

Energy Secretary Watkins Speaks to Sandians

Following are excerpts from an address by Secretary of Energy James Watkins during his Feb. 15 visit to Sandia.

Employees who could not attend the colloquium and who wish to see and hear it in full should view a videotape, available from the Technical Library. To check out a tape, call extension 5-8195 or 5-8287. One copy of the tape will remain in the library to be viewed there.

I've read about Sandia for 45 years. I've been excited about the science, excited about the people whom I've met over the years. Coming up through the scientific route myself, having been educated at Oak Ridge in my graduate work, I have a special sensitivity to the Laboratories' importance to the nation as a whole.

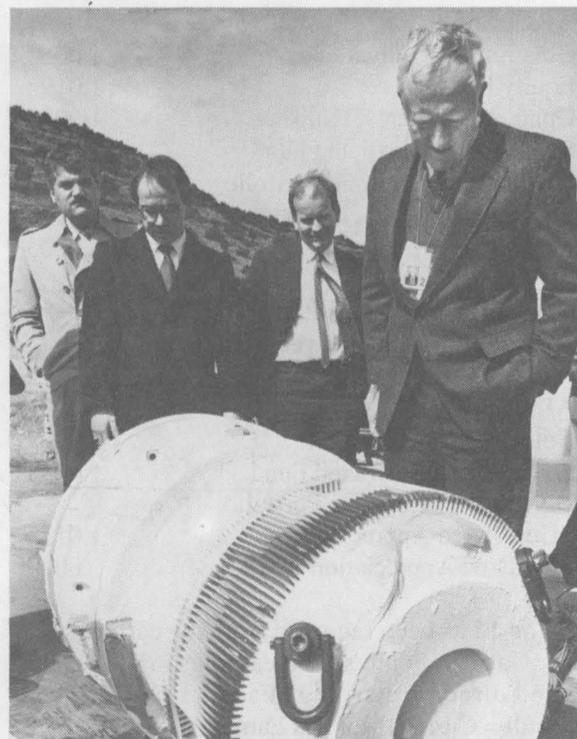
The first point I'd like to make, because I think it's the most salient point that I can leave with you, is that this Laboratory [and] its counterparts — not only the other two weapon laboratories, but our entire national laboratory system — are the crown jewels in the nation's potential for the future to lead the free world and to accomplish incredible objectives for the benefit of mankind.

And isn't it ironic that this comes out of the birth of the Manhattan Project, which was a project to end World War II with a nuclear bomb, which we've been talking about now for 50 years. . . . I see today at Sandia — as I did yesterday at Los Alamos, as I did a few weeks ago with the President at Lawrence Livermore — the exciting technical spin-offs that come out of this kind of laboratory for the good of mankind.

Much More Than Weapons

Here [at the weapon labs] is a body of some of the greatest minds, certainly in our nation, if not the world, who, when given a task to do something for the nation, do it well, do it competently, do it on time, do it with cost-effectiveness in their minds, and do it with the idea that somewhere inside that technology there'll be spin-offs for the betterment of mankind. Besides weapon development, look at what you're into:

- Hazardous nuclear- and chemical-waste management: probably one of the most important



ADMIRAL BRUCE DeMARS (right), DOE Deputy Assistant Secretary for Naval Reactors, examines a scale model of a Naval Reactor M-140 Spent-Fuel Cask after a drop test at the cable site at Coyote Test Field. Also checking the cask are (from left) Carl Rogers and Don Krawiec — Bettis Atomic Power Labs, designers of the cask — and Barry Miles of DOE's Office of Naval Reactors. During the Feb. 13 visit, Admiral DeMars was also briefed about Sandia's work in nuclear weapons for the Navy, intelligence, and advanced submarine technology.

growth industries in the United States today, and not only in the United States, but in the world. If you think we have environmental problems in this nation — which is one of the cleanest nations in the world, one of the most sensitive to the envi-

ronment — you need to go to the impoverished eastern-bloc nations like Poland, and see what has been done to devastate their environment, and how much we can do to bring our technologies to
(Continued on Page Four)



AFTER COLLOQUIUM TALK in the TTC, Secretary of Energy James Watkins gets ready to answer reporters' questions at a press conference. Sandia President Al Narath (right) introduces Watkins and members of New Mexico's congressional delegation: (from left) Rep. Steve Schiff, Sen. Jeff Bingaman, Secretary Watkins, and Sen. Pete Domenici.

Labs Accomplishments for FY89: See Middle Section



LAB NEWS

VOL. 42, NO. 4 SANDIA NATIONAL LABORATORIES FEBRUARY 23, 1990

Innovative Physicist Sets the Standard For Weapons and Materials Testing

When Lynn Barker (DMTS, 1534) first came to Sandia in 1955, it wasn't long before he began tackling the problem of how target materials behave when hit by projectiles.

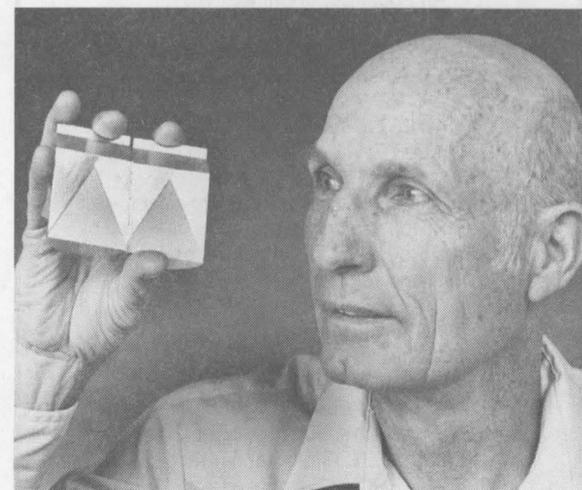
State-of-the-art technology at the time — developed at Los Alamos in the 1940s — involved planting tiny, electrically charged pins behind a target that shorted out one by one during impact.

The precise time when each pin shorted out, together with the distance the projectile moved, gave an indirect measurement of its velocity. The velocity, in turn, could be used in an equation to determine the shock compression of the target material.

However, the pins didn't provide a continuous account of the target's speed at each moment during impact. A more detailed picture of the shock wave during impact became possible when Lynn suggested using a slanted wire resistor instead of unconnected pins. Each point on the wire would burn out in progression as the target was impacted, providing a smoother, more continuous tracking of the impact.

The slanted wire was the first of many innova-

tions by the 61-year-old physicist, who retires March 1, ending a 27-year Sandia career. Jim Asay, manager of Solid Dynamics Dept. 1530,
(Continued on Page Six)



A SAMPLE of aluminum, cut in half, demonstrates how Lynn's Fractometer machine works — it applies a load to a material, cracks it open, and takes measurements during the process.

This & That

What Happened? — Here's your chance to find out. This issue contains our annual Labs Accomplishments supplement, summarizing 118 Sandia FY89 accomplishments (selected by the VPs). The eight-page supplement is inserted in the middle of the paper. Sandia doesn't issue a formal annual report, but this is probably the closest thing. It's a way to keep in touch with what's going on across the Labs, and — tucked away at home where you can find it — can come in mighty handy when Uncle Fred drops by on his vacation and asks what "that Sandia place" does.

Assistant Editor Phyllis Wilson put in lots of hours coordinating this project. Thanks to her, to all Sandians who submitted accomplishments (even if they didn't make the cut), and to everyone who reviewed the copy.

The "State-of-the-Labs" supplement — in previous years sometimes published along with Labs Accomplishments — will be published separately (probably April 6). That supplement features in-depth interviews with the Sandia President and Executive VPs.

* * *

A Preview of the Interviews — We've already done some talking to Al Narath and, for those concerned about the road ahead, here's one thing he had to say: "I don't have any tremendous concern about future budgets if we're successful in streamlining our operations and realizing the increased efficiencies that we're looking for. At the same time, we're mindful of shifting national priorities and, as a result, we've pushed into some new areas. . . . We're doing these things not so much for fear that our budget would suffer great calamities in the near term, but simply responding to changing needs, national needs."

* * *

Thirty Years — The Hard Way — Senior Fellow Gus Simmons (National Security Studies 200) has had his pretty face pictured in the LAB NEWS many times, but never on the Milepost page, he says. After 30 years of Sandia service, Gus finally makes it this issue. He accumulated his 30 the hard way and thinks he may have the record for the number of times to join/rejoin the Labs. He hired on four different times — first in '54 and again in '58, '64, and '71. He left several times to work on advanced degrees.

* * *

Outwimped — Sorry, Karen Shane (3551), but the Benson Bunnies don't qualify as the wimpiest school mascot. Sandia newcomer Roger Plowman (temporarily 3538, 7222 when cleared) graduated from Hickman High in Columbia, Mo., known as the Hickman Kewpies — after the cute, cuddly kewpie doll. What's worse, says Roger, is that opposing schools took severe liberties and often called them the Hickman "Cow Pies."

Sam Cancilla (2854) graduated from a Pennsylvania school nicknamed the Flying Dutchmen. He says the name was especially appropriate for the football team (the "Flying Dutchman" was a ghost ship). Sam says, "Our team often played so poorly, it was as if the other team didn't even know we were there." Sheri Martinez (1846) says her dad, Don MacKenzie (1554), graduated from Freeport (Ill.) High, known as the Pretzels (also known for folding?). There's more, but they'll have to wait for another issue. Those "Fighting Sand Crabs" are from Calhoun High, a consolidated school in Port Lavaca, Tex. And the school's even located on Sand Crab Blvd. Transplanted Texan Ace Etheridge (3161) clawed up that info. ●LP

Out With the Old, In With the New

Tons of Phone Books Recycled

In a program coordinated by Property Management and Accountability Div. 3412, Sandia recently recycled more than 37 tons of last year's telephone directories. At a rough estimate (nobody counted precisely), that's more than 10,000 sets of yellow and white pages.

Don Schubeck (3412) searched several weeks for a recycler willing to accept the directories — most don't want them. Just as new phone books began to arrive at Sandia, Don located a company that would take the old ones.

Frank Comiskey (3412) then became coordinator of the effort. Frank arranged for Transportation Services Div. 3423 to put collection boxes at strategic locations. Judy Hubbard, supervisor of Mail Services 3154-4, spread the news of the program to secretaries.

With the help of Phil Vouterin (Custodial Services Div. 3426) and the custodians — who picked up many directories left in halls — the recycling efforts were successful. When the collection was completed in mid-January, Jim Davis reported that his group, Transportation Sec. 3423-1, had picked up 75,000 pounds of directories and delivered them to the recycler. ●

Sympathy

To Phil Stanton (DMTS, 2514) on the death of his father in Dallas, Feb. 7.

To Lee Walton (2635) and Walt Vandevender (2635) on the death of her mother and his mother-in-law in Albuquerque, Feb. 12.

To G. C. Hollowwa (3411) on the death of his mother in Texas, Feb. 12.

To Jackie Hines (9334) on the death of her mother in Albuquerque, Feb. 12.

Earnings Factors November 1989

Savings Plan for Salaried Employees (SPSE)	Earnings Factors
AT&T Shares	.9893
Government Obligations	1.0068
Equity Portfolio	1.0196
Guaranteed Interest Fund	1.0070
South Africa Restricted Fund	1.0073
Diversified Telephone Portfolio	
Unrealized Appreciation	1.0120
Realized Appreciation	.0000*

Savings and Security Plan — Non-Salaried Employees (SSP)

AT&T Shares	.9892
Guaranteed Interest Fund	1.0071
South Africa Restricted Fund	1.0088
Diversified Telephone Portfolio	
Unrealized Appreciation	1.0123
Realized Appreciation	.0000*

* The 1 has been removed from the earnings factor. Current month's DTP earnings may be calculated directly: Earnings Factor x DTP Current Worth = Current Month's Earnings.

1990 GIF Rates Announced

Estimated annual earnings rates for the Guaranteed Interest Funds in the AT&T Savings Plan for Salaried Employees (SPSE) and the AT&T Savings and Security Plan (SSP) were recently announced. Effective Jan. 1, the estimated rates for 1990:

- SPSE 9.0 percent
- SSP 8.8 percent

LAB NEWS

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Welcome

Albuquerque — Gustavo Arellano (3215), Carl Axness (2147), James Hilts (131), Glenn Jensen (9211), Albert Lucero (3716), Roger Plowman (7222), Gladys Powell (22-2), Ernest Vinsant (7554), Nicholas Winowich (7851), Whitney Wolf (7252); **Other New Mexico** — Susan Bourcier (6454), Richard Gido (6429), Sally Kalemba (7213), Glen McCoy (9325), Rick Ramirez (7844), Karen Rogers (2625), Adam Slavin (1524), Larry Young (7251).

Elsewhere: **California** — Kent Budge (1531), Elizabeth Moser (3141), Timothy Petersen (7851), Phillip Volland (3734), John Weed (7471); **Nebraska** — Leslie Krumel (2545), Brenda Perk (5175); **Nevada** — Bernard Gomez (9127); **Pennsylvania** — Joseph Michael (1822); **Texas** — Jeffrey Chou (2311), Joel Turner (7264); **Utah** — Eric Lindgren (6416).



New Laser-Based Diagnostic May Be Important Research Tool

Researchers at Sandia, Livermore's, Combustion Research Facility (CRF) are developing a new laser-based combustion diagnostic for revealing the complex chemistry of combustion processes.

Called degenerate four-wave mixing, the process has been shown to produce detailed, two-dimensional images of the distributions of key molecules formed during combustion. By creating such realistic "snapshots" in just a few billionths of a second, the technique may become an important research tool.

David Rakestraw (8362) and visiting scientist Thomas Dreier of the University of Heidelberg are part of a team of CRF researchers exploring the possibilities of the new technique.

Potential industrial applications for four-wave mixing appear to be widespread. One application that David and Thomas are working on is understanding the chemistry of engine knock, a phenomenon that occurs when gasoline in an engine's combustion chamber explodes prematurely due to extremely fast chain reactions, generating pressure oscillations that are damaging to the engine as well as to fuel efficiency. Using four-wave mixing could accelerate the discovery of new fuel blends and additives to reduce engine knock.



**SANDIA
LIVERMORE NEWS**

David notes that four-wave mixing should also prove useful for measuring the emissions from combustion. But the technique's usefulness is likely to go beyond the world of combustion; Sandia has already received an inquiry from a medical instrumentation company that is interested in using the technique to measure low concentrations of biological molecules.

Four Laser Beams

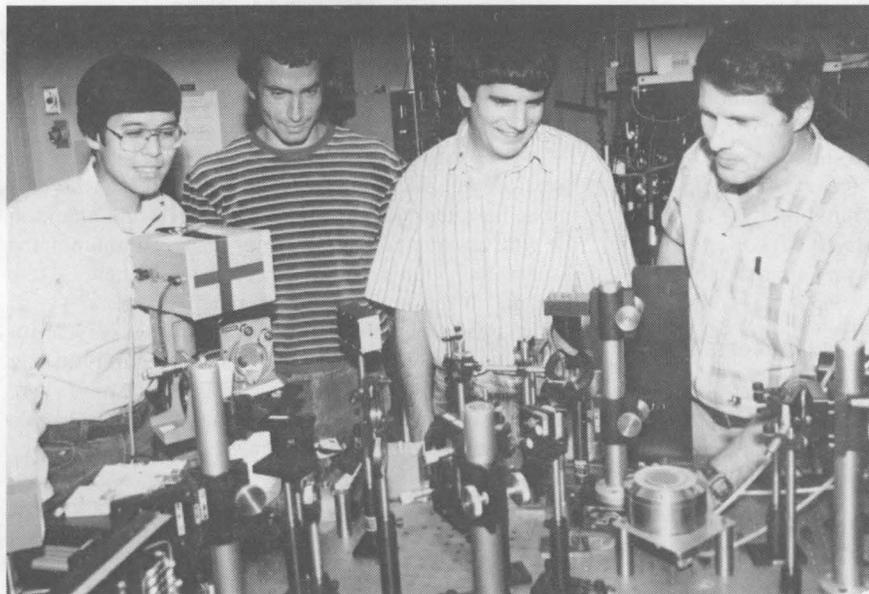
The technique requires the convergence of three coherent laser beams, which are created by splitting a single beam emitted by a standard, commercially available laser. A fourth coherent beam is then generated from the interaction of the three laser beams in the medium. The frequency-dependent generation of this beam supplies important data about key molecules under investigation — data that's easily analyzed and interpreted.

"The technique appears to be well suited for measuring the concentrations and temperatures of molecules such as nitrous oxide and others that are important in combustion chemistry," says David. "Investigating these molecules can be a tough task because of their relatively small numbers, as well as the hostile environments of most combustion processes."

Such environments — with high temperatures, pressures, and turbulence — can readily damage mechanical probes. Further, inserting probes tends to perturb the environment under study. "Combustion is a dynamic process," David explains, "with many physical and chemical processes occurring simultaneously. Placing anything in the environment changes those dynamics."

