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THE ATOM

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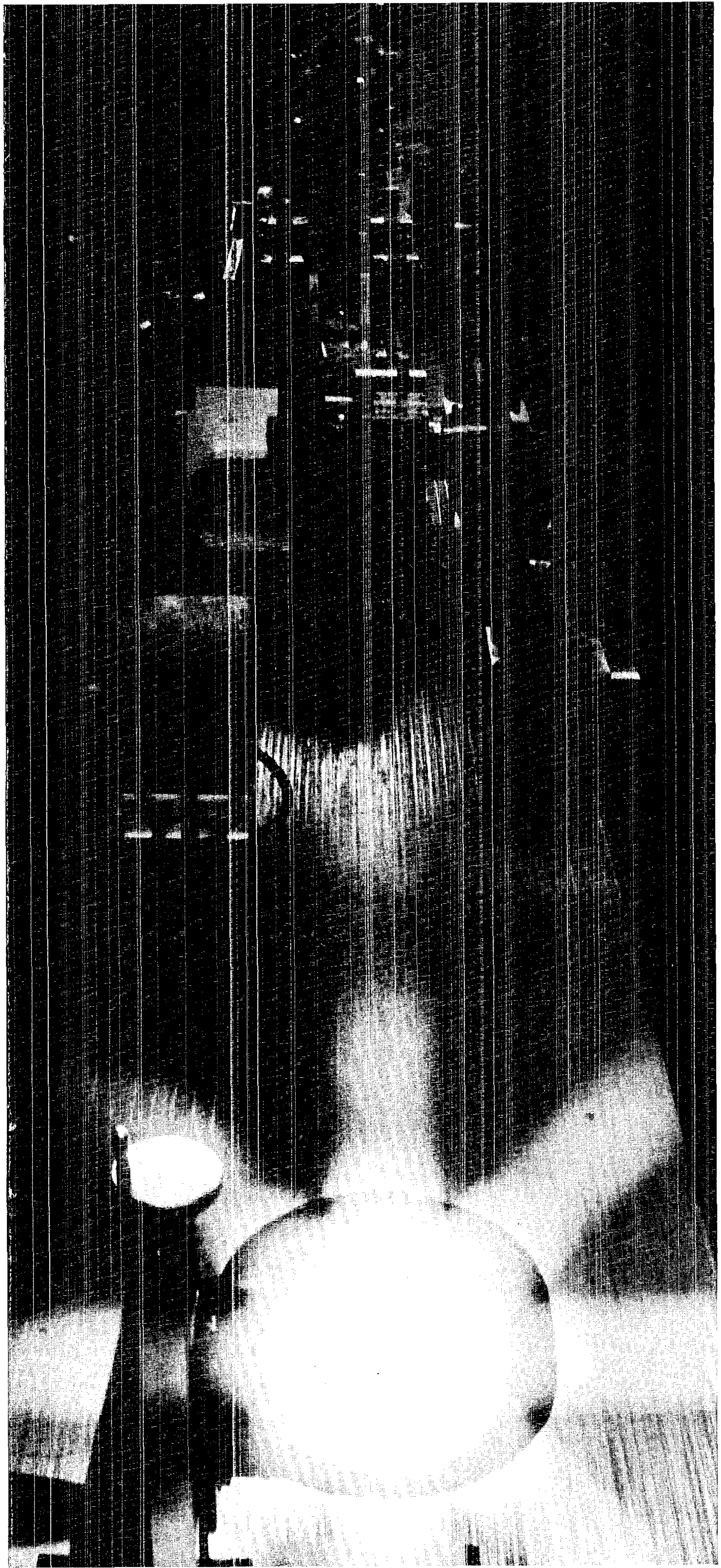
COVER AND PHOTO AT RIGHT

How do you take a picture of energy? With a bit of darkroom magic and a great deal of creativity, Bill Jack Rodgers, ISD-7, came up with the striking abstraction on the front cover. He combined a shot of the sun, taken through a special filter, with Q-Division's symbol for solar energy.

The Atom then asked Rodgers to enhance the photo of Group L-2's neodymium glass laser (right). Again, Rodgers employed his photo of the sun, this time superimposing it over one of the laser. In this situation, he expressed the power of modern lasers more effectively than he could have by conventional means.

In other situations, realism is more effective. On page 2, the photo of the CO_2 laser by Eugene Lamkin, L-2, is dramatic because of its realism. Those bullets of light are really there.

As a final footnote, all other photos in this issue are "straight." On the rare occasions that *The Atom* prints "doctored" photos, they are identified as such.



"Our job is to get it out," Edward F. Hammel, Jr., Q-Division associate leader for applied technology, said as Robert B. Duffield, division leader, and he were explaining Q-Division's energy programs.

Hammel wasn't making a speech, but his remark eloquently summed up what Los Alamos Scientific Laboratory's energy research is all about.

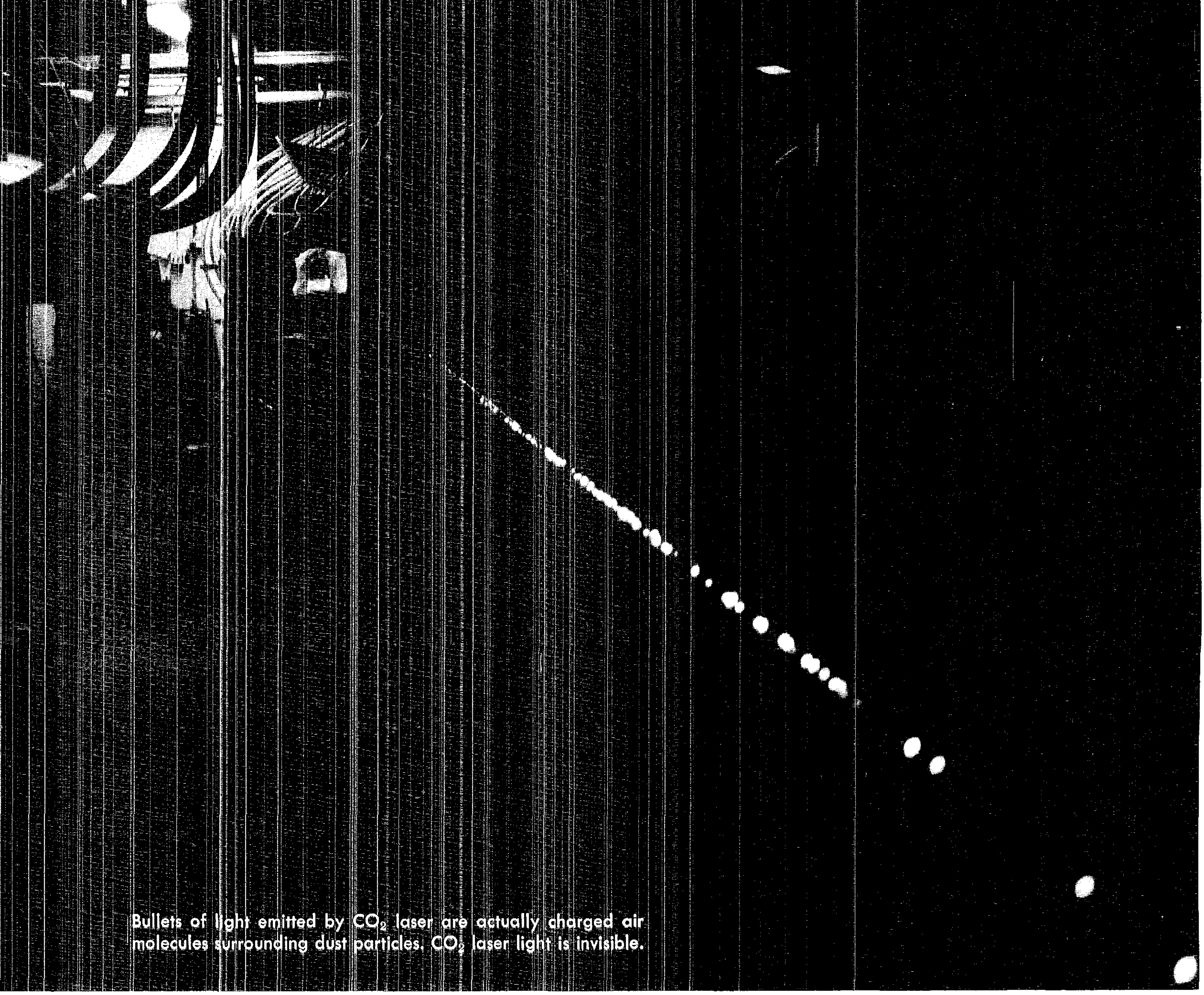
LASL programs are short-term and long-range, multi-faceted and interwoven. Even the following special section cannot describe them all. Subsequent issues will deal with other energy subjects.

It's more than coincidence that this section appears as two divisions heavily involved in energy research celebrate their anniversaries.

L-Division was formed in February, 1972, to coordinate a number of laser research programs. Development of laser-fusion as a practical means of energy generation is a program of highest priority.

Q-Division was formed in March, 1973, to integrate research for energy programs under a unified direction. Today its programs range from getting energy from the sun and the earth to getting it from controlled thermonuclear reaction.

The two divisions now number over 200 each. But no one is planning an anniversary party. Celebrations will come when the nation can be invited to open a special package marked Energy.



Bullets of light emitted by CO_2 laser are actually charged air molecules surrounding dust particles. CO_2 laser light is invisible.

LASER FUSION: passing a milestone

The arrival of ordinary-looking crates at the Los Alamos Scientific Laboratory last summer was more than an ordinary event. In those crates were components of a fourth and final electric discharge amplifier for L-Division's carbon dioxide (CO_2) laser.

By December, the painstaking installation was completed. Now integrated into the world's most powerful CO_2 laser system, it enables LASL to conduct laser experiments at the same power density output that theory suggests will induce thermonuclear burn—3 x 10^{14} watts per square centimetre.

L-Division is now using its single-beam instrument at intermediate power levels "to prove that the laser-target interaction physics contains no surprises which could alter the theoretical prediction," as Thomas F. Stratton, L-1 alternate group leader, put it.

If no such surprises are forthcoming, L-Division foresees other milestones on the road ahead: a 2-beam laser generating 2,500 joules later this year and an 8-beam laser system generating 10,000 joules in 1975-76.

Later, experiments using 10 times

more laser energy (10^5 joules) are expected to yield a useful net energy return. Such a laser system is in the planning stage and construction funds have been requested for FY-1975.

Why CO_2?

Design and construction of the CO_2 laser at LASL began, shortly after L-Division was formed 2 years ago, on the premise that this type of gas discharge laser offered the likeliest prospects for operation at the power and efficiency required to produce a net power return when utilized to initiate fusion. Theoretically, advanced laser fusion systems should be able to return 50 to 100 times as much fusion energy as the laser energy used to initiate the reaction.

The CO_2 laser originated in the early '60's, largely as the result of work of C. K. N. Patel of Bell Laboratories who built the first molecular laser. Its laser light, invisible to the eye, is in the infrared spectrum. It thus has the ability to penetrate the atmosphere with little loss due to scatter and absorption, and is ideally suited to long-distance laser communication.

In developing early CO_2 lasers, it was learned that the power of the laser beam increased directly with the length of its generating tube. One such "folded" tube was built on this principle by the Raytheon Company that was 183m (600 feet) long. A similar one was built by Prokhorov in the Soviet Union.

But Keith Boyer, L-Division leader, and Charles A. Fenstermacher, L-1 group leader, (now on professional leave in Germany), who formulated many of LASL's CO_2 laser design concepts, suggested another approach as more appropriate for a very compact high-power, short-pulse laser useful for the laser fusion process. They developed a technique to excite the laser by establishing an electric discharge transverse to the laser beam, controlled by an electron beam, which could operate over large cross-sectional areas and at high pressures.

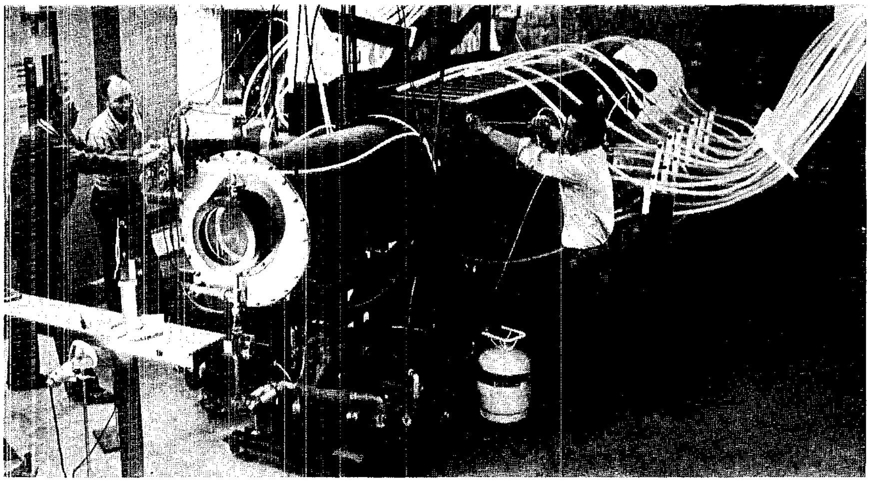
Thus, L-Division's CO_2 laser system employs an oscillator of modest length (less than 1m) to generate a pulse by the stimulated emission principle. Within the tube, electrons generated by an electrical discharge collide with CO_2 molecules (intermixed with those of nitrogen and helium to enhance the process), elevating many of them from their normal ground state to a vibrationally excited energy level. These molecules then descend spontaneously from this elevated energy level to the next lower level, emitting photons of monochromatic light.

