants growing above on older fenced solid waste disposal site revealed maximum levels of 1,000 micro-curies per milliliter — more than a million times normal.

"It (tritium) moves in the vapor and will penetrate asphalt or whatever," Johnson noted. "The only thing that asphalt does is retard it, which buys you some time and therefore effects more radioactive decay. But the asphalt has not made made a significant difference. So that has not been successful."

Yet despite the apparent difficulty encountered by LASL waste management officials in preventing the movement of tritium from the lab's disposal trenches, the final LASL Environmental Impact Statement says: "Only contaminants which are present as gases or volatile liquids may be transported by diffusion of water vapor. Although tritium falls in this category, present practices assure proper containment."

The delaying strategy is also applied to tritium in water and in its gaseous form, again with only limited success.

Although there are only relatively small quantities in the 25,000 gallons of liquid radioactive effluents generated every day at LASL, the processing technology at the Central Waste Treatment Plant is not capable of removing tritium and therefore it is dumped, unchecked, into the canyons at Los Alamos. One LASL study reported a peak tritium concentration of 77,700 picocuries per milliliter at the point where the radioactive liquids are discharged into Mortandad Canyon — a level considerably above the concentration guide for uncontrolled areas but within the on-site, controlled area guideline which applies to the Mortandad area.

The final EIS on LASL operations, released in February, 1980, notes: "The preliminary results of these studies have revealed that tritium, in the form of tritiated water, is present at levels above background in the soils and biota of Los Alamos and Mortandad Canyons.

Emissions of gaseous tritium from the stacks at several LASL technical areas can similarly only be slowed before their inevitable release to the statosphere.

"That is probably the aim in terms of tritium disposal," Dr. Johnson explained. "Come up with a scheme so that when you dispose of it — you know it's going to move from the outset, there's nothing you can really do to get total containment — so what you do, you do everything you can to it so that by the time it does reach the biosphere, it's radioactively decayed."

But with tritium's 12-year half-life, which means it will remain radioactive for at least 120 years, the delaying strategy implemented by the lab has fallen far short of that time period.

In 1978, tritium releases to the atmosphere from LASL were measured at 18,600 curies, with a large portion contributed by routine emissions from the stacks at the Tritium Handling Facility where classified work related to nuclear weapons is performed.

Routine tritium emissions from that installation were 30 times higher last year than 1977 because of "increased research activity," according to a LASL report issued last year.

Although there is a proposal to replace the tritium facility to cut emissions to within a range of 1 to 200 curies per year, construction activities have not yet begun and the proposed budget for the new Tritium Test Facility was recently cut back.

"TA-33 (the tritium handling facility) will be, until it's replaced, a major tritium source," said Dr. Wayne Hansen, LASL's Environmental Surveillance Group leader.

Aside from the routine emissions of radioactive tritium at Los Alamos, there have been a number of recent accidential releases of the isotope, resulting in both exposure to LASL technicians and large gaseous leaks to the atmosphere.

Liquid waste facility at LASL. Photo by Dede Feldman.

The most recent mishap involving tritium occured May 4, when an estimated 3,000 curies of the radioactive hydrogen gas was vented when its container became overheated. That accident resulted in the exposure of nine LASL employees, one receiving more than twice the permissible annual dose for that radionuclide.

On July 15, 1976, an "operational error" in the Cryogenics Building in the main LASL technical area allowed about 22,000 curies of tritium gas to escape through a vent. The 1976 LASL Environmental Surveillance Report said of that incident: "The gas was transported and dispersed by a northeast wind. Urine assay of potentially exposed laboratory personnel and environmental measurements for air and vegetation samples showed no measureable exposure resulting from the release, either on or off site."

Another tritium leak estimated at 800 curies, this time at the Van De Graaff Accelerator facility used for various nuclear experiments, occured in May, 1977. That release resulted in measured concentrations of tritiated water vapor greater than normal, but again, lab officials said the accident did not pose an exposure problem for either lab employees or the public.

Later that year, on Oct. 6, 1977, an estimated 30,800 curies of tritium were accidentally released to the atmosphere from the stack at the Tritium Handling Facility as a result of a "loose fitting during a transferring operation in a ventilated chamber." An analysis of three nearby monitoring stations showed a "slightly higher tritium concentration" at the facility than had been measured during 1976 or 1977 LASL Enviromental Surveillance Report for 1977 concluded: "Urinalysis results from people at the Tritium Handling Facility during the release indicated no detectable exposure. Thus, there was no apparent exposure received by either laboratory personnel or of the general public."

Commenting on the tritium leaks which have occured in recent years, the LASL Enviromental Impact Statement says: "In all these inadvertent releases during routine operations, the response and decontamination procedures provided a thorough amelioration of the incident and left no lasting environmental or human hazard potential. Similar minor operational incidents will probably occur in the future, but are not expected to result in significant environmental consequences."

Concentrations of tritiated water vapor, which can be taken up by the

human body by inhalation or ingestion, as well as by absorption through the skin from air containing tritium moisture, last year were measured at Los Alamos three to four times higher than regional background levels. Elevated concentrations of tritium have reached maximum levels 10 times higher than background in the immediate Los Alamos environs as a result both of routine stack emissions and the other, unplanned releases.

Although LASL officials agree that a concentrated dose of about 20 curies of tritium in the body would be fatal, they point out that tritiated water vapor or gas disperses very rapidly in the atmosphere which therefore minimizes the chance of a large dose to any one individual. Dr. Hansen conceded, though, that a single large dose to some members of the Los Alamos community from accidental releases is possible, if not probable. "In the absolute sense, yeah, it's possible," he said. "That's why we have an emergency response team."

The LASL "emergency response team," made up of representatives from various groups within the LASL Health Division, is dispatched to the field in an accident situation to take air samples and determine whether anyone may have received a potentially harmful dose. The best antidote to tritium ingestion or inhalation, according to one lab physicist, is to "drink lots of beer" or some other liquid to flush the contamination from the body.

According to the final EIS on Los Alamos, "The effects of chronic tritium exposure are assumed to be the same as those for whole body radiation, i.e. at a high enough exposure, various types of cancers and possible genetic effects in later generations may occur."

The report goes on to state that "the induction of cancer by radiation has generally been observed only as a result of doses and dose rates that are quite high with respect to even occupational limits." In the case of tritium, those exposure limits for workers are larger than the permissible public exposure by a factor of 25.

Tritum retention in the body — and the potential accompanying health hazard — are considerably higher when the source of contamination is water vapor, rather than a gas. Tritium gas is rapidly converted to water vapor once it reaches the atmosphere, however, though how soon this occurs after release to the atmosphere is not known.

"Tritium contributes to relatively small but measureable dose to the public," said Dr. Hansen. The maximum dose estimate, according to the current report on environmental monitoring at LASL, is 176 millirem per year — less than one percent of the radiation standard for that isotope.

How does that translate in terms of human health risk?

"The current models of risk are that any amount of radiation carries some risk," said Hansen. "That risk is proportional to the amount of radiation. That is why we like to use background (natural sources of radiation as well from atomic fallout) as a comparison. The doses are very very small compared to background radiation."

The measured concentrations of tritium released from LASL are miniscule compared to what is allowed by the concentration guides used to determine compliance with radiation protection standards. In 1978, for example, despite the fact that some tritium measurements were many factors above background, those air contaminants were less than one-ten thousandths of the Department of Energy standards for air. Put another way, atmospheric releases from LASL could be 10,000 times higher than present releases and still not exceed the federal standards.

While LASL officials discount the potential adverse impact of tritium pollution from the lab, there are those who suggest that present radiation protection standards for the isotope may be too lax.

In an article by writer Howard Morland in the February 1979 issue of The Progressive, one Florida health official questioned the generally accepted belief that tritium is not a serious public health problem because it is flushed from the human body relatively rapidly. "It may not stay in the body forever, but it can give you a hell of a dose while it's there," said Ulray Clark, public health physicist in the Office of Radiological Health Services in Tallahassee. "It doesn't need penetrating power to cause harm. Hydrogen goes into every cell in the body."

While tritium has proved to be probably the most perplexing radionuclide to contain, it is but one of a number of radioactive airborne contaminants facing waste management officials at LASL.

The waste management techniques employed to contain radioactive emissions generated by the weapons and other research programs at the lab have improved considerably since the earlier days of the lab's existence. The final impact statement notes that "most" of the facilities where plutonium and americium are handled are now equipped with High Efficiency Particulate Air (HEPA) filters, which are capable of capturing 99.7 percent of the minute exhaust particles from the waste stream.

The HEPA filters, which are disposed of as solid waste after regular replacement in the ventilation systems, do not retain gases, however, and as a result, radioactive contaminants are routinely vented from 90 stacks in 14 of the lab's technical areas.

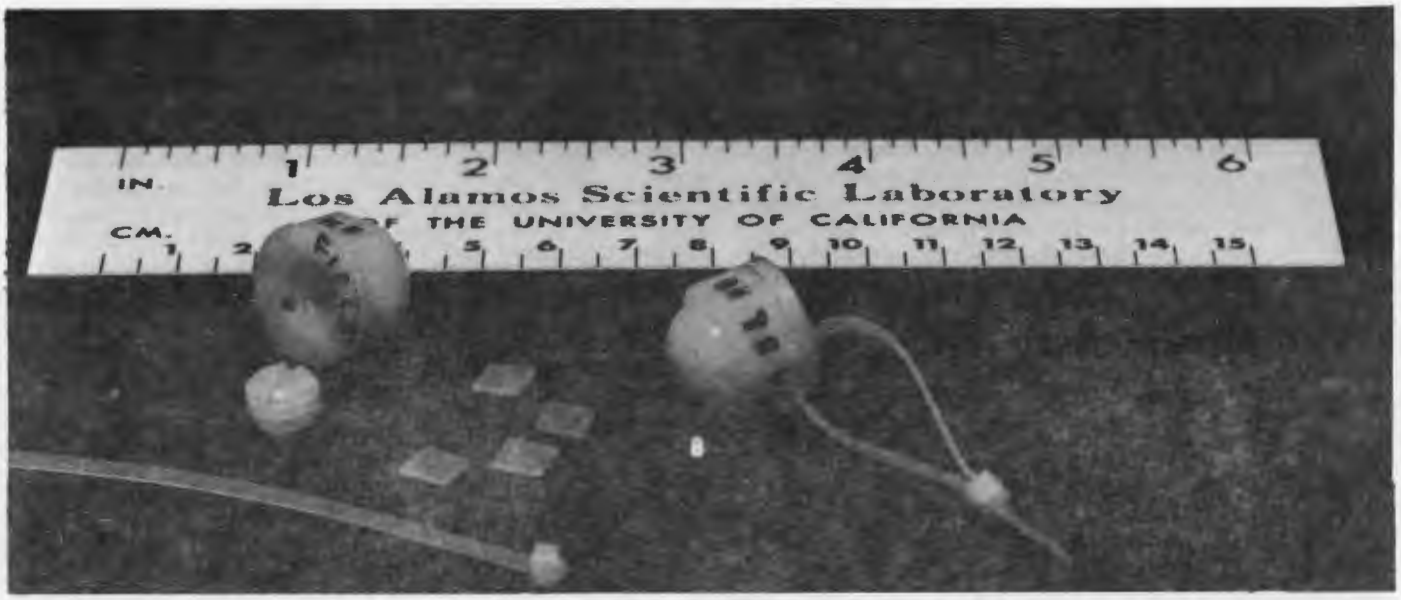
The final EIS concludes: 'The amounts of waste radioactive materials released to the atmosphere are small enough that environmental concentrations resulting from these releases are well below the DOE concentration guides for uncontrolled areas for airborne radioactive material as measured by the routine environmental monitoring program. The waste materials released include radioactive isotopes of americium, plutonium, uranium, tritium, iodine and argon."

Despite the improved capture rate afford by the HEPA filters, airborne plutonium releases were about 90 percent higher in 1977 compared to 1976, officials explain, largely because of work conducted at the Central Waste Treatment Plant in decontaminating some experimental equipment.

One of the largest sources of penetrating radiation is the Critical Assembly Facility, located adjacent to the much-traveled Pajarito Road used by the Los Alamos population to commute to and from the bedroom community of White Rock. Measurements taken at the edge of the road near the "Pajarito Site" facility have revealed radiation levels as high as 1,120 millrem per year, compared to background levels of about 140 millirem per year.

"Travelers along the road may be exposed to some fraction of this increment if they happen to pass the site when an experiment is in progress," the LASL impact statement says.

Dr. Hansen noted that releases from the Critical Assembly Facility, where experimental studies of the behavior of nuclear chain reactions are conducted, equal the levels of airborne contamination emitted from the rest of



TLD monitoring device used at LASL. LASL photo.

the LASL facilities combined. "It's an area where we know we have something going on," he said.

Lab officials estimate a person making 15 round trips per week, at a speed of 40 miles an hour, past Pajarito Site when experiments are under way would receive a calculated dose of one millirem per year.