For these reasons, researchers use nonintrusive laser diagnostics to investigate the chemistry and physics of combustion. One standard technique is called CARS (coherent anti-Stokes Raman scattering), which is typically used to measure temperatures and concentrations of molecules present in large numbers. However, measurements using CARS are very difficult when molecules are present in low concentrations.

Another laser diagnostic method, called LIF (Laser-Induced Fluorescence), permits the measurement of minor species. However, because of its incoherent nature (the signals are not direc-



LOOKING OVER LASER DIAGNOSTICS EQUIPMENT used in their four-wave mixing experiments are (from left) Roger Farrow (DMTS, 8354), Thomas Dreier (University of Heidelberg), David Rakestraw (8362), and Larry Rahn (DMTS, 8354).

tional), LIF is often difficult to use in engines and other combustion vessels.

Combining CARS and LIF

David says scientists have needed a laser diagnostic technique that combines the strong coherent signal qualities of CARS with the measuring sensitivity of LIF. Degenerate four-wave mixing is an important step toward that goal. A group at Sandia led by Larry Rahn (DMTS) and Rick Trebino (both 8354) has also used the technique to investigate the structure of atomic gases.

The process was first used as a combustion diagnostic a few years ago by a group at Oxford University, which reported detecting OH molecules in a flame. Intrigued by the Oxford report, David and

Industrial applications range from determining the causes of engine knock to measuring tiny concentrations of biological molecules.

Thomas began to test the new process with the hope of using it in Sandia's internal-combustion-engine research. Using the technique, they obtained extremely strong signals on OH and NH in atmospheric flames. Subsequent joint experiments with Larry Thorne (8350) using a low-pressure flame demonstrated high sensitivity at much reduced molecular concentrations.

"We can actually see these signals propagating as a laser beam," says David. "Unlike with CARS, which requires focusing of high-intensity laser beams, we are able to use unfocused laser beams of only moderate intensity. That's a very desirable property, because you don't want to perturb the environment by introducing large amounts of laser energy."

The two found that the strength of the signal

was proportional to the square of the population of molecules they were measuring. And instead of having to do complicated mathematical analyses normally required with many techniques, they were able to use a spreadsheet software program on a personal computer to get the final result.

"It was very exciting to make measurements like this with very large signal intensities and to be able to interpret the signals so easily," David says.

The researchers then obtained temperatures by measuring the rotational-state populations of the molecules under investigation. Molecules have different energy states that correspond to their speeds of rotation, David notes. By comparing the number of molecules rotating very fast with those rotating very slowly, their total energy — and, thus, their temperature — can be measured.

Two-Dimensional Measurements

Together with Roger Farrow (DMTS, 8354), the researchers went one step further and obtained two-dimensional measurements of OH molecules.

"We wanted to know the distribution of this molecule in a region of interest," David says. To do that, they produced "sheets" of laser light to cut out a two-dimensional profile. The interaction of the OH molecule and the laser sheets produced an outgoing coherent beam containing the two-dimensional information. This beam was reflected onto a

(Continued on Page Nine)

Take Note

President George Bush's 15-minute address to Lawrence Livermore National Laboratory employees on Feb. 7 was beamed to Sandia, Livermore, on closed-circuit TV. Livermore Sandians filled the Bldg. 906 auditorium to watch the speech. The President, accompanied by Secretary of Energy James Watkins and other Washington officials, also toured some LLNL facilities.



MARKING BLACK HISTORY MONTH, students from McClymonds High School in Oakland visited Sandia's Combustion Research Facility. Here, Reggie Mitchell (DMTS, 8361, at center) points out some of the equipment he uses in his coal combustion lab.

(Continued from Page One)

Watkins' Talk

bear to them and to other emerging third-world nations.

- Nuclear non-proliferation: becoming more and more important all the time, and I saw today, in the laboratory tours, the technologies applied to that, which are significant. And the spin-offs from those technologies have applicability in the private sector in many ways.

- Verification and control: Verification practices lead to initiatives that can be transferred to the private sector [and are] vital for other national interest items, such as security — security out at the local department store, for example: amazing things that are available to the American people, born out of a weapons laboratory.

US Competitiveness a Labs Concern

- Economic competitiveness of US industry: This is probably the most important of the issues that these laboratories must face over the next ten years. We're putting \$71 billion [proposed] into research in FY91 in the federal government.

A good portion of those dollars comes into our national laboratories. A good portion of that comes here. About \$1.2 billion comes into Sandia out of that to pay for the incredible work that's going on here. But today as we wandered through the variety of activities in which you're involved, we were always told, "See what this applicability is to the private sector."



The transfer of technology to our own commercial sector, before it moves offshore — only to cause us a trade deficit and other problems in the nation — is absolutely critical to the survival of this nation and its continued leadership in the world. This is at the heart of what's called "competitiveness." And you have the keys to that kingdom right here in this Laboratory.

Fortunately, you're good enough at your work to see that, and to move it expeditiously, and to establish a whole new process structure to ensure that this isn't just happenstance. This is a matter of priority. We want to move [technology] — and move it expeditiously — into the private sector to gain the revenues we need to continue research work here at Sandia to do even more. And that's where the dollars are going to come from: from our own ability to move and sell these incredible products of your basic research before they're sold back to us. We have evidence even in the Laboratory here of your technologies now being sold back to us — in terms of products from offshore. And we should take a certain amount of umbrage to that and recognize that if we can flip that around, we have a real winner for the nation.

- Illegal drugs, terrorism, and crime: Who would have thought that a weapons laboratory would have the technologies to deal with that issue, and that the nation's drug leader, Bill Bennett, my colleague back in the Cabinet, would come out here and find some of the most impressive technologies that are available to him in his work? [Bennett visited Sandia last November 29.]

One of the most exciting things I heard today was

... about the educational programs that now are going to be a matter of mission and task and goal at Sandia. We have more to do, and I hope you'll all be a major part of that. We have to pick up our society by its bootstraps and find a new mechanism to obtain scientific and math literacy of the nation. [Nearly everything] we do today in the private sector is ... surrounded by the most sophisticated technologies — whether it's at a fast-food vending place, or whether it's at this Laboratory. We simply have to know a lot more than we do to assess the risks that are going to be there as technology "explodes."

As I mentioned yesterday in response to one of the questions at Los Alamos, we had a recent case where, at one of the sites at Hanford, we allegedly had uranium in the wild asparagus. The headlines read, "Uranium in the Asparagus." That's the bad news. The good news — the next day, after the hysteria had reached a peak — was that you had to eat 5000 tons of that asparagus a year for 50 years to get the equivalent of one [radiation] dose at Aspen, Colorado, for one day of skiing. So somewhere we've lost the ability to inculcate into our young people enough science and enough knowledge of mathematics to be able to assess the risks in their lives, on their own. And they don't need to listen to those who would hype them up to some frenzy that is totally unjustified. ...

Perspective Needed

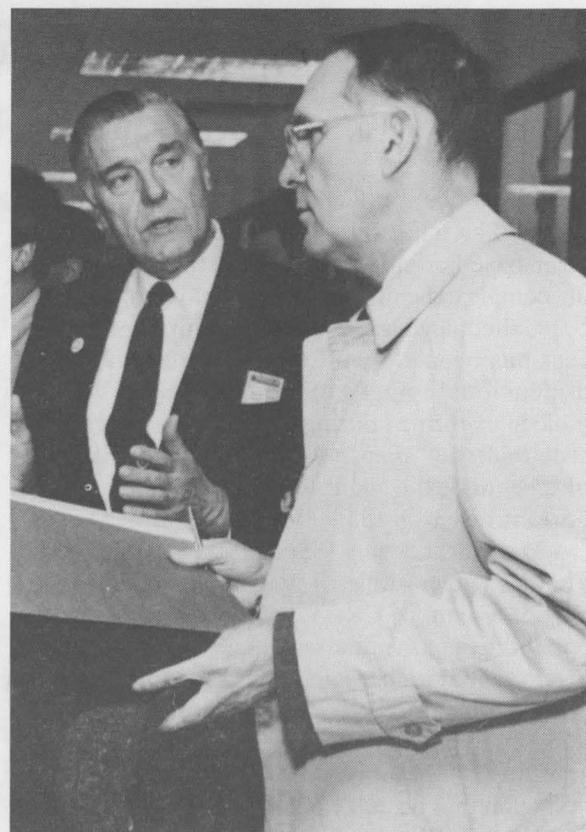
Somehow we have to place into perspective what risks are all about in life — what risks we're willing to accept and what risks we're not willing to accept — on the basis of sound science. So I see this as an opportunity again for the laboratories to reach out in this educational program, and help us bring our youngsters into adult life knowing a little bit about space, a little bit about nuclear energy, a little bit about technologies to clean up our environment, a little bit about defense issues, so we can put a program like SDI into perspective.

The spin-offs coming out of SDI in virtually every single area I mentioned today are some of the most impressive for the long-range good of our global society. Yet it always receives recrimination from those who think it is nuclear weapons exploding in space. They have no idea what's involved in defense versus offense, in weaning ourselves away from mutually assured destruction. We had to accept it for a period of time, but we don't have to accept it in the future, because of the work that you're doing here at Sandia and that's going on at the other laboratories.

So these are the kinds of things that bring to mind the human potential which is as critical a Lab objective as the research itself. [We have to pay attention to human potential] if we assume that the future researchers are going to be there for space, going to our space station, going to a pad on the moon, then to Mars, doing all the things we're going to do in setting up an entire defense network that will outlaw war in the future as a useful political tool. To do the things in medical research so necessary to cure some of the world's ills — we can't just look behind us on that, we've got to look forward to the next mutants that are going to come around the bend, which will be every bit as devastating as the AIDS virus. We've got to look at all these things in new ways, recognizing that we have the power in the minds right in this room and here at this laboratory to do something about it.

Success in Face of Scorn

Never have we given the Labs an assignment they have not carried out, and carried out well, even when some have said "it ain't going to work" — "why are you trying it, it's impossible?" — "doesn't meet the basic



OBSERVING CLEAN ROOMS in the Microelectronics Development Lab, Secretary Watkins and Glen Cheney, Vice President for Component Development 2000, discuss Sandia's work in semiconductors.

physics." The next thing you know, Sandia produces it, and there it is, doing the job. I don't know where those people [the skeptics] are when we prove a concept like that and deliver. I never hear them coming back and writing an article saying, "I'm sorry that I wasn't there helping you with your idea, rather than trying to cut you off early before you had a chance to bring your mind to bear on something."

As we move away from nuclear weapons in the numbers that we have had in the past to something lower — and we will, no question about it, [because] the world wants it, the Soviet Union wants it, we want it — we're going to do it right. The reason we're going to do it right is [largely] because of the work you're doing here in giving us the tools we need to deal with such things as threshold test ban treaties or peaceful-use-of-nuclear-energy treaties. All the things we have to deal with, you can give us answers of how far and fast we can go.

For the good of mankind as a whole, we're going to use our laboratories as a continuing national treasure ... to stay stable in their intellectual potential. We'll feed programs in as necessary to meet the needs of the nation to keep the laboratories stable. That makes us somewhat untethered to nuclear weaponry alone.

Transition to Safer World

And yet, having said that, I want to also emphasize that nuclear weapon research and continued work is absolutely critical during this period of transition to a safer world — to a defensive world instead of an offensive world, to a better world for all of us. And you here can do that and have done that. So you should take great pride in being one of the keystones to the events going on in Eastern Europe today and in the Soviet Union. I think too often we overlook the fact that we "won." We won, probably, with our continued and sustained resolve. We had the strategic deterrent solidly in hand because of the scientific excellence that these labs have brought to bear.

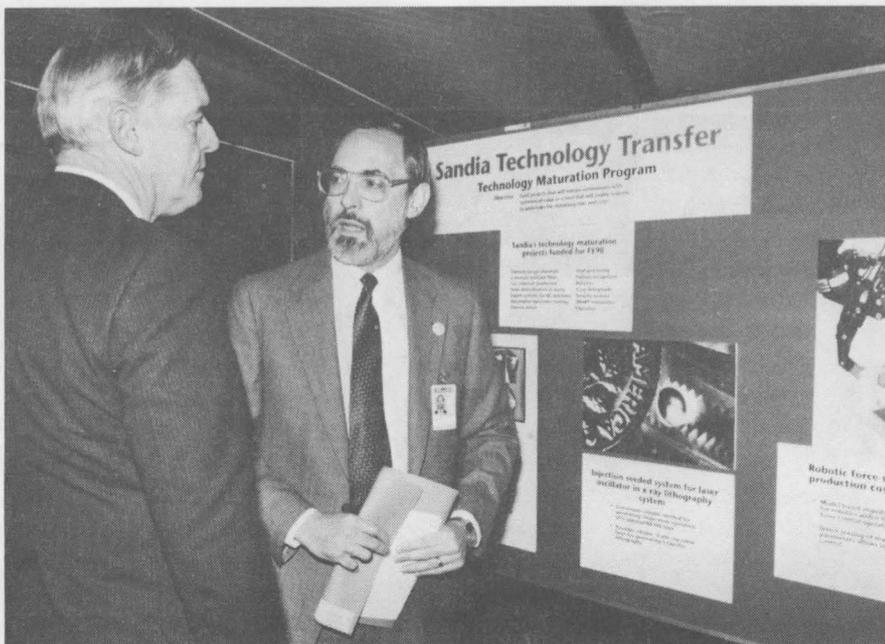
We've done it responsibly, we've done it with great safety consciousness, and we've done it with the idea that we can do it better than the other person, which means that the first strike won't ever take place — they [our potential adversaries] know it, and we know it. And now we've hung onto that long enough that the "peace through strength" concept has carried the day. You should take great pride here in this Laboratory and raise the victory flag because you've done it. Therefore, to wean ourselves away from offensive nuclear weapons should be of great pride to us, not a concern that somehow we're not sure about the future of the Labs.

'Your Lab Is Solid'

I guarantee you that this Lab is as solid as it ever was, and it'll get more so as we capitalize on this \$71 billion of research and the part you receive here. If we don't have the threat of World War III — which we do not —

(Continued on Next Page)

GERRY YONAS, Director of Laboratory Development 400, briefs Secretary Watkins on some of Sandia's initiatives — such as the Technology Maturation Program — in technology transfer.



(Continued from Preceding Page)

then we can focus on the kinds of improvement in our lives and those of our neighbors around the world that can start a whole new world of friendly relationships with other nations, particularly if we can help those that are emerging — help them come on-line with a clean environment, with good safety practices, and good health practices. I tell you, that is the best diplomacy that we can bring to bear on these frightened and emerging Eastern-bloc nations right now that need a lot of help. We can help in this area without violating anybody's treaties or concerns or hang-ups about it.

So I want to congratulate Sandia Labs for the tremendous work you've done. I very much appreciate this opportunity to come out and "kick the tires" and see first-hand what you're doing. It gives me a lot more strength as I go before the congressional committees to ask for their support in the variety of things that we're doing now that go beyond the classic mission of the Department of Energy. You will see us moving out aggressively. . . .

Your Lab is solid for the long haul in the nation — in fact, it is key to it. Therefore you can assume that you have not only a solid position in the scheme of things as this new decade unfolds — which will be exciting for the world, in my opinion — but you'll be contributing to the national good and the international good in a very special



PACE VANDEVENDER, Director of Pulsed Power Sciences 1200, tells Secretary Watkins (left) and Sen. Bingaman (center) about Sandia's research program in pulsed power.

way by assuring that we move your technologies, when applicable, rapidly into our own [private] sector. That will be a number-one objective of all our laboratories as we establish this greater cooperative relationship among universities, industry, and the laboratories.

Remarks following the main address and responses to questions at a press conference immediately afterward:

We're very much involved in global climate change study in the Department of Energy. The President has put \$1 billion into research in a variety of government agencies. We're very serious about it. It's very well coordinated in the Office of Science and Technology policy in the White House. We're going to have a major science meeting [in April] in Washington, sponsored by



MEMBERS OF NEW MEXICO'S congressional delegation visited Sandia along with Secretary Watkins. Shown here are Sen. Pete Domenici (left) and Rep. Steve Schiff. Sen. Jeff Bingaman also accompanied the Secretary.



VIEWING PBFA II, Secretary Watkins (second from right) hears from Pace VanDevender (1200) about Sandia's progress in inertial confinement fusion. Also shown (from left): Bruce Twining, Manager of DOE's Albuquerque Operations; Sen. Jeff Bingaman; Rep. Steve Schiff; Sandia President Al Narath; and Sen. Pete Domenici.

the White House. That will help us move more aggressively. It'll be a key element of the national energy strategy — which is evolving very rapidly — because if we handle it well, it will be a solid module to go into the national energy strategy. The labs are all involved with us [DOE] and with other agencies. . . .

Question: How will DOE increase the accountability of the University of California and Sandia Corporation for any errors or negligence in the operation of the labs?