These photons then oscillate between mirrors in the tube, colliding with CO_2 molecules that have not yet begun their transition, and triggering the release of additional photons, thus snapping out the stored energy as coherent laser radiation. A complex optical switching device than "pulls out" a very short burst of laser light—1 nanosecond in duration, or about 300-mm (1 foot) in length—and directs it out of the generating room and into a second and much larger room. There it enters an arrangement of mirrors and lenses directing it through the heart of LASL's CO_2 laser system: four amplifiers.

These bulky amplifiers essentially repeat the process in the oscillator. Each photon striking an excited CO_2 molecule frees yet another. The pulse gains 10 to 100 times in energy as it passes through each amplifier, leaving the final amplifier with 200 joules as compared to 1/1000th joule with which it started. After initial target interaction experiments are completed, the final amplifier will be pushed to its design value of 1000 joules.

In subsequent laser systems, the final amplifier will serve double or triple duty by reflecting the beam back and forth through the same lasing medium thus reducing the number of amplifiers needed and simplifying the system.

Entering a third room, the pulse is pinpointed on a target where extensive instrumentation records its interaction with the target material.

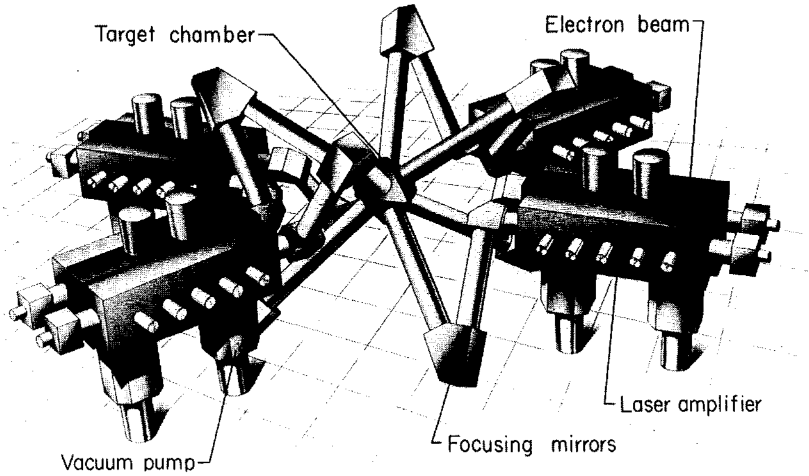


New amplifier boosting CO_2 laser to theoretical power level for fusion is adjusted by Roy L. Johnston, Thomas F. Stratton, and Manuel F. Baldonado, all L-1.

From Light to Fusion

Utilizing the special characteristics of laser energy to initiate fusion requires a special form of fuel. Initially, at least, L-Division plans to employ pellets of deuterium and tritium. Deuterium is an isotope of hydrogen easily extracted from sea water: the world's oceans contain a supply sufficient for millions of years. Tritium is a manufactured hydrogen isotope that more readily ignites in thermonuclear burn.

The pellets might be liquid, the size of a raindrop, a small frozen solid measured in cubic millimetres, or a more complex structure.



To initiate efficient burn, this fuel must be raised to an ignition temperature of about 45 million kelvins and compressed to several thousand times its normal solid density—conditions more extreme than exist in the center of the sun.

These effects are achieved through the unique properties of laser in which a substantial amount of energy can be stored in the lasing medium, released in an extremely short period of time, and concentrated into a very tiny volume.

The fuel pellet is exposed to a number of intersecting laser beams which deliver energy to its surface at a rate which, for a fraction of a second, is equal to the power output of almost a million Hoover Dams. This enormous energy flux delivered to the surface of the pellet causes a violent explosion which implodes the core of the pellet.

This initiates the fusion of deuterium and tritium nuclei, forming helium nuclei and free electrons with the release of a great deal of energy. The nuclear burning is completed in a few millionths of a millionth of a second.

Although the energy release is equivalent to that contained in a few kilograms of high explosives, the actual explosive force is very much less due to the tiny mass which is exploded. Most of the energy is carried by the neutrons. Capturing and using this energy calls for development of a practical power system.

From Fusion to Power

In one likely system, CO_2 laser-beam channels are arranged as in the drawing on this page. The beams would converge from several different directions on a target point within a spherical chamber perhaps 2m in diameter. These beams may be generated independently or, more likely, split from one or more master beams. The same laser outputs could be delivered to a number of chambers or modules.

A procession of pellets—dropped or ejected—would enter the chamber, each timed to arrive at the central target point at the instant the converging laser pulses do. Each encounter would initiate the fusion sequence.

The energy-carrying neutrons produced by the thermonuclear burn would be absorbed in a blanket of molten lithium surrounding the chamber. The lithium would serve the dual purpose of breeding more tritium, which would later be extracted for fuel, and of transferring the heat to a steam boiler which would then power conventional turbogenerators. In more futuristic schemes, direct conversion processes such as MHD (magnetohydrodynamics) might be used to convert heat to electricity more efficiently.

Such a power plant could not suffer a nuclear excursion (or runaway reaction) and would generate only minimal radioactivity. Thus, safety and environmental problems would be much less than for fission reactors.

Further development of this technology may make it possible to burn pure deuterium, thus simplifying the process by eliminating the need to manufacture tritium.

More Milestones Ahead

Answers to many questions must be learned before the turning point to power from laser fusion is reached. One such question: will the 10.6 micron wavelength of the CO_2 laser prove too long for optimum fusion ignition? If so, L-Division has some solutions in mind. One would be to alter the pellet shape—making it hollow—to mitigate this effect. Investigations are also underway to either shorten the wavelength of the CO_2 laser output or to develop other lasing media which can use the same pumping techniques to generate shorter wavelength laser radiation.

Once over the hurdles of demonstrating scientific feasibility and then obtaining adequate energy gain for a power cycle, many engineering and material problems remain such as: the manufacture and delivery of pellets, the development of reliable long-life lasers, the development of radiation damage-resistant optics and reaction chambers, and the development of high-temperature lithium technology.

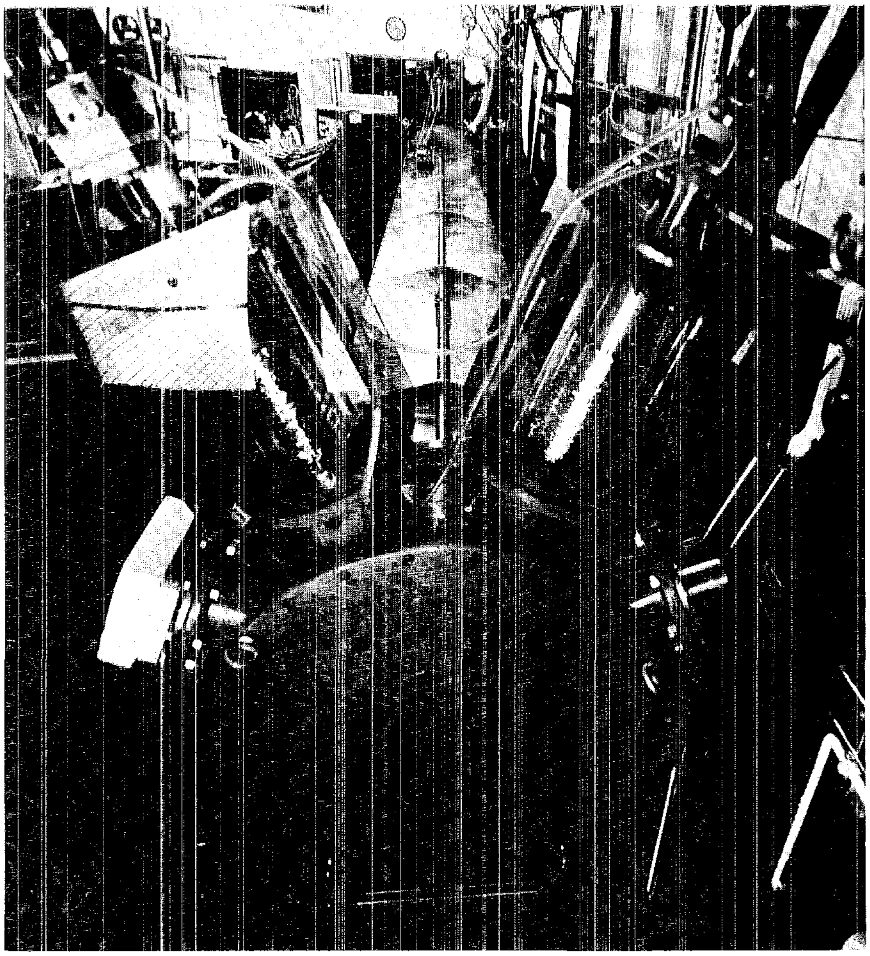
These and a host of other technical problems must be solved, which is why the program is envisioned as requiring 2 or more decades to develop economic power plants.

Yet, all theory points towards the feasibility of developing a technology, based not on the knowledge that may emerge tomorrow, but on the materials and hardware that exist today.

More and more, it appears that a number of answers—long-range, short-range, nuclear, and nonnuclear—are needed in response to the nation's complex energy problems.

Pellets of liquid hydrogen isotopes exploded by bullets of light may be one of the more promising ones.

SUPERCONDUCTORS: going to bed



On Tuesday, January 8, 6 men of Group Q-26 stood quietly but intently about a long metal "coffin" in Room 104 in the Cryogenics Building. Cool "smoke" curled lazily around two high-current, vapor-cooled leads jutting like bunny ears at one end of the long glistening box.

The checkoff was routine, but the moment wasn't. Finally, Eugene C. Kerr, Q-26, gave the go-ahead. As William E. Keller, group leader, R. Dean Taylor, associate group leader, and others watched, Thomas E. McDonald, E-5, turned the controls, initiating the flow of electric current into the box.

By steps, the dc current was boosted to 4,000 amperes--approximately 5 times the amperage carried by today's largest conventional transmission lines.

Within the long box, in reality a 20-metre superconducting testbed, was a superconducting sample through which the current flowed. For 18 hours it had been chilled, first by liquid nitrogen to 75 kelvins, then by liquid helium to approximately 4K.

This marked the first occasion that the testbed, under design and construction since early 1973, had been used to cool a conductor by liquid helium to the point where it became a superconductor.

More than a test of the conductor within it, this was a test of the testbed itself. It passed with flying colors, giving Q-Division an important tool for development of superconducting transmission lines.

Accent on Efficiency

Power companies today find it feasible to build their transmission systems as they need them, acquiring more right-of-way and building more towers from which they hang more copper lines.

But this may change. With 7 million acres of America now utilized for right-of-way, power companies find it more difficult and expensive to obtain additional land as well as answering questions raised by environmentalists. Soaring costs for increasingly "precious" metals such as copper, and for other material and labor as well, have vastly compounded the problem of investing enough money fast enough to meet power demand that is now doubling every 8-10 years.

Thus, the concept of superconducting transmission systems is attracting increasing interest among power companies. These lines would require less right-of-way than a two-lane road, would be buried underground, and would have a capacity to carry power far exceeding present and future demands as well.

Such a system would pay another bonus. It would transmit power with as little as 0.5 per cent energy "cost" as compared to 3-10 per cent losses experienced generally in conventional long-distance ac transmission today.

While transmission losses could be ignored in the past, they cannot in the future. Projected to 1990, losses in conventional transmission systems would equal all the energy that the Alaska Pipeline could deliver.

Hairbreadth Transmission

Currently, Q-26 considers Nb_3Sn —a compound of 3 atoms of niobium and one of tin--as the most promising current carrier.

A single line could theoretically carry from 10 to 100 times the power carried by a typical present-day ac transmission line.

The power needs of the city of Albuquerque (300 megawatts) could be fulfilled by a wire with the diameter of human hair if an NB_3Sn conductor were used in a superconducting cable.

This high current density provides another advantage: delivery of power at relatively low voltage (about 100 kilovolts), thus avoiding a multitude of high-voltage transmission problems.