In an attempt to minimize the impact of the facility on the public, experiments are discontinued during rush hour at Los Alamos and during the time school buses pass the site.

Air quality at the lab and the surrounding area is regularly monitored by two networks of thermoluminescent dosimeters, which are small air sampling devices which record external penetrating (primarly gamma) radiation in the atmosphere.

The first network of 50 TLDs includes a total of 31 on the lab property, two-thirds of which are located near facilities which are known sources of radiation releases; 16 have been placed within two miles of the LASL boundary; and three are in the neighboring communities of Espanola, Pojoaque and Santa Fe. The second network of 29 TLD monitors, all located with in the LASL boundary, has been established to measure the gaseous releases from the Clinton P. Anderson Meson Physics Facility.

The $120 million LAMPF facility, one of the world's largest nuclear research installations, is another principal source of public exposure to direct radiation at Los Alamos.

The heart of LAMPF is the half-mile long proton linear accelerator which produces a beam of energy up to 800 million electron volts for use in a variety of nuclear, medical and other scientific experiments. The intense proton beam at the facility, which came on line in 1974 after six years of construction, is now operating at an average of about 40 percent design capacity.

Over the past few years, the power of the beam and its duration have been steadily increasing — and so too has the amount of radioactive releases.

The releases from LAMPF of primary concern are the so-called "air activation products" — the radioactive isotopes of carbon-11, nitrogen-13 and oxygen-15. The final impact statement, in tracing the atmospheric releases of radioactivity from LASL stacks from 1974 to 1977, reports that the amount of activation products vented to the air increased from 5,890 curies in 1976 to 48,174 curies in 1977 because of the increasing operating power of the facility.

LASL officials have encountered a continuing leakage problem resulting from the collision of the primary beam with the "beam stop" or target. Although the radioactive half-lives of these radionuclides are extremely short, between two and 20 minutes, there is little delay time before these contaminants reach the atmosphere.

"They are mainly neutron activation products," Dr. Hansen explained. "When the beam collides with the beam stop, it produces neutrons that go outside the piping and they activate the air itself. And there's carbon dioxide in the air and of course oxygen and nitrogen."

At Philomena's Restaurant, next to the Los Alamos Airport, the estimated maximum yearly dose received by employees is about 2 millirem from emissions of the activation products released from the LAMPF facility.

"The population that eats there is going to get much less," said Hansen.

Aside from the routine ventilation of these activation products from the LAMPF facility, which represents the primary exposure mechanism at LASL, there have also been spills of radioactivity onto land surrounding the plant — one this year involving the break of a cooling line which dumped 5,000 gallons of tritium-contaminated water.

"Essentially they are encountering radiation levels within the shielded area (at LAMPF) that have not been encountered before because of the intensity of this machine," said Hansen. "And actually, they suffered radiation damage in the copper tubing and it became brittle and broke. So they're changing materials. But in the process, a leak occured and ran into the tuff."

The draft EIS notes: "There is uncertaintly as to the possible direct radiation effects from LAMPF." Because of the problems being encountered as the operating level of the facility is increased, a special task force has

been formed to study ways of reducing the radioactive effluents from LAMPF. The final EIS notes that LASL officials are now making attempts to reduce the amount of radioactivity released from the LAMPF facility, including a retrofitting program to seal the tops of target cells with large sheets of metal, sealing cracks with polyurethane foam and reducing air volumes around the target cells. "Thus, positive steps are being taken to reduce public exposure as far below the limits as is practicable" the report states.

Another source of airborne contamination at LASL is the testing of conventional high explosives at several sites in remote areas of the lab property. An estimated 226,500 pounds of natural and depleted uranium, as well as other chemical substances including mercury, berylium and lead, have been dispersed at the firing sites over the past 35 years.

Of the total, about 165,000 pounds of natural and depleted uranium has been deposited at a detonation area known as E-F Site, which has been a test firing range since the lab's beginning. In 1976 a LASL study at the site revealed that "significant penetration and/or migration of uranium into the soil profile has occured."

Bayo Canyon, another high explosives testing site between 1944 and 1961, was decommissioned by 1963 with the removal or demolition of structures and the cleanup of surface contamination. It was concluded that the canyon was sufficiently free of radioactivity to allow the land to be released from federal control and turned over to Los Alamos County on July 1, 1967.

In 1976, however, the Energy Research and Development Administration (the forerunner of DOE) identifited Bayo Canyon, long with Acid-Pueblo Canyon, as a potential "hotspot" and ordered a resurvey of the land under the program to correct mistakes from previous practices. Results of the resurvey of Bayo Canyon showed strontium-90 contamination on the soil surface was still about three times higher than the levels attributed to fallout and surface uranium concentrations were about 90 percent higher than is naturally present in the area's volcanic soils.

"Health physics interpretations of the data indicate that the present population of Los Alamos living on mesas adjacent to Bayo Canyon is not receiving any incremental radiation dose due to the residual contamination," says the LASL Environmental Surveillance Report released earlier this year.

Although LASL officials, in lab reports and during interviews, generally express the view that the airborne radioactive release from the installation add only a small additional dose to the surrounding population, there are those who are not so optimistic.

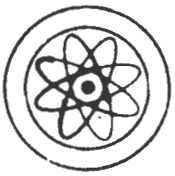
Dr. Robert Watt, a nuclear physicist who worked at LASL for 30 years prior to his retirmenet in 1977, believes the levels of radioactivity allowed by federal standards may be too high.

"In talking with professional persons engaged in developing nuclear power, I find a tendency to underrate the importants of the industry's impact on nearby individuals and even the whole world's population," he said in a paper presented to a meeting of the American Nuclear Society in Sun Valley, Idaho in 1976. "Airborne radioactive isotopes create new hazards peculiar to the nuclear industry," Watt wrote. "Hazards may be localized and of short duration, or spread over the whole earth and last for millenia. . . . Unfortunately, our knowledge of the effects of low-level radiation on humans is inadequate and we have even less information about the effects on most other organisms."

Solid radioactive waste awaiting burial in LASL disposal trenches. Photo by Dede Feldman.

V

LASL Aide Admits Waste Report "Misleading"



LOS ALAMOS — A well-publicized Los Alamos Scientific Laboratory report describing the disposal of solid radioactive waste flatly states that no radioactivity has leaked from the disposal sites at the lab.

Dr. Lamar Johnson, director of the LASL office of waste management, now says, however, that the report is "misleading" in light of the several known instances of movement of radiation from the lab's disposal trenches.

The report, written in 1978 by Dr. John Warren who heads the lab's solid waste disposal operation, concludes: "No migration of radioactive contaminants away from disposal sites has been observed by the continuing monitoring program."

The report was distributed to the news media in New Mexico and was the basis for a lengthy Associated Press article transmitted statewide.

"I'm not very happy with some of the statements that we made in there (in the LASL report)," Johnson said. "Like we haven't had any materials migrate. Tritium obviously has migrated."

"Migration" is the nuclear industry's euphemism for the movement or leakage of radioactivity.

A 1973 LASL technical report on "Underground Movement of Tritium from Solid Waste Storage Shafts," which was not distributed to the news media, documents that tritium has in fact "migrated" from solid waste burial pits at the lab. The leaks of tritium, a radioactive gas related to hydrogen, continue to routinely occur at the lab.

"Perhaps this was a mistake on my part, a poor explanation," Warren said. "I meant to say that there was no migration of waste beyond the boundaries of the entire site and that no contamination of waterways or acquifers had occured. It (the report) is misleading and a revised mini-review is now coming out."

In defense of the report, Dr. Johnson said he did not believe Warren was trying to hide anything from the public through the erroneous statements contained in his report. "I think he (Warren) is doing something that is pretty common in journalism in this country — putting a tone to it. Just carelessness on our part," Johnson said.

There are about 300 million pounds of solid radioactive waste buried in trenches and shafts dotting the mesas that make up the LASL grounds — enough to fill 1,266 railroad boxcars.

Lab officials say the 300 million figure is really only an estimate of what might be in 15 disposal areas — 13 of them inactive and two now in use — spread over 56 areas acres within the lab boundaries. No formal records of the wastes were kept until the mid-1950s and detailed records were not maintained until 1959.

A program to get a more accurate picture of what has actually been buried is now under way, but officials from the lab's Waste Management and Environmetal Surveillance Groups remain confident that "no safety or environmental hazards have resulted from these (waste disposal) practices."

Solid wastes include both combustible and non-combustible laboratory trash, material from glove boxes (remote handling devices), contaminated equipment, sludge and cement pastes from the liquid waste treatment plants, chemical oils, animal tissues and debris from demolished buildings. The waste material, which is now generated at a rate of about 9,000 cubic yards a year, is contaminated with plutonium, cesium, strontium, americium, tritium, uranium and other radionuclides.

The largest source of contamination is tritium which makes up about 90% of the radioactive content of the wastes buried since 1972. Based upon present and planned lab projects, LASL officials predict that 30,000 curies of tritium will be buried each year through the forseeable future.

LASL officials believe that about 20 pounds of plutonium is interspersed in the burial trenches from the lab's early days — though exactly where these contaminants are located is not known.

During the first several years of the lab's operation, expediency dictated rapid and, by present standards, casual disposal of contaminated wastes. A 1973 LASL report describes those procedures: "Contaminated solid wastes were sometimes dumped into scrap piles near the laboratory and both solid and liquid wastes were dumped outside buildings or down sink drains during emergencies."

Each technical area, from the explosives division to the plutonium processing plant, operated its own burial area and there were few, if any, records kept on liquid discharges into buried tanks and absorption beds at several of the solid wastes sites. The result was the gradual creation of over a dozen separate disposal areas.

Since then, techniques for handling and storing nuclear waste have evolved from "crude, uncontrolled dumping" to more sophisticated burial practices.

Beginning in 1972, the longer-lived radionuclides (about 10 percent of LASL's solid waste) have been placed in retrievable storage for removal at a later date to a permanent waste repository. These retrievable wastes, called transuranic or TRU waste, contain radioactive concentrations of more than 10 nanocuries per gram and special attention is given to them in the burial process.

The 70,000 cubic feet of these wastes are stored in modified pits and shallow trenches and packaged in 55-gallon drums, wooden crates coated with fire retardent material, corrugated pipe secitons and 30-gallon drums encased in concrete casks.

Some TRU wastes are stored in the form of cement paste at a disposal area near the plutonium processing facility. Most of the wastes, however, are stacked on the asphalt floor of large trenches in the Mesita del Buey disposal site, covered wfth three-quarter inch plywood and heavy vinyl sheeting and then backfilled with dirt.

The high activity wastes, such as plutonium 238 and uranium-233, are packaged in 30-gallon drums and placed in concrete casks. Plutonium-americium contaminated cement sludge is pumped into two-and-a-half-foot diameter pipe sections standing vertically in 23-foot-deep pits.

Two main disposal areas have served the lab since the late 1950s. One, located near the intersection of Parajito and Pecos Roads in Los Alamos, is no longer in operation. The other, on the mesa known as Mesita del Buey, now handles all the low-level radioactive waste consigned to permanent on-site burial.

After screening by a special computer called a multiple energy gamma assay system (MEGAS), which indicates an item's level of contamination and whether it should be buried retreivably, the waste is consigned to the appropriate type of burial. Computer records are now maintained of all solid waste products buried at Los Alamos.

When possible, waste materials are crushed in a compacter-baler press designed to handle low-level, trash-type wastes. The machine, in use at LASL since 1977, reduces the volume by a ratio of five to one, thus decreasing the acreage needed for burial.

Once the low-level waste has been screened and compacted, it is buried in layers in huge trenches or in shafts 25-60 feet deep. The trenches are capped with dirt, the shafts are sealed with concrete.

Combustible wastes placed in the trenches are backfilled with dirt the same day to prevent fires. Since 1963, tritium-contaminated wastes have been disposed of in asphalt-lined shafts or drums.

Radioactive waste, including the material generated at LASL's plutonium processing plant, is now trucked through the townsite, over the Los Alamos bridge and out Pajarito Road for ultimate burial in the principal solid waste disposal site.

The upgraded procedures now used at the lab have earned LASL national recognition in the field of radioactive waste engineering. According to Dr. Thomas Keenan, waste management group leader, the techniques employed at Los Alamos will have wide application in the commercial nuclear industry, particularly an experimental system involving the incineration of transuranic waste.

The "controlled air" incineration process, being developed at a new $1.6 million LASL facility, is designed to reduce the volume of radioactive TRU wastes by 150 to 1 and help stabilize chemicals in the wastes.

In developing the process, LASL scientists have modified a conventional incinerator to handle radioactive materials, adding high-efficiency filters, an off-gas cleaning system, a condenser and a scrub solution recycling system. "What you're seeing is a hell of a big test tube," Keenan said during a tour of the facility. "This will never burn routine LASL wastes, it's primarily a research facility."

If the tests at the pilot plant are successful, however, a similar, full-scale incinerator facility will be constructed at the lab.

In spite of the advances made at Los Alamos in nuclear waste disposal, there have been containment problems.