Fortunately, the labs have been run very well. . . . Now, can they be run better? Yes. The directors of all the national laboratories have picked up the baton and are running with it in environment, safety, and health issues. . . . At Sandia, you're going to see a whole new structure being put into effect by Al Narath and the contractor here, AT&T, to get serious about all aspects of the environment — [from] design on waste minimization all the way through to waste remediation technologies.

I have a whole concept of safety for employees, including following our policy, which in the past has been to comply with OSHA specifications — a policy that was never [completely] carried out. We have to do that, and we have to be sensitive to that, and the employees like that. Al Narath briefed us today that . . . these areas, which in the past have been treated somewhat as peripheral to the primary mission, are now part of the primary mission. They're equal to the product . . . and in fact we all believe very strongly that once we raise all of those elements of administration; environment, safety, health; and security to high levels of excellence, the entire productivity of the labs will pick up. . . .

Can we find new contractual relationships that will enhance the effectiveness of the labs? In my opinion, yes; but they have to be mutually agreed to by both sides. Is there need for additional contractual focus on incentives, for example? If a lab does well in running its environment, safety, and health programs, and those things that are not normally that attractive to scientists to have to deal with — the kind of things an administrator has to deal with all the time — but if they do that well, and they can save some monies, should those monies not be put back into the laboratory, into programs that Al Narath and AT&T might feel are essential here for employment morale, or other things that might not reach the cut-off list when we go through the budget process?

[We hope to] build in some incentives and some performance standards [for the labs] . . . This will be done sensitively, not driven down anybody's throat. It's going to be very closely allied to the regional concerns and the peculiarities of [each] lab. I think out of it will come a better system.

Question: What is your response to the National Academy of Sciences' report on inertial confinement fusion, which charged that the weapon laboratories seem to be more concerned with winning the billion-dollar Laboratory Microfusion Facility than they are in the basic science of inertial confinement fusion [ICF]?

My sense is that the labs understand that intellectual competition is essential to good research. We want

that competition going in the very earliest stages, when we don't know the outcome. At some point downstream, however, we've got to make a decision to move in certain directions. . . . The labs are talking, there's more cross-pollination of thoughts, and they're integrated totally in things like ICF. There are going to be differences of opinion, but my feeling is that some of those differences are essential to ensure that we have the product downstream. . . .

Question: Is there a target opening date for WIPP [Waste Isolation Pilot Project], or when do you expect to have one?

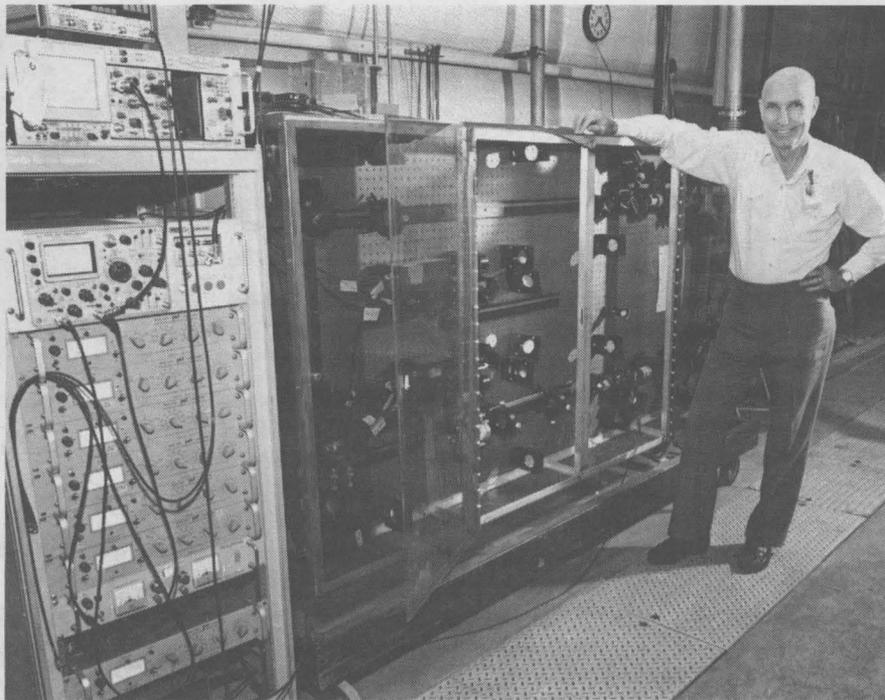
There is no target opening date. WIPP will open when it's safe to open. . . . We have eliminated many of the problems that we've had in the past — there's a finite number left now, not an infinite number, and we know where we stand on those. . . . We will put out a date when it's very clear that we meet all the specifications that everybody has agreed to. . . .

Safety is the number one objective. . . . I hope that this will be a year in New Mexico of less negativism about WIPP, because we have done our job better. I think criticism in the past has been legitimate criticism — I think there has been confusion — but I do believe when we put out Revision 2 to the WIPP plan, you'll see a very solid plan that has a finite number of objectives left. . . . I think we can get the research work started in a responsible way this year, and that's as close as I can come to a date. ●CS



ENERGY SECRETARY Watkins (left) discusses technology transfer with New Mexico Sen. Pete Domenici (right), as Sandia President Al Narath listens to the visitors' exchange.

LYNN BARKER (1534), pictured next to the portable VISAR machine he developed in the early 1970s, has set the standard for measuring the effects of shock waves on any target. To the left is a control panel for operating the laser optics on the right.



(Continued from Page One)

Innovative Physicist

credits Lynn with setting many of the standards for shock wave research at Sandia, as well as other laboratories, particularly through the use of laser beams.

"He's extremely innovative, one of the most creative individuals I've worked with," says Jim, who has worked with Lynn for the past 18 years. "In addition, one of Lynn's strengths is that he is able to make systems that are simple and easy to use. He knows how to engineer a system and make it people-friendly."

Leader in Shock Wave Dynamics

Lynn is probably best known for the VISAR device he developed with Red Hollenbach (ret.) in 1972. VISAR is an acronym for Velocity Interferometer System for Any Reflector, which means it tracks any surface, not just one equipped with a mirror to reflect the laser beam.

The target could be anything — a heat shield, a nose cone, an explosive, even a file cabinet, explains Jim.

The VISAR makes use of a characteristic pattern of reflection, known as a speckle pattern, that is produced when a laser beam bounces off the target. Originally developed elsewhere, the instrument at first was only about 10 percent accurate — woefully inadequate for weapons research — until Lynn figured out a way to make it accurate to within 0.2 percent.

Today, some 100 VISARs are in use throughout the world, including Japan, Europe, China, and the Soviet Union, not to mention universities and

"He knows how to engineer a system and make it people-friendly."

laboratories across the US. They have a wide variety of scientific applications in weapons research and other fields, such as geology.

The device is portable and can be wheeled onto almost any terrain as long as there is a power supply and a water source for cooling the laser.

According to Jim, the VISAR is a classic example of Lynn's ingenuity and inventiveness. "Everything he does is easy to use. It's human-engineered," says Jim. "He finds solutions to problems that help Sandia."

Laser Research

Lynn began working with lasers when they were introduced in the early 1960s. His first idea was to use laser beams to measure the displacement of the target during impact. Just as a high

wind traveling across the desert overturns tumbleweeds in its path, a shock wave during an impact moves the target.

He was the first to use laser interferometry in shock wave studies. The resulting instrument, developed at Sandia, is called a displacement interferometer and makes it possible to measure movements as small as one-millionth of an inch.

Soon, however, Lynn saw the need to improve on the device because it gave only an indirect measurement of target velocity. He realized that velocity could be measured directly by reflecting the laser beam from the target surface, then splitting

"Some of my best ideas have come while I was in the shower or lying awake in bed in the morning."

the beam in two and delaying one-half of the beam before recombining the two halves. The resulting instrument, which Lynn developed at Sandia in 1967, is known as the velocity interferometer.

The velocity interferometer works because of the Doppler shifting of the laser light frequency when the laser beam is reflected from the moving target surface. The Doppler shift is what causes a train whistle to change from a high, piercing sound as it approaches an observer to a long wail after it passes. Like the sound waves from the train, light waves appear to change in frequency as the source of light moves relative to the viewer. In this way, the laser beams bouncing off the impact target appear to change in frequency.

Both instruments, and later the VISAR, have set the standard for shock wave studies elsewhere, says Jim. "Sandia is a leader in that area. And Lynn played a vital part because of his developments in interferometry."

Other Innovations

During a seven-year stint at Terra Tek in Salt Lake City from 1974 to 1981, Lynn developed a new method of measuring fracture toughness, and invented a machine called the Fractometer to perform the measurement. The American Society for Testing and Materials has recently adopted two new standards based on Lynn's fracture toughness test method.

Fracture toughness is a material property, explains Lynn, that is crucial in evaluating how much stress can be applied before everyday structures, such as bridges, airplane wings, drill bits, and train wheels, crack.

Other innovations pioneered by Lynn include the "Tiny TIM," or Target Insertion Mechanism, a mechanical device that puts a target in place and automatically fires a gun in cryogenic experiments; the SWAP (Stress Wave Analysis Program), a computer code that predicts the dynamic response of any target material; the "pillow," a circular pad

made of different powders of metal and plastic that cushions an impact between a projectile and a target, thus controlling the distribution of heat and pressure; a theory for describing wave propagation in composite materials; and an analog computer, which remained in use at Sandia until the 1980s and analyzed the heat load on structures, such as an airplane wing flying at hypersonic speed.

Recently, Lynn tackled a problem by purchasing some balsa wood and building, in his garage, a device for measuring the precise center of mass of a projectile. His homemade instrument enabled him to solve a recurrent problem at the STAR (Shock Thermodynamics Applied Research) gun research facility — the baffling destruction, every so often, of a \$50,000 gun barrel because of gouging by an errant projectile.

The metal projectile noses are insulated with a layer of plastic to prevent such gouging, says Lynn. But on occasion, the center of mass of a projectile is off-center. Now, the projectiles are tested with his device before being fired.

The gouging phenomenon, which Lynn studied for two years, occurs when a metal piece, traveling faster than a mile per second, slides against a stationary metal surface. Based on his understanding of the phenomenon, Lynn also suggested a new design for Sandia's rocket sled track that has solved the problem of costly gouging of the rails.

Last month, Lynn used his "pillow" to minimize turbulence and accelerate a plate fired from a two-stage gas gun to an unprecedented speed nine times as high as a bullet fired from a high-powered rifle.

"I like to think about problems," he says. "They're kind of like puzzles. I like to toy with them. Sometimes you can do your most creative thinking when you're not in the office. Some of my best ideas have come while I was in the shower or lying awake in bed in the morning."

And he also credits his wife of 25 years, Val, with giving him terrific support, such as marketing his Fractometer machine and helping to name the STAR facility.

"I've had a lot of great support at Sandia, and I've really appreciated it. With good support at home and good support at work, how can you miss?" he asks. ●LD

Fun & Games

Bowling — December SANDOE Bowlers-of-the-Month were: Scratch — Wayne Yoshimoto (7412), 667; and Mildred Smith (2831), 621; Handicap — Fred Gunckel (2543), 603, 657; and Charlie Husa, 550, 673.

SANDOE Bowling Association Best Ball Tournament was held Jan. 20-21 at Holiday Bowl. First place winners were Harry and Susan Harrison with a handicap series of 759 (3 games). Second place was a tie between Marv Butler and Marty Jones and Alice and Lyle Davis (2825) with a handicap series of 748.

SANDOE congratulates Fidel Perez (7485), who rolled a sanctioned 300 at Holiday Bowl Jan. 21 in the Las Vegas Flyers League. He had a 676 scratch series.

Soccer — The New Mexico Association of the US Soccer Federation is sponsoring a beginning-referee clinic Friday, Feb. 23, 7 to 9:30 p.m., and Saturday, Feb. 24, 8:30 a.m. to 5 p.m., at the Am-fac Hotel. A field session will be held Sunday, Feb. 25, from 1 to 5 p.m. at Jackson Middle School. There is no charge for the clinic. For information, call Paul Mix (DMTS, 1262) on 299-7547.

New Kind of Skin Game



A computerized "apple" with a beeswax skin is being packed in containers of real apples to study the way fruit bruises. Developed by the US Dept. of Agriculture and Michigan State University engineers, the apple may be adapted to study damage to melons, peaches, and tomatoes.

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Laboratories Accomplishments FY89

Continuing a LAB NEWS feature begun nine years ago, *Laboratories Accomplishments FY89* sums up what we, Sandia National Laboratories, consider our principal achievements for the fiscal year that ended Sept. 30.

The work summarized here has been submitted by organizations in Albuquerque, Livermore, and Tonopah. No attempt has been made to rank items, but an attempt *has* been made to group project-related items. The responsible directorates are shown in parentheses after each item.

Requests for further information should be sent to Public Information Division 3161, Sandia National Laboratories, Albuquerque, NM 87185.

Nuclear Weapons

- We achieved all performance goals and schedule requirements in support of the Navy's Initial Operational Capability (IOC) for the **Trident II weapon system**; by fall, all reentry bodies necessary to support the IOC had been shipped to Navy facilities. During a production-evaluation missile flight test of a D5 missile launched from an Ohio-class submarine, our components performed successfully and met all technical objectives. We successfully concluded ground tests of the Trident II W88/Mk5 arming, fuzing, and firing system. (5100)

- We designed and developed a fiber-optic interface to provide maximum protection against accidental high-energy power discharge into the **Trident II warhead** during assembly testing at Pantex. The battery-powered tester receives light signals from an AC-powered tester and reconstructs waveforms for application to the warhead. New nuclear safety guidelines and the prototype tester will serve as references for the development of future critical-assembly-area test equipment. (2300/7200)

- After production yields for the SA2998, a nonvolatile memory unit used in the **Trident II system**, became erratic, a team from Sandia and the Albuquerque Microelectronics Operation/Allied Signal was formed to troubleshoot the problem. Within three months, the team identified causes of manufacturing problems and implemented solutions to correct them. Yields on this part are now consistently averaging 65 percent on initial tests at wafer-fabrication completion, and more than 25,000 good die were produced within a six-month period. Depending on yields through packaging and certification tests, this inventory may prove sufficient to satisfy all known delivery requirements. (2100)

- We conducted neutron-vulnerability and hardness tests of a **Trident II W88 warhead component** for Los Alamos National Laboratory at the Annular Core Research Reactor. The experiment used the newly developed 20-in.-diam. Fuel-Ringed External Cavity, version II, to certify that the component would function properly after exposure to the most severe neutron threat in its requirement specifications. The test facility satisfactorily met ten intricate LANL-developed test parameters — an unprecedented performance in neutron threat simulation. As a result, the W88 achieved successful certification for survivability in all required neutron environments. (6400)

- We completed development of the explosively driven ferromagnetic firing unit for the **W82 155mm Artillery Fired Atomic Projectile**. The firing unit, selected for this application because of its small size and resistance to the environments present during firing of the 155mm shell, worked normally during tests subjecting it to extremely high, long-duration, axial and angular accelerations. Explosive-function tests on production prototypes indicate the unit will meet its reliability goal and production schedule at originally projected cost. (2300)

- The cost and complexity of logistical support for the **W82 155mm Artillery Fired Atomic Projectile** will be significantly reduced through deployment of a newly developed Integrated Control Unit (ICU). For the first time, the ICU integrates Sandia-designed Command Disable and Permissive Action Link decoder electronics with an Army fuze setter module in a single, modern electronic package. The ICU will perform use-control and pre-fire functions that currently require three separate ancillary support systems. (8100)

- We worked with the production



F-118 AIRCRAFT carries a B90 Nuclear Depth Strike Bomb during an in-flight test to check NDSB separation from the aircraft. (US Navy photo)

complex to generate **B90 Nuclear Depth Strike Bomb** baseline costs and to develop readily producible designs. Activities included system impact tests to generate data on an energy-absorbing nose design. We also worked with the Navy to achieve mechanical compatibility between the B90 and Navy aircraft. Other joint activities with the Navy involved tests on the B90 parachute system, carrier suitability, aircraft ejection, and in-flight separation from aircraft. The Design Review and Acceptance Group draft of the B90 development report was published. (5100)

- First production of the **Code Activated Processor (CAP)**, a new locking device for Permissive Action Link-equipped nuclear weapons, was achieved. The CAP has cryptographic

capability and can be configured to meet the security requirements of specific weapons. (2300)

- As part of our **Direct Optical Initiation (DOI) program**, we demonstrated the feasibility of optical firing systems using optically driven slapper detonators and miniaturized laser sources, and have worked to make system elements more rugged and reliable. Goal of the DOI program is to develop a firing system that would enhance nuclear safety in an accident environment; the system would transmit only optical energy into the exclusion region, directly initiating the detonator. Laser firing systems under development are compatible with current weapon-system volume and environmental requirements. (2500/1500/5100/2300)

- We developed a **miniature**

From the President

To all Sandia employees:

While our energies are usually focused on current commitments and future plans, I believe it is important to pause from time to time to reflect on the Laboratories' achievements. As you weigh the significance of the illustrative examples covered in this issue of the LAB NEWS, I think you will agree with my assessment that FY89 was a year marked by numerous important accomplishments, both technical and administrative. Some of these resulted from individual initiative; most can be attributed to dedicated team effort. In the aggregate, they attest to the ability of Sandians to respond successfully to the difficult challenges posed by continued expansion in the scope and complexity of Sandia's activities.