A possible cable configuration would be a small copper core clad with Nb_3Sn (probably filaments in tape), surrounded by sheaths of liquid helium coolant, vacuum, and insulation. A pair of these cables, each 125-150 millimetres (5-6 inches) in diameter, would be required for transmission, although other possible configurations could incorporate the two superconductors in a single cable.

If linked to present ac generators, then conversion to dc is required, as superconductors perform more efficiently with dc current. The efficiency gain of the superconducting cable would more than compensate for the slight energy cost of this conversion.

Peakshaving with SMES

Peakshaving, or storage of energy generated in slack demand periods for release during peak demand periods, is a subject of growing interest to America's power industry. Peakshaving becomes attractive when the cost for such devices becomes as low as for standby generators.

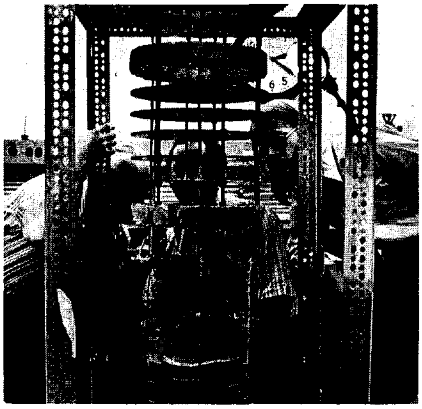
Many devices have been proposed; only one has been put into practice, and that by only a handful of power companies—pumped hydro storage.

In this simple scheme, water is pumped up into a lake during slack-demand periods, then drained back through generators during peak demand periods. Maximum efficiency is about 70 per cent.

Q-26 is working on a far more efficient and compact method: Superconducting Magnetic Energy Storage. As William V. Hassenzahl, Q-26, explains, an electric current introduced into a superconducting storage device would, in theory, flow forever. It could be withdrawn at any time at no energy cost other than the small amount (less than 5 per cent) required to refrigerate the device and make ac-dc conversions.

The storage devices would consist of one or more large magnets, probably of toroidal geometry, housed in suitable insulation with refrigerating systems. One scheme visualizes a huge "doughnut," occupying an area no larger than a football field. Such a design would accomplish peakshaving for a generating plant supplying a medium size city.

Another possibility is the integration of transmission and storage, with a storage device placed every 20 km (12 miles) along a superconducting transmission line. Among its advantages would be a single refrigerating system cooling both the transmission lines and the storage devices.



Robert D. Turner, William V. Hassenzahl, both Q-26, and Bruce Baker, UNM, with magnetic storage device.

Interlocked Programs

LASL became involved with cryogenics and superconductivity in employing liquid hydrogen isotopes in early thermonuclear devices.

With the inauguration of LASL's Scyllac experiment in the Controlled Thermonuclear Research program, it became apparent that storage and transmission of the dc current required to create a magnetic pinch on hydrogen plasma might best be accomplished ultimately through superconducting transmission and storage. Hence, a parallel experiment is being directed by John D. Rogers, associate group leader, and Henry Laquer, both Q-26, named Magnetic Energy Transfer and Storage (METS). METS is intended to converge upon the Scyllac experiment at some future date.

It also became apparent that research connected with METS could have broader application. Thus Edward F. Hammel, Jr., associate Q-Division leader for applied technology, proposed two collateral programs for meeting the needs of America's power industry in the 1980's: Superconducting Power Transmission Lines and Superconducting Magnetic Energy Storage.

Multiple usage of personnel, facilities, equipment, and knowledge is producing significant economy: the programs are funded by the Atomic Energy Commission at a cost measured in hundreds of thousands of dollars rather than the millions such independent programs might otherwise cost.

Tomorrow's Systems

The thrust of these programs illustrates the need for a total-systems approach. As an example, a Controlled Thermonuclear Reaction power plant would be most efficient in the production of dc, rather than ac, current. Superconducting transmission lines would appear ideal used with a CTR generator. And CTR would operate most efficiently at unvarying design loads. Peakshaving via a superconducting magnetic energy storage device would be a logical adjunct.

Mated to the CTR power plants of the future, superconducting transmission and storage may give generations to come electrical energy produced and delivered at efficiencies and with sophistication undreamed of today.

On your mark, get set, go. A slow but important race begins as Lawrence L. Hupke and Richard L. Renfro, both Q-23, remove vinyl covers from collector units to expose them to sun at TA-46 Test Station.

SOLAR ENERGY: a race begins

Which collecting unit captures solar energy best?

A contest to find out has just begun at TA-46 where Q-Division completed the installation of their new Solar Collector Test Station in January.

There, 3 black, glass-faced finalists stand tilted at 45° to face the sun. Their proportions are attractive, at least to architects and builders: 0.6 x 3.0 metres (2 x 10 feet) to conform to design and building practices.

Within the units, glycol or silicone fluids course through "veins" quilted between 2 spot-welded plates of 0.8 millimetre (0.03 inches) mild steel. Automated controls meter fluids through the units according to temperature differentials. Behind the scenes, computers keep a running score.

Because nothing moves, the race lacks somewhat in excitement. Nevertheless, there are a number of interested spectators including J. Douglas Balcomb, Q-Division assistant leader for analysis and planning, Stanley W. Moore, and James C. Hedstrom, both Q-DO. By spring, they hope to know the winner, which would become the prototype for production models which best combine materials, design, manufacturing simplicity—and low cost.

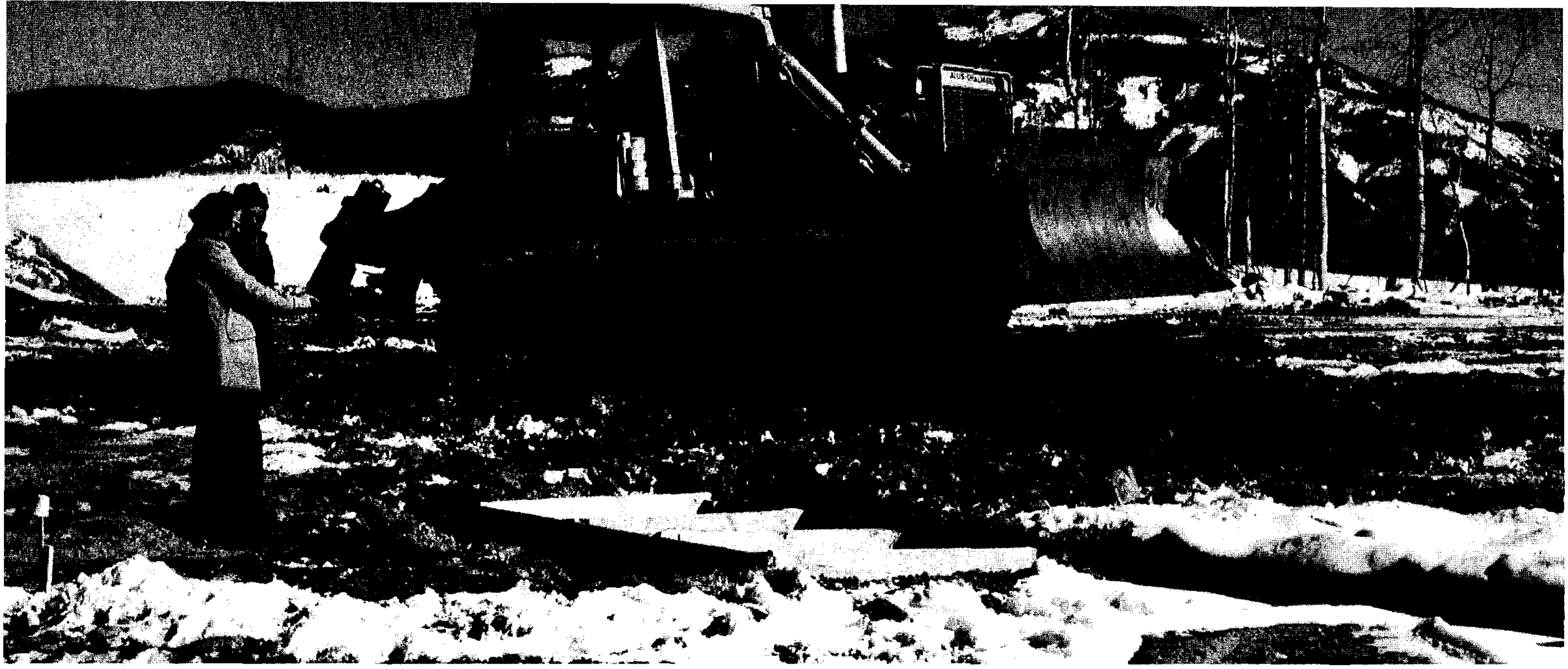
According to a current proposal, 500 of these units would be installed on the roof of the National Security and Resources Study Center, construction of which is planned to begin in 1975 on a site near the Administration Building. These units would provide 80 per cent or more of the Center's heating and air-conditioning energy. (A small conventional auxiliary heating unit would supplement energy supply in overcast weather.)

The proposed installation would become a national showcase, complete with instruments showing visitors how the system was functioning at any time. Such a "live" demonstration might spark widespread public interest and adoption by the building industry.

As presently designed, the price difference between conventional roofing and that incorporating solar collector units would be $11.94 to $16.68 per square metre ($1.11 to $1.55 per square foot)—a cost that would be repaid by fuel savings in a few years.

In addition to schemes for large office buildings and residences, plans for mobile homes have been formulated. With experts predicting that 20-30 per cent of the nation's population will eventually live in mobile homes, the integration of solar energy systems into mobile homes could effect important savings both in national fuel resources and in energy costs for mobile home owners.

Although solar energy is no panacea for America's fuel shortage, it eventually could alleviate it. As Balcomb points out, approximately 1/5 of America's energy is expended in heating and cooling. Shifting some of this burden to Old Sol could lessen the one on our overstrained fuel resources—and on the homeowner's pocketbook as well.



Framing marks the spot where Q-22 will drill for heat. Site is in Jemez Mountains on flank of extinct volcano. Redondo Peak is in background.

GEOTHERMAL: things are looking down

During January, dozers completed grading a small site near Los Alamos on the western flank of an extinct volcano—a welcome sign that Los Alamos Scientific Laboratory's dry geothermal energy program was moving out of the laboratory and into the field.

But Group Q-22, conducting the project, was only scratching the surface.

Soon, drilling will start. Morton C. Smith, Q-22 group leader, reports that casing is now on hand and contracts have been signed for drilling to begin as you're reading this.

Because shallower test holes were drilled earlier in the vicinity to learn subterranean temperature gradients and the feasibility of cracking granite hydraulically, LASL men on the job (in shifts around the clock, 7 days a week) are optimistic. Donald W. Brown, Q-22 assistant group leader, Darrell L. Sims, Q-22, Francis G. West, Q-22, William D. Purtymun, H-8, Daniel J. Miles, Q-22, and others at the Fenton Hill site believe that by boring down 1.3 kilometres or more, a region of granite at 150°C will be encountered.

If so, in April, attempts will be made to fracture the rock in a 150 metre radius from a point near the bottom of the hole.

Success in this test would lead to drilling two deeper holes, 1.8 to 2.3 km, about 0.5 km from the test hole this summer. If these holes meet expectations, pumping, control, and heat exchanging systems would be installed in the first half of 1975. Perhaps by that summer, the world's first facility for extracting energy from the earth's deep, dry heat would go into operation.

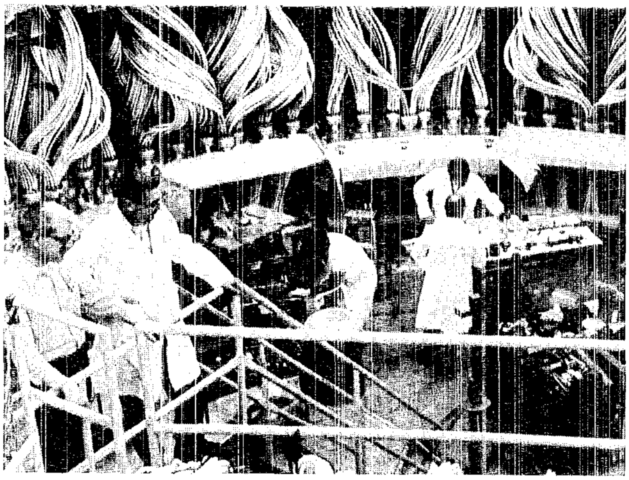
Lest this tentative forecast touch off a geothermal wildcatting boom, Smith reminds that answers to many questions are needed. Where is all this heat? How deep? Knowledge of the geology underlying the continent, let alone of its heat flow, is sketchy at best.