A 1975 U.S. Geological Survey report, "Evaluation of Monitoring of Radioactive Solid Waste Burial Sites at Los Alamos, N.M.," written by Dr. Thomas E. Kelly, cites fires, plutonium leaks and movement of tritium vapor from waste storage areas. Kelly, a geohydrologist who now works for a private consulting firm in Albuquerque, declined to be interviewed on his report.

Another report published by LASL in 1973, however, details the leakage of tritium from 15 shafts in the currently-used disposal area and lab officials have reported additional tritium migration in another abandoned disposal area as well.

According to the 1973 report, tritium had moved 105 feet in four years and the downward migration may have been even greater. The movement of radioactivity occurred through open joints commonly found in the Bandelier tuff and at points between two ancient ashflows.

The report also stated that there has been "an uptake of tritium by plants from the soil and tuff and tritiated moisture is being transpired into the atmosphere." A vegetation sample above one shaft contained tritiated moisture 10 times the concentration guide for tritium in water in on-site, controlled areas.

According to Dr. Thomas Hakonson, a radiologist with the lab, the plants whose roots had penetrated to the buried waste were probably the source of food for a colony of bees near the site. In a report published in 1973, Hakonson said the bees showed an "unexpectedly high" concentration of tritium — 3 to 30 times greater than bees from the Espanola Valley — and through the production of honey, he concluded that the bees served as a "vector in the transportation of tritium to man."

Dr. William Purtymun, a LASL geohydrologist who once descended into the shafts to measure the leaks, said he does not consider tritium migration a problem. "It's a very localized area," he said. "It's a fenced area and there's not enough moisture in the tuff to drive the tritium into the main acquifer."

The acquifer, which serves as the principal Los Alamos water supply, is about 850 feet below the surface.

Dr. Alan Stoker, assistant Environmental Surveillance Group leader, noted that while it is true that tritium moisture is being absorbed by the plants growing above the disposal site, "People don't have access to that area and concentration guides for tritium do not really apply to plants, just to water. I'm not aware of many people who get all their water from clover."

Another problem LASL officials have encountered is fires in the currently-used solid waste disposal area. The USGS report written by Kelly states, "On two different occasions,

Dr. Thomas Keenan (left) and Dr. John Warren (right) inspect packaged waste at LASL disposal site. Photo by Dede Feldman.

fires have started in wastes stored at Area G (the Mesita del Buey site)."

Commenting on the fires, Dr. Wayne Hansen, the Environmental Surveillance Group leader, stated: "The fires were not substantial, but they were enough to call the fire trucks. We have had fires in the waste areas, mainly because they include so much combustible trash-type waste from the labs — rags or paper with oil on them."

Aside from the problems at the current waste disposal site, the earlier, haphazard disposal practices have left a radioactive legacy which lab officials are now deciding how to handle. To do so, the Environmental Surveillance Group is undertaking a resurvey of the old disposal sites.

"We have a special charter to go through the old records, correspondence and memos and find out what's in the waste areas," Hansen said. He said the two-year survey will also consider alternatives "in terms of what to do with the site — whether to continue as is, improve or even retrieve the waste materia"

In one old disposal area near the plutonium processing facility, lab officials have started to exhume plutonium-contaminated liquid waste from two, 50,000-gallon stainless steel tanks buried eight feet below the ground. These so-called "General's Tanks," named for Gen. Leslie Groves, the Army officer in charge of the lab during the war years, were used from 1945 to 1946.

While there are no precise records, the tanks have been estimated to contain about 94 grams of plutonium-239. At present, wastes from the tanks are being pumped out and routed to the principal liquid waste treatment plant, where they will be processed, encased in cement and buried as solid waste.

Dr. Johnson, assistant leader of the LASL Health Division, said the tanks have not leaked or corroded but that the tanks are being emptied "to avoid the Hanford experience." (Johnson was referring to the leakage of 500,000 gallons of radioactive liquids from similar tanks at the sprawling Hanford nuclear reservation in the state of Washington.)

Increased concern over low-level radioactivity led the Atomic Energy Commission in 1971 to request environmental surveys of lands formerly used for nuclear research. One of

those areas in the re-survey program is the former main technical area at LASL — TA-1 — which bordered Ashley Pond in the heart of Los Alamos before it was demolished.

The re-survey and decontamination of this area, which was released to the county for public and commerical development in 1966, revealed an "unexpectedly" high level of plutonium near the septic tanks of an old laundry facility. The high concentration of plutonium (125,000 picocuries per gram) was 277 times th the acceptable limit recommended by LASL scientist J. W. Healy and, according to a LASL report, "brought into question the significance of earlier survey results."

Other findings from the survey, which lasted from 1974 to 1976, indicated higher than regional concentrations of uranium and gross alpha activity in the area.

After nearly two years of excavation and removal of about 20,000 cubic yards of dirt and debris, the lab concluded that all likely sources of contamination in the undeveloped portion of the TA-1 site had been investigated. "All contamination found was removed to the lowest levels practicable on the basis of the high cost of further action and the insignificant health and safety benefits anticipated."

The lab was unable to give assurance that all contamination was found, however. "Some contamination may exist in the fill material under Trinity Drive (a primary Los Alamos road), including two contaminated manhole structures from the old sewer line," the lab reported, "but the pockets of contamination would have been greatly diluted by the gathering and spread of the backfill during road construction."

Extensive commercial development on the old site, including gas stations, a fast food outlet and the Los Alamos Inn, which is located almost directly above the site of an old uranium processing building, made total sampling "impracticable." As a result, no exploratory excavation was conducted in the developed areas.

Summarizing the lab's evaluation of the site, the LASL environmental impact statement says "It is believed that the TA-1 area in its present condition poses no risk to human health."

Another former waste site, still under government control, is a partially-paved area now used by county residents for storage of campers and trailers. Although no records are available, it is known that the six-acre area across from the *Los Alamos Monitor* was used for radioactive and chemical waste disposal from 1946 to 1948. In 1948, the area was retired as a waste disposal site because of its proximity to residential areas. Until the mid 1950s a mobile home park was located west of the area.

According to the USGS report, there have been several cave-ins on the asphalt in the parking lot at the site, "indicating that some compaction and settling of the waste has occurred."

Plant samples taken recently at the site, which were not analyzed for all radionuclides, indicate trace tritium concentrations, Dr. Hansen reported. He said the cracks have been re-sealed but during a recent visit to the area, he noticed two more cracks had appeared.

"The area will need continued maintenance and surveillance," he said.

In a comment on the Los Alamos environmental impact statement last year, the Environmental Protection Agency asked why the public was allowed in the exposed area and said DOE should describe in the final impact statement what measures were being taken to eliminate public access.

In a response to the EPA the LASL final Environmental Impact Statement

'Accountability' a Key Issue

One problem facing officials at Los Alamos Scientific Laboratory, as well as officials at nuclear installations throughout the country, is keeping track of the exact amount of weapons-grade plutonium and enriched uranium on hand.

Designated by the Department of Energy as the nation's lead laboratory for the development of nuclear safeguards, LASL has pioneered major innovations in nuclear material measurement and accountability.

One of the developments is the "Non Destructive Assay," a technique that measures nuclear materials in their many forms as they pass through a facility. Another is called DYMAC (Dynamic Materials Control), a program which integrates the non-destructive assay instrumentation with data processing equipment to provide almost instantaneous nuclear materials accountability and control. After testing and installation in LASL's new plutonium plant, DYMAC will be ready for other nuclear facilities nationwide.

In spite of these advancements, however, LASL has problems with accountability.

According to a 1977 Energy and Resource Development report on strategic special nuclear material inventory differences and two subsequent updates, the lab cannot account for approximately 362 pounds of weapons-grade plutonium and uranium.

The figure, alternately called "material unaccounted for" (MUF), is the difference between the actual inventory of radioactive materials and the amount accounting records show to be on hand.

The lab's 1978 Environmental Impact Statement says that the figures "do not necessarily represent stolen or diverted special nuclear materials," and LASL officials indicated the difference is more likely due to measuring flaws, chief among them the unmeasured amount of waste buried at sites before 1970.

In addition, the LASL final Environmental Impact Statement says that most, if not all, of the inventory differences are attributable to plutonium and enriched uranium trapped in pipes, tanks, ducts, and gloveboxes which have been buried at the lab's radioactive waste site over the years. The FEIS estimates the amount of Material Unaccounted For as of Oct. 1978 at 293 pounds rather than DOE's cumulative figure of 362 pounds.

acknowledges the use of the old waste disposal site as a trailer/camper park, but states that "No one should receive any radiation above background from this present use."

"Routine monitoring and surveys indicate no radiation levels above natural background are present in the fenced trailer/camper storage area" the FEIS states.

How adequate are LASL's techniques of solid waste disposal?

Kelly's USGS report in 1975, one of the only outside evaluations of LASL radioactive waste management, criticized the lab for its lack of post-burial monitoring and made a number of specific recommendations including the eradication of clover and other vegetation from atop the pits, construction of berms on the upslope side of each pit to reduce surface runoff, monitoring of the "General's Tanks," and excavation of many of the sites where records are poor.

According to Wayne Hansen, the USGS report was "very helpful" and many of its recommendations have been followed.

Purtymun registers frustration when asked about the safety of LASL disposal practices.

"As far as I can see," he said, "there's not enough water out there to move anything, and in all the drilling and analysis, nothing's moved. There just isn't enough water to move anything.

Purtymun and other lab officials feel the dry conditions and impermeable volcanic tuff of the Pajarito Plateau are ideal for waste burial and he says LASL disposal practices are among the finest in the nation.

Some lab officials are so confident of LASL's ability to contain the waste that they would prefer it remain buried at Los Alamos, rather than be shipped to another repository. "We were hoping that they would keep the wastes right here — the safest place is right here," said Dr. Gerald Buchholz, the manager of the Central Waste Treatment Plant.

One member of the San Ildefonso Pueblo tribal council, who asked not to be identified, said his people are concerned about radioactive pollution from Los Alamos, but can do little because they are economically dependent on the lab.

The San Ildefonso reservation borders lab property on the north and east and portions of the land nearest the LASL perimeter have been designated by the tribe as sacred land. The ruin of the Tshirege Pueblo, thought by archaeologists to be the home of the ancestors of the modern San Ildefonso Indians, lies about 300 yards east of one radioactive waste disposal area.

According to Charles Skeen, an archaeologist who consults for LASL, the ruin, which is on lab property, has been nominated to the National Register of Historic Places.

"They tell you there's no danger, but I know better. There's radiation dumps all over the place and rain puts radioactivity into the soil," a San Ildefonso spokesman said. "That solid rock thing is bull — the tuff is porous as hell."

The lab's principal disposal area is located atop Mesita del Buey. The land at the foot of the mesa is owned by the pueblo.

Partially buried contaminated equipment at LASL waste site. Photo by Dede Feldman.

VI

Cancer Rate Elevated In Los Alamos County

LOS ALAMOS — Statistical studies of cancer rates among Los Alamos County residents compiled by the New Mexico Tumor Registry indicate an above-average incidence of breast cancer and cancer of the digestive system, but officials at Los Alamos Scientific Laboratory say the elevated rates are more likely the result of diet and other socio-economic factors than exposure to radiation.

The Tumor Registry, established 10 years ago in Albuquerque as a cancer record-keeping center, has found the incidence of breast cancer in white females from Los Alamos to be "greatly elevated" between 1969 and 1974 — more than twice the U.S. average. While the nationwide statistics show an average of 75 cases of breast cancer per 100,000 females, the attack rate in Los Alamos was found to be 177 per 100,000.

Furthermore, cancer of the various organs of the digestive tract appears to be far more common in white males and females from Los Alamos than for New Mexico as a whole, according to the registry. During the same 1969-1974 study period, statistical rates of cancer of the stomach, pancreas, bladder and rectum in males were each three times the New Mexico average and more than double the statewide-rate for cancer of the large intestine.

The New Mexico Tumor Registry, one of five such state centers with relatively complete records, explains in a report the problems inherent in making statistical comparisons with the community: "Los Alamos County is incomparable. Comparisons of disease or death rates between Los Alamos and other places are invalidated by population differences in age structure, occuption, education, income; by enviromental differences in altitude and region of the country; and by different exposure levels to atomic radiation.

During a television interview shortly before his departure last May as LASL director, Dr. Harold Agnew was asked whether the incidence of cancer in Los Alamos is higher than normal. "No, it doesn't seem to be so," he replied.

Agnew, who left the lab after serving seven years as its director to take the job of president of General Atomic Corp. in San Diego, Cal., did concede during the telecast that there appears to be "slightly higher" intestinal tract cancer in Los Alamos County, but he placed the blame for that on the rich foods consumed by the affluent Los Alamos population, including the widespread appetite for hot green chili.

While the rates of some cancers are considerably higher, statistically, in Los Alamos County for the 1969-1974 period, the incidence of the disease in other parts of the human anatomy studied by the Tumor Resistry — including the brain and nervous system, the biliary passages and the liver, the respiratory system, and the blood — were roughly similar to the rest of New Mexico.