On this occasion, I want to congratulate all of you for a job well done. We can take great pride in being part of a progressive organization that has long enjoyed a reputation for excellence. At the same time, I urge you to support Sandia's rapidly expanding quality initiative. Your active participation in defining and implementing necessary improvements in our operating style will ensure that our future contributions to national security measure up to expectations created by Sandia's past performance. I am confident that — working together — we can accomplish this critical objective.

Al Narath

SANDIA COMPONENTS performed successfully and met all technical objectives during this Trident II production-evaluation missile flight test launched from an Ohio-class submarine.



laser-triggered, high-voltage vacuum switch, using metal-ceramic construction. Reliable triggering is achieved with only 20 microjoules of laser energy. Switch life greater than 1000 shots without performance degradation has been observed. Switch applications include firing sets and field test. A technology transfer program with Raytheon is in progress. (2500)

• We successfully completed Phase 2 and Phase 2A studies for the **Short Range Attack Missile, Tactical** in a one-year time span. Phase 2 activities began when Sandia and Los Alamos laboratories were designated to continue design refinement and cost studies on one of their Phase 2 candidates. All functional, safety, schedule, and cost

commitments are being satisfied. (5100)

• We completed the two-year Phase 2 feasibility study for the Army **Follow-On-To-Lance (FOTL)**. Subsequently, the New Mexico design team was selected to conduct the Phase 2A design definition and cost study. A warhead common to both the Air Force Short Range Attack Missile, Tactical and the Army FOTL missiles was chosen to realize significant cost savings during development, production, and stockpile evaluation. (5100)

• We completed basic structural and thermal designs and analyses of the War Reserve and test units for the **W89/Short Range Attack Missile II**. Structural experiments verified predictions of warhead stress distributions. A

thermal model was used to specify thermal test environments, and resulting test data helped calibrate the model. We are modeling and studying abnormal and mechanical environmental conditions to examine nuclear safety issues for the W89. (8200)

• We designed an information-controlled weapon interface for the **W89/Short Range Attack Missile II warhead**. The design allows all critical arming functions to be controlled through a digital interface with the missile, but does not compromise first-principle nuclear safety concepts. A wireless firing set is used to preserve the integrity of the exclusion region in abnormal environments. Also, both the electrical and high-explosive firing systems are interrupted by independent unique-signal strong links. Size constraints dictated the development of new interconnection techniques that minimize inductance of the firing system to provide the required energy to the detonators. The warhead electrical system has been successfully tested in the laboratory, using development versions of all components. (8100)

• We completed negotiations with the military services and the Defense Nuclear Agency/Field Command (DNA/FC) on review and approval of **Sandia-produced training videotapes**, and of a joint management system for the videotapes. The tapes will be managed and distributed through the Joint Nuclear Weapons Publication System; DNA/FC will forward tape orders from the military services to Sandia and is also re-

sponsible for distributing the tapes and providing feedback from users. (7200)

• We developed the **capability to predict the hydrodynamic performance of vehicles** entering water at speeds up to 2000 ft./sec. Sub-scale water tunnel tests and full-scale flight tests were used to validate computer predictions of three-dimensional, incompressible cavitating flows. Sandia-developed technology and analysis codes have made possible simpler future weapon systems such as depth bombs and air-launched torpedos with enhanced water-entry and underwater performance. (1500/5100/8400)

• We designed and flight-tested a 6-in.-diam. **artillery shell for airborne-reconnaissance applications**. The fully instrumented shell acquires an image of a wide swath of the ground over which it flies by using a single photodiode and telescope combination to collect light (through a hole in the shell's side) from the ground. The diode views different sections of the ground because of the spinning and longitudinal motion of the projectile and produces images comparable to high-quality television pictures. Video information is telemetered to a ground station for analysis. (8400/8100)

• We performed a **review of statistical sampling requirements** for recently produced and stockpile warheads in our New Material and Stockpile Evaluation programs. The review resulted in an overall reduction in the required sample size and a corresponding cost savings. (7200)

Components/Materials and Processes

• We designed and developed the **world's first all-organic, optically clear radioluminescent lights**. Current commercial technology uses tritium gas in sealed glass tubes. Our solid-state lights offer a safety advantage, since the tritium is chemically bound in the solid. Also, the new technology makes it simple to fabricate lights of virtually any size or shape that can produce any desired color. Possible military applications include infrared decoys, and "pathfinder" lighting to help retrace one's footsteps in the dark. A patent application has been filed. We also recently produced several other new tritium lighting materials that make use of solid-state inorganic or mixed organic/inorganic systems. (1800)

• We developed a **digital encoder/decoder**, suitable for airborne applications, for remote transmission of video images. Digitization of the video information serves three purposes: encryption for data security, resistance to corruption by noise, and incorporation of multiple cameras. The digitized video data are compressed to reduce the data transmission rate required to reconstruct a high-fidelity image at the ground receiving station. The system's architecture is flexible, yet simple, leading to a very compact design: 37 cubic inches, consuming 10 watts of electrical power. Possible commercial applications: airborne telemetry, and crowd monitoring that involves the relay of images to a central receiving station. (8400)

• We developed a precision **computer-controlled film and foil capac-**

itor winding machine to wind advanced-development, high-energy-density capacitors. The machine can wind up to eight layers of film and foil into 13 x 13cm packages in extended and buried foil capacitor configurations. Our efforts focused on developing processes for weapon and field-test firing-set capacitors, and on advancing the state of the art for perfluorocarbon-liquid and plastic-film dielectric capacitors with aluminum foil conductors. (7400)

• We developed a Fourier transform infrared spectrometer **system to examine cleanliness of gas reservoir tubes before pinch welding**. The system, which can be used in a production environment, allows an *in situ* cleanliness examination not previously possible because of small dimensions. (High-quality welds are known to be dependent on the cleanliness of the tube.) The system can also be used to determine weld-wire cleanliness, and was instrumental in solving a weld-wire contamination problem in reservoir production at Rocky Flats. (8300)

• We developed a **hybrid-circuit processing technology for a new soft-substrate material** needed for higher-frequency micro-strip circuits in radar applications. Copper used for circuit conductors is laminated to the soft substrate, and a brass or aluminum backing plate is bonded to the reverse side to make the substrate rigid enough for hybrid processing. A high-speed, precision machining technology was developed to provide locational accuracy

for component relief holes, plated-through holes, and edge contouring — a difficult task because of the matrix of hard and soft materials that must be machined simultaneously. We successfully produced and tested prototype circuits using the new technology. (7400)

• Data from field-return batteries show that a Sandia-modified **lithium-sulfur dioxide cell** will operate continuously in a five-year application with a reliability rating of >0.9995. We now feel confident, based on storage and discharge data on these cells and on cells for the Galileo space probe, that the Sandia-modified cells will operate reliably for periods of ten years or longer. The cells are suitable for use in any high-reliability application requiring extended storage or low-rate continuous drain for ten years — for example, for memory backup, timers, treaty-verification applications, and space probes. (2500)

• Integrated-circuit packaging facilities, new assembly processes, and stockpile package aging can now be objectively evaluated using a Sandia-designed **Assembly Test Chip (ATC)**. For example, first-generation ATCs with sensors to measure corrosion, electrostatic and mechanical damage, and moisture are being used to evaluate chip protective coatings and to monitor the integrity of hermetic packages. Current ATCs are fabricated in Sandia's Microelectronics Development Laboratory, but the design employs standard CMOS (Complementary Metal

Oxide Semiconductor) processing, so that either the complete design or individual sensor cells can be transferred to industry. (2100)

• We developed a **thin-film heater** to vaporize lithium for the Particle Beam Fusion Accelerator II, which is designed to accelerate a lithium ion beam. The heater system consists of an alumina ceramic substrate whose surface is carefully ground, cleaned, and sputter-coated with molybdenum and lithium thin films. The substrate is supported by a steel housing and is connected to electrical pulsers by 15-metre-long flex-cable transmission lines. During operation, the pulsers heat the thin films to ~1200°C, thus vaporizing the lithium. The heater system is a key element in the development of a lithium ion source for PBFA II. (7400/1800/1200)

• Prototypes of Sandia's next-generation, **16-bit microprocessor** and its support chips were characterized in single event upset (SEU) and transient gamma-radiation environments after prototype silicon was completed in the 1.25-micron, radiation-hard process co-developed by Sandia and Bell Laboratories engineers. Better-than-expected SEU behavior resulted. A 64K Static Random Access Memory (SRAM) — again, jointly designed by Sandia and Bell Laboratories — was also fabricated, resulting in the availability of highly reliable, megarad-hard 64K and 256K SRAMS for government system development. (2100)

Safeguards and Security

● We introduced Sandia's **security-systems approach to the US commercial aviation industry**. Until recently, FAA and industry focus has been on individual security measures — for example, explosives detection — rather than on integrated security systems. As the result of a study we completed on US airport security, the FAA Technical Center has funded a project to develop, install, and evaluate security technology, and to demonstrate a systems approach to aviation security at Baltimore-Washington International Airport. The program is a major element of a more aggressive policy on aviation security by the FAA and the aviation industry. (5200)

● We developed a number of concepts relating to the **survivability and security of nonstrategic nuclear forces**. Two of the concepts were presented at the NATO Senior Level Weapon Protection Group's "Junefest" meeting held at Sandia. The "FORT" model, a unique methodology for nuclear weapon storage, integrates several new technologies for enhanced protection of nuclear assets. An Automatic Rapid Attachable Warhead Section demonstrator shows how a warhead can be quickly and automatically assembled to a weapon and how interface communications can be done with magnetic circuitry, thereby reducing the need for connectors, cabling, and human actions. (5200)

● As technical advisor to NATO's Senior Level Weapon Protection Group (SLWPG), Sandia hosted SLWPG's "**Junefest**" meeting, which addressed issues related to the safety, security, and survivability of nonstrategic nu-

clear forces in Europe. Demonstrations included advanced nuclear weapon technologies, weapon vaults and containers, survivable command-center technology, robotics, intrusion detection systems, and the Tactical Engagement Simulation System. The SLWPG, chaired by Robert Barker, Assistant to the Secretary of Defense for Atomic Energy, consists of representatives from NATO nations, Supreme Headquarters Allied Powers Europe, NATO staff, and various US military headquarters. (5200/5100)

● Using a Jeep Cherokee Mobile Testbed Vehicle at Sandia's Robotic Vehicle Range, we demonstrated the feasibility of using an **unmanned robotic security vehicle** to perform exterior physical-security functions autonomously. From the safety of a security control center, one remote operator can oversee, under computer control, several robotic vehicles covering many miles. The operator can make critical decisions without risk and, when necessary, take over control of the vehicles for closer surveillance or to initiate various defensive measures such as dispensing tear gas or directing water cannons. (5200)

● We implemented an **advanced entry-control system for the US Secret Service** to enhance security at the White House Complex in Washington, D.C. The system integrates commercially available, state-of-the-art entry-control technologies into a fast, reliable, user-friendly computerized system. The system provides identity verification of authorized persons and screening of visitors for weapons and explosives. (5200)

● In August, the International Atomic Energy Agency (IAEA) of the United Nations placed a contract with Aquila Technologies Group, Albuquerque, to produce 50 of the Sandia-developed **Modular Integrated Video System (MIVS)** and spare subsystems. MIVS, designed to provide the IAEA a video-surveillance capability, allows the recording of 26,000 snapshots or scenes (with more than 99 percent reliability) during unattended operation of a facility. Consisting of a camera module, a recording control unit, and an interconnecting cable, MIVS is designed to operate in an indoor environment in ambient temperatures from 5 to 40°C. We also developed a system to assist IAEA inspectors during their review of MIVS surveillance tapes. MIVS is expected to be a valuable element in IAEA implementation of the Nuclear Non-proliferation Treaty. (5200)

● We developed and presented a workshop to licensing, evaluation, and inspection personnel from Nuclear Regulatory Commission (NRC) Head-

quarters and NRC's regional facilities. The workshop — including lectures, field demonstrations, and in-class system exercises — focused on **performance testing and evaluation of security systems at commercial nuclear facilities**. Sandia is DOE's lead laboratory in physical security for inter-agency transfer of technology to the NRC community. (5200)

● We completed Phase I development of the **Tactical Engagement Simulation System (TESS)** project, sponsored by the Defense Nuclear Agency. The TESS provides a nonhazardous mechanism for counter-terrorist training and evaluation of security forces responsible for NATO's nuclear weapon storage sites. The microprocessor-based laser engagement system consists of an eye-safe laser transmitter attached to the trainee's weapon barrel and a player-worn detector vest that responds to "hits" from laser-beams that substitute for bullets. Plans are proceeding for full-scale implementation and field evaluation of the system. (5200)



"TERRORISTS" go on the attack during a demonstration of Tactical Engagement Simulation System equipment at the "Junefest" meeting of NATO's Senior Level Weapon Protection Group.

Supporting Technologies

● We developed new **Surface Acoustic Wave (SAW) sensors** for materials characterization and advanced sensor design. Using SAW devices, we obtained real-time diffusion measurements on organic films and measured surface areas, average pore sizes, and pore-size distributions of sol-gel-derived thin-film coatings. The SAW technique is more than four orders of magnitude more sensitive than traditional surface-area measuring devices. (1800/1100)

● We successfully demonstrated feedback control to stabilize a flexible truss structure against mechanical disturbances such as impacts, using — for the first time — an optimal projection algorithm. The technique is applicable for **stabilizing a variety of flexible structures**, from robots to space stations. (1500/7500)

● We developed a **Robot Independent Programming Environment (RIPE)** to speed software development for intelligent robot systems by forcing the development of highly modular, reusable codes. (Software development is a major cost in the application of such systems to complex problems such as the cleanup of hazardous waste sites.) We also developed a standardized Robot Independent Programming Language (RIPL), in which different intelligent robots are programmed using the same language. RIPE and RIPL apply to

the development of other Sandia languages and environments, such as for command and control or weapon systems. (1400)

● We designed and built several **new compound semiconductor devices** that have significant performance advantages: (1) A steerable laser array, applicable to optical radar and free-space communications, allows electronic beam steering of the output from a high-power, phase-coherent semiconductor diode laser array; (2) a buried blocking heterojunction laser fabrication method is much more compatible with processes for photonic switches, modulators, and optoelectronic components than currently used techniques; (3) a radiation-hardened, light-activated switch, triggered by a few milliwatts of light power, is immune to strategic levels of flash x rays, and was developed to provide increased safety and simplicity in weapon systems; and (4) newly developed nonvolatile transistor memories can be written at high speed and have unlimited endurance. (1100/2500)

● We developed a new **algorithm for solving time-dependent partial differential equations on parallel computers**. Previously, individual processors were used to work on separate parts of the spatial domain. We have found a way to break up the time domain, as well as the spatial domain, into

slices that can be computed in parallel. Using only spatial parallelism, we solved a realistic diffusion problem 371 times faster on a 1024-processor NCUBE-10 computer than on a single processor. By using a combination of spatial and time parallelism, we solved the same problem 813 times faster on the 1024-processor computer. (1400)

● We developed a **bright, tunable source of soft x-ray radiation**, using a laser plasma source (LPS) coupled to a high-throughput monochromator. The source is being used to characterize a variety of new-candidate resist polymers for x-ray lithography and to measure soft x-ray reflectivities for a variety of synthetic multilayer mirrors. The mirrors are crucial for future x-ray projection printing where the goal is attaining feature sizes of 0.1 micron or less. We have a program under way with AT&T Bell Laboratories to compare reflectivities as measured using line sources, our LPS, and a synchrotron radiation source at the National Institute for Standards and Technology. (8300)

● Our studies of **glass fracture mechanisms** led to new techniques for modeling and predicting the surface chemical reactions that weaken glass and slowly cause mechanical failure. Understanding factors that control the strength of glass under stress for long periods of time is critical to the reliability of advanced electro-optic technolo-

gies that involve optical fiber networks. In an ongoing joint program with AT&T Bell Laboratories' Undersea Systems Department, work is under way to apply these new fracture models to silica glass fibers produced in controlled-environment conditions. This first-of-a-kind experimental capability allows exploration of new molecular coatings that can protect the mechanical integrity of optical fibers in hostile environments. (1100/1800)

● We developed a **primary voltage calibration system** based on a new Sandia-developed cryogenic probe and an integrated-circuit array developed at the National Institute of Standards and Technology. A Sandia-designed refrigeration system permits continuous operation at 4° Kelvin (-269° Celsius) with no operator intervention. The system will allow calibration of the volt to an accuracy of 0.0003 percent throughout the Nuclear Weapon Complex. (7200)