Based on recent tests, seismic effects of fracturing the rocks are expected to be negligible, but this needs further demonstration. Costs of deep drilling may be unacceptable. While LASL's subterrene, a device that melts its way through the earth (*The Atom,* Nov.-Dec. 1973) may ultimately reduce costs, its use awaits further development.

And the system for injecting water into the earth, circulating it through cracks in the hot rock where it is heated, and withdrawing it must be proven in practice.

Yet, the principles are simple, present materials and engineering know-how appear equal to the task, and progress has beeen encouraging.

Perhaps once again the Jemez Caldera, the remains of the great volcano whose titanic eruptions shaped much of northern New Mexico's terrain, will play another role in history. By yielding its remnants of heat to LASL scientists, it may contribute to research leading to an important new energy source.



Scyllac: Making Ends Meet

Group Q-3 is closing the gap in its torus, heart of the Scyllac experiment to develop power through a controlled thermonuclear reaction in plasma confined by a magnetic field.

Well into 1973, Q-3 conducted experiments with 5 segments of the toroidal chamber in place. As **The Atom** goes to press, 8 segments have been installed. A coil for the 9th segment is being finished at LASL prior to installation. Within weeks, hopefully, the coils for the final 6 segments will have arrived from California.

Q-3 will then "make haste slowly" to install the segments, completing the circular chamber, thus creating a tube without ends from which plasma cannot escape.

Theory suggests this will lengthen CTR burn substantially—a requirement for raising "power out" toward the level of "power in."

Key experiments are imminent in this major Q-Division energy program.

Hydrogen Pickup To Albuquerque

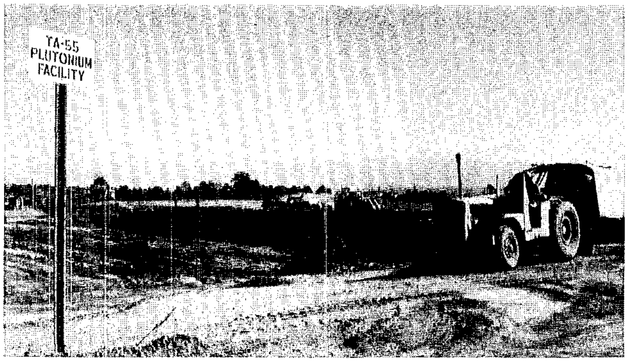
Q-Division is sending its hydrogen-fueled pickup (**The Atom**, Nov.-Dec. 1973) to Albuquerque Feb. 20-21 for display during Engineers' Week at the Winrock Shopping Center. Since service stations with hydrogen are few and far between on the Albuquerque Highway, the pickup will travel via flatbed trailer.

Next for the pickup: installation of one or more dewars for experiments with liquid hydrogen fuel.

Energy Planning Office Formed

In response to rapidly increasing responsibilities in national energy research, an Energy Planning Office headed by Edward F. Hammel, Jr., Q-DO, was formed in January at LASL.

EPO's 10 working groups are Energy/Resource Conservation, Oil and Gas Stimulation, Clean Fuels from Coal, Nuclear Energy (Fusion), Nuclear Energy (Fission), Renewable Energy Sources, Environmental Effects Research, Energy Transmission and Storage, Synthetic Fuels, and Systems Studies.



Grading Begins for Plutonium Facility

Grading has begun for a new $55 million plutonium facility at TA-55 which incorporates latest health and safety standards. When completed in 1977, it will replace the present facility at DP West.

Among its functions: research in fast breeder reactor fuels, of interest to the nation's power industry. Fast breeder reactors have the capability of creating additional fissionable fuel while providing energy for power generation.

New Busses Save Gas

Commuter bus service initiated by LASL and beginning Feb. 4 may be saving 1,000 or more gallons of gasoline a month that would otherwise be burned by employees' private cars.

The estimates assume that 2 busses carry a full load of 41 passengers each, that employees' cars would otherwise carry an average of 2 employees each, and that employees' cars average 50 miles a day at 17 miles to the gallon driving to work.

short subjects

Honors: **Jennie L. Boring,** ADW-PM, elected president of the Rio Grande Chapter of the Association for Computing Machines. **Louis Rosen,** MP-Division leader, elected councillor at large of the Council of the American Physical Society. **William R. Stratton,** P-5, elected chairman of the Atomic Energy Commission's Advisory Committee on Reactor Safeguards.

Morton M. Kligerman, LASL assistant director for radiation therapy and a UNM staff member, in January was a member of a team visiting the Soviet Union to observe cancer treatment in several Soviet institutions. The AEC anticipates receiving a comparable Soviet team in the U.S.A. in the future.

Following its hit performance in Washington, D.C. (**The Atom,** Nov.-Dec. 1973), the subterrene staged an encore in Denver, Colo. Federal and state officials, news media, and private industry representatives watched the subterrene melt its way through earth and rock.

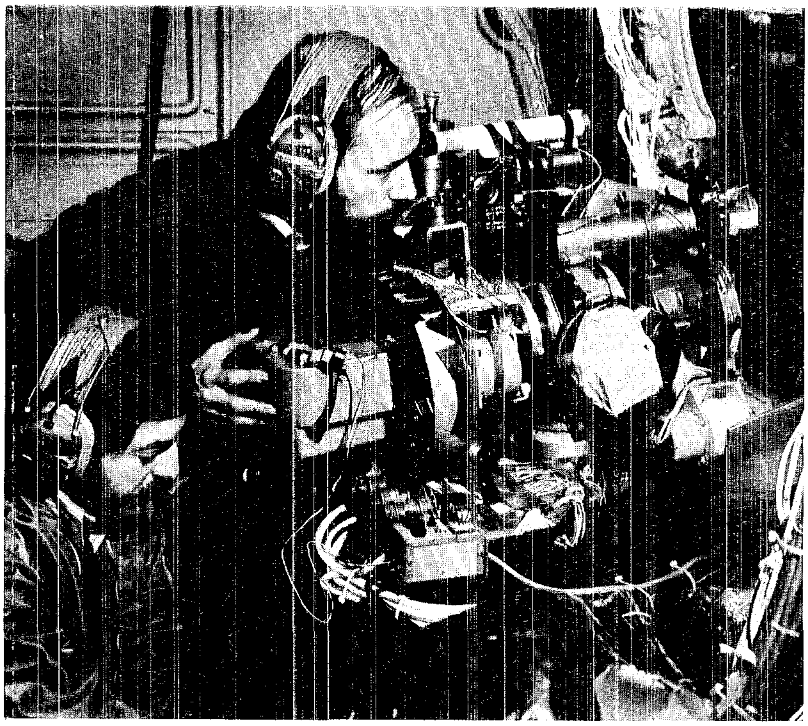
A visual approach indicator has been installed at the east end of the Los Alamos Airport runway. When tested and approved by the FAA, it will give pilots an extra safety margin, signalling the correct descent angle to miss obstacles in the final approach path.

Deaths: **Fremont W. Carroll,** retired, former ENG-2 senior designer; **Leo R. O'Neil,** SD-5 developmental machinist; **Leopoldo Romero,** WX-3, chemical plant operator; **Betty E. Smith,** H-2 occupational health nurse; **La Verne Turner,** retired, former Shop Department employee.

Participants in the Jan. 11 charter meeting of the New Mexico Emergency Council in Los Alamos demonstrate transporting a litter across a canyon. Meeting, attended by 23 search and rescue teams, was hosted by the Los Alamos County Civil Defense Search and Rescue Organization.

Photo Shorts

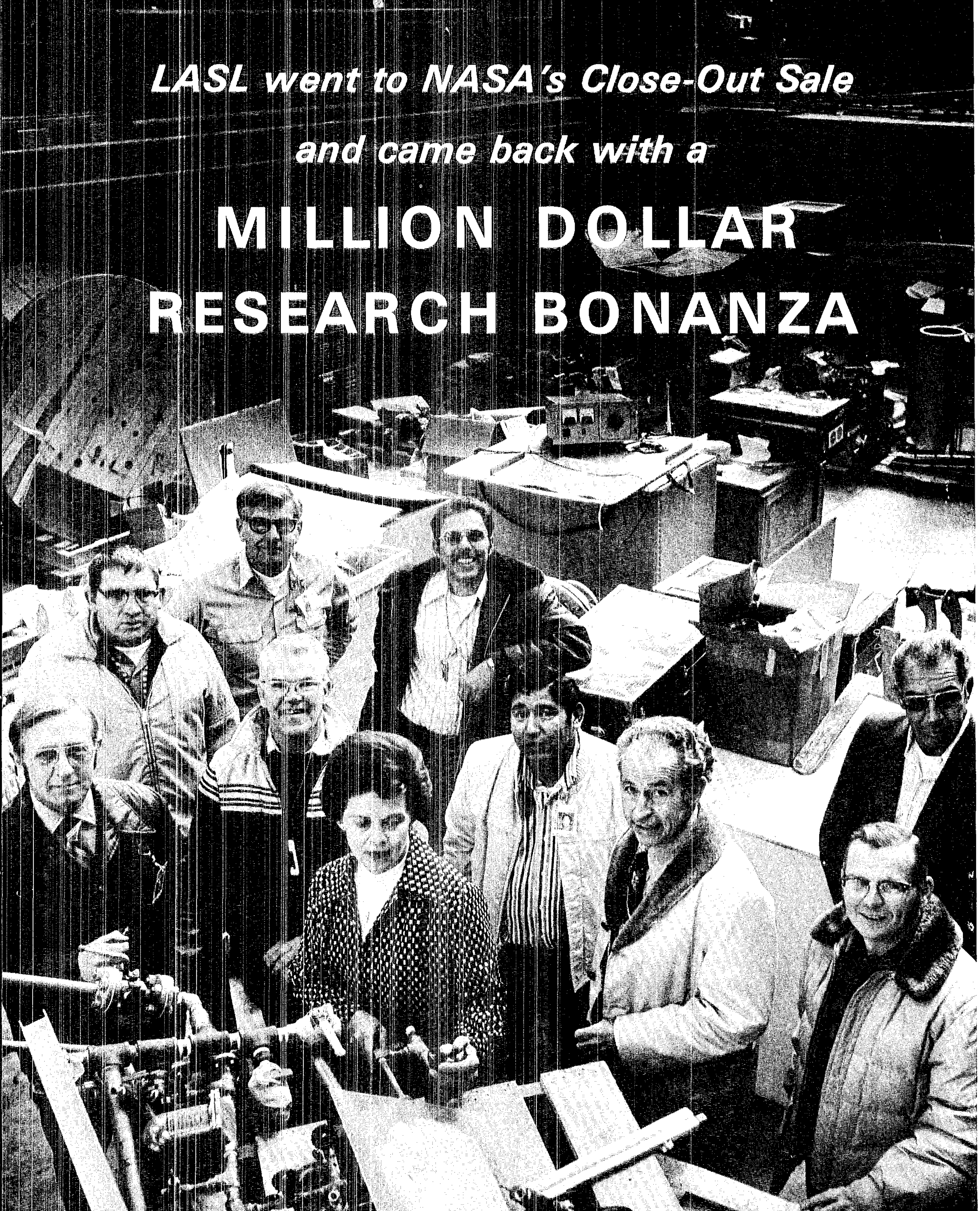
History of another sort was made in Los Alamos 2 days before Christmas with the arrival of the first triplets born in the city. A girl, Janaanne, held by father Gregg C. Giesler, CNC-11, and 2 boys, Jonathan and Jeffrey, held by mother Maryjane Giesler, joined Susananne who preceded them by 19 months.



To Joseph A. Montoya, M-3, and Charles F. Keller, Jr., J-15, Kohoutek comet was no disappointment, but a subject yielding valuable optical data. Montoya and Keller, here zeroing camera for comet photography aboard an AEC/Air Force NC-135 flying laboratory, were part of LASL team making 6 comet observation flights from Albuquerque. A series of flights in Alaska was cancelled. Despite puzzling performance, scientists expect to learn more from Kohoutek than from any previous comet.

Funny at the time was the fall of this filing cabinet in the Administration Building. But it might have been no laughing matter: heavy filing cabinets can deal serious injury. Jackie Meketa, ISD-1, and Harry Williams, Jr., ENG-4, apparently in charge of holding filing drawers in with his stomach, survey the scene. Moral: never open more than 1 file drawer at a time.

LASL went to NASA's Close-Out Sale and came back with a MILLION DOLLAR RESEARCH BONANZA



"Never in my 26 years experience with research programs have I seen a bargain like this. It's like buying a $50 cartload of groceries for $2.

"And it's the first time, to my knowledge, that a major laboratory, virtually in its entirety, has been transferred from one government agency to another."

So says Duane C. "Hank" Winburn, L-Division technical administrator, still a bit awed by the magnitude of a windfall which brought $1 million worth of equipment to the Los Alamos Scientific Laboratory from the Johnson Space Center in Houston for a "take-it-away" cost of under $40,000.