In its evaluation of the cancer data from 1969-1974, the Tumor Registry noted that there have never been significant number of persons over 65 years old living in Los Alamos, an age bracket considered "prime" for the development of many types of cancer. (In 1970, only two percent of the Los Alamos population was over 65).

"Therefore, Los Alamos is not ripe for cancer," the registry concluded.

Yet though the Los Alamos population is not considered to be particularly susceptible to cancer, a composite of all malignancies suggest a statistically higher incidence than the statewide totals. Throughout New Mexico during the 1969-1974 study period, the cancer attack rate was 311 cases per 100,000 population; in Los Alamos, it was 420 cases per 100,000, according to the Tumor Registry.

Dr. George Voelz, director of LASL's Health Division, said the higher statistical rates for various cancers in Los Alamos County do not necessarily mean that the disease there is on the rise. And he rejects the possibility that the 20-25 latency period between radiation exposure and the appearance of cancer could be a contributing factor in the statistical rise of cancer rates during the early 1970s.

"Although there are trends and differences within the (Tumor Registry) statistics, the differences in those numbers are not significant, statistically," Voelz noted. "If you look at the numbers, it is true that one number is higher than another. But when you put the statistical tests to it, it says that those numbers are still essentially equal to each other."

"You're falling into the trap that radiation is the only thing that causes cancer and that simply isn't true. We have many other factors which are more important than radiation in many respects," said Voelz, who has served as LASL's Health Division leader since 1970.

The attempt to statistically compare health histories of persons working and living in Los Alamos with those of the New Mexico and U.S. populations as a whole are complicated to a degree by the unique nature of New Mexico's "Atomic City" — — the population there is mostly white, younger, better educated and higher income than most communities in this country.

Aside from the unusual demographic characteristics created by the presence of Los Alamos Scientific Laboratory as the dominant industry, health officials point out that another obstacle is that there simply are not that many people in the community, which makes meaningful interpretation of the cancer statistics difficult.

The statistics are compiled according to the number of cases per 100,000 population. Voelz noted that because the Los Alamos population is less than 20,000, even a single cancer case can result in a relatively large change in the statistical rates. "If we had the

Dr. George Voelz, LASL Health Division Leader. Photo by Phil Niklaus.

same rate with a population that was twice as many people or four times as many people, then the rate (of cancers reported by the Tumor Registry) might well be significant. But this simply is that we are dealing with small numbers."

Another important, if obvious, consideration w hich makes comparisons difficult is that about one-third of the entire Los Alamos population of 19,600 is employed at the lab, one of the nation's oldest and foremost nuclear research installations. As one LASL report put it, "Los Alamos has been more intimately associated with the plutonium industry than any other community in the country."

The statistical findings of elevated breast cancer rates between 1969 and 1974, which represents the latest figures published by the Tumor Registry, have nevertheless attracted the interest of the LASL Health Division. "We don't have our own data (on breast cancer rates) but we are aware of the Tumor Registry data," Dr. Voelz said. "That's what their data show and we're curious about that."

Aside from the data indicating increased rates of breast cancer, as-yet unpublished data collected by the Tumor Registry show that the number of actual deaths in Los Alamos due to breast cancer is also elevated during the past 10 years. Tumor Registry figures show 16 breast cancer deaths in Los Alamos during the decade from 1969 to 1978, while during the previous 20 years there were only 12.

Dr. Robert Buechley, epidemiologist, NM Tumor Registry, said that while the incidence of breast cancer is elevated, statistically, during the 1969-1974 period, as compared with 1950-1969, he believes the higher rates are because the younger women who originally came to the lab during the 1940s and 1950s are now reaching the age when breast cancer begins to appear most frequently.

"There's a certain age at which ladies get breast cancer — it begins to come up strongly after menopause," he said. "The population (at Los Alamos) has now got into that age group."

Buechley emphasized, however, that absolute conclusions as to what the elevated breast cancer rates mean are not possible. "This (the aging Los Alamos female population) is our explanation. If it is a true explanation or not, I don't know. It's our best guess," he said.

In a report on cancer in Los Alamos, the Tumor Registry suggested other possible explanations for the elevated breast cancer rates in the 1969-1974 survey.

"Late marriage, consistent with the high educational attainments, may raise the actual breast cancer rate. And highly educated women may seek, and find, more diagnostic service for these malignancies than less educated women."

In its analysis of the breast cancer data, the Tumor Registry noted that the mean age of a mother in Los Alamos giving birth to her first child is older than the New Mexico average, 24.3 years old compared to the statewide average of 21.7 years.

Voelz offered some credence to the contention that earlier diagnosis may be a contributory factor in the above-average breast cancer figures recorded at Los Alamos.

"I'll give you a very personnal experience," the LASL health physicist said during a recent interview. "My wife died of breast cancer on March 15 (1979). She had it first diagnosed at an early stage four years ago. Now if she was living in a part of the country where there wasn't medical services readily available, she might have been diagnosed in 1979 when the spread (of cancer) became apparent, instead of 1975 when it was first diagnosed.

"In other words, if she came in terminal and hadn't seen any physicians, her diagnosis and her record would now be four years later than it would have been if she had it diagnosed at its earliest stage. That would mean that in the statistics, comparing across the country where those conditions might exist, you'd be comparing a rate at an age that's four years different, so it would look like those rates were different but that's because the curve has been shifted. If you disagnose it at a different stage, you get a shift in the curve because you're now listing that one at a different age as to when it was diagnosed."

Dr. Voelz amplified further on some of the possible factors which he said may influence the apparent increase in breast cancer in Los Alamos.

"The economic factor is an important one because there are some data that suggest that fat percentage in diet may have something to do with breast cancer — it increases it," he suggested. "Another economic factor is birth control pills economically change as you get into different social strata. Even the type of birth control changes. I don't know all that much about it and we certainly don't know what Los Alamos does as compared to, say, Albuquerque women.

"There are just lots of factors," he said. "There are lots of people looking at all this all over and gradually we are accumulating more information."

The notion that socio-economic factors are responsible for the statistically elevated cancer rates in Los Alamos has been challenged by one medical doctor with the New Mexico chapter of "Physicians for Social Responsibility," an international group founded by Australian anti-nuclear activist Dr. Helen Caldicott.

Dr. Kathleen Schneider of Albuquerque pointed out that the higher-income classes of people generally have better nutritional habits and health care and therefore would be expected to be less susceptible to cancer. "I would think there would be less cancer in Los Alamos because of (higher socio-economic) class," she stated.

One New Mexico Tumor Registry study, however, does compare Los Alamos to control counties elsewhere in the country selected on the basis of high income, education, professional and government employment. Results from the study indicate that cancer mortality rates in Los Alamos county white males from 1950-1969 ranked highest compared to as control counties for leukemia, lymphosarcoma, cancers of the liver, prostate and bladder.

Dr. Schneider further dismissed as a "pretty thin explanation" the allegation that a preference for green chili might contribute to the higher digestive tract cancer rates, noting in fact that New Mexico's beloved green chili is actually considered to be good for the digestive system.

Voelz himself conceded that he does not think that the socio-economic factors he mentioned are sufficient by themselves to explain the elevated breast cancer rates in Los Alamos during the 1969-1974 period. "We don't know what the cause of this is," he admitted. "It's like a lot of things — when you first get the information, you just can't say and you start looking for it and maybe ultimately you may be able to say more about it.

"We don't know a heck of a lot about these factors," he added.

Yet despite the lack of conclusive epidemiological data, Voelz said he does not believe that the small increase in radiation exposure received by Los Alamos residents has a significant influence on cancer rates in the county.

"We know fairly well what our occupational exposures are and in terms of the standards, they are pretty low. And we know what those risks fairly well are of those things (exposures)," he said. "Overall the social and economic and cultural factors appear to be more important (than radiation exposure). We have information on both and then you have to make a judgement."

The difficulty in gauging the causes of cancer in the Los Alamos area is exemplified by the statistics on leukemia. The survey of cancer by U.S. counties conducted for the years 1950-1969 showed the leukemia rates in Los Alamos County were double the New Mexico and U.S. averages, though those rates appear to level off in the following four years to where the incidence of leukemia among Los Alamos residents was slightly lower than the New Mexico rates. A LASL report, noting the lower rates relative to statewide averages for the five-year period, states: "This suggest that any excess of leukemia between 1950-1969, if real, was probably occupationally induced prior to employment at Los Alamos or during early years when controls of all hazards, including chemicals, in the work place were not up to current standards."

Although LASL officials say the elevated leukemia deaths in Los Alamos from 1950-1969 are not statistically significant, they admit that the findings represent a "borderline" excess.

Leukemia induced by radiation is believed to have a shorter latency period than other cancers.

Dr. Voelz reiterated that the relatively small population in Los Alamos makes it difficult to gauge the incidence of leukemia. "The other problem of course is that leukemia has some sort of a cluster phenomenon. In other words, it does not occur randomly — it occurs in clusters. There are some cancers that do that. We don't know why."

Dr. Buechley, meanwhile, is not convinced there is not an elevated leukemia rate, despite the low figures during 1969-1974 compared to the preceding 20 year statistics. "My personal belief is that leukemia may well be elevated but we haven't had time to study it."

The question of the impact of low-level radiation exposure over extended periods of time is, of course, one of the most controversial subjects of the entire nuclear debate today There are scientists — Dr. John Gofman of the University of California, at Berkeley, Dr. Ernest Sternglass of the University of Pittsburg, and others — who insist the possible adverse health effects of low-level radiation may have been greatly underestimated in

the past.

Dr. Peter Montague, a long-time nuclear opponent in New Mexico, who, with his wife Katherine, founded the Southwest Research and Information Center in Albuquerque in 1971, criticized LASL health officials for their failure to more seriously consider the influence of radiation in the Los Alamos area as a possible cancer-causing source.

"They have a cancer problem in Los Alamos and they can't explain it, but they won't even look at plutonium. It (plutonium) seems just as likely a cause as green chili or living on high on the hog," Montague remarked, adding, "At the very least, there should be a more solid study of cancers in the county."

Although the LASL Health Division has for years been studying the health histories of some lab employees who have received accidental doses of radiation while working at the lab, there have been few specific studies of the cancer-causing effects of routine exposure of lab employees and other residents of the Los Alamos area. "We haven't had time to really look at all these things yet," said Voelz.

One LASL study, undertaken to assess the risks associated with the growth of the nuclear industry, analyzed plutonium in the tissues of the general population in six areas of New York, Pennsylvania, Illinois, Colorado, Georgia, South Carolina and Los Alamos. The study, based on autopsies performed from 1959 to 1970, found that plutonium in the lungs, lymph nodes and kidneys at Los Alamos were about twice as high as the plutonium content of organs from the other regions.

An abstract from the LASL report explains the findings this way: "This (the elevated plutonium levels) may be due to a large number of cases from older residents who lived in Los Alamos at a time when possible release of radioisotopes to the environment was not controlled to the level required by present regulations and provided by current engineering controls."

Dr. Voelz said, however, that the study has been looked into since the 1976 report and it has now been determined that the averages in the report were not properly calculated.

In order to beef up the admittedly slim data based on radiological impact, a major nationwide study of nuclear workers exposed to plutonium since the 1940s is now underway at Los Alamos. The DOE-supported study is being coordinated by Dr. James Stebbings, a LASL epidemiologist, who previously studied the health effects of air pollution for the Environmental Protection Agency in North Carolina.

Stebbings and two young research assistants, Paul Mills from the University of Minnesota and Shelley Reyes-Baker from the University of California at Berkeley, are gathering Social Security and death records of about 20,000 nuclear workers who over the past 33 years have been employed at six principal U.S. nuclear installations — the Hanford Reservations near Richland, Wash., the Mound Laboratory at Miamisburg, Ohio, and Oak Ridge National Laboratory, Oak Ridge, TN, the Rocky Flats Plutonium Plant near Golden, CO, the Savannah River Plant at Aiken, SC and Los Alamos Scientific Laboratory.

The study, initiated in 1974, will compare the health histories of persons known to have received plutonium doses with non-exposed workers at the nuclear facilities.

One chart compiled by the LASL Health Division shows there have been a total of 4,751 workers at the six nuclear plants who have received measureable body burdens of plutonium over the past 35 years and another 8,930 who have received "negligible" doses. Another group of 6,475 workers at the six sites have not been tested, according to the LASL compilation.

In the category of most severely exposed workers who have received at least half of the maximum permissible body burden of plutonium, 63 of the total of 141 at all six facilities received their doses at Los Alamos. According to the chart, LASL ranks behind only Rocky Flats in numbers of workers with plutonium exposures in excess of one nanocurie — 1,066 workers at LASL compared to 2,879 at Rocky Flats.

(A nanocurie is one-billionth of a curie, the standard radiation dose measurement, and 2.5 percent of the maximum permissible body burden of 40 nanocurie permitted by federal regulations).

Voelz points with some pride to the 1,000-plus figure because, he said, it represents a small fraction of the approximately 500 workers who handle plutonium each year at the lab. "I think that's a pretty good record," he said.