● We developed a **fixture to simulate ignition and combustion of a new liquid propellant** being evaluated by the Army to supplant solid propellants in 155mm artillery. The Sandia fixture provides critical information about the origin of pressure oscillations observed in liquid-propellant firings of a prototype 155mm howitzer. These oscillations are not observed in solid-propellant firings and must be eliminated if liquid propellant is to be a

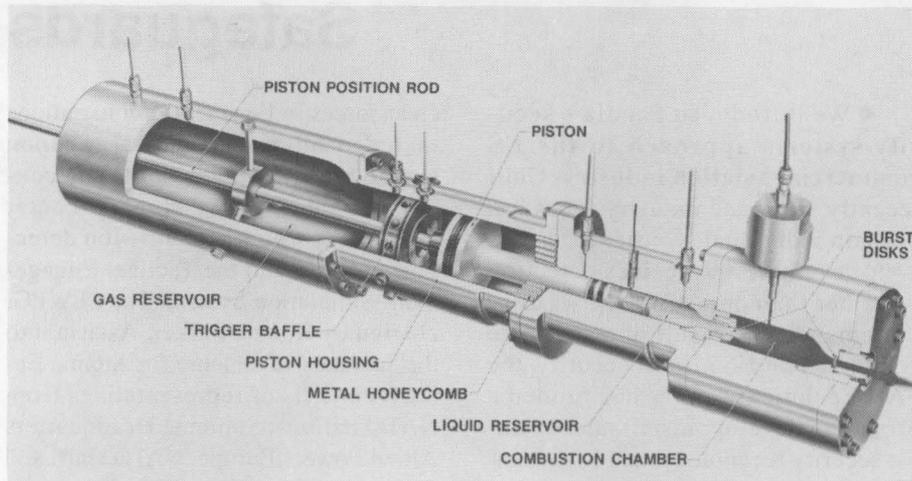
viable alternative to current solid-propellant technology. (8300/8400)

- We developed a new **design approach for large-scale, reactor-driven laser systems** in the FALCON reactor-laser program. This continuous-wave-mode FALCON concept has potential for significantly improved beam quality from a reactor-driven device. (Beam quality has been the primary issue during development of large-scale, reactor-driven laser systems.) A series of reactor and laboratory experiments to verify the scaling and beam-quality potential of this approach is under way. (6500/1100)

- We developed a **thermal modeling capability** that allows a component- or process-engineer to predict the path of the gel front in an encapsulated component during encapsulant curing and to identify regions of the mold cavity that may not be properly fed during resin shrinkage. Once problem areas are identified, changes in

mold design, processing parameters, or component geometry can be made to control gel-front progression and to prevent the possibility of voids and separations, thus increasing the margin for acceptable product. (7400/1800/1500/2500)

- The concurrence of two or more persons is commonly required for the initiation of an irreversible action of serious consequences — for example, launching a missile or enabling PAL devices in nuclear weapons. Schemes designed to ensure that an authorized concurrence exists before initiation of a controlled action are called **shared-secret or shared-control schemes**. Until now, such a scheme was possible only if an individual, mutually trusted by all, constructed the private pieces of information (shares) and distributed them in secret to participants — meaning that the “trusted person” was in possession of all the information needed to unilaterally initiate the ac-



SANDIA-DEVELOPED FIXTURE, called a liquid-propellant injector/combustor, provides critical information about the origin of pressure oscillations observed in liquid-propellant firings of a prototype 155mm howitzer.

tion. In real-world situations, especially those involving national treaty-controlled actions, it is unlikely that any one person is trusted by everyone; thus, there is no way to set up a shared-control scheme as described above.

However, a protocol has been found that makes it possible for a collection of mutually distrustful participants to set up, without outside assistance, a shared-control scheme they can mutually trust. (200)

Testing

- We developed a new **155mm projectile recovery system** to soft-recover artillery projectiles fired from 155mm howitzers. The nose-deployed system contains a new electronic timer with integrated safing and arming devices and less sensitive explosives in the deployment train. The system has been qualified to the worst-case firing environments of modern-day artillery systems and has demonstrated increased reliability — compared to the 80-percent reliability of its predecessor — in all 15 of its tests to date. Increased reliability will save resources in both weapon development programs and post-production quality assurance programs. Enhanced safety and simplicity of assembly and testing are additional benefits. (8100/1500)

- We conducted a test series to investigate the **survivability threshold of space satellite solar power concepts** when exposed to x-ray environments having energies of a few kilo-electron volts or less. The effort involved tests of more than 40 different materials (from four separate aerospace contractors) on Sandia's Proto II facility, which was used to generate x-rays from neon, krypton, and argon plasma sources. The test series, the largest of its type conducted at Sandia, served as the basis for an Air Force evaluation and

selection of candidate satellite solar concepts. (6500/1200)

- During the **DISKO ELM weapon effects test**, we performed a variety of radiation diagnostics and earth-motion and pipe-diagnostics measurements in support of all the event experiments, including the Navy's W88/Mk5 system final proof test. Support activities included development of a low-photon-energy radiation diagnostics capability for use in future events, and advanced weapon development experiments on radar components, explosive devices, and advanced heat shields. We also fielded measurements to improve pressure sensors and developed a technique to reduce noise in strain-gauge applications. In support of these experiments, Sandia fielded a 100-percent-successful, 520-channel data-acquisition system. (9300)

- A successful (100 percent data recovery) AGT/UGT (aboveground test/underground test) **cross-correlation simulation fidelity experiment** was performed during the DISKO ELM underground weapon effects test. Purpose of the experiment was to study foam-hardened printed circuit boards typical of state-of-the-art reentry vehicle electronics. The experiment, the first in a proposed series, is significant because future restrictions on UGTs could compromise our ability to obtain adequate hardness assurance with our current AGT and modeling capabilities. (9300)

- We conducted 37 drop tests from the 5000-ft. aerial cable facility on four **TRUPACT-II nuclear waste transportation containers**. Following these tests, three of the containers were subjected to jet-fuel fires. Other TRUPACT-II support activities included analytically predicting the performance of waste forms inside the doubly contained package. The tests (simulating accident scenarios) and other activities led to TRUPACT-II certification by the Nuclear Regulatory Commission in August. (7500/6300)

- **Tonopah Test Range (TTR)** conducted 225 tests, including air drops, rockets, artillery rounds, and earth penetrators. Test-activity highlights included the launch of an Air Force Operational Test Launch Short-

Range Attack Missile from a B1-B — the first test of the B90 recovery system using the new B90 test unit — and tests using the Army Multiple Launch Rocket System to evaluate fuze performance. Two of TTR's instrumented M-247 Sgt. York tanks provided simulated threat signals for “attacking aircraft” during a Nellis AFB (Nev.) training exercise. The new 16-in. Davis Gun is now operational, as is the TTR digital instrumentation radar — a mobile, precision-tracking radar that was used at several locations in support of TTR test activities. (7500)

- We developed and released a **coupled electron-photon discrete-ordinates transport code**. The code enables the radiation-effects community to exploit, for the first time, the advantages of the discrete-ordinates method, a well-established technique in neutral particle transport. For radiation-effects predictions, this one-dimensional code is from ten to a thousand times more efficient than transport codes relying on Monte Carlo techniques. (9300)

- We developed a new **technique for simulating intense magnetic fields generated by nearby lightning strikes** for use in lightning-effects tests on weapon electronics. The test setup mates a modular 20-ft.-long, 10-ft.-diam. test chamber to the existing lightning simulator. Test items placed inside the chamber are exposed to magnetic



PARACHUTE RECOVERY SYSTEM to soft-recover artillery projectiles fired from 155mm howitzers has demonstrated increased reliability, compared to its predecessor, in all 15 of its tests to date. The test shown here was at Tonopah Test Range.

fields produced by the simulator's current. Excellent fidelity is achieved, with respect to magnetic-field rise time, intensity, and waveform of real lightning. (7500)

- At Tonopah Test Range, we conducted a **nighttime flight test of a Tomahawk Land Attack Missile, Conventional**, to demonstrate the reliability of the digital scene-matching area correlator at night over a variety of scenes, and to develop range nighttime scoring methods. All major test objectives were achieved. (7500/7100/Navy)



TRUPACT-II nuclear waste transportation container is readied for a drop test at Sandia's 5000-ft. aerial cable facility.

Pulsed-Power Development

- We developed the fully **three-dimensional, electromagnetic particle-in-cell computer code, QUICKSILVER**. The code is a powerful new tool for advancing our understanding of the physics of complicated pulsed-power devices such as accelerators, diodes, and microwave systems. A user-friendly preprocessor and state-of-the-art visualization software, combined with efficient use of Sandia's supercomputers, make feasible simulations of the interaction of electromagnetic waves and charged particles with complex structures. We have used QUICKSILVER to simulate a new voltage monitor, a high-power microwave

device, an intense ion-beam diode, and electron losses in multimodule accelerators. (1200)

- Using Sandia's Particle Beam Fusion Accelerator II, we succeeded in focusing an ion beam to power and energy densities equivalent to 5.4 trillion watts and 73 thousand joules per square centimeter on a 6mm-diam. spherical target. This is a **world's record for ion beam focusing**; it advances our capability to drive inertial confinement fusion targets with light ion beams to within a factor of 20 of the power and energy density we believe is required for ignition. (1200)

Arms Control Verification

- We provided support for the negotiation and implementation of several arms control treaties between the US and the Soviet Union. Support for the Intermediate Nuclear Forces Treaty included technical advisors to the Special Verification Commission in Geneva, and field testing and inspection of monitoring equipment (largely developed at Sandia) being installed in the Soviet Union in support of the treaty. We also provided technical experts at the Nuclear Testing Talks in Geneva, as well as the Scientific Advisor to the Strategic Arms Reduction Talks (also in Geneva). Two Sandians on assignment in Washington, D.C., are currently providing full-time support to DOE's Office of Arms Control and to the Office of the Secretary of Defense, Verification Policy. (9200)

- We completed definition for a high-reliability, radiation-hardened microcomputer for use in satellite payloads. The computer's first application will be data processing from a number of Los Alamos National Laboratory/Sandia-designed sensor subsystems planned for the Boost Surveillance and Tracking System satellite. The computer design is modular and flexible and could be used in other satellite applications as well. The computer will use high-performance processor chip sets developed by both Honeywell and IBM under contract to the Air Force Space Technology Center at Kirtland AFB. (9200)

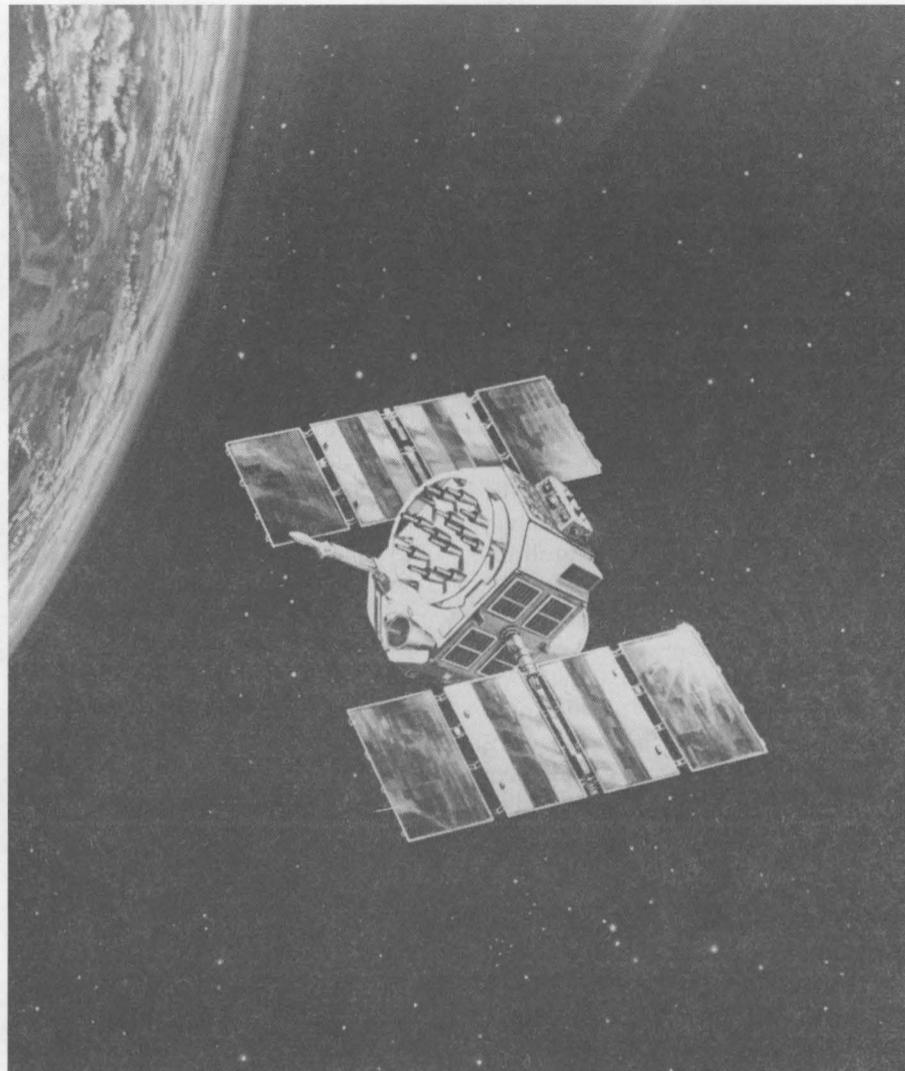
- We completed the first-phase installation of a distributed-architecture satellite ground station consisting of multiple, geographically distinct, networked workstation nodes. System processing includes generating time-dependent uplink command sequences, as well as real-time downlink data collection and display. Through the use of an interactive command-plan compiler, operation command plans are translated into payload command sequences that,

in turn, are transmitted to a remote satellite ground control station. The system also includes an on-line training and analysis capability, isolated from the operational segment. (9200)

- We developed radiation-detection equipment for making measurements on nuclear warheads. This equipment is used in verification procedures for the Intermediate Nuclear Forces Treaty. At the request of the US government, through DOE's Office of Arms Control, we assisted in negotiations to determine the equipment specifications, then designed, built, and tested it. Finally, we participated in the Radiation Detection Benchmark Measurements on SS-20 and SS-25 missiles in the Soviet Union; results of the Benchmark Measurements, as well as the equipment, will be used as part of on-site verification for the remainder of the 13-year treaty. (9100/9200)

- To determine the impacts associated with treaty-imposed, short-notice inspections of DOE facilities, we organized and documented a full-scale, on-site inspection exercise at a DOE facility. Videotapes and reports of the exercise — and of the entire DOE On-Site Inspection Evaluation Program — had a significant impact on DOE's position concerning the inspection regimes of the Strategic Arms Reduction Talks Treaty. (9200)

- We provided the Nuclear Detonation Detection System payloads for the four Global Positioning System satellites launched during the past year. The operational 21-satellite constellation will be fully deployed by late 1992. Our latest-generation satellite ground station data acquisition and display system successfully supported the post-launch on-orbit checkout of these payloads. When satellite deployment is complete, this ground station system will provide DOE and DoD users with a continuous, worldwide, real-time ability to detect nuclear detonations on the



SANDIA PROVIDED Nuclear Detonation Detection System payloads for the four Global Positioning System satellites (one is shown in this drawing) launched last year.

earth's surface. (9200)

- We completed implementation and flight-qualification testing of a precision alignment mechanism for a satellite instrumentation payload. The device permits the autonomous on-orbit correction of thermally induced optical misalignments with one arc-second accuracy; overall instrument pointing errors can be continuously corrected as a function of time of day and season. (9200)

- We developed and demonstrated a new generation of seismic monitoring system, the Deployable Seismic

Verification System (DSVS). The system incorporates upgraded seismometers and high-resolution digitizers to provide a dynamic range of 130 decibels with a resolution of 22 bits. Seismic data are acquired over the bandwidth from .01 Hz (hertz) to 50 Hz. The DSVS, which includes remote seismic stations, data communication links, and a receiving and monitoring station, was developed to provide a capability for monitoring underground nuclear tests for verification of either a threshold test ban treaty or a comprehensive test ban treaty. (9200)

Other Defense-Related Work

- Simulation models play a significant role in effective interpretation of scenes from Synthetic Aperture Radar (SAR) data. We developed a massively parallel version of a major

SAR model on Sandia's 1024-processor NCUBE-10. The new code runs about eight times faster than the same model on a CRAY Y-MP. We estimate the code will run about 50 times faster on

Sandia's NCUBE-6400 (as compared to the CRAY Y-MP) with a significant potential cost savings. (1400/9100)

- We completed design, development, testing, and evaluation of the Weapon Storage and Security System. This system provides a new method of weapon storage that improves survivability and security, permits a substantial reduction in security personnel, and improves operational response time. Our drawings and specifications, done on a reimbursable basis for the Air Force, have been used in the placement of a contract for production and installation of the system at 20 different sites. Production is in process, with the first installation scheduled for the second quarter of FY90. (5200/2300/1500/7200)