But in the context of today's energy crisis, Winburn adds, the savings in time may be far more meaningful to the nation than those in dollars. The equipment will accelerate L-Division's research leading to hydrogen fusion initiated by high-powered pulsed laser to produce electricity. Neither Winburn nor anyone else at L-DO can say just what the time savings may be, but they're believed to be very substantial in a program that is projected for decades.

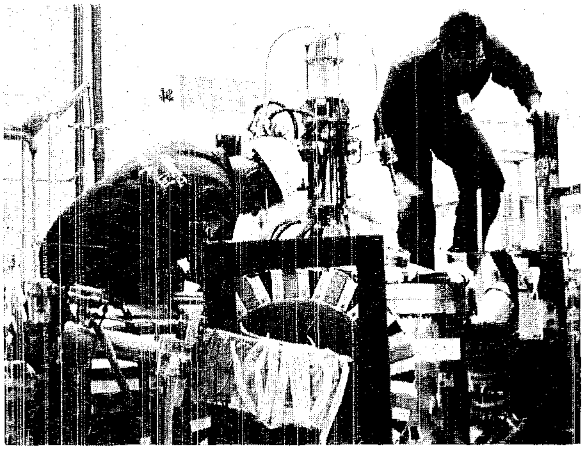
The equipment, practically the entire Lunar Receiving Laboratory at the Johnson Space Center, consists of sterile and nonsterile nitrogen processing lines used throughout the lunar landing program. It includes vacuum pumps, valves, flanges, chambers, and stainless steel pipe. Other equipment includes gloveboxes, dryboxes and other equipment for materials handling, and electronic devices, TV cameras with accessories, and control consoles helpful in monitoring laser beams.

About 60 per cent of this equipment is now in use or, with some modification, soon will be at TA-35 and TA-46 in several laser systems. Some equipment has been assigned to CNC-, MP-, and CMB-Divisions. And about 20 per cent is being stored in anticipation of utilization in a major expansion of L-Division facilities scheduled for completion in 1975.

Under existing budgets and procurement procedures, this equipment (one 1200 litre/second ion vacuum pump alone costs about $7,000) could only have been acquired over a period of time and at a cost, according to the National Aeronautics and Space Administration, of $2.5 million including engineering and installation.

Not the least of the advantages associated with this equipment is that it is virtually new (used only upon the return of Apollo lunar missions) and that it is all intact: Parts have not been cannibalized to serve as replacements in other equipment.

How it all came about is a timely example of how the lateral transfer of excess equipment from one government agency to another can provide maximum benefits to the

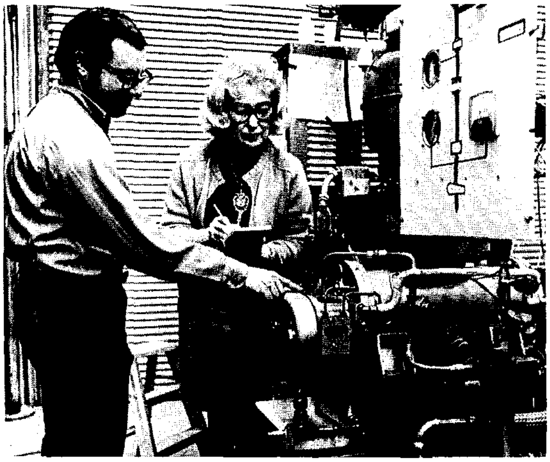


Taking it out: Richard Johnston and Roy Johnston disassemble Lunar Lab equipment in Houston.

Members of the LASL team who went to Houston and brought back Lunar Lab bargains. Back row, left to right, James A. Edmonds, L-1, Eugene Lamkin, L-2, and Roy L. Johnston, L-1. Front row, left to right, Alan L. Olcott, L-DO, Richard E. Johnston, L-3, Bonnie Marriott, SP-12, Librado E. Esquibel, L-DO, Duane C. Winburn, L-DO, Raymond C. Vandervoort, CNC-4, and Jesus M. Martinez, SP-4.

Bringing it in: Zia Company riggers unload equipment in Los Alamos.

Checking it in: David B. Fradkin, L-3, and Wanda King, L-DO, record property number of vacuum pump.



"If kitchen sinks had been available . . . the LASL team would have brought them back, too."

nation at minimum cost.

Apollo 17 brought the last cargo of lunar specimens back to earth in December 1972. It was sent to the Lunar Receiving Laboratory at the National Aeronautics and Space Administration's Johnson Space Center in Houston. By April 1973, some 110 kilograms (243 lbs.) of samples from this final flight had been processed and transferred to the Lunar Sample Curatorial Facility. The Lunar Receiving Laboratory's mission was completed and the Lab was closed in June. Its equipment was declared excess property.

Awareness of the availability of the Lunar Lab equipment came about in almost an offhand way, well before the Lunar Lab was closed. On a tip from George Cowan, CNC-Division leader, through Bonnie L. Marriott, SP-12 excess property coordinator, Winburn and Alan L. Olcott, L-Division property supervisor, inquired about the Lunar Lab equipment during a regular excess property screening trip to Houston in January 1973. They learned of the impending Lab closure and probable availability of its equipment.

Reporting their preliminary findings to Keith Boyer, L-Division leader, they were directed to "get the wheels turning" immediately in applying for the excess equipment.

In the spring, Robert E. Stapleton, assistant group leader, L-1, Philip F. Moore, CNC-11, and Winburn went to Houston for a closer look at the potential windfall. The group confirmed that the equipment was indeed in excellent condition and totally usable.

In June, Marriott and Winburn flew to Houston and agreed on the issues of a proposed contract between LASL and the Johnson Space Center.

But the paper work and approvals were far from complete. Marriott spent the summer heavily involved in the execution of the contract, ironing out details, and preparing documents for final NASA, Atomic Energy Commission, and General Services Agency approvals.

The transfer was approved in late September. R. J. Van Gemert, Supply and Property Department head, assigned Jesus Martinez, SP-4, to the LASL team for his knowledge of loading and rigging. Other personnel experienced in these matters were assigned from L- and CNC-Divisions to comprise the team that went to Houston on October 1. It had been agreed that NASA contractor personnel would isolate the equipment from utilities and LASL personnel would disassemble and load it.

Arrangements had been made with Pyramid Van Lines for drivers and special electronic vans. Careful preplanning reduced the number of vans required from 12, as originally planned, to 6.

Preplanning paid off in other savings, too. Original estimates allowed 2 to 3 weeks in Houston for the delicate disassembly and loading operation. Instead, Devon Baker, CNC-11, Lee Esquibel, L-DO, Don Housel, L-4, Richard Johnston, L-3, Roy Johnston, L-1, Eugene Lamkin, L-2, Raymond Vandervoort, CNC-4, and Martinez did it in 10 days. Assisting Winburn in coordinating the project was James Edmonds, L-1.

The LASL team brought home one item that has no bearing on laser fusion research, but saved LASL $500-1,000: a steel staircase. Colleagues at L-Division joked that if kitchen sinks had been available at the Johnson Space Center, the LASL team would have brought them back, too.

According to John W. Ramsey, SP-DO, costs other than for LASL time and travel, amounted to $7,500 for shipping (down from an originally budget of $20,000) and $30,000 to NASA for detaching the equipment.

As Boyer wrote to Van Gemert, "The exact savings realized cannot be accurately calculated, but the overall value to L-Division, the major LASL user, is considerable in terms of availability and adaptability as well as cost. Please accept my personal compliments for a difficult job done efficiently by a well-trained team."

"Swing that spacecraft, Do-Se-Do . . .
Around past Venus . . . lookit 'er go!

MARINER 10's INTERPLANETARY SQUARE DANCE

Some 54 million kilometres (32 million miles) from Earth, an incredibly precise square dance of interplanetary proportions is now taking place.

Launched from the Kennedy Space Center at Cape Canaveral on November 3, the National Aeronautics and Space Administration-Jet Propulsion Laboratory's Mariner 10 space probe passed by Venus February 5. Like a partner in a square dance, Venus' gravity has swung Mariner 10 toward a new partner 154 million km (92 million miles) away: Mercury.

The dance goes on. On March 29, Mercury in turn will swing the spacecraft into a do-se-do around the sun. So carefully calculated is this maneuver that Mariner will return to promenade by Mercury again towards the end of September.

And that is still not the end. If all goes with absolute perfection, Mercury will swing Mariner 10 once again around the sun to bring it back by the planet a third time in 1975.

The Mariner 10 voyage is scoring a number of historic firsts: the first use of TV cameras to take pictures of both Venus and Mercury for relay to Earth; the first visit of a spacecraft to Mercury for man's first close look at that mysterious planet; the first dual-planet fly-by; and the first use of the gravity of one planet to aim a spacecraft at another.

Aboard Mariner 10 is instrumentation by the Los Alamos Scientific Laboratory, as it has been on many of America's space capsules and probes since 1959. Senior staff members such as Samuel J. Bame, John R. Asbridge, and William C. Feldman, as well as many others in P-Division and elsewhere, hope that Mariner 10's instruments will gather a wealth of new information.

This would include mapping the pattern of solar wind streams in greater detail, learning more of plasmas, x-ray and gamma-ray radiation for application in thermonuclear research, and predicting with greater accuracy the violent particle and electromagnetic storms that from time to time erupt from the sun and affect man's life on Earth.

Gremlins Aboard

It would be pleasant to report that all is going well aboard Mariner 10. Not so.

First, heating elements for delicate TV camera lenses failed to function. Technicians feared that fluctuating temperatures would distort the glass. Fortunately, their fears proved exaggerated. The cameras are taking fine pictures.

Then, part of the radio frequency link to Mariner 10 has been lost, resulting in a lower rate of information return than planned.

The electrostatic analyzer designed and built by LASL appears to be operating, but seems to be reporting only background counts of cosmic rays. Conjecture is that a door designed to expose the counter to space has not opened.

(On the other hand, an electrostatic spectrometer developed jointly by LASL, the Massachusetts Institute of Technology, and the Goddard Space Flight Center is functioning perfectly.)

Yet, even if these malfunctions persist, the yield of new scientific information and data collected from points in space where it has never been obtained before will be enormous. And there remains the real possibility of correcting some or all of these deficiencies as the flight progresses.

Questions and Answers

Even before Mariner 10 reached Venus, it had tossed a question loaded with far-reaching implications back to earth-bound astronomers. A far ultraviolet spectrometer, designed to look for traces of atmosphere on Mercury, was being used en route to chart hydrogen and helium distributions in the solar system when suddenly needles jumped. The instrument had de-

"'For all its high-flying research, LASL expects some down-to-earth results.''

tected intense radiations from the Gum Nebula indicating temperatures 10 times those of the sun's surface.

The enigma: why should radiations be there at all? This nebula had been pronounced dead, a cosmic relic of the past. The discovery may lead to fundamental revisions of theories on the nature of nebulae and stars.

During Mariner 10's passage by the moon, it photographed its surface, answering some questions about lunar topography.

But answers to major questions lie ahead. One of special interest is what happens when the solar wind (comprised chiefly of a plasma of hydrogen ions, electrons, and other particles) encounters planets other than Earth?

The effects around Earth are fairly well known, but what shape will a shock wave assume when the solar wind hits Venus, which has atmosphere but virtually no magnetic field, and Mercury, which has virtually no atmosphere and may or may not have a magentic field?

Understanding of these and other phenomena could lead to a better comprehension of the solar wind's influence upon radio communications on Earth and, as many scientists increasingly believe, its subtle but profound effects upon Earth's weather and environment.

No Stranger in Space

LASL's space involvement began in 1959 with instrument pods placed aboard early rockets launched by Sandia Laboratories at Tonopah, Nev., to measure space radiations. Soon, LASL instruments were riding Atlas and Scout missiles to study protons and other particles in the outer Van Allen radiation belt.

By early 1961, the instrumentation had demonstrated its reliability in the harsh space environment and its further development was placed under the Vela satellite program for detecting nuclear tests in and above the atmosphere by detecting light, neutrons, gamma rays, and thermal x rays released during a nuclear explosion.

During the 1962 high altitude nuclear tests at Johnston Island, prior to the atmospheric and space nuclear test ban accord with Russia reached a year later, 17 rockets with LASL payloads were fired in the vicinity of the detonations to measure effects. All instrumentation performed to design expectations.

In 1963, the Vela satellite launches with LASL instrumentation aboard began. Subsequent launches, every one or two years, have sustained the program through the present.