The current, broad-based study under Stebbings direction will expand in part on two previous studies of nuclear workers known to have received plutonium exposures while working at LASL.

One group of 26 Manhattan Project workers employed at LASL from 1944 to 1946 has been checked at five-year intervals by the lab's Health Division. Although some received more than the maximum permissible body burden, there is "no evidence suggesting that adverse health effects have resulted from the 32 years of exposure to internally deposited plutonium," says one LASL report.

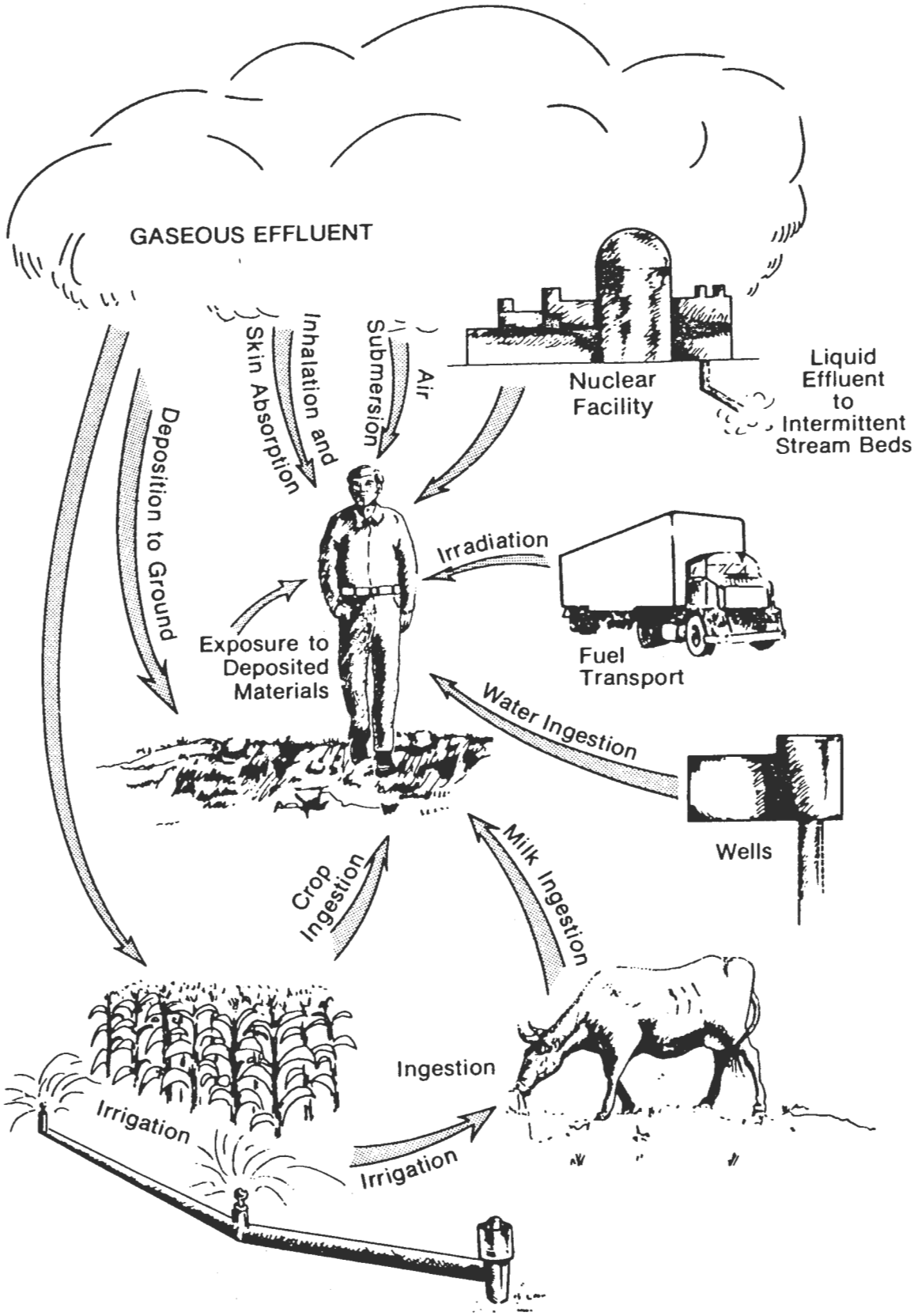
In a paper delivered to the International Symposium on the Latent Biological Effects of Ionizing Radiation held in Vienna, Austria March 13-17, 1978, LASL officials stated that based on clinical study of 26 workers: "...No medical findings were reported which could be attributed definitely to plutonium." The Vienna paper was prepared by Voelz, Stebbings, long-time LASL epidemologist Dr. Louis M. Hemplemen, who began following the health of the 26 plutonium workers in 1951, and Dr. L.K. Haxton and Dr. D.A. York.

One lab report noted that there have been only two deaths in the group, half of what would be expected for that age bracket, and neither of these deaths were cancer-related. "Thus there is indication in this study that neither cancer mortality nor cancer incidence is unusual in this group of persons exposed to plutonium," the report states.

An examination of the medical records of the 26 exposed workers in a follow-up study indicates, however, that while none have died of cancer to date, there have been tumors, skin cancers, coronaries, bone lesions and broncial ailments. Commenting on these health problems, the follow-up report says: "It is our conclusion that none of the positive findings in these medical examinations can be attributed to the plutonium body burdens."

Dr. Edward Martell, a radiochemist who is studying the effects of internal alpha emitters at the National Center for Atmospheric Research in Boulder, Colo., has called the LASL study "more disturbing than reassuring."

During testimony on the study of the 26 workers at hearings several years ago in Denver, Martell took issue with the conclusion that none of the medical findings could be linked to plutonium. "With equal justification, one



LASL diagram shows pathways of radiation to humans.

may state that most of the serious medical findings in this group can be attributed to plutonium," he said.

Martell said his research indicated that coronaries, lung and skin cancer, as well as damage to the teeth in one subject, could be connected to plutonium. "The medical experience of this small group thus far provides no basis for complacency about the health consequences of plutonium exposure," he said.

A larger study initiated at LASL in 1974 includes a group of 224 plutonium workers who had been exposed to more than 10 nanocuries of plutonium, which is one-quarter of the permissible lifetime dose.

In conducting the study, the lab's Health Division contacted each of the plutonium workers, many of whom had moved away from Los Alamos to take jobs elsewhere, in order to collect urine samples and otherwise follow their health histories. A 1974 letter sent by Dr. Voelz to the former plutonium workers concludes: "Although we do not expect to find evidence of injury of any sort due to plutonium exposure, we are anxious to prove that this is so. Following all of the early plutonium workers at Los Alamos is an excellent opportunity to do this. Please cooperate to help us prove that exposures to low levels of plutonium are not harmful."

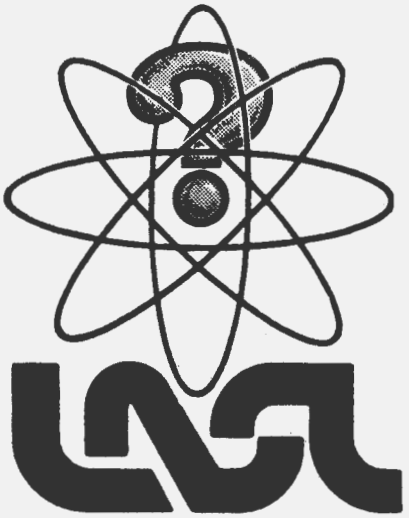
According to Dr. Voelz, the study found seven cancer deaths as compared with 11 which would be expected based on the average statistics for white males. "So you've got something like two-thirds of the expected cancers," he said.

Although there have been only seven deaths, however, the LASL report states there are five additional cases of cancer among the study group members still alive.

All of the cancers found in the group, including the five cases in still-living persons, have been found among workers with comparatively low exposures (less than 20 nanocuries).

According to Dr. Stebbings, a major problem with the current effort to follow some 20,000 nuclear workers is the 1974 Privacy Act, which prohibits the federal goverment from disclosing personal information on individuals without their written consent.

There are those who view the problems inherent in the present studies from a different perspective, however. Bob Alvarez of the Environmental Policy Institute, a Washington, D.C. group studying the effects of low-level radiation, feels that another agency, rather than the Department of Energy, should be conducting the studies. "Radiation epidemological research cannot be performed by federal agencies who administered the radiation to the people being studied, for reasons of conflicting interest — not the least of which is the potential liability faced by those agencies. To do so will increase even more public distrust in federal nuclear programs," Alvarez said.



Measures of Health Risk Questioned

In the Department of Energy's draft environmental impact statement issued last year on Los Alamos Scientific Laboratory, there are no calculations of estimated health impacts from public exposure to radiation released from the various lab technical areas. Rather, there are simply estimates of the average doses to the public — averages arrived at by taking the total estimated dose and dividing it equally among the affected population around Los Alamos.

Last year, for example, the total dose from LASL operations was placed at 10.5 man-rem which, when divided among the 105,000 persons living within an 80-kilometer circle around Los Alamos, averages out to one-tenth of a millirem per person.

In omitting the estimated health effects in favor of the man-rem concept, DOE was essentially challenging the "linear hypothesis" theory used by the Environmental Protection Agency in establishing health standards. (The linear hypothesis assume that there is some potential for adverse health effects from any exposure to ionizing radiation and that the extent of damage is directly proportional to the radiation dose recieved).

The failure to include health-effect estimates from LASL operations in the impact statement did not sit well with EPA officials who reviewed the document. In a letter to the Department of Energy dated Oct. 26, 1978, Peter L.

Cook, acting director of EPA's Office of Federal Activities, states: "EPA believes that the discussion of public health impact from activities at the laboratory is inadequate."

EPA further noted in its review: "We maintain that it (the linear hypothesis) is currently the most reasonable model to use in estimating health effects arising from low dose and low-dose rate exposure of the general public. If the Department of Energy wishes to dispute the accuracy of this model, that is its perogative. However, we do not believe that this is sufficient reason to eliminate estimates of health effects altogether. EPA strongly encourages DOE to include such estimates in the final EIS."

The final version of the LASL impact statement was released in Jan. 1980. Because there were only 15 comments received on the draft document, DOE officials said there was no need to hold public hearings before release of the final document. At present, there are no plans for hearings on the final Impact Statement.

The push to use man-rem dose calculations, rather than health effect estimates, came from DOE, according to Dr. Voelz. "This exercise (preparing the impact statement) was at DOE's behest and they set up the criteria of what would be done," he said.

Voelz said that while LASL did have "consultation" as what would be included in the report, "The ones we had consultation on, we lost. It's a DOE report — we're just putting it together for DOE."

Voelz acknowledges that the man-rem concept favored by DOE has virtually no meaning and that such risk calculations should be based on worst-case estimates. "It was our (LASL's) judgement at the time that dose rates to the most susceptible person was the most logical."

Voelz noted, however, that the man-rem system of estimating average doses is found in other DOE documents. "We don't think the man-rem is a very useful number but they (DOE) wanted it that way (in the impact statement) for consistency," he said.

Commenting on charges that no health impacts are included in the LASL draft environmental impact statement, Ray Miller, the DOE official in Albuquerque responsible for the report, said, "It's my opinion that the LASL statement has a whole series of health-effect evaluations in it. We equate how much activity is released into the air and water and then equate this with the standards and limits — that in itself is a health effects evaluation."

"The doses are so low with reference to the standards that it's a meaningless exercise to translate them into risks," Miller said.

Voelz added: "It's [the man-rem concept] too simplified to be meaningful. It can be misleading if there are sizeable differences in exposures to different parts of the population."

"It's been seriously objected to by many people," Voelz said.

According to Dr. Wayne Hansen, who heads the group responsible for radiation monitoring in the Los Alamos area, the decision to include only man-rem was made despite the fact that health effect calculations had already been completed and were included in a preliminary draft.

Hansen said he did not agree with that decision and has now received permission from both LASL and DOE to include the data in the final version of the impact statement.

Asked why the decision was made to exclude health effect estimates in the draft version, Hansen replied: "The main logic behind it, as it has been explained to me, is that conversion from man-rem to health effects results in small fractions of health effects. That's not very informative— it didn't add any information to put in fractional health effects."

Hansen explained: "Coming up with .01 cancers doesn't mean a lot. But if it's one chance in 12 million, I think the layman can understand that. That's what I do in the [final] impact statement. It's a lot clearer than millirem, which is professional jargon."

"Other areas of safety compare risk, why shouldn't we," he said. "There is uncertainty but we can come up with maximum and minimum risk estimates."

In the final Environmental Impact Statement, the Department of Energy, while still maintaining that the linear hypothesis overestimated cancer risks, added a section on the cancer risk in Los Alamos county due to laboratory activities. The section states, "The added risk of injury by cancer is estimated as between 0 and 1 in 12,000,000 per year for the townsite and between 0 and 1 in 100,000,000 per year for White Rock due to LASL activities. The normal incidence of cancer occurring in an individual is 1 in 405 per year for the New Mexico population."