- For the first time, we measured the growth rate of the ion-hose instability in transporting a high-current, relativistic electron beam (1 kiloampere, 1 microsecond, 2.5 megavolts) on a plasma channel. The growth rate was smaller than predicted by early models and agrees with the recently developed BUCKSHOT code. The beam was then

efficiently transported a world's-record distance of 91 metres on a laser-formed channel. This work was supported by the Strategic Defense Initiative Organization. (1200)

- We designed and demonstrated an all-electronic Safety and Arming (ESA) device for conventional (non-nuclear) weapon systems. An ESA verifies a safe launch before arming the weapon's explosive warhead. The safety architecture for the ESA has been accepted by the three military services, and represents a major improvement in reliability and performance, compared to the DoD's current mechanical systems. (9100/2300/2500)

- We developed a computer model of Soviet strategic attacks on the US. This tool, called AURORA, simulates the allocation of Soviet nuclear weapons and generates threat scenarios that are used to develop requirements for US strategic defenses. The Strategic Defense Initiative Organization has chosen AURORA as the designated threat model for its Phase I Strategic Defense Program analyses and is supporting its transfer to, and



SANDIA-DEVELOPED PORTABLE GAS GUN was used for stability assessment tests on the Navy's Advanced Bomb Family penetrator. Here, a 100-lb. projectile slams into a 6-in.-thick reinforced concrete slab at 700 ft./sec.

use at, the SDIO National Test Facility at Falcon AFB (Colo.). (8100)

- We successfully carried out two **high-altitude experiments** (Project STARMATE) sponsored by the USAF-Space Systems Division and the US Army-Strategic Defense Command. Two Terrier-Malemute sounding rockets each carried eight high-altitude experiments on dawn missions from Kauai Test Facility in Hawaii. The payloads were deployable objects and space flares designed to provide a research data base. The southeast flight path enabled instrumentation sites on Kauai, Oahu, and Maui to view the payloads and collect visible, infrared, and radar signature data for preliminary system design. (9100/7500)

- We completed construction, funded by the Strategic Defense Initiative Organization, of \$5.8 million worth of **new launch facilities at the Kauai Test Facility**. All launch control, communications, and telemetry equipment in the new Launch Operations Building functioned successfully in the two Terrier-Malemute rocket launches in support of the STARMATE Test Program. The new launch facilities expand our capabilities to support vertical-launch rocket systems. (7500)

- We completed development of a portable, 6-in.-bore, **high-performance compressed gas (air/helium) gun**, de-

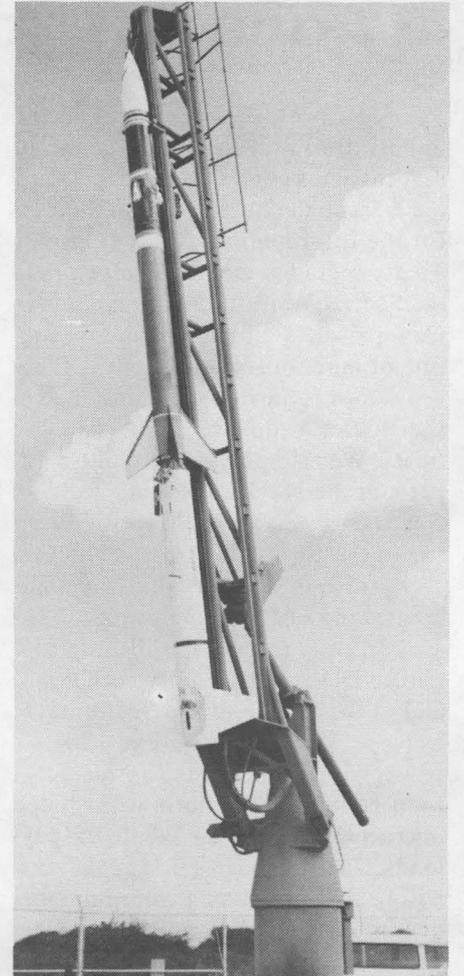
signed to support penetration mechanics programs at Sandia. The gun, the largest-known of its type, can propel projectiles — weighing from 5 to 100 pounds — 2500 to 900 feet/second, respectively, into geologic media at a variety of impact angles. The gun, a self-contained system with all of its equipment mounted on a modified flatbed trailer, was used in 50 instrumented tests during the year. (9100)

- We worked with the Army's Missile Command and Infantry School to develop a Tactical Multipurpose Automated Platform (TMAP), an **unmanned ground vehicle** whose purpose is to save lives on the battlefield. The remotely controlled TMAP is used for reconnaissance surveillance and for pinpointing — with a laser beam — the location of enemy tanks. We contracted with Martin Marietta and Grumman for each to build a TMAP, and performed acceptance testing at Sandia and during field exercises at Fort Benning (Ga.) and Camp Pendleton (Calif.). (5200)

- We designed and delivered a clip-in **simulator for B-52 aircraft nuclear-bomb-delivery training**. The clip-in simulator is an electronic device capable of simulating the electrical and mechanical features of the clip-in assemblies used to carry four B28, B61, or B83 nuclear bombs on the B-52. This

simulator, combined with another Sandia-developed interface simulator, provides — for the first time — realistic B-52 bomb-delivery training without the need to use aircraft clip-in assembly hardware. (5100)

- We completed development and evaluations of **subsystems for advanced guidance and control systems**. One — our first miniature (12-lb.) Ring-Laser Gyro inertial measurement unit — combines high environmental capability with high accuracy and low power drain (less than 15 watts). We also demonstrated, in tests at the HERMES III facility, a circumvention recovery program that enables high-speed microprocessors to be used where transient radiation levels would exceed the operating radiation limits of the microprocessors. A circumvention recovery program restores the system software to its previous state, allowing the system to continue its mission with minimal error. A special-purpose computer, based on AT&T digital-signal processor technology and designed for airborne and missile applications, was also developed. The computer — an extension of SANDAC (SANDia Airborne Computer) technology — occupies less than 25 cubic inches, is capable of 12.5 million floating-point operations per second, and consumes less than 5 watts of power. (2300)



PROJECT STARMATE rocket used for high-altitude experiments awaits launch from new facilities at Sandia's Kauai Test Facility in Hawaii.

Energy/Environment

- We developed, constructed, and tested a **bench-scale liquid-sodium heat-pipe solar receiver** to determine fabrication techniques and operational capabilities of a large heat-pipe solar receiver. Under heavy thermal loading, the wick in the heat pipe was able to continually pump liquid sodium almost one foot against gravity using capillary action alone. This technology is being used to build a solar receiver that can efficiently transfer high-energy fluxes from the focal point of a parabolic-dish solar concentrator to heater tubes of a Stirling engine that will drive an electric generator. The bench-scale testing system allows alternate wick configurations to be tested safely and inexpensively before full-scale testing is attempted. (1500/2500/6200)

- We achieved a peak solar-to-electric conversion efficiency of 20.3 percent, a **new record for a photovoltaic module**. The module features improved solar cells, transparent cell covers to reduce reflection losses from cell grid lines, and low-cost cell mounts. A combination of industry, university, and internal Labs efforts funded by DOE

contributed to component development. We consider the cells and cell mounts of our module to be prototypes for commercial use in the near future; in fact, several companies are now adapting our ideas for their module designs. Simplified packaging techniques using proven materials in novel ways are expected to decrease cost and to enhance reliability. (6200)

- We demonstrated the **use of solar energy to destroy toxic wastes** while leaving no harmful by-products. Two different methods were successfully tested: one for purifying water and the other for destroying concentrated organic wastes. The first uses a simple titanium-dioxide catalyst and the ultraviolet portion of sunlight to convert low concentrations of organics (for example, solvents and pesticides) to only carbon dioxide, water, and dilute halogen acids. The second uses the high-temperature (800 to 1000°C) capabilities of concentrating solar systems to convert toxic organics (such as contaminated solvents and alcohols) to useful fuels or chemical feedstocks. We are working with industry to accelerate commercial implemen-

tation of these processes. (6200)

- In our fuel-oxidation studies, we discovered a gas-phase chemical mechanism for the **catalytic dehydration of alcohols**. Reactions in which the oxidizing free radical OH abstracts a hydrogen atom from most alcohols produce intermediate species that dissociate at elevated temperatures to OH + alkene; the net reaction is the conversion of the alcohol to water + alkene. This reaction sequence intimately links the combustion chemistry of alcohols, which are potential alternative fuels, and alkanes — the predominant components of gasoline. Because both alcohols and alkanes are now known to burn through the production of alkene intermediates, our models of alkane combustion will be transferable to a detailed understanding of how alcohols burn. (8300)

- We used **degenerate four-wave mixing (DFWM)** to detect OH and NH (small molecular species important in combustion processes) and to measure temperatures in flames. A very promising laser-based diagnostic, DFWM creates a highly collimated signal beam, permitting efficient rejection of interfering radiation, and requires minimal optical access. DFWM has also allowed us to make two-dimensional images of molecular distributions in atmospheric-pressure flames. The phase-conjugated images from single laser pulses exhibit excellent signal-to-noise ratios and illustrate that DFWM has outstanding potential as a multidimensional diagnostic for combustion environments. (8300)

- A major problem for the Waste Isolation Pilot Plant program has been determining the amount of brine that can be expected to flow into the repository after it is sealed. We planned and initiated a **large-scale brine-inflow experiment**, for which a 3-metre-diam., 100-metre-long cylindrical room was

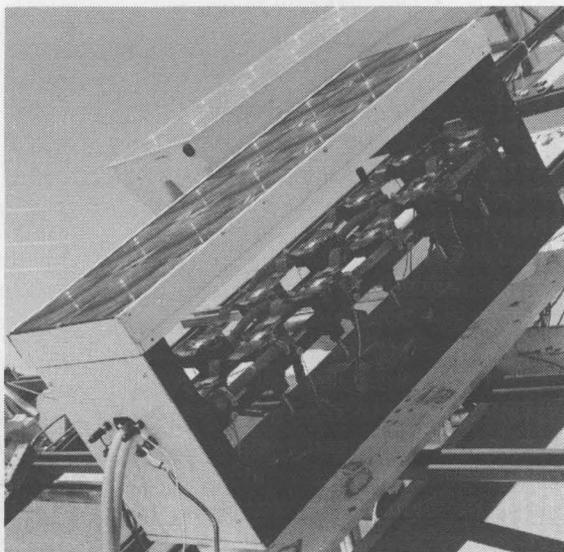
mined in the Salado Formation. The experiment — instrumented to measure room closure, patterns of crack formation close to the excavation surface, room humidity, brine inflow, and pore pressure at various depths in surrounding rock — will continue collecting data for three to five years on the possibly interrelated phenomena of brine inflow and room closure. (6300)

- We significantly improved analysis capability for **predicting creep closure** of the waste storage rooms in the Waste Isolation Pilot Plant. Over almost a five-year period, agreement within 2 percent was achieved between calculations and experimental measurements for the vertical closure behavior of one of the design-validation rooms excavated specifically to allow monitoring of displacements; previous comparisons had differed by a factor of three. (6300)

- We established the **Sandia Aerosol Research Laboratory** for the investigation of airborne particulate material and the development of aerosol instrumentation. The laboratory's state-of-the-art capabilities include calibration of aerosol generation, calibration and characterization of instruments, and sampling and measurement of aerosols from hostile environments. The facility has provided support to programs related to nuclear reactor safety, fuel-air explosives, and microcontamination in clean rooms. It also provides the capability to address other aerosol-related issues: site remediation efforts, production-reactor safety evaluations, and nuclear materials safety. (6400)

- In a joint effort with the University of Pennsylvania and the National Center for Electron Microscopy (NCEM) at Lawrence Berkeley Laboratory, we collaborated on the first experimental and theoretical determination of the **detailed atomic structure of grain boundaries**

RECORD-SETTING PHOTOVOLTAIC MODULE features improved solar cells, transparent cell covers to reduce reflection losses, and low-cost cell mounts. The module achieved a peak solar-to-electric conversion efficiency of 20.3 percent.



in a metal. High-resolution transmission electron microscopy performed at the NCEM, and more recently at a new Sandia facility, has been used to resolve the structure of grain boundaries in aluminum on the scale of atomic separations. The atomic positions at the boundaries cannot be deduced directly from micrographs, so the Embedded Atom Method — developed earlier at Sandia, Livermore — was used to calculate the atomic positions from which a simulated micrograph was produced. Agreement between the experimental micrographs and the theoretical simulations is excellent. (8300/LBL/U. Pa.)

● We provided the key geotechnical analysis for a DOE study being used by Congress as it considers expanding the nation's **Strategic Petroleum Reserve** from the currently authorized 150 million barrels to one billion barrels. Our analysis developed criteria and data — based on technical, security, environmental, and economic considerations — that narrowed the potential 550 salt domes available for storage to a few domes, plus expansion of existing sites. (6200)

● We completed a laboratory model that validates the concept of **acoustic telemetry in standard drill pipe**. This approach to transmission of data (drilling, formation, and safety parameters) while drilling can increase data rates by at least one order of magnitude. We constructed transducer arrays that transmit (or receive) waves in only one direction and that provide active noise and echo cancellation. This technology has been formally transferred to industry for commercial evaluation and development. (6200)

● We participated in the design and R&D of the plasma-facing components for the **International Thermonuclear Experimental Reactor** project, which involves the US, Soviet Union, Japan, and the European community. The proj-

ect, in Garching, West Germany, may ultimately lead to the development of a 1000-megawatt (thermal) tokamak that produces sufficient heat and confinement times to approach the ignition of deuterium and tritium. Our work on fabrication technology, thermo-hydraulic and stress analysis, tritium retention and inventory, and disruption and runaway electron analysis has been directly incorporated into the design of several reactor components. (6400/1100/8300)

● We continued our evaluation of the Yucca Mountain (Nev.) site as a possible location for the nation's first **civilian radioactive waste repository**. We participated in a major DOE study to evaluate the impacts of a monitored retrievable storage facility on the total waste management system and conducted a cost/benefit study on design of the repository surface-waste handling facilities to withstand a range of earthquake amplitudes. In support of the exploratory-shaft facilities (ESF) design, we defined ESF requirements and developed a seismic design basis. We successfully implemented a DOE and Nuclear Regulatory Commission-accepted quality assurance program — a prerequisite for initiating site-characterization activities at Yucca Mountain. (6300)

● We developed a **technical approach to nuclear plant license renewal** that will extend nuclear power plant operation from 40 years to 60 years and beyond. The culmination of a three-year development effort, "Methodology to Evaluate Plant Equipment for License Renewal" establishes the technical framework for license renewal and specific criteria for implementation. The approach — endorsed by the Nuclear Management and Resources Council as the nuclear industry's official position — will be used to evaluate the first two plant-license renewal applications, which will establish and demonstrate the regulatory process. (6500)

Technology Transfer

● In collaboration with the University of New Mexico School of Medicine, we developed a **blood glucose sensor for diabetes management**, using infrared spectroscopy and chemometric data analysis. The sensor can determine blood sugar levels as precisely and much faster than the enzymatic method currently used in hospitals nationwide. It would currently be useful to diabetics in surgery, childbirth, or intensive-care situations. Extension of the technology to noninvasive blood sampling is under way, a development that would significantly improve the daily quality of life for millions of US diabetics. (1800)

● The **Semiconductor Equipment Technology Center (SETEC)** was established at Sandia. The Center will operate with funding from SEMATECH, the government-industry consortium attempting to improve international competitiveness of US integrated-circuit (IC) manufacturers. Tools such as furnaces, etching and deposition reactors, and photolithography systems are critical elements in IC manufacturing; thus, a strong IC industry depends on ready access to a strong tool industry. The SETEC mission is to transfer Sandia's advanced technologies and computer models — generally not available to tool companies — to the tool industry. (1100)

● We expanded our efforts to understand the fundamental chemistry, fluid mechanics, and heat transfer of materials processing by **chemical vapor deposition (CVD)**; currently, we are working with United Technologies Research Center (Hartford, Conn.) to scale the CVD process of applying structural coatings on composite materials. In other CVD work, our predictions of the parameter space for stable flow in a rotating disk reactor were confirmed experimentally, and we made the first pre-

dictions of time-dependent and three-dimensional flow in horizontal and inclined reactors. In association with SEMATECH, we are scaling our models of a rotating disk reactor for semiconductor processing. (8200)

● As part of a more aggressive approach to technology transfer, we developed a **technology maturation program**. Under the program, selected Sandia-developed technologies with potentially high commercial value will be brought to a level of maturity that will enable industry to undertake the remaining risks and costs of developing a marketable commercial product. Fifteen one-to-three-year projects, involving 20 Sandia organizations, have been selected for funding in FY90. (400)

● We helped develop an active, on-line **data base to help promote technology-based economic development in New Mexico**. The data base, on-line at New Mexico Technet (a private, nonprofit network communications organization), is a combined effort of volunteers from business, industry, and universities. It was developed under the auspices of the Governor's Technical Excellence Committee and the New Mexico Department of Economic Development and Tourism. Data-base information includes technical support or R&D services — and the sales and procurement of technical products and services — of New Mexico companies and research organizations. On average, 150 data-base inquiries are received each month. (400)