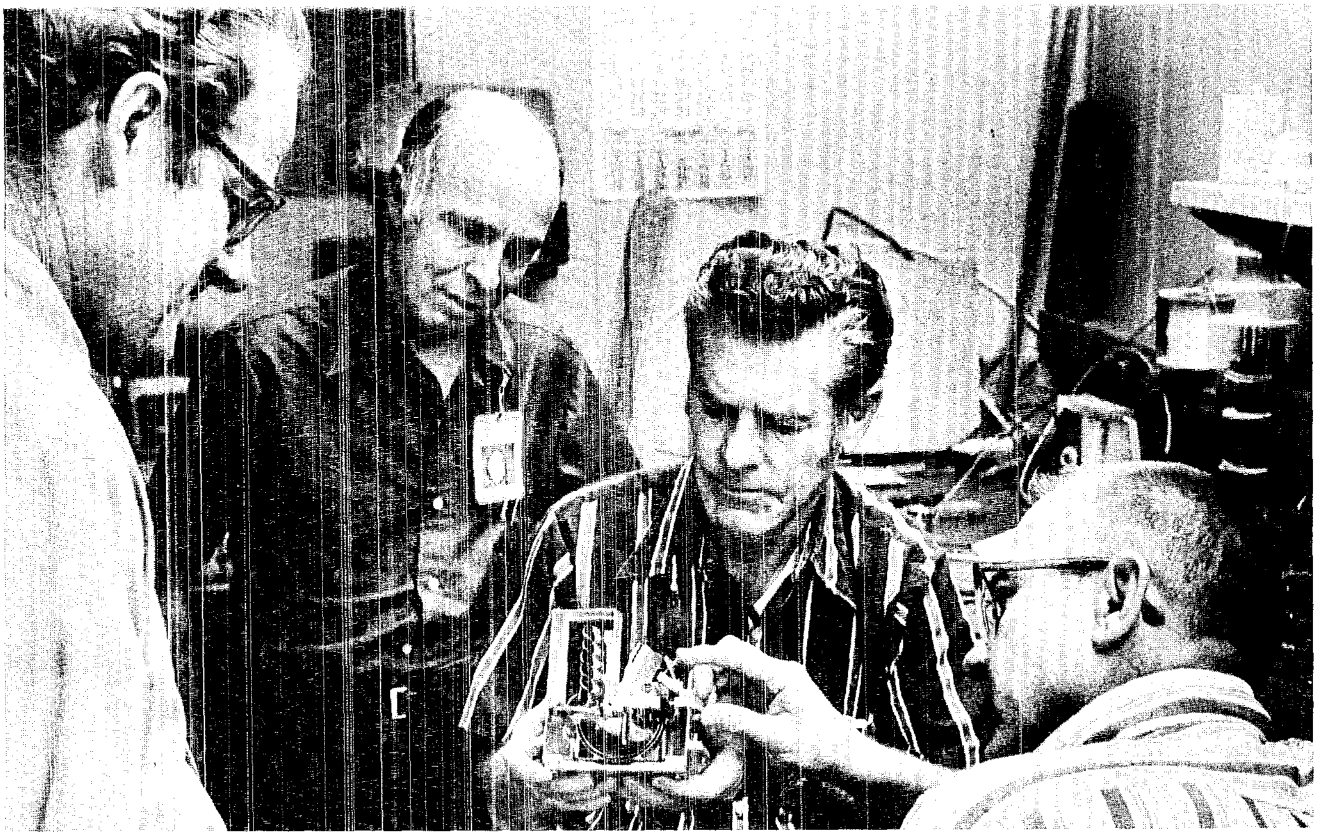
In 1969, P-4 staffers, in analyzing data returned by Vela satellites, discovered a rare, transient x-ray flareup in the southern celestial hemisphere (see *The Atom,* Sept. 1969). The event created considerable excitement and has been the subject of analysis and interpretation since.

Similarly, LASL instrumentation on Vela satellites last year made the first discovery of short-duration pulses of high-energy, electromagnetic radiation originating beyond the solar system (see *The Atom,* June 1973). LASL analysts of astronomical matters believe the Vela instruments reported gamma-ray bursts that might signal the formation of a supernova, the catastrophic explosion of a dying star.

In 1968, a LASL solar x-ray spectrometer rode aboard OSO-6 (Orbiting Solar Observatory), whose mission was to gather more data of the sun.

And from 1971 through 1973, LASL instruments were guests on NASA's IMP (Interplanetary Monitoring Platform) 6, 7, and 8 for conducting plasma experiments.

Currently, CMB-Division is providing a vital function to the Pioneer 10 mission past Jupiter: four RTG (Radioisotope Thermoelectric Generator) generators fueled by plutonium-238 dioxide and generating 120 watts for 11 experiments (see *The Atom,* Feb. 1972). This type of power generation was chosen because solar energy in the



Examining a fundamental instrument of LASL space research, an electrostatic analyzer (with casing cut away to reveal components), are P-4 men involved with development of such instruments. Left to right: Harry E. Felthauser, Samuel J. Bame, J. Paul Glore, and John R. Asbridge.

outer reaches of the solar system is so weak that a solar-cell array to provide necessary power would be unacceptably large.

Pioneer 10 has now passed Jupiter; similar RTG units are aboard Pioneer 11 now en route to Jupiter and, possibly, on to Saturn.

New Sophistication Ahead

A new generation of satellites is scheduled to appear in the years ahead. One of the more intriguing is the innovative Mother-Daughter launch planned for 1977.

The Mother-Daughter project is an ambitious international endeavor in which the U.S.A. and 7 western European member nations of the European Space Research Organization are participating. LASL is cooperating with the Max Planck Institute in West Germany in the design and construction of much of the instrumentation.

The scheme calls for launching 2 satellites together into a high earth orbit, whereupon the "daughter" separates from the "mother," but follows a suitable distance behind. Various interlocked instruments can then determine wave and particle speeds (by measuring time differences as particles encounter first one satellite, then the other) and direction (by triangulation) with greater accuracy than heretofore.

And finally, there's the Heliocentric Explorer planned for 1978. In this plan, a satellite is projected 1 per cent of the distance from Earth to the sun, where it is abruptly turned to travel an orbit parallel to that of the Earth around the sun, like 2 horses running together around a circular track. Among its capabilities will be that of giving an hour's notice of bursts of particles from the sun approaching the Earth, a valuable "Distant Early Warning" of possible disruption to radio communications and other effects.

Down-to-Earth Benefits

For all its high-flying research, LASL expects some down-to-earth results.

Space exploration offers an ideal opportunity to observe and increase our understanding of plasmas, x and gamma rays, and neutrons and other particles in space. Such knowledge is fundamental to LASL's continuing weapons research and development.

But today, the acquisition of such data assumes even greater urgency. The same information is also essential to the development of controlled thermonuclear reactions as a source of energy.

Who knows but that data from space, much of it garnered by LASL instruments, may hasten the day when abundant controlled thermonuclear energy lights our homes and powers our industries.

Metric Committee charts course for LASL metrication during frequent meetings. Clockwise from left: Allen R. Driesner, SD-2, Robert K. Osborne, TD-4, Walter F. Sommer, Jr., P-11, Melvin G. Bowman, CMB-DO, Richard J. Bohl, ADWP-1, Robert H. Masterson, ISDO, Eugene F. Olsen, SP-3 (non-member), Robert J. Van Gemert, SP-DO, and Jerry J. Koelling, ENG-7.

Going Metric

You're a lot more "metric" right now than you may realize. And you'll become more so as the Los Alamos Scientific Laboratory changes over to the International System of Units (embodying modernized metric measurements) in a program that began with the New Year and is surfacing more and more each day.

If you work in scientific areas, you are already familiar with metric units. But if you're a layman—an administrative worker, a tradesman accustomed to familiar inches and fractions thereof, or a housewife—you'll want to increase your understanding of metric measurements.

Fortunately, metric units have been entering your life more and more in recent years, and this alone may make your fuller understanding that much easier to achieve.

Cameras and skis are familiar products that are now metricated, that is, designed, made, and described in metric terms. If you drive a foreign car, you know that it is metricated. You may not know, though, that some current Detroit models are also metricated—or have components that are.

Eyeglasses and drugs are prescribed in metric terms, and the contents of many food packages now show their contents in metric as well as U.S. Customary units.

And at least one illegal commodity is measured metrically: marijuana is sold by the "kilo."

Metric units have been standard laboratory tools for more than 100 years because they are clearly superior in their coherence, precision, and simplicity. Extending their usage to all phases of LASL activity will give LASL employees the same advantages. And by adopting this universal language of measurement, LASL will be "in step" with an increasing number of government agencies, research facilities, and industries at home as well as abroad.

A Metric Primer

When proposed by France in 1790, the metric system was as revolutionary as the era from which it emerged: the French Revolution. At last, here was a system grounded on science and logic rather than custom and lore, with units easily convertible to larger or smaller units—and even between units measuring different things—by moving decimal points to multiply or divide by 10, 100, 1000, or more.

The metric system was subsequently made compulsory in France in 1840 and was adopted by most other European countries during the 1800's.

But as with any system, age took its toll. Experts felt that increasingly sophisticated science and technology made it both possible and essential to redefine metric units in more precise terms and to discard many measurements that were redundant or inappropriate.

In 1948, the General Conference of Weights and Measures meeting in Paris voted, in effect, to overhaul the metric system. In the Conference of 1954, the basic principles of a modernized system were established and in 1960 it was named the International System of Units (SI).

The differences between the metric system with which you may have become acquainted in high school and the SI units of today fall into two categories: definitions and usage.

A basic redefinition was of the metre. Until 1960 it was defined as 1/10,000,000 of that portion of a circle of longitude between the North Pole and the Equator at certain points in Europe. It is now defined with greater accuracy as "1,650,763.73 wavelengths in vacuum of the radiation corresponding to the transition between the levels $2p_{10}$ and $5d_5$ of the krypton-86 atom."

Similarly, the second as a measurement of time is keyed to periods of radiation of the cesium-133 atom. Units of electric current (ampere), thermodynamic temperature (kelvin), substance (mole), and luminous intensity (candela) are defined with equal meticulousness and by procedures that can be followed in modern laboratories regardless of geographic location.

Only mass (kilogram) has continued to be defined as a unit equal to an international platinum-iridium prototype in Paris. It's original definition as the "weight" of 1 litre of water has been discarded.

The foregoing comprise the seven basic units from which other SI units are derived, such as for frequency (hertz), force (newton), pressure (pascal), and of special interest to LASL, energy (joule).

Defying definition as either basic or derived measurements are two angular units, the radian (plane) and steradian (solid) which were accepted into the International System.

SI in Practice

But while definitions are crucial to those setting standards and of importance to those engaged in precise work, it is in usage that the differences between the old metric system and SI become apparent.

Within the old metric system, subsystems favored by different disciplines had developed, making the metric system subject to the same sort of criticism leveled at the English and U.S. Customary systems: a proliferation of units.

The best known examples are cgs (centimetre-gram-second) and mks (metre-kilogram-second). These subsystems in turn bred a welter of derived and invented units measuring the same qualities, notably for energy, electromagnetism, radiation, and luminescence. Nonmetric units were frequently used in conjunction with these subsystems, such as the BTU, foot-candle, and kiloton.

Clarity of communication between research institutions and between disciplines was becoming increasingly clouded by having to make conversions, despite their ease by the simple decimal process.

The American Society for Testing and Materials, vitally involved with SI, seeks to reduce the units in circulation and restore the simplicity of the original metric concept by promulgating principles of usage such as:

—Stating measurements in the 7 basic and 2 supplementary SI units wherever possible.

—Employing other approved units that are multiples and submultiples of 1000 of the basic units in preference to the lesser multiples and submultiples of 10 and 100.

—Using units without prefixes in the denominators of compound units, such as megagrams per cubic metre.

—Using approved name prefixes (or their symbols) rather than multiple prefixes, or with infinite flexibility, a number prefix—10 to a plus or minus power.

As the Metric Committee deliberated how SI principles such as these should be applied at LASL, two schools of thought, each supported by formidable logic, emerged.

One school proposed a strict adherence to ASTM guidelines. The other, while supporting metrication, held that strict adherence at this time posed unnecessary impediments.

The differing viewpoints were reconciled by a policy announced by Harold M. Agnew, Director. In essence, the policy states:

—The ultimate goal is conversion to the predominant, but not necessarily exclusive, use of the SI system.

—Those who have begun conversion to SI units are encouraged to continue their efforts.

—After March 1, LASL scientific and technical documentation will use metric units, including cgs units where such usage is consistent with established practice within a discipline.

—U.S. Customary units may not be used without the specific approval of the Laboratory Director.

The incorporation of SI units and practices into LASL's modus operandi is foreseen as an evolutionary process guided on the one hand by the desire to achieve a simpler, more uniform measurement language and on the other by the realities of activities as conducted in the laboratories and in communication with outside organizations.

LASL's Conversion

An informal spot-check by *The Atom* showed a laboratorywide positive response to the new policy, with the pace of the conversion determined by the realities with which individual divisions must deal.