Camper/Trailer park across from the *Los Alamos Monitor* located on former waste disposal area.

VII

Atomic Mishap Ever Present Danger

Accidents involving radioactive materials do not happen with a crash and a bang. More often, they occur in the form of releases of colorless and odorless radioactive gases which can not be detected without sophisticated monitoring equipment.

A chemist at Los Alamos Scientific Laboratory was exposed to over twice the annual permissible dose of radiation during an accident on May 4, 1979, but the incident went unreported to either LASL health officials or the Department of Energy until several weeks later.

The accident, caused by the overheating of a uranium-tritium storage pot, released approximately 3,000 curies of tritium at the lab's cryogenics building, an experimental facility in the lab's main technical area. A total of 11 employees were exposed but only one received a dose above federal standards. Due to defects in the building's ventilation system, some of the tritium was sucked into a basement laboratory before it was eventually released through the stack.

Because of the intangible nature of radiation, the technician involved was not aware of the extent of his exposure until a urine sample was analyzed several weeks later.

According to a DOE-LASL report on the accident released in August 1979, ten other technicians in the building at the time of the mishap (including an outside consultant whose desk was located in the lab where the accident occurred) received exposures less than 12 percent of the five rem standard for nuclear workers.

The chemist performing the operation, however, absorbed 13 rems.

Dr. George Voelz, Director of the LASL Health Division, said that "the extent of the exposure isn't enough so that he is going to feel or notice it or have any problems with it." Meanwhile, the chemist has been taken off tritium related work.

According to Dr. Theodore Davis, a Jemez Springs physician who is a member of Physicians for Social Responsibility, an international group founded by anti-nuclear activist Dr. Helen Caldicott, the exposure is equivalent to approximately 433 chest x-rays.

Safety routines at LASL include monitoring of employee exposures through urinalysis, radiation film badges and other methods, as well as the reporting of accidents to LASL's Health Division and the Department of Energy in Albuquerque.

Asked why the accident was not reported, Voelz said, "I'm not sure I can entirely answer that. The operations group did not report it."

The chemist involved in the accident, however, said there was a mixup in communications because he didn't initially realize the seriousness of the exposure.

In the May 4 incident, the chemist said he was aware that the tritium, which is odorless and colorless in its gaseous form, has been released into the room when the alarm went off. But he did not realize that the tritium had been ignited on furnace coils and changed into tritium oxide, which is more readily absorbed by the body than gaseous tritium. Had the tritium been released as a gas and not tritium oxide, the chemist said the whole body exposure would have been at least 10,000 times less.

"I know that you or the press is not going to believe this, but there was no attempt to cover this up," said Ray Miller, chief of health protection with DOE's Operational Safety Division in Albuquerque.

Work with radioactive materials is a "daily event" at LASL and, in spite of the May accident, there have been relatively few exposures even approaching the standard, according to Dr. Voelz.

"After 30 some years in an industry in which we've employed annually at least 500 people working directly around or with plutonium, we've only got 220 some people who have had as much as 25 percent or more of the permissible limits.I think in terms of protection of people this was really an outstanding record," Voelz said.

According to LASL figures, there have been more than 1,000 LASL employees who have accumulated a measurable body burden of plutonium over the last 30 years, the vast majority of these absorbing 2-10 percent of the maximum permissible standard.

The lab has, nevertheless, experienced some serious accidents in its 36-year history, including three fatal "criticality" accidents involving the inadvertent triggering of a fission chain reaction, a non-nuclear explosives accident that claimed four lives and a 1977 explosion in a plutonium glovebox that exposed five technicans.

In the early years of the lab's operations, inexperience accounted for several accidents.

The lab's first fatality occured in August 1945 when a young scientist, Harry Daglian, was killed in a critical assembly experiment. Daglian was fabricating a small uranium brick wall around two plutonium hemispheres to find out at what point the mass would become critical and initiate a chain reaction which leads to explosion. A brick slipped and the assembly went supercritical, exposing Daglian to a blue glow of radiation that caused burns and took his life 28 days later.

Overconfidence may have been a factor in another criticality accident about a year later than claimed the life of another young scientist, Louis Slotin. The experiment, known in nuclear circles as "tickling the Dragon's tail,"

Several accidents have occurred at LASL's old plutonium processing plant. Photo by Dede Feldman.

involves slowly merging two plutonium hemispheres and then, at the last minute, separating them with a screwdriver. During the May 1946 experiment, however, the screwdriver slipped and a blue flash blanketed the room where seven other scientists were working. Slotin, who absorbed 900 rems of radiation, died nine days later; Slotin's assistant, Al Graves, sustained serious injuries and suffered partial disability.

"It doesn't take long to go from the initial fission to the final holocaust, you don't have time to react," commented James Osborne, a colleague of Daglian's who was in the building during the Slotin accident.

Osborne, who is now employed in the lab's explosive group, said that after the Slotin accident, easily the most famous at the lab, all critical assembly experiments were performed by remote control.

"The incidents ultimately led to standard operating procedures which were more foolproof," Osborne said.

An AEC document summarizing accidents from June 1945 to December 1955 lists four other criticality accidents, as well as a number of uranium fires both outside and inside of a building which has been located at the present site of the Los Alamos Inn. There were no injuries in any of these incidents, although several employees exposed in a 1945 criticality accident were hospitalized for observation.

Another criticality accident occured in December 1958 and claimed the life of Cecil Kelly, a LASL plutonium technican. The accident occured during a plutonium recovery operation when Kelly, 38, was stirring a vat of radioactive waste with an automatic paddle. Kelly absorbed 12,000 rems of radiation and died the next day.

In October of the following year four men were killed in a non-nuclear explosives accident, apparently while unloading materials for routine scrap burning.

More recently, lab officials have pinpointed the present plutonium processing plant as the scene of potentially grave accidents. This potential derives in large measure from the plants obsolescence and location near both the airport and the townsite.

The plant, which will soon be "retired," was the location of the 1958 criticality accident involving Cecil Kelly and in 1977 it was the scene of an accident that caused the exposures of five technicans.

The accident, termed a "chemical processing incident," in a LASL press release, was described at the time by Dr. Voelz as "one of the most serious exposures we've had."

The accident was caused by a defective gasket on top of a container in which plutonium "buttons" were being fabricated. According to a report released by the lab, when the gasket failed to hold the seal, a violent chemical explosion resulted, rupturing the glovebox surrounding the operation and spewing about five grams of plutonium and molten calcium into the room.

The report describes the incident this way: "When the accident occured the supervisor saw a yellow or orange flash along the top of the reduction coil...The flash seemed to spread and almost instantaneously a loud boom was heard by all five personnel, followed by a blue or purplish haze in the room: In addition, the report says that the supervisor saw "flashes above and below the outside of the gloveboxes," and a technician saw "molten material and sparks come down the aisle on the floor at the south side of the reduction station glovebox."

After the explosion, the five technicans in the room evacuated the area and entered an adjoining room to obtain facial respirators, which were not available in the work area.

The report notes that although providing respirators in all work areas had

been discussed at LASL on many occasions, that recommendation was never implemented and current safety instructions are "to hold one's breath and evacuate by the closest exit."

The room in which the technicians went for their respirators, however, had also been contaminated, but because there was no air monitor or alarm in the room, the technicians did not realize it.

An investigation by a team of Energy Research and Development Association and LASL officials after the incident recommended a review of the use of air monitor and respirators in plutonium processing areas.

According to Dr. Voelz, who treated the exposed men, all five absorbed less than the permissible limit of plutonium. One of the men, however, who had been exposed previously, absored enough of the radionuclide to put him over the permissible lifetime body burden for plutonium and force transfer to an area where plutonium was not handled. Another technician, who received the highest dose, was treated with thylenetriamine-pentaacetic acid, a chemical which combines with plutonium in the body and induces its excretion.

According to Voelz, the five men are now doing fine. "There have been no problems," he said.

Voelz says that since 1970, the Health Division has been called in about once or twice a year to deal with accidents involving the inhalation of plutonium and other radioactive elements. However, he says that the handling of radioactive materials is a "daily event" at the lab and safety procedures and controls limit routine contamination.

Measures taken to minimize exposure of workers at LASL include the use of respirators, air monitoring devices, protective clothing, gloves, and film badges. Lab areas having significant radiation sources are clearly marked and entrances controlled. Routine urine samples are taken from personnel handling radioactive materials to detect possible exposures and more thorough analysis is performed if necessary.

Health Division monitors survey areas where radioactive materials are handled and individuals in each area are responsible for cleaning up spills and maintaining a record of their radioactive source.

In the case of severe accidents, employees are instructed to notify everyone in the area, confine the spill by turning off air circulating devices or dropping absorbent paper on liquids, vacate the room, and notify the Health Division. Health Division may then call upon a group of "decontaminators" or monitors who will assist in the clean-up of the area, resurfacing or painting contaminated areas if necessary.

Three law suits charging LASL with damages, incurred as a result of working with radioactive materials at the lab, are currently pending in courts in New Mexico and California. Of the three suits, one has been filed by the widow of a former lab employee who died of lymphosarcoma (a malignant tumor of the lymphatic system) in 1975 and another by an Espanola man who claims he has been disabled by a "neurotic fear of radiation" caused by his work in a LASL uranium foundry. The third case was brought by Saul Bramer, 57, an employee of TRW Nuclear Systems Inc., a California defense contractor.

Bramer was present at the lab during the 1971 accidental plutonium release which occured when scientists were disassembling a heat source capsule in a glovebox in the Chemistry-Metallury Research Building. Nine people were in the room at the time of the release, caused by a leak around the manipulators of the glovebox.

A LASL report released a year after the incident indicates that personnel who had been in the area were monitored and "found to have contamination on their hair, necks, and shoulders," but "no one exposed was considered to have received a serious enough exposure to require any therapeutic measures."

Bramer, however, contended that he had inhaled plutonium particles, and on March 23, 1973 he filed an administrative claim against the AEC for $1 million in damages. The claim was turned down but a year later, Bramer brought legal action against the ERDA.

In 1976 a U.S. District Court in Southern California ruled against Bramer on the grounds that the University of California, which administers LASL under federal contract, was the responsible agency, rather than the federal government.

Bramer's case is currently on appeal before the Ninth Circuit Court of Appeals in California.

In another court action, a Massachussetts woman, Ms. Bernice Lasovick, filed a $1.5 million suit against the lab in U.S. District Court in Albuquerque a year ago claiming that her husband's work with plutonium and uranium at the close of the war years caused his death from cancer in 1975.

The suit contends that LASL did not provide her husband, Daniel Lasovick, with a safe place to work and "negligently failed to inform him" that he carried a dangerous body burden. The suit, which may come to trial in Albuquerque, this spring, also contents that LASL "negligently failed to provide proper and timely medical care and treatment."

In a telephone interview from her home, Ms. Lasovick said that the lab had "never warned us about anything." She said that the first contact with the lab on the possibility of adverse health effects of the plutonium exposure was in May, 1974. Her husband, she said, got sick in August of the same year and died on March 23, 1975. He was 54.

"Before that there was no warning," she said, "and now there's a cure for localized lymphoma. We could have caught it earlier if we had known what to look for, but when we found out, the lymphoma had gone gonzo."

Dr. Voelz said, however, that Lasovick has been contacted earlier as part of a general follow-up of plutonium workers. "We contacted him before he or anybody else knew his disease was present — that was just routine." said Voelz.

Voelz said he is uncertain what types of warnings were given to men working with plutonium during the "pretty hectic days" of World War II. But he said exposures of Manhattan Project workers should be seen in the context of other wartime assignments.

"There were millions of men who didn't come back," said Voelz "so many of the men exposed at the time at LASL feel pretty good about their war-time assignments here."

Voelz says that when the AEC decided to do health follow-ups of Manhattan Project workers, it was known that law suits would likely be filed. It was felt, however, that the information was vital, he said.

Lasovick's case is one among a growing number of cases nationwide brought against the AEC and its successor agencies on the grounds of occupationally-induced cancer. Dr. Voelz feels that there will be more cases of this type in the future.

In another suit filed against LASL, a New Mexico man who worked at the lab for 30 years was awarded $75,000 by an Espanola, New Mexico court in 1978 for damages stemming from a neurotic fear of radiation.

Lawyers for Ramon Martinez, 57, of Espanola, contended that an anxiety neurosis resulted from their client's work fashioning and heating uranium in a lab foundry.

On Sept. 26, the New Mexico Supreme Court upheld the lower court ruling, which had been overturned by the state Court of Appeals in April.

In February 1976, a few months before his planned retirement, Martinez underwent surgery to remove a cancerous tumor in his right eye. Although doctors told Martinez they had removed the entire growth, Martinez believes he will die from cancer. Since the operation, he says he had suffered from nervousness, headaches and dizziness.

Robert Salazar, who worked with Martinez, said that he left the lab in 1956 because he was afraid of radioactive exposure. Salazar now works with the Small Business Administration in Albuquerque.

In testimony at the trial, Salazar said there were "numerous spills," poor ventilation, and "a number of hazards of various and sundry types" in the old Sigma uranium handling plant, which was used until 1956.