● Mentor Graphics (Beaverton, Oreg.) has integrated a **Sandia-developed software program** into its Cellgraph Electronic Design Automation tool. The software program, with more than 400,000 lines of code, is used in the layout of integrated circuits. Mentor refined the code, made it more user-friendly, and is now marketing the Cellgraph tool. (2100)

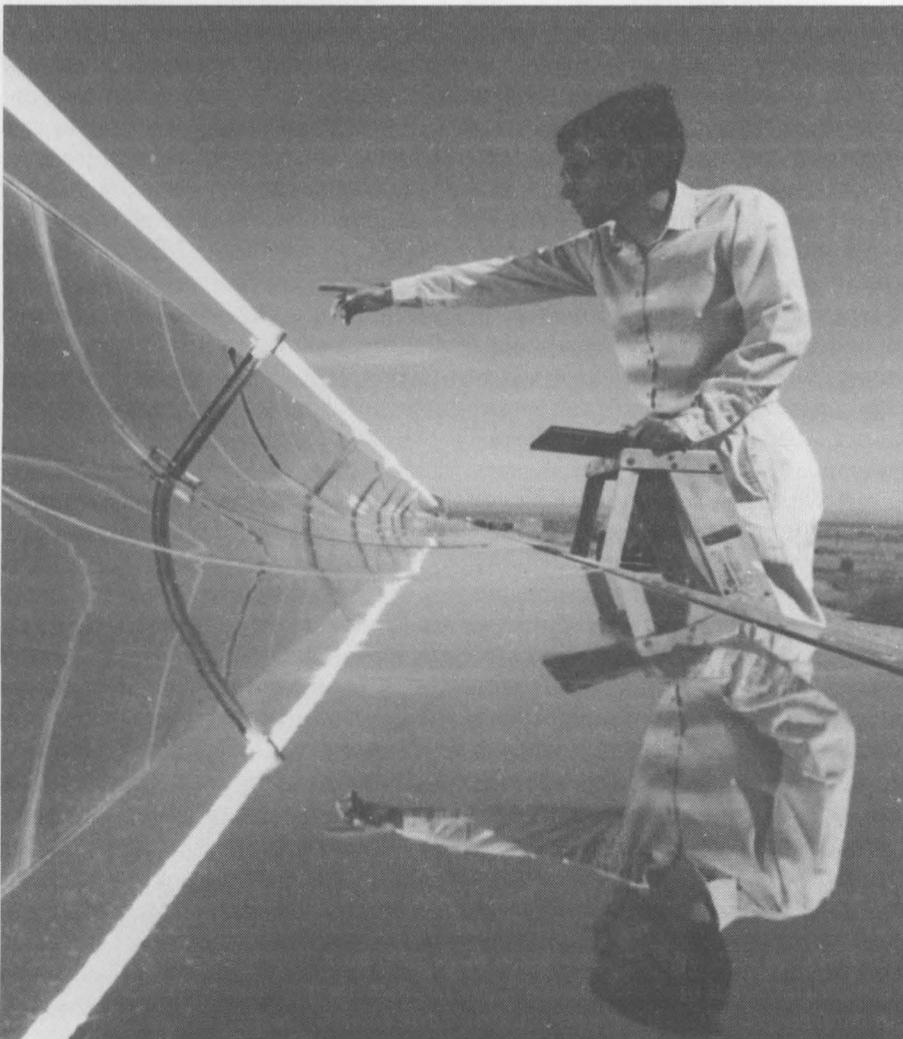
Laboratories Support

● We completed a new computerized **Personnel Reporting System** — a modern, menu-driven system that provides human-resource information services to the Labs. Sandia staff and management, with on-line screens, can retrieve Labs-wide manpower statistics and detailed information about organizations, jobs, and employees. Customers may schedule reports as they need them, and downloaded data to the customer's PC may be used instead of hard copy, if desired. The system also provides better access to previously generated Personnel programs and data. (3500)

● We implemented the first major phase — a new Personnel Reporting System — in the switchover of **administrative information systems** from UniSYS to IBM. Commercial software packages were procured for the Financial and Human Resource Information systems. The Integrated Procurement System Replacement development team used a new approach called APLAN to define system re-

quirements; APLAN allows customers to use the new system and refine their requirements before making a heavy investment in programming. The new system also allows uncleared employees to access the Laboratories Information System and Human Resources nodes. (2600)

● The **ES&H (Environment, Safety, and Health) effort** at Sandia, Albuquerque, was elevated to directorate-level status to better meet the expanding needs of the Labs in institutional ES&H training, documentation, and internal appraisal. A pilot internal appraisal of priority areas was conducted, followed by the first Labs-wide external assessment of ES&H regulatory compliance. The latter provides a structure for planning an intensive, comprehensive OSHA and environmental-regulation compliance survey to be conducted this fiscal year. Also, we established training programs in construction safety, rigging, and hoisting, and set up a hazards-communication system. (3200)



JIM PACHECO (6216) inspects facility used in a program involving the use of solar energy to destroy toxic wastes in water and organic wastes.

• Thirty-two **underground storage tanks** (40 percent of all underground storage tanks at Sandia, Albuquerque) were removed. Removal activities included documentation, soil sampling and analysis, and decontamination, where necessary. The old tanks have been replaced with above- or below-ground tanks that have leak-detection and level indicators, secondary containment, and over-fill protection. The new tanks dramatically decrease the leak threat posed by unprotected and uncontained tanks. (3200/7800)

• We established a **chemical exchange program** whereby the availability of free unused chemicals is publicized in a list published monthly. Thus far, six vice-presidencies have participated in the program, saving the purchase price of new chemicals and the disposal costs that would have been incurred had the chemicals been discarded. The exchange program also fulfills regulatory requirements to minimize hazardous wastes. (3200)

• We installed **monitoring networks to intercept groundwater** at the surface level of the water table in Area III, where previous waste management practices included the shallow burial of chemical wastes and radioactive/mixed wastes at two separate locations. The monitoring networks include 10 wells drilled to a depth of 500 feet. The monitoring program will use these and other wells to determine local and regional flow patterns; also, we will use numerical simulations of local flow paths to estimate the effectiveness of the networks to detect contamination. A continuing program of sampling and analysis will assure the landfills are not affecting groundwater beneath each site. (3200)

• The **Supernet parallel processing system** permits a single application program to use Sandia's entire network of Vaxes as a single distributed computing resource. One application runs more than twice as fast on Supernet as it does on a Cray-1S, thus providing a new supercomputing capability through efficient use of existing hardware. The Supernet project was cited during FY89 by *Research & Development* magazine as one of the 100 best technical accomplishments of the preceding year. (8200)

• As the lead lab for technical development and implementation of DOE's **Computer Integrated Manufacturing (CIM) program**, we implemented weapon-complex-wide agreements for the exchange of drawings and specifications using electronic methods. We provided major inputs for the CIM complex-wide tactical plan, which serves as the keystone for continued improvement of electronic exchange of information. (2800)

• As part of the Nuclear Weapon Complex (NWC) Quality Managers' subcommittee on **software quality assurance (SQA)**, we worked on assigned activities that included establishing a common NWC glossary of SQA terminology, investigating and compiling abstracts of SQA-requirements documents affecting the NWC, developing and providing a survey to evaluate SQA activities and attitudes

within the NWC, investigating use of automated tools, and recommending strategies to achieve high-quality software. (7200)

• Among our **socioeconomic procurement accomplishments**: More than \$314 million — almost 60 percent of the Labs' total commercial procurement dollars — were placed with small businesses, exceeding our goal by more than \$16 million. We also accomplished our goals of 10.4 percent for awards to disadvantaged businesses and 6.1 percent to woman-owned businesses. (3700)

• To enhance our total procurement quality, we developed and implemented a **vendor rating system** for suppliers providing manufactured items based on Sandia drawings. We held a briefing for more than 150 local vendors to explain the inspection and delivery criteria for this rating system. Local mechanical and electrical suppliers receive monthly reports of their delivery and quality performance. (7400/3700)

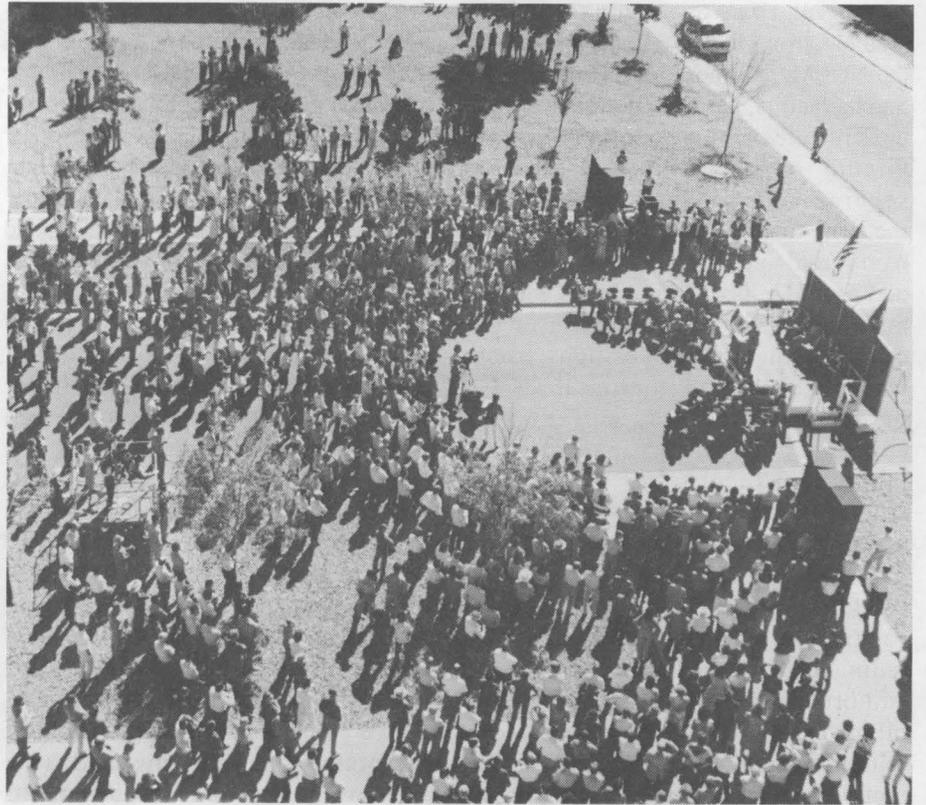
• Construction was begun on the **Acoustic Test Facility** in Tech Area III. The facility's 16,000-cu.-ft. chamber will provide the capability for high-intensity acoustic testing to simulate satellite launch and similar environments. The chamber has been designed for an overall sound pressure level of 160 decibels. Scheduled completion date: April 1990. (7800)

• We designed and began construction of the **Radioactive and Mixed Waste Management Facility** in the southeast corner of Tech Area III. (Mixed wastes are toxic materials that have been radiologically contaminated.) The facility will be used for analyzing and processing Sandia-generated wastes in preparation for transport to a permanent storage facility. (7800)

• The **Neutron Measurement Facility** was constructed in Tech Area IV to support internal confinement fusion experiments conducted at the Particle Beam Fusion Accelerator II. The new facility, located on a direct line of sight to the center of PBFA II, is a separate building, since high-quality neutron measurements can be made only at large distances from the target (because of the neutrons' high initial velocity after a fusion reaction occurs). The facility will also support other related nuclear diagnostics. (7800)

• Construction of the **Computer Aided Engineering/Rocket System Development Lab (CAE/RSDL)** was completed. The new CAE facility will allow potential customers to receive instruction on state-of-the-art hardware and to test-run new software/hardware package combinations at one location. Since the facility is constantly receiving and reviewing new hardware systems, its design is flexible and easy to modify. For example, the entire office and computer-lab complex is built on a raised floor, allowing easy access to the subfloor plenum for modifying cabling as needs change. (7800)

• **AT&T's management of Sandia for the past 40 years** was commemorated in several ways. Employees and retirees received a 40th-anniversary lapel pin and a copy of "Recollections for Tomorrow," a specially prepared booklet of



AT&T's MANAGEMENT OF SANDIA for the past 40 years was recognized in several ways. Shown here is part of the large crowd of Sandians who gathered for the 40th anniversary commemorative program.

vignettes about our first 40 years. LAB NEWS published a special anniversary issue. About 2500 employees and special guests, including former members of Small Staff, attended a commemorative program last fall in Tech Area I; ceremony highlights included an employee presentation to AT&T, presentation of the first Sandia Award for Excellence to Sol Buchsbaum (EVP, AT&T Bell Labs), and reissue of the Sandia Corporation stock certificate. (3100/3400/3700/7800)

• We bargained a **labor agreement with the Nonregular Recurrent Security Inspectors (NRRSI) Union** — the first new labor agreement at Sandia, Albuquerque, since 1952, and the first ever for a group of nonregular employees. The agreement balances the union members' requirement for economic security with the Laboratories' requirement for an on-call, supplemental security force. (3500)

• We conducted a **Labs-wide employee communications survey**, with the objective of assessing trends and measuring progress or changes in Sandia employee attitudes since the August 1984 benchmark communications survey. Follow-up actions and programs that address survey findings are being planned. (3100/3500)

• We began a **connector selection program** that enables system and subsystem engineers, using desktop terminals, to quickly and easily locate information about connectors that best meet their requirements. Through the program, engineers can search for connectors by either nomenclature or requirements; information provided includes contact-type and materials, product specifications, types of mating connectors, and associated accessories for each connector. (2500)

• We completed the conversion to **Computer Aided Design (CAD)** stations for production of all new design definition using electronic methods. The use of CAD, integrated text/graphics systems, and general computer support systems allows de-

sign production entirely in digital form. Products include drawings, specifications, procedures, and standards. Also, Sandia's design-definition contractor has been converted to electronic methods. (2800)

• We converted the exempt **technical-employee classification system** into one consisting of three levels of Members of the Technical Staff: MTS, Senior MTS, and Distinguished MTS. The new system fosters the hiring of BS engineers to create a better job/skills match, provides a career ladder for technical staff members, recognizes the continuum existing in MTS work, and strengthens Sandia's contractual posture by increasing comparability with AT&T. (3500)

• We implemented a health care management supplement (**Health-\$mart**) to the Sandia Medical Care Plan. The supplement will help Sandia manage health care costs and maintain high-quality coverage in the face of rising health care costs. It includes new and changed benefits, including coverage for alternatives to in-patient hospital treatment; pre-treatment review of hospitalization, surgery, and psychiatric/chemical dependency treatment; and a medical information telephone hot line. (3500)

• We established broad **new technical curricula** to support the major quality initiative of Sandia. So far, the program consists of three new curricula: Design for Manufacturability, Project Engineering, and Software Engineering. Also, some existing courses will be modified into two other curricula: Core and Computing. Methods and strategies being introduced in these curricula will significantly enhance the quality of Labs designs, with an emphasis on performance, cost, and timeliness. (3500)



feed back

Q. I recently visited Bell Laboratories and was impressed to see two waste baskets in each office. One was actually for waste; the other was for recyclable paper. With Sandia's large ES&H compliance effort now under way, it seems that we should also consider such a system to minimize solid waste. In the same spirit, we could perhaps also provide a collection point in each building for aluminum; a central location such as the janitors' closet or near the elevators would work. It would be very easy to find volunteers to pick up aluminum. Recyclable paper may require a contractor to pick it up from each building's dock. Could Sandia initiate these environmental programs?

A. Sandia currently recycles precious metals and some other selected scrap metals. When new telephone books were issued, the coordinator of "Keep Albuquerque Beautiful" helped us locate a recycler who accepted our old books. Individual employees, on their own initiative, are recycling aluminum cans.

Sandia's earlier paper-recycling program was discontinued in 1986 because it was very labor-intensive and not cost-effective. While we continue to be interested in economical ways to handle all solid wastes — we monitor the various programs and approaches used elsewhere — we must carefully weigh the options to assure that all taxpayers' interests are considered.

Jim Martin — 3400

Collector's Piece: A Masterpiece



An art dealer in Sydney, Australia, was appalled to learn that two men who bought a signed Picasso print for \$10,000 planned to cut it into 500 pieces and sell them for \$135 each by mail order. One of the mail order tycoons, unabashed, responded that "if this thing takes off, we may buy other masters as well and give them the chop."

Wall Street Journal

Alcohol + Other Drugs = Trouble for Teenagers — And Teenagers' Parents

By Steve Anderson, Substance Abuse Program

If you're a parent of teenagers, you probably worry about how well your kids handle pressures to use alcohol and/or other drugs. If you have the idea that alcohol is less dangerous than some of the other stuff, think again. Alcohol is a drug and, in fact, is the drug of choice for most teens.