In general, "the harder the hardware, the harder the conversion." This became apparent as the fundamental usages of measurements were sorted out: (1) as abstractions, (2) as communication symbols, (3) as working laboratory tools, and (4) as integral "parts" of equipment and materials.

According to Roger B. Lazarus, alternate C-Division leader, "Computers don't care what units they use." Consequently, Lazarus foresees no wholesale revision of existing libraries and data banks; SI conversions can be made simply at the input or output stage. In the matter of hardware, though, C-Division's conversion is related to that of the computer industry. Metric equipment will be phased in as available.

Units used as communications symbols pose more intricate problems linked to the receptivity of the audience to which they're addressed. For instance, ADWP-1 (Technical Liason) deals entensively with outside agencies such as the Atomic Energy Commission and the Department of Defense. According to Harry C. Hoyt, assistant director for weapons planning, "We will leave out the customary unit and use only the SI unit whenever that unit is one with which most readers will be familiar. Dual units will still be required when we use the less familiar SI units. The SI units will be expressed first, followed by the Customary units enclosed in parentheses."

Because of readers' familiarity with traditional units expressing nuclear yields, ADWP-1 will state nuclear yields in both terajoules and kilotons.

The same approach is in effect for the Information Services Department, but with specific policies for certain material, according to Robert H. Masterson, alternate department head. SI units will be used exclusively in LA-series reports. In other material, Customary units will be allowed in parentheses following SI units when they would significantly increase clarity. As an example, *The Atom* has implemented this practice.

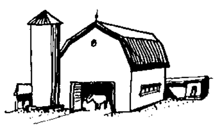
Measurements stated on engineering drawings and specifications are, of course, communication devices. On a laboratorywide basis, the response is to use a dual system as relevant to the outside vendor, or if absolutely necessary, "good old" Customary units.

In CMB-Division, "After a short period of preparation and education now in progress, the substitution of SI units for cgs units will be required in all publications originating in CMB-Division," reports Richard D. Baker, division leader.

George O. Bjarke, E-Division equipment services section leader, says "The impact of metrication on E-Division is slight. The electrical and electronic quantities are already metric." Bjarke notes hardware problems, however, with the stockroom carrying some dual stocking, changing of travel dials on milling machines, and replacement of some equipment. Costs are not seen as "seriously perturbing the capital program."

Robert N. Thorn, Theoretical Design Division leader, says, "TD-Division has switched to metric units in correspondence. We plan to retain the kiloelectron volt as the unit of particle energy and temperature. Our codes will continue to use units convenient for machine man-

Shakes, Jerks, and Barns



You've read, at one time or another, of the quaint origins of U.S. Customary units, inherited by us from antiquity by way of England. Some accounts hold that a mile was the distance a Roman legionnaire could cover in 1,000 strides of 2 paces each. An inch was 3 barleycorns, and a yard was the length of a sash worn by Saxon kings to settle measurement disputes.

Modern measurement lore is just as colorful, and as time passes, is beginning to acquire the patina of legend.

Not discotheque dances, but measures of time and energy, are the shake and the jerk—two of the units devised during those urgent Manhattan Project days.

A shake is 10 nanoseconds, relating comfortably to certain reactions in nuclear weaponry. Even briefer is the jiffy: 33 picoseconds or the time it takes light to travel 10 millimetres in a vacuum.

A jerk is a "jillion" ergs of energy or, more precisely, 10^{10} joules—roughly equivalent to 0.25 ton TNT.

A barn is a nuclear cross section, invisible to the eye, but "big as a barn" to nuclear researchers. It may be expressed in SI terms as 10^{-28} m^2.

These and other units devised here and elsewhere led to a proliferation of measurements which increasingly impeded communications between research facilities and various scientific disciplines. The fewer, simpler, and universally used SI units are their logical replacements.

Thus, the colorful units of the recent past seem destined to move out of our laboratories and into our lore.

ipulation; however, inputs and outputs have been changed to metric."

Louis Rosen, Medium Energy Physics Division (MP) leader, reports some complications: "Because our construction of LAMPF is essentially complete and because we must be responsive to many university people and their equipment requirements, MP-Division will have to accommodate equipment built with conventional parts and to present standards for a long time. However, in all new construction we will change to the SI mode."

Where divisions or departments deal with actual nuts and bolts, the changeover will of necessity take longer. Yet, it is here that the desire to make the change fast seems most intense. The feeling is to get over this "schizophrenic" existence as soon as possible and settle in on the single, simpler SI system.

Allen R. Driesner, Shop Department assistant head, reports, "The fellows in the shop are picking it up rather easily. We're now making inspections with metric tools and are recalibrating machines in the meantime. We're still stuck with Customary nuts, bolts, and fasteners, but will switch to OMFS (the U.S.-supported Optimum Metric Fasteners System) as soon as commercially available, which may be this summer. In addition, OMFS stands a good chance of being adopted internationally."

But it is in construction and maintenance, in office equipment and furniture and related items, that Customary units will linger longest. The construction business, in particular, has virtually no stake in international trade, no incentives and many problems in going metric. No one in the Engineering Department foresees an early end to calling out specs to the building trades in inches, feet, and cubic yards.

One department seems blissfully unaffected. "After all, we've been using a modern decimal system for years," says Accounting Officer Sherman B. Sweet, with a smile.

"It's called money."

Why We're Where We're At

The tides of international affairs are washing around the base of the Pajarito Plateau. One by one, the nations of the world have "gone metric" or are now doing so. The U.S. remains the only industrial nation, major or minor, that has not.

Aside from the obvious difficulties of marketing "Customary" products in "metric" countries and the added costs to U.S. industry in parallel manufacture of products to two measurements systems, there is the less publicized matter of standardization.

Nations participating in the International Organization for Standardization and the International Electrotechnical Commission have set some 2,500 standards for such items as thread specifications and "preferred numbers" for rod and wire diameters. The list may increase 10-fold in 10 years. As a nonmetric nation, the U.S. does not have the influence appropriate to its scientific/technical/industrial stature in the international give-and-take that sets such standards.

Many U.S. government or government-supported agencies and facilities (such as NASA and the Lawrence Livermore Laboratory) and industries are "going metric" on their own for practical reasons. Most observers believe the pace would quicken when, and if, the U.S. enacts legislation to create a National Metric Conversion Board coordinating conversion over a 10-year period.

At LASL

In recent years, LASL representatives have become increasingly active with various formal and ad hoc organizations concerned with metrication.

In 1968, the U.S. Congress passed a bill authorizing a metric study by the National Bureau of Standards. When it was published in 1971 under the title "A Metric America—a decision whose time had come," it gave strong impetus to the movement.

In 1972, metrication began to "surface" at LASL when NASA asked LASL to consider metricating the Rover program. LASL answered affirmatively.

The query "started wheels turning." Robert N. Thorn, TD-Division leader, suggested LASL metrication in December, 1972.

In June, 1973, Harold M. Agnew, LASL Director, appointed a Metric Committee of Richard J. Bohl, ADWP-1 (Chairman); George O. Bjarke, E-DO; Joseph B. Bourne, WX-3; Melvin G. Bowman, CMB-DO; Allen R. Driesner, SD-2; Jerry J. Koelling, ENG-7; Robert H. Masterson, ISDO; Robert K. Osborne, TD-4; Lawrence L. Rice, J-7; John C. Rowley, Q-23; Robert J. Van Gemert, SP-DO; and Walter F. Sommer, Jr.; P-11. Their mission: gather information, analyze problems, prepare recommendations.

By September 7, 1973, the Metric Committee had tabulated 117 returns from a survey made of LASL groups. Only 17 groups reported no involvement with metric units while half reported 50 per cent or more of their activities involved metric units. The Committee recommended SI conversion.

Meanwhile, the Atomic Energy Commission had initiated moves of its own to explore the subject, and queried its contractors. Agnew answered unequivocally favoring metrication for the Laboratory, the AEC, and the country, and advocated formation of a metric committee by the AEC and participation in meetings of International Standards Committees abroad.

A policy signed by Agnew and distributed in November set the stage for LASL "going metric" on a cost-effective program that began January 1.

Today, educational and training programs, posters, and various other manifestations of LASL conversion are increasingly evident.

Who knows but we may soon begin thinking in terms of walking a mere 0.5 kilometre to the cafeteria for a lunch dispensed to us by a lass of comely 914-662-914 mm proportions.

Service Pins Awarded to Over 500 LASL Employees

During January, service pins were awarded to over 500 employees. *The Atom* salutes those receiving these awards, and in this issue names those receiving pins for 20, 25, and 30 years of service. In the next issue, *The Atom* will name recipients of pins for 10 and 15 years of service.

30 Years

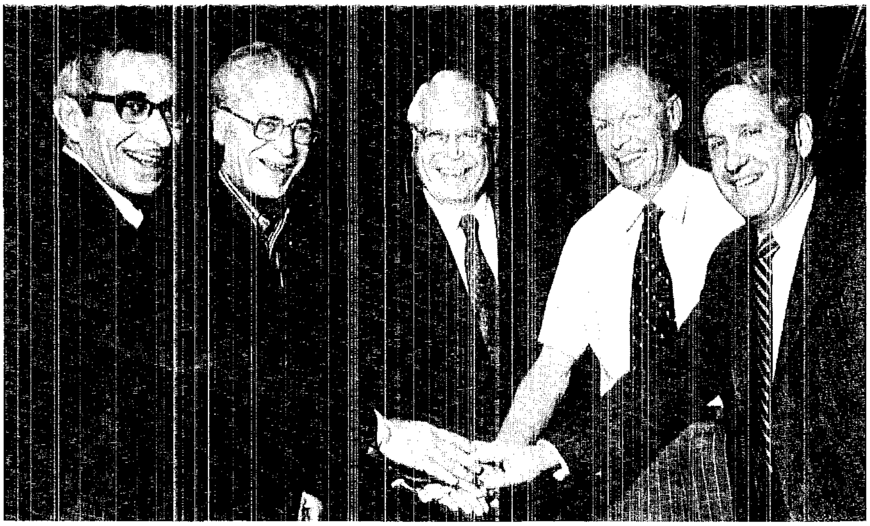
Ashley, William, CMB-1
Baker, Richard, CMB-DO
Brixner, Berlyn, M-5
Coon, James, P-4
Davis, Jean, Dir-Off
Davis, Roland, P-6
Garn, Wray, M-6
Jones, Wesley, CMB-11
Kasunic, Stephen, WX-1
Krohn, Robert, ISD-6
McKibben, Joseph, P-9
Nagy, Gaza, SD-5
Osvath, Frank, SD-1
Raies, William, AO-1
Schreiber, Raemer, Dir-Off
Sturgess, Robert, E-5
Taschek, Richard, Dir-Off
Van Buskirk, William, SD-1
Van Gemert, Robert, SP-DO
White, Roger, P-5

25 Years

Agnew, Harold, Dir-Off
Antos, Lawrence, WX-3
Armenis, Nicholas, WX-1
Bertino, James, CMB-8
Bond, William, J-8
Brousseau, Armand, Q-3
Brown, Gordon, SD-2
Clifford, John, ISD-7
Coca, Anthony, WX-2
Court, Donald, CMB-7
Cowan, George, CNC-DO
Cowan, Helen, TD-3
Deal, James, Jr., E-5
Delano, Cecil, CMB-7
Dominguez, Bernabe, WX-1
Drake, Robert, WX-DO
Dube, Marjorie, Dir-Off
Dunn, Theodore, PER-5
Enders, John, H-8
Esquibel, Maximiano, MP-8
Eyster, Eugene, WX-DO
Fresquez, Tony, SP-3
Garcia, Elias, E-1
Garcia, Eugenio, WX-3
Garcia, Tony, H-1
Gibney, Robert, CMB-8
Gray, Raymond, M-4
Heil, Bertram, ADWP-1
Holcomb, Edward, A-3
Hull, Donald, CMB-7
Johnson, Beatrice, ISD-7
LaBerge, John, M-3
Levinson, Leonard, CMB-8
Lewis, F. Burton, CNC-2
McCloud, Burt, E-2
McCreary, William, CMB-6
MacDougall, Duncan, Dir-Off
Madrid, Aurelia, WX-DO
Maestas, Ben, L-1
Martinez, Ascension, WX-3
Martinez, Jesus, SP-4
Martinez, Jose, WX-3
Martinez, Robert, MP-8
Martinez, Silas, WX-3
Martinez, Vences, WX-3
Merryman, Roy, WX-2
Montoya, Eloy, J-14
Mosley, John, WX-5
Nelson, Margaret, SP-8
Newton, Thomas, CNC-2
Nuckolls, Donald, CMB-6
Oliver, Petrita, CNC-11
Ortiz, Alfredo, WX-3
Osvath, Peter, CMB-11
Pacheco, Charles, E-2
Page, Leslie, Jr., ENG-4
Paxton, Hugh, P-5
Perry, Joseph, Jr., L-2
Petersen, Peter, SP-10
Peterson, Rolf, Dir-Off
Post, Leslie, CMB-8
Pulliam, Ludie, CMB-1
Quintana, Alfonso, WX-7
Rael, Esequiel, WX-3
Rawcliffe, Alan, Q-3
Reider, Roy, H-3
Salazar, Viola, ISD-4
Sandenaw, Thomas, CMB-8
Sass, Edward, SD-5
Scarafiotti, Domenic, Jr., CMB-8
Schulte, Harry, H-5
Schulte, John, CMB-14
Sena, Arthur, CMB-11
Smith, Alex, SD-5
Stallings, James, WX-3
Sydoriak, Stephen, Q-26
Tafoya, Carolyn, WX-7
Tallmadge, Francis, P-DO
Tapia, Edward, SP-4
Taylor, Joseph, CMB-6
Thomas, Paulus, SD-3
Tometich, Adela, SP-3
Valdez, Daniel, E-2
Vogt, Glenn, ENG-4
Wahlen, John, ENG-2
Ward, Carter, CMB-1
West, Clarence, WX-3
Wood, William, Q-DO
Zeltmann, Alfred, CNC-2

20 Years

Alarid, Frank, SP-3
Anderson, Richard, J-10
Archuleta, Rudy, WX-1
Baca, Bert, CMB-1
Ballance, Harry, WX-3
Bayhurst, Barbara, CNC-11
Beckett, Ruth, Dir-Off
Bergstein, Ivan, AO-2



On hand to award service pins to 20-, 25-, and 30-year veterans on Jan. 23 was John Perkins, vice president of the University of California (center). He is flanked by Richard F. Taschek and Raemer E. Schreiber (left) and Duncan P. MacDougall and Harold M. Agnew (right), all DIR-OFF.