Salazar said that about 10 to 15 times during the course of his employment in the building, radioactive materials including uranium-235 would "spurt-out" from a centrifugal furnace.

"It would throw it just all over the walls, so you have to go and scrape it out and pull it out and clean the rest with acetone," he said.

Salazar said that there were no exhaust fans around furnaces used in those days and respirators did little to prevent inhalation of vapors and gases.

Salazar said that the men in the division wore masks when entering the furnaces, but "when you took off the mask you could see the blackness of the oxides all over your face."

The oxides were uranium-235 and uranium-238.

During the trial, Martinez also testifed that uranium oxide, "comes off on your face and coveralls."

Alex Lovato, a retired foundry worker who lives in Los Alamos, now blind, worked in the same group as Martinez and Salazar. Like Martinez, part of Lovato's job was looking into the furances where uranium were fabricated with an optical pyrometer.

Lovato, who was not a witness at the

Unlikely Accidents Get Study

In the growing debate over nuclear energy, one of the most controversial topics involves hypothetical accidents.

The environmental impact statement released in Jan. 1980 by Los Alamos Scientific Laboratory includes an analysis of the likelihood and consequences of such accidents at the lab—accidents which could affect the 20,000 people who live in the towns of White Rock and Los Alamos and possibly more outlying areas.

The report analyzed possible explosions at the lab's weapons site, an "unintentional burst" from the critical experiments facility, a criticality (an unintentional chain reaction), at the new plutonium processing plant, airplane crashes at the LAMPF facility and the plutonium processing site, and a meltdown at the Omega West reactor.

After examining the possible — but highly unlikely events — the document concludes: "The maximum doses to the public from accidents at LASL could be of the same order as the maximum permissble annual doses to occupationally exposed persons. The consequences of accidental releases are approximately ten times the recommended annual exposure of the public from routine operations but less than recommended emergency dose limits."

The accident analyzed by the lab with the most serious public consequences is a meltdown at the Omega research reactor, located in Pueblo Canyon. Because the reactor is a low-pressure, low-temperature reactor with a natural convective coolant system, the report states that "the probability of even a partial fuel melting is vanishingly small."

The report does note, however, that a melting of fuel as a result of low blockage in one or more fuel elements has occured in at least three reactors of the same general type and "the possibility exists for a large release of fission products — — particularly iodine."

If such an accident were to occur, three public areas could be affected, the report states, a residential area to the north, an ice skating rink nearby and State Road 4. The dose from such an accident to a member of the public on State Road 4, which traverses Los Alamos County, would be 57 rems to the thyroid, the report estimates.

Rems are units used to measure radioactivity in humans. Under normal conditions, the maximum permissible dose of such radiation to the thyroid (the critical organ) is 3 rems per year for a member of the public and 30 rems per year for a nuclear worker.

Apparently not satisfied with the draft Environmental Impact Statement's failure to consider many other possible, but less severe, accidents, the N.M. Energy and Minerals Department called LASL's discussion of accidents "inadequate."

In its review of the draft Environmental Impact Statement, the state agency said that consequences of different accidents, emergency procedures, evacuation, restoration, decontamination and clean-up after accidents should be discussed. The impact statement also does not discuss possible property damage or loss of life following any of the postulated accidents. In addition, potential transportation accidents were not considered in the original document but a section on transportation was added in the final Environmental Impact Statement.

The new section on transportation accidents at LASL states that both on- and off-site shipments of radioactive materials occur at LASL with the dominant modes of transportation being truck and air freight.

trial, said that the black dust on the faces of many men in the division resulted because most of the time people wore only coverings on their mouth and nose, rather than full-face respirators.

Commenting on the case, Dr. Harry Schulte, retired industrial hygenist with the lab, said that the black dust on the men's faces could have been from the graphite crucibles used by the men to melt the uranium.

Schulte said that nuclear materials were scarce in the early days and every scrap was used in experiments or recovered. "You didn't let U-235 get away because the monetary value is so high," he said.

In a 1979 decision, the New Mexico Supreme Court, however, ruled that the protective articles worn by Martinez and others were ineffective.

Commenting on charges of cancer deaths and illnesses in Martinez's group, Dr. Voelz said that it was one of the largest groups in the lab and that "if you didn't find a few cancers it would be kind of crazy."

Voelz said that the cancers were not necessarily caused by work with radioactive materials. He said his understanding is that, one-fifth of the population actually dies from cancer.

According to the final EIS, all outgoing shipments are made in compliance with Department of Transportation packaging requirements. Transfers of radioactive materials between LASL technical areas conform with LASL controls and standard operating procedures, with special attention given to packaging, monitoring and documentation of shipments.

Shipments of special nuclear materials in strategic quantities, classified forms or with special safeguard requirements are made both on and off site in "Safe Secure Vehicles" (SSV) under the supervision of LASL's Nuclear Materials Department.

Most of the on-site transfers of wastes are made by the Zia Corporation. Each year thousands of shipments of both plutonium and enriched uranium are picked up and delivered from technical areas at the lab, while hundreds of shipments are taken to the lab's nuclear waste dump. The most common types of packages used for these materials are drums.

Air shipments of plutonium to and from LASL terminated in 1977, although the shipment of other radioactive materials continues.

According to the final Environmental Impact Statement, "the primary population at risk for on-site transportation is laboratory employees, members of the public who use laboratory roads, and county residents who may be downwind of a plume from an accident. The population at risk for incoming and outgoing shipments theoretically includes the entire U.S. population."

LASL calculations indicate that a transportation accident involving plutonium-238 (considered one of the worst possible accidents) could result in a maximum individual dose of 18,600 rems. When the risk is spread over the entire population and calculated in man-rems, however, the final Environmental Impact Statement concludes that the risks from both accidents and routine transportation of nuclear materials are "insignificant."

One natural disaster that could affect the lab is an earthquake, which is considered in the impact statement.

On Jan. 24, 1980, LASL's sister facility, the Lawrence Livermore Lab in California, was rocked by a major earthquake that resulted in $10 million in damages and caused the leakage of a small amount of radioactive water from a 25,000 gallon storage tank.

Los Alamos is situated on the Pajarito Plateau, a geologic formation crossed by four major north-south faults. Los Alamos experienced an earthquake measuring 5 on the Richter Scale in 1952.

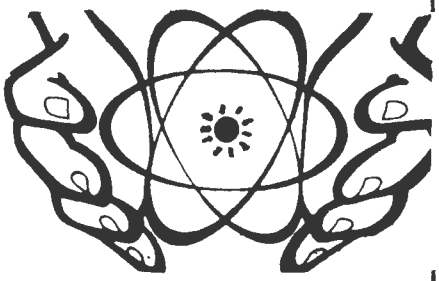
According to a 1976 LASL study of earthquakes based on historical records, the area is subject to earthquakes of the magnitiude of 5.5 on the Richter Scale once every 100 years, making it, an "area of relative low seismicity."

In a 1971 comment on the Environmental Impact Statement for the new plutonium facility however, Sideny Galler, Deputy Assistant for Environmental Affairs in the Department of Commerce, said that "occurances of intensity 7 and 8 earthquakes all along the Rio Grande rift cannot be downgraded or avoided." Galler pointed to a 1966 earthquake in Dulce, N.M. and a 1952 earthquake in Cimmaron as evidence of recent seismic activity.

In another comment on the plutonium facility impact statement, Jack Horton, deputy assistant secretary of the Interior, cited "recent history of many repeated movements of the Pajarito fault," and said that these, as well as the 1952 Los Alamos earthquake and another earthquake in Cerrillos in 1918, indicated that the area was "moderately seismically active."

Horton called for a more careful analysis of earthquake risk in the area.

In the LASL final Environmental Impact Statement, however, lab officials downplay the seismic risk to the area. According to the report, "laboratory facilities are not located across any known fault zones," and nearby rock pinacles with boulders located on top of them have been standing for thousands of years, indicating the absence of tremors in the area.



VIII

Self-Monitoring Raises Bias Question

Monitoring of radioactivity released from Los Alamos Scientific Laboratory is currently conducted exclusively by the lab's environmental staff, with only minimal oversight by state and federal regulatory agencies.

Although sampling data accumulated by the LASL Environmental Surveillance Group on radioactive concentrations in air, soil and water in the Los Alamos area is regularly submitted to the U.S. Environmental Protection Agency for review, that federal agency has only peripheral regulatory authority over the lab.

The lab is not legally bound, for example, by the EPA standard for radiation exposure to the general public. That standard, adopted in 1977, limits exposure to members of the public from nuclear facilities to 25 millirem per year. Instead, LASL is governed by the more lenient Department of Energy regulations, which allow an exposure level of 500 millirem (or one-half rem) per year.

Dr. Wayne R. Hansen, who heads the lab's Environmental Surveillance Group, said that while there has been no independent oversight at LASL, he sees no problem with the lab monitoring its own radioactive releases. "What we do is participate in an EPA quality assurance program where we submit samples to them and see if they get the same result as we get, essentially," he said. "We're (the Environmental Surveillance Group) part of the Health Division, which is an independent division of any of the (LASL) operating groups."

The state of New Mexico, meanwhile, is virtually excluded from any participation in LASL affairs.

"We maintain a polite overview but we're in no position to regulate," said Al Topp, an official with the New Mexico Environmental Improvement Division's radiation section. "Basically, LASL is self-regulated under DOE (Department of Energy) manual requirements."

The final environmental impact statement assessing the effects of LASL operations, released in Jan. 1980, was subject neither to official review by the state environmental agency nor to public hearings. A lab spokesman said no hearings will be held on the document because there was insufficient public interest in the draft report issued last year.

For a 15-year period beginning in 1955, the U.S. Geological Survey had participated with the lab in measuring radioactivity in the Los Alamos area, but that joint effort ended in 1970 over an apparent difference of opinion over the interpretation of data collected at the lab.

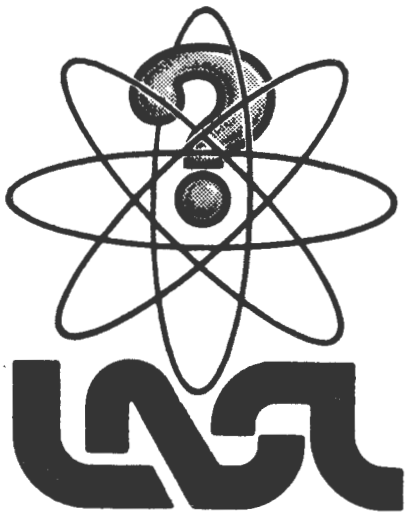
There are conflicting accounts of the "problem" which resulted in the termination of USGS involvement at Los Alamos.

During an interview, William Hale, district chief for the USGS regional office in Albuquerque, said his agency was "asked to leave" in 1970. "We had helped Los Alamos through DOE," Hale said of the contractual arrangement for the joint LASL-USGS monitoring program. "But this was never a real responsibility on our part. During all that period, we worked closely with the lab. Much of the analysis was done by Los Alamos, although we participated in the sample collection."

During a subsequent interview, Hale modified his original comment that USGS was "asked to leave" the laboratory.

"When I said we got kicked out, we really didn't," he said. "They (LASL) never objected to our participation in their monitoring. We just wanted a bigger part of the analytical part of the system. It was their choosing to do this (analytical) part of the work — they felt it was their responsibility.

"We were getting tired of that," said Hale, a 40-year veteran of the Geological Survey. "We could have probably continued to monitor certain features all along [after 1970] — just collecting samples. We wanted more of a hand in interpreting what was being done."



One of the USS officials involved in the joint monitoring program at Los Alamos from 1955 to 1970 was Dr. William Purtymun, who is now a member of LASL's Environmental Surveillance Group specializing in liquid radioative waste. Hale said Purtymun left USGS to join the LASL staff "about the time we terminated our efforts up there."

Dr. Purtymun reacted angrily to the allegation that the lab did not want the monitoring data interpreted by USGS. Purtymun said that while he was with the USGS he personally interpreted all the data — "15 years of it."

Dr. Hansen also challenged the suggestion that the lab was opposed to USGS interpretation of the sampling data. "They (USGS) have been invited to come here," he said. "In fact, the Albuquerque operations office of DOE had independently funded them to come up here and make measurements but what's happened is that there have been more pressing needs for the USGS equipment they have in other parts of the country, so they haven't had an opportunity to get up here."

Dr. William Purtymun (left) and Dr. Alan Stoker (right), members of Environmental Surveillance Department. Photo by Phil Niklaus.

Hale's response to that: "I don't quite know what they're referring to," he said, adding, "We could probably fit it in (further participation in the LASL monitoring)."

Despite the fact that USGS no longer is a participant in the LASL monitoring, Dr. Purtymun insists there are still relatively close ties between the lab and the geological survey. "We have cooperative program with them — we exchange ideas with them," he pointed out. "We had one of their drilling engineers down here for two weeks teaching a drilling course. I've gone to Denver to seek information from them. We had one of their foremost authorities on sediment transport a couple of weeks ago here to give us a talk. There's a lot of exchange — we're not just an isolated little group."