Let's face it; adolescents are under a lot of pressure about drugs — from their peers ("join the crowd"), or from ads and news stories that imply that "everybody's doing it" (including movie stars, sports heroes, and politicians). Internal pressures, such as the need to escape from unpleasant emotions or to feel more confident about appearance or actions, can also trigger drug use by teenagers.

You Can Help

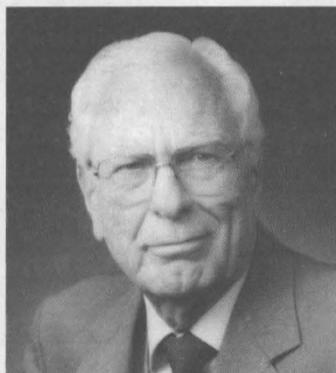
As a parent, you can help your teenager cope with those pressures. The place to start is at home. Teens need plenty of love, good family communications, and calm and consistent standards about drug and alcohol abuse.

Educating yourself about symptoms that could imply drug use is another important parental re-

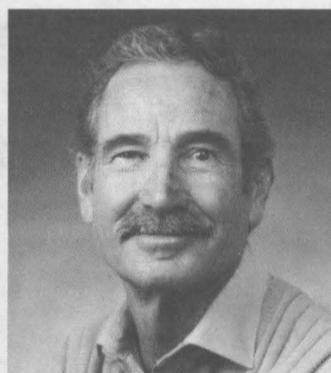
sponsibility. Some of the things to look for: behavioral problems, including arguing, lying, and irresponsibility; new friends, especially if they are older; bad grades and poor school attendance; hyperactivity, drowsiness, or forgetfulness; depression or mood swings; weight gain or loss, junk-food cravings; disappearance of alcohol, drugs, or possessions from your house; and less involvement in family activities.

If you believe your teenager has a drug or drinking problem, you can take action in several ways:

- Call Florence Parnegg, Sandia's Substance Abuse Program Family Counselor, on 4-3993 to learn more about alcohol and other drugs;
- Choose an appropriate time to talk calmly and honestly with your teenager about changes you see and harmful consequences of drug abuse;
- Don't protect or make excuses for a teenage drug abuser; shielding him/her from the effects of abuse can have severe long-term consequences; and
- Talk with other parents and join a support group such as Al-Anon.



Billy West (7135) 37

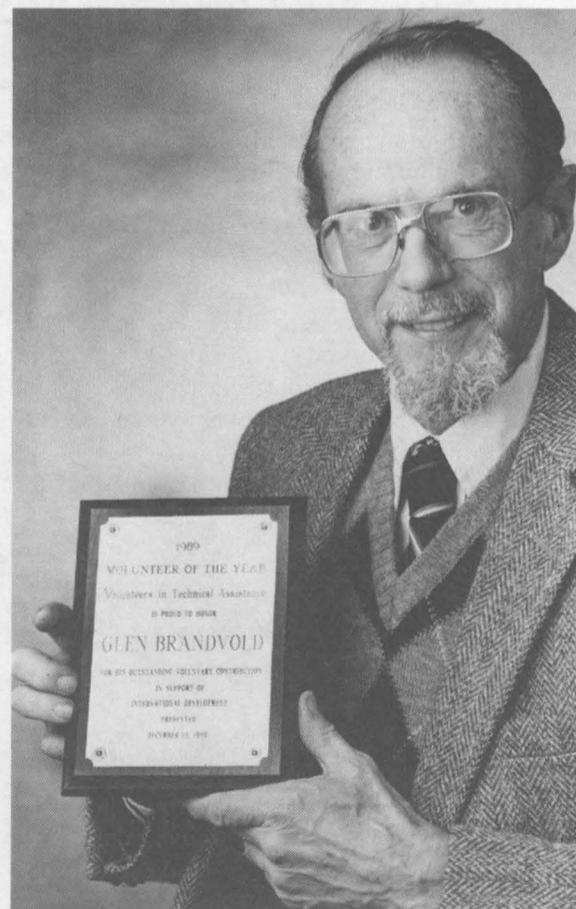


Donald Bush (2525) 35

Recent Retirees

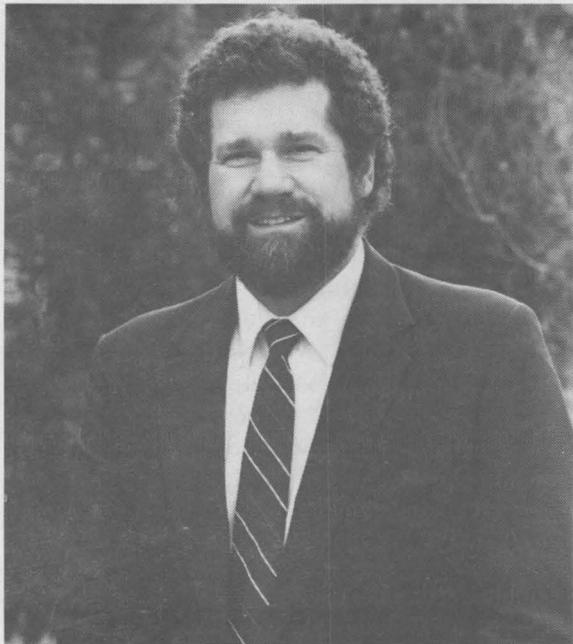


GOING IN STYLE! — Bill Myre as he prepared to pull out of his parking spot for the last time when he retired Feb. 9. Bill was Director of Monitoring Systems 9200 when he retired, and earlier was Director of Nuclear Security Systems 5200. He joined the Labs' field test organization in 1950 after graduating from Texas A&M University and spent his entire career — more than 39-1/2 years — at Sandia. Bill's auto — a 1941 Chevy "Businessman's Coupe" — was a familiar site along "executive row" in front of Bldg. 800; he bought the car in '63 and drove it to work regularly. Bill wears this hat (it just looks older than the car) only when driving this car and when river-running — one of his hobbies. He says he may use some retirement hours to restore the car. We don't know if he plans to restore the hat.



GLEN BRANDVOLD (ret.) was notified recently by VITA (Volunteers in Technical Assistance) that he'd been selected to receive that organization's Volunteer of the Year 1989 award, shown here. VITA cited Glen for his "unselfish contribution" in helping start up a photovoltaics-panel factory in Morocco last year (see LAB NEWS, Nov. 17, 1989). VITA is a private, nonprofit organization that's a clearinghouse for requests for technical assistance from people in third-world and developing countries.

Supervisory Appointments



RONALD TRELLE to supervisor of Project Engineering Div. II 5176.

Ron joined the Labs in June 1976 as a member of the Minicomputer Software Division, where he provided Labs-wide minicomputer software support, including writing software for system test equipment at Pantex, data acquisition at Sandia's wind tunnel, and device control for survivable command center programs.

In March 1985, Ron transferred to Project Engineering Div. I, and was temporarily assigned to the Defense Communication Agency in Washington, D.C. He returned to Albuquerque in 1986. Before his promotion, he was project leader for the Strategic Air Command Proof-of-Concept/Experiment Test Bed (POC/ET) survivable command center project.

Ron has a BS in physics and an MS in computer science from New Mexico State University. Before coming to Sandia, he was an Air Force officer, working in the Operations Research Division of the USAF Data Automation Agency. He has been a member of the Digital Equipment Corporation User Society (DECUS) at the national and local level since 1976.

He enjoys racquetball, skiing, and music. Ron, his wife Patricia (2315), and his daughter live in the NE Heights.

TED FREDERIKSEN to supervisor of Test Operations Section 7264-1.

Ted joined Sandia's Weapon Evaluation Test Laboratory Division at Amarillo in February 1983. His work has involved testing the W50, W56, W80, and W84 fuzing and firing sets.

He attended Miami (Ohio) University's electrical engineering program, and has an AAS in electrical engineering technology from Amarillo College. He worked for Monsanto Research Corp. at its Mound Lab in Miamisburg, Ohio, for 18



TED FREDERIKSEN (7264-1)

years, doing production testing for 42 Sandia-designed explosive components.

Ted is a pilot, ham radio operator, and an American Red Cross CPR and first-aid instructor.

He and his wife Kathy have two daughters and live in Amarillo.

BOB BENNER to supervisor of Parallel Computing Science Div. 1424.

Bob joined the Labs in November 1983 as a member of Fluid Mechanics and Heat Transfer Division I. He worked on several fluid mechanics research and code development projects using the Cray 1 and on an ELXSI parallel computer.

In 1986, he joined the new Parallel Processing Division, where his research continued on an NCUBE hypercube computer.

Bob and his colleagues subsequently won the first Gordon Bell Award and the Karp Challenge in 1988 and an R&D 100 award in 1989 for their research in applications, algorithms, and software for massively parallel computing.

He has a BS in chemical engineering from Purdue and a PhD in the same field from the University of Minnesota. He's a member of the Society for Industrial Applied Mathematics, the



BOB BENNER (1424)

Institute for Electrical and Electronic Engineering, and the Computer Society.

Bob enjoys softball, fishing, reading, remodeling, and furniture finishing. He and his wife Jannette are expecting their third child. They live in the NE Heights.

GARY SANDERS to supervisor of Safety Assurance Studies Div. 7232.

Gary joined Sandia in September 1980 as a member of the Reactor Safety Studies Division, where he analyzed decay heat removal and studied the impact of natural-disaster emergencies (hurricanes, lightning, tornadoes, tidal waves, earthquakes) on nuclear reactors.

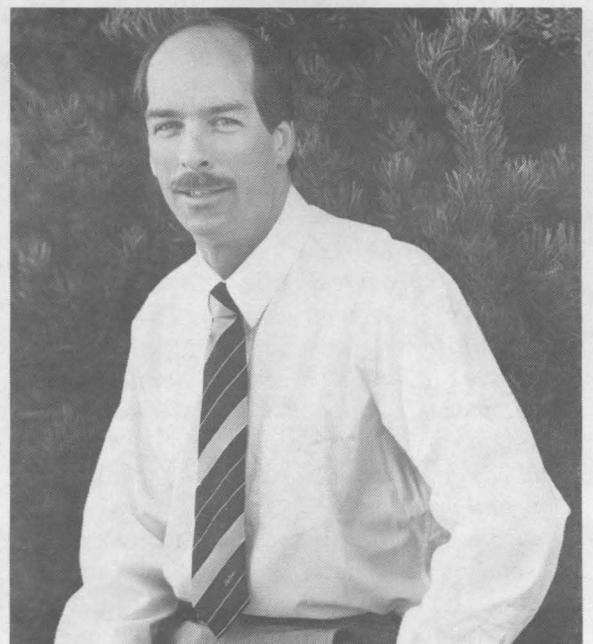
In 1986, he transferred to the Safety Assurance Studies Division, where he studied insensitive high-explosive response to lightning, nuclear weapon responses in abnormal environments, and future safety concepts. He also designed a safing/arming/firing system for NTS and reviewed weapon system safety features.

Gary has a BS in nuclear engineering and an MS in mechanical engineering, both from Pennsylvania State University. Before coming to Sandia, he worked for Bettis Atomic Power Laboratories in West Mifflin, Pa.

He enjoys skiing, karate, bicycling, and reading. He lives in the NE Heights.

ROBERT AXLINE to supervisor of Signal Analysis Div. 2344.

Bob joined the Labs in January 1976 as a member of the Signal Analysis Division, where he



GARY SANDERS (7232)

analyzed performance characteristics of the MC3049 radar fuze for the B83 bomb and predicted radio-wave propagation losses and signal-processing performance for radio-frequency communication and measurement systems.

In 1983, he transferred to the Electronic Development Division I, where he was project leader for a number of different electronic systems. He transferred to the Safety Assessment Technologies Division in 1986, where he performed adversarial analyses of weapon use-control systems. He co-authored "Guidelines for Software Security," a report describing techniques for enhancing security in critical, software-controlled systems. He also developed security enhancements for microprocessor-controlled systems.

Bob has a BS, MS, and PhD in electrical engineering, all from the University of Kansas. Before joining the Labs, he worked for Teledyne Brown Engineering in Huntsville, Ala.

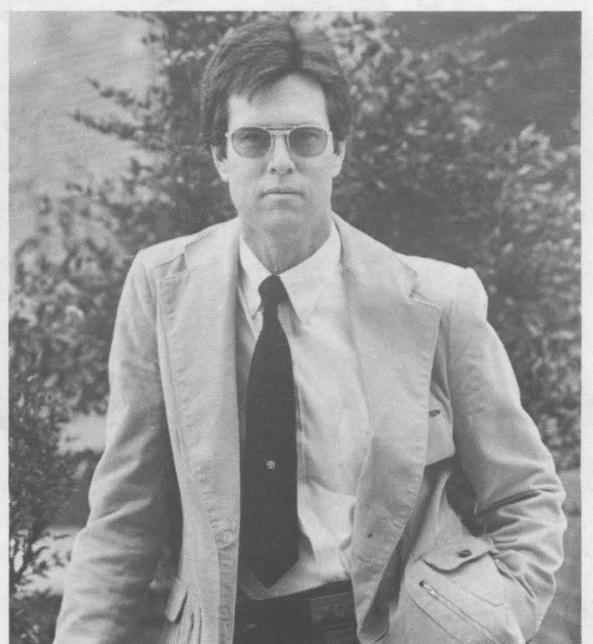
He enjoys music, reading, softball, and four-wheeling. He and his wife Terry have three children and live in the NE Heights.

WILLIAM NICKELL to manager of Telemetry Development Dept. 5140.

Bill joined Sandia in December 1965 as a member of the technical staff. He developed concepts for using digital instrumentation and computer techniques for underground nuclear weapon testing, performed weapon Phase 1 and 2 activities, participated in nuclear reactor safety studies, and did advanced weapon development.

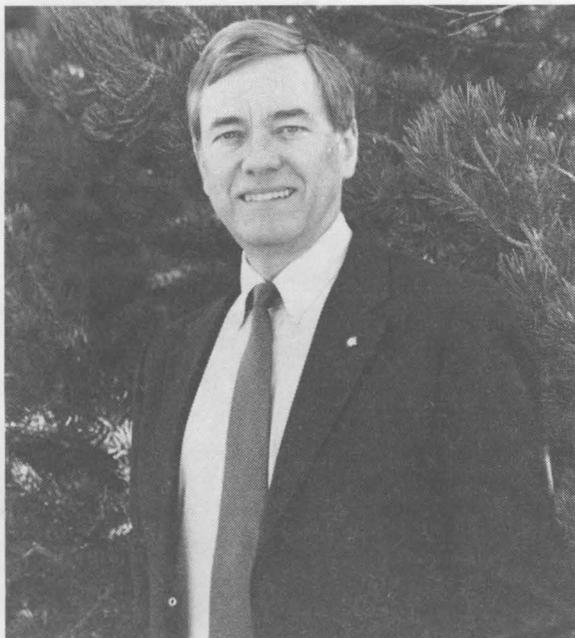
In 1979, he was promoted to supervisor of the W81 Development Division. He also supervised the Peacekeeper Fuze Development Division. Be-

(Continued on Next Page)



BOB AXLINE (2344)

Supervisory Appointments



BILL NICKELL (5140)

(Continued from Preceding Page)

fore his recent promotion, he was supervisor of the W88/Mk 5 Arming, Fuzing, and Firing Division, responsible for the design, development, and analysis of a major assembly for the Trident missile system.

Bill has a BS in electrical engineering from UNM. During an Air Force tour at the National Security Agency, he completed the Catholic University of America's master's study program. Before coming to Sandia, Bill worked for Philco-Ford Computer Division in Willow Grove, Pa., Packard Bell Computer, and Ford Motor Company. He is a member of Sigma Xi.

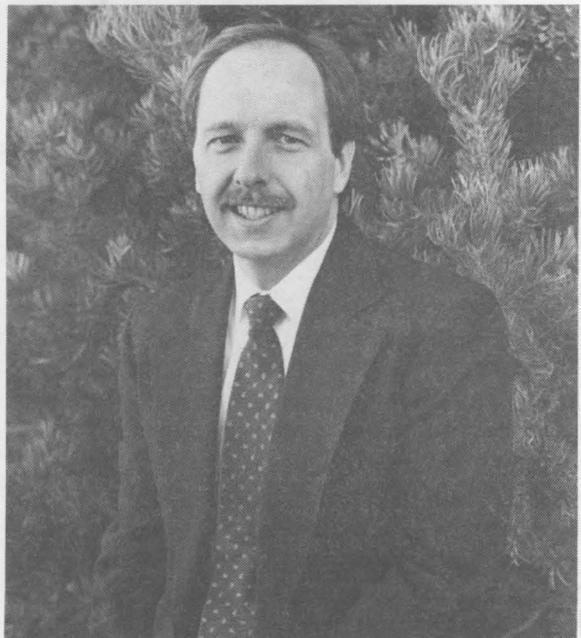
He enjoys golf, personal computers, photography, and the commodities market. Bill and his wife Carole have four children. They live in the SE Heights.

WAYNE POTTER to supervisor of Employee Accounting Div. 152.

Wayne joined Sandia in January 1981 as a member of the Contract Auditing