Bergstein, Joe, MP-2
Bivins, Robert, C-4
Blackledge, Virginia, AO-1
Bolton, Vernon, CMB-7
Bond, Victor, A-3
Braun, William, SD-5
Bronson, John, Q-26
Brophy, James, SD-5
Browne, Nancy, P-3
Campbell, Charles, P-5
Campbell, Evan, H-5
Chamberlin, Donald, SD-DO
Cole, George, WX-1
Cooper, Thomas, L-1
Corn, Doris, WX-7
Cramer, Joe Wanda, WX-1
Dade, Avis, SP-DO
Damiano, Fortunato, CMB-7
Dannewitz, Robert, WX-1
Davey, Richard, WX-2
Davidson, Keith, CMB-6
Diaz, Bon, SD-1
Dickinson, James, CMB-6
Dummer, Jerome, Jr., H-1
Duran, Edward, SD-5
Edwards, Paul, MP-DO
Farley, Burton, SD-5
Farley, Florence, ISD-5
Ferrell, Robert, WX-1
Finley, Jim, WX-1
Fisher, Billy, WX-7
Ford, Mary Ann, Dir-Off
Gallegos, Buddy, SP-3
Garcia, Angie, ENG-DO
Garcia, Fidel, ISD-6
Glass, James, CMB-6
Gould, Thomas, M-4
Graves, Glen, Dir-Off
Griffith, Virginia, ISD-4
Guenther, Aloys, SP-2
Guthrie, Lupe, SP-10
Haley, Lucille, SP-4
Hall, Georgia, E-2
Harlow, Francis, Jr., T-3
Harris, Fay, ISD-7
Hatch, Walter, E-3
Hayes, Bernard, M-3
Henry, Earl, SD-1
Hockett, John, WX-5
Hoffman, Darleane, CNC-11
Hohner, Darrel, ENG-4
Howenstine, Marianna, PER-1
Hoyt, Harry, ADWP
Jarmie, Nelson, P-DOR
Johnson, Raymond, SD-1
Jordan, Harry, Jr., H-DO
Jordan, Thomas, C-3
Kazmier, Philip, SD-1
Kennedy, Robert, J-7
Killoran, Bernard, L-3
Koetter, Amil, CMB-5
Kressin, Ivan, H-5
Lang, Robert, E-5
Lee, Clarence, TD-1
Lewis, Homer, CMB-11
Liberman, David, T-4
Lopez, Margarito, SD-1
Lujan, Augustine, WX-3
Lujan, Jose, WX-3
McCracken, Flora, DIR-FMO
McHale, John, Jr., T-9
Maes, Antonio, AO-1
Martinez, Juan, SD-1
Martinez, Rubel, J-10
Melton, Barbara, J-15
Mills, Carroll, T-6
Mitchell, Dean, WX-3
Montgomery, Donald, ENG-9
Montoya, Arthur, PER-4
Moore, Roger, C-5
Moss, William, H-5
O'Keefe, Josephine, J-16
Orr, Robert, TD-2
Ortiz, Joseph, SP-3
Peck, Mabel, AO-2
Ranken, William, Q-25
Riebe, Bruce, H-1
Rivera, Manuel, AO-3
Robinson, James, SD-5
Rogers, Raymond, WX-2
Romero, Daniel, SD-1
Rowen, Jerome, CMB-6
Roybal, Maria, WX-7
Roybal, Tony, ENG-2
Salazar, Clara, J-DO
Salazar, Johnnie, SP-2
Saunders, Roy, J-9
Serrano, Eulogio, SD-3
Smith, Dorothy, P-4
Southard, Marcella, SP-3
Spalding, John, H-4
Staake, Harold, Q-23
Stein, Edgar, ADWP-1
Stewart, Fred, M-1
Struebing, Neville, ENG-3
Tapia, Joseph, WX-3
Thorn, Robert, TD-DO
Thorpe, Leona, PER-1
Van Etten, LaMoine, AO-5
Vucenic, Joseph, SD-5
Weinbrecht, John, L-1
Welch, Franklin, AO-7
Wells, Mark, C-10
White, Ralph, CMB-8
Whittemore, Alta, E-2
Wilkerson, Lloyd, ENG-6
Williams, George, M-6
Williamson, Ralph, TD-2
Wilson, Robert, WX-5
Wimett, Thomas, P-5
Winchell, Donald, WX-3
Zeigler, Keith, C-5

10 

years ago in los alamos

Culled from the January and February, 1964 files
of The Atom and the Los Alamos Monitor by Robert Y. Porton

UHTREX—May lead to reduced power cost

It is safe to bet that the nation's nuclear power firms, always looking for a way to reduce their costs, are keeping an eye on UHTREX. LASL's Ultra High Temperature Reactor Experiment is one of the major efforts in the Laboratory's civilian reactor program which is aimed at new developments permitting significant reductions in the cost of nuclear power. Installation of the reactor will begin following AEC acceptance of the building.

Campers get a place in the sun

In the very near future all camping at Bandelier National Monument will have been moved from Frijoles Creek to the top of Frijoles Mesa, just south of Highway 4. Access is by a new road turning west a little short of the fire lookout tower. Part of the old camping and picnic area will be converted to picknicking with adjacent parking. The rest will be allowed to revert to nature, with some marked trails in addition to the main trail up and down the canyon.

Hill humor

The Episcopalian minister just couldn't figure it out. Every time he turned away from the altar during the wedding of Alice Johnson of Hobbs and Chris Anderson of Los Alamos, he heard muffled laughter from people in the congregation. It wasn't until after the lovely, dignified service had ended that he found out why. As the bridegroom knelt he exposed his shoe soles, carefully lettered by his "friends" before the ceremony. One was "H-E." "L.P." was on the other.

"Smasher" to arrive

LASL will become the best equipped, low energy particle physics laboratory in the world for some time to come, with the installation of a new Van de Graaff accelerator, according to Richard L. Henkel, Laboratory physicist in charge of the project. The new tandem unit will be installed in conjunction with the present vertical Van de Graaff.

Homeowners blast plans

Strong objections were voiced to the location of the mobile home subdivision and light industrial area on North Mesa by many of the 150 persons attending a Barranca Mesa Homeowners Association meeting Tuesday evening. Many of the residents expressed views that North Mesa should be left strictly for residential development. Many thought it was a logical site for low-cost housing.

"J. J. Gutierrez, Please"

Manhattan Project veterans felt more than a little nostalgia at the sudden passing of John J. Gutierrez, 75, at his home in Santa Fe on January 8.

As Mrs. Bernice Brode, a chronicler of those wartime days, wrote in her *Tales of Los Alamos,* "It was well understood in inner circles that the three top people running the project were General Leslie Groves, J. Robert Oppenheimer, and J. J. Gutierrez."

Old-timers will recall the loudspeakers in T Building crackling with announcements, official and otherwise. They say the most frequent call was, "J. J. Gutierrez, please. We have a problem in T Building. J. J. Gutierrez, please."

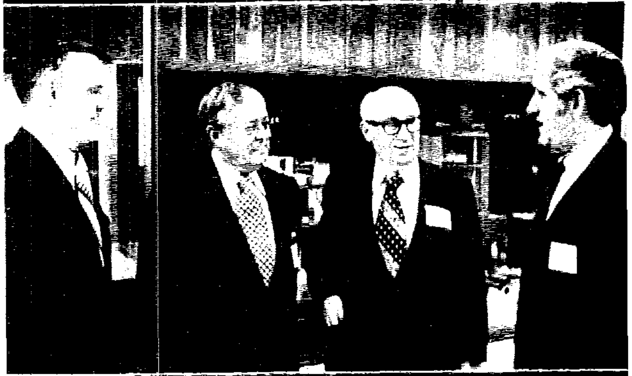
And Gutierrez, as the head superintendent, always answered, whether it was to coax a balky coal furnace into emitting heat as well as soot or persuading a reluctant door to open and close again. The nature of wartime construction being what it was, it is no wonder that Gutierrez' magic touch and cheerful willingness is so fondly remembered.

From 1947 until his retirement in 1965, Gutierrez was involved in maintenance management for the Zia Company.

Among Our Guests

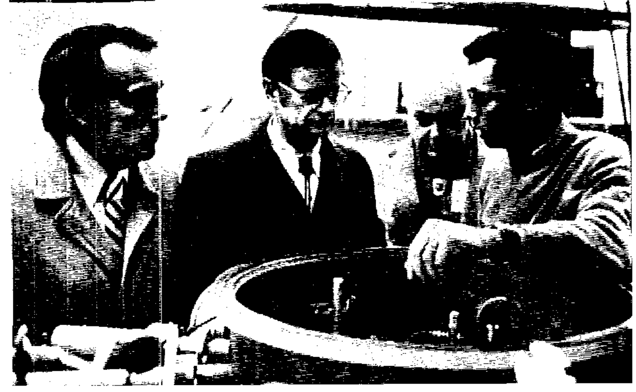
To begin what is hoped will become a regular scientific interaction between the U.S.A. and Mexico, six top-level Mexican scientists visited LASL during January. Group here learns about Scyllac from George A. Sawyer, Group Q-3 leader (without jacket).

To speak on "Military Realities in the Postwar Era" at a colloquium, Major General Jeanne M. Holm, highest ranking U.S. Air Force woman, visited LASL on Jan. 22. By pleasant coincidence, General Holm (left center), joined her brother, Dale M. Holm, H-6 group leader (right center) in a meeting with Edward R. Laymen (left) and Charles R. Canfield (right), both PER-DO.



To attend orientation briefings, (left to right) Major General Ernest Graves, USA, assistant general manager of the AEC Division of Military Application, U.S. Senator Joseph M. Montoya, New Mexico, member of the Joint Congressional Committee on Atomic Energy, and U.S. Congressman Melvin Price, Illinois, chairman of the Joint Congressional Committee on Atomic Energy, came to LASL in January. Here they confer with Harold M. Agnew, Director.

To attend briefings, Brigadier General Albion W. Knight, USA (Ret.), technical consultant to the Joint Congressional Committee on Atomic Energy (right center) and Congressman Orval Hansen, Idaho, (right) visited LASL in January. Here they meet with Harold M. Agnew, Director, (left) and Robert H. Gattis, ADWP-1, (left center).



To inspect laser-fusion and isotope separation activities, (left to right) Larry Killion of the Division of Military Application of the AEC and F. C. Gilbert, DMA deputy head, visit with Keith Boyer, L-Division leader, and Damon Giovanelli, L-4, during January.

MØTZ HENRY THØMAS
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As thermostats go down, ingenuity goes up. Ruth Watkins, FMO secretary, neatly solves the problem of how to keep her fingers free for typing while keeping her hands warm by wearing gloves without fingers.

In November, curtailed heating and other conservation measures reduced Los Alamos Scientific Laboratory's usage of electric power by 4 per cent and of natural gas by 11 per cent compared to the same month a year ago.