Although the joint monitoring effort was terminated in 1970, the USGS was later contracted by DOE to perform a study of the lab's solid radioactive waste disposal practices. That study, which resulted in a report in August, 1975, titled "Evaluation of Monitoring of Radioactive Solid Waste Burial Sites at Los Alamos, N.M.," was somewhat critical of some parts of the waste disposal system.

The report, prepared by T.E. Kelly of the USGS, stated in part: "In general, the level of activity in waste has been closely monitored prior to burial, however little emphasis has been placed on post-burial monitoring. In order for a monitoring program to be completely effective, it needs to be based on well-defined geologic and hydrologic parameters. At Los Alamos, these parameters have not been adequately defined."

The study concluded in part: "Insufficient data are available to design an effective monitoring program at the present time."

Dr. Hansen said that the recommendations contained in the Kelly report have been implemented to the extent that available resources permit. "Their (USGS) report was extremely helpful," he said.

Kelly declined a request for an interview concerning his findings from 1975.

Should an independent agency be performing the monitoring at Los Alamos?

"I suppose from an outsider's view, it might be better to have a third party doing it," Hale said. "But it's not in our charter or authority to necessarily do that. A third party would remove the onus of bias, just like you have CPAs (Certified Public Accountants) audit a company's books. They (a third party) might see things that could be considered that (LASL) might possibly overlook — two heads being better than one. It would remove suspicions (of bias), if there is any."

Does Hale consider the LASL interpretation of the monitoring data to be unbiased? "It's not evident that they're biased, though one might not expect them to knock their product — that's a fuzzy answer," he said, adding, "We don't know if they're biased or not because we haven't reviewed their reports — we haven't been asked to. I saw no evidence of bias."

Asked whether he believes USGS should be involved in the collection and interpretation of the LASL monitoring data, Hale paused and then remarked: "The reason I hesitate is it's not really in our charter. The final interpretation or decision rests with the agency that's responsible," which he said, in this case, is LASL. "I guess I don't have an answer."

Another USGS official suggested, however, that an independent authority should be reviewing the LASL data. "There really is no independent monitoring at Los Alamos," noted J.L. Kunkler, a geophysicist with the USGS in Santa Fe, who participated in the cooperative monitoring program at the lab during the 1960s. "They are producing their own waste and then monitoring it. How could you be sure if there was a serious accident that it wouldn't be covered up? This is an ethical point that should be debated."

Dr. Purtymun denounced what he said was the implication that an independent assessment of the LASL monitoring results may be needed to insure objectivity, saying,"We aren't trying to cover up anything. We're the watchdogs of this laboratory and as I've seen it, you could shut down an operation if you don't think that it's ...if it's doing anything to the environment or anything."

From its beginning, LASL was placed under administrative control of the University of California, where the lab's first director, Dr. J. Robert Oppenheimer, had performed his early nuclear research. Oppenheimer, who helped select the site for the secret Manhattan Project during World War II, believed that the university could provide administrative expertise, academic freedom and a measure of security disguise.

More than three decades later, UC's relationship to the lab continues. LASL employees are still paid by the university, their children enjoy resident tuition at California colleges and they are beneficiaries of the university's retirement plan.

LASL and its sister nuclear facility, the Lawrence Livermore Laboratory in Berkeley, Calif., are the only national labs administered by a single university — a fact which has provoked considerable controversay in California and resulted in a review of whether UC should continue to operate the two research centers. In May, 1979, a DOE-appointed "blue-ribbon" panel, headed by Dr. Solomon Buchsbaum of Bell Laboratories, recommended that UC administration continue and even broaden to include increased participation by the California Regents.

The UC Nuclear Weapons Lab Conversion Project, a coalition of anti-nuclear, religious and peace organizations, has been pressing for several years to end the university' ties with LASL and to convert the Lawrence Livermore Lab to non-weapons work. According to the Associated Press, 869 UC faculty members signed a petition calling for the termination of the LASL-UC relationship, and Gov. Edmund Brown Jr. forced a vote on the issue at the California Regents meeting July 20, 1979.

At that meeting, the regents voted 15-7 to continue UC administration at Los Alamos, ignoring the recommendation of the governor. Brown, a presidential candidate in the approaching 1980 elections, has said, however, that he will bring the issue up again.

Although LASL is run administratively by the University of California, DOE is the source of the lab's budget as well as the ultimate owner of lab property and facilities.

Currently less than one percent of the total LASL budget is spent on nuclear waste management, technology, research and environmental monitoring. The budget for the Environmental Surveillance Group, which is responsible for all monitoring, sampling and the various environmental studies, for the current fiscal year is about $1 million.

Officially, waste management officials at the lab say the money spent on handling and disposing of radioactive waste is adequate.

"I would say, overall, yes I think it is," said Dr. Lamar Johnson, who last spring was appointed acting head of the Office of Waste Management in the LASL Director's Office. "We can continue to work on these problems and technical development needs. Obviously, we can always do more."

Some LASL officials involved in the nuclear waste programs note, however, that there are some technical innovations which would be helpful in reducing the amounts of radioactive contaminates released to the environment which have not as yet received funding.

One report prepared by the U.S. Geological Survey, based on an analysis of the lab's solid waste disposal system, made a series of recommendations for improving the containment efficiency and monitoring capability at the various burial sites.

Asked whether the recommendations contained in the USGS study from 1975 had been implemented, Dr. Hansen responded: "As much as we can. And you have to realize we are somewhat resource limited but we are expecting — I can say with some certainly — we are expecting a substantial budget increase next year. We had one this year, to add to the surveillance of the waste areas."

Another LASL scientist, Dr. Gerald Buchholz, who is in charge of the lab's Central Waste Treatment Plant, further noted that he would like to see the installation of solar evaporation ponds to reduce the release of liquid radioactive effluents to the canyons around Los Alamos. That money, he said, has also not yet been approved.

There are other LASL officials, on the other hand, who believe that there may be too much emphasis on controlling radioactive pollution, relative to the amounts ear-marked for other environmental contaminants.

"Right now we are way overspending efforts and money on controlling risks and hazards from radioactivity in comparison to the amount we are spending on control of sulfur dioxide and the other air pollutants," said Dr. Stoker. "I'm not making an absolute statement that either one is enough but that the priorities are pretty funny."

He added: "Just from my personal point of view, I think that, say right here in Los Alamos, more money spent on improvements of roads and signs and that kind of thing is going to save more lives and health effects than the same amount of money spent on additional controls on radiation. We don't have an infinite amount of resources – we've got to make some choices."

Some See LASL Scientists as Lobbyists for Nuclear Causes

Although U.S. Department of Energy regulations prohibit political lobbying by Los Alamos Scientific Laboratory, they do allow LASL employees to testify as experts before state and federal legislative bodies and other govenmental agencies.

During the 1979 session of the New Mexico State Legislature, several nuclear physicists from Los Alamos appeared before House and Senate committees to give their views on specific bills dealing with nuclear-related issues facing the state. Most noteable of the legislation that attracted the interest of LASL witnesses were the politically sensitive bills on the proposal to locate the nation's first permanent nuclear waste disposal site near Carlsbad and on nuclear waste transportation through the state.

LASL officials stress that the members of the staff who testify in Santa Fe are acting as individuals, not as representatives of the lab. "We don't have paid lobbyists," said Dr. David Freiwald, a LASL spokesman. "If you look at the DOE rules, I don't think you'll find those people were really lobbying. We are allowed to go out and disseminate information for educational purposes."

The distinction between lobbying and expert testimony by LASL officials is not alwasys clear, some legislative watchers in Santa Fe contend.

Sally Rodgers, New Mexico representative of Friends of the Earth, suggests that when LASL staff members appear befor legislative committees, they bring with them a "certain mystique" which helps put across their point of view. According to Ms. Rodgers, a long-time New Mexico environmentalist, the reputation of "nuclear expert" comes automatically

Radioactive hotspot discovered in parking lot of the Los Alamos Inn, in the center of town. Photo by Dede Feldman.

with employment at the lab, regardless of job.

"They could be janitors and it would still hold true," she said.

Dr. Freiwald downplayed the influence by LASL physicists in the New Mexico legislative process. "The history has been that if you introduce a bill and you're from Los Alamos, it will be killed," he said. "They just think we're a bunch of nuts — weird people with seven arms and five eyes."

There are currently two LASL employees serving in the New Mexico State Legislature — Sen. John Rogers, D-Los Alamos, and Rep. Vernon Kerr, R-Los Alamos. Despite Freiwald's assessment of the ineffectiveness of Los Alamos legislators in Santa Fe, both men were instrumental during the last session in shaping a number of bills relating to nuclear energy in New Mexico.

Sen. Rogers, a 30-year LASL veteran who works with applied superconductivity, led the fight against bills which would have allowed a public referendum on the Waste Isolation Pilot Plant (proposed for southern New Mexico). Furthermore it was a Rogers-sponsored amendment which excluded the requirement that the WIPP site be licensed by the federal Nuclear Regulatory Commission.

Both Rogers and Kerr were also at the forefront of the legislative wrangling over the issue of New Mexico's right to veto the WIPP project. In the ensuing legislative debate, the proposed veto was watered down to provide only for state "concurrance" of the waste site.

Kerr, an organic chemist who has been at LASL since 1954, agrees that both he and Rogers are considered opinion leaders on nuclear matters in the legislature. "Most of them (New Mexico's state legislators) can't grasp the technical stuff but you can tell them the reasoning behind the WIPP project and they can understanding this," Kerr said during an interview in his LASL office and laboratory. "I'd like to see the WIPP project in the state — it's a necessary project."

Kerr, a native of Gallup, believes that decisions concerning New Mexico's nuclear future should be based on the recommendations of those with expertise in the field. "We have enough of a background that we can be trusted," he said.

Rep. Kerr is a member of New Mexicans for Jobs and Energy, a pro-nuclear lobbying group founded by John Dendahl, president of Eberline Instrument Corp. in Santa Fe. Eberline is one of three suppliers of monitoring equipment to LASL.

Kerr says he sees no conflict of interest in this association with a pro-nuclear lobbying group, his job at LASL and his work in the state legislature.

Rogers, for his part, says he favors neither a New Mexico veto of the WIPP project nor a popular vote on the issue. "There comes a point when you must put the faith in people who know. The people who are familiar with something are best capable of making decisions about it," he said.

The experience at Los Alamos in handling radioactive wastes have in recent years been touted as justification for proceeding with the WIPP project, especially during testimony before the state legislature. During the 1978 session, Dr. Thomas Keenan, a waste management official at LASL, told one legislative committee: "It (nuclear waste) has been handled safely and properly since the days of the Manhattan Project. The safe handling of radioactive waste has been proven in New Mexico."

Editorials • Comme

ALBUQUERQUE JOURNAL

LASL's Waste Woes

Familiarity breeds indifference or outright contempt when it comes to dealing with and explaining potentially hazardous radioactive waste materials.

That's a conclusion drawn from an eight part series of articles by free lance writers Phil Niklaus and Dede Feldman that appeared recently in the Albuquerque Journal.

The writers explored the nature of radioactive waste generated at Los Alamos Scientific Laboratories, its possible effects upon the health of those exposed to it, methods used to dispose of the waste and how it is monitored.

There emerges a picture of overlapping jurisdictions and conflicting interpretations by federal agencies. Protection standards vary from agency to agency. Scientists disagree upon the effect of low level radiation upon humans. The laboratory produces its own waste, monitors its disposal and the possible effects upon those exposed to it.

There also emerges a picture of inattention. While thousands of pounds of waste have been disposed of since the early 1940s, its locations, its environmental impacts, its conditions are more a matter of conjecture than fact.

The early history of the LASL was dominated more by wartime expediency than either safety or recognition of the potential hazards radioactive waste represents to present and future generations. More recently, hazards have been recognized and safeguards vastly improved.

Still, practices seem dominated by scientific arrogance. Data have been covered up. Accidents have been downplayed or concealed from the public. Statistics that appear to indicate a higher than usual incidence of cancer at Los Alamos are derided. Standards to determine protection of humans from excessive radiation are subject to scientific dispute.

There also is disagreement among scientists that existing standards for radiation exposure are adequate to protect the public health from radiation injury.

All too frequently, the scientific community has taken a defensive attitude toward nuclear energy and its potentially harmful byproducts. That defensiveness has led to a growing public outcry against nuclear power and nuclear experimentation. The public wants to be reassured before it supports continuation of the development of nuclear power.

An example of the arrogance the industry has toward the public is found in the annual LASL budget. Less than 1 percent — approximately $1 million — is budgeted for the disposal and monitoring of radioactive waste at Los Alamos. Scientists believe the amount is adequate. The public naturally is skeptical.

It falls upon the scientific community to pay more attention to public safety so that waste disposal methods are effective, that the waste represents no threat to present or future generations of mankind and that their scientific experimentation contributes to the welfare of all mankind. Without those assurances, the pressure will continue to grow against the nuclear industry.

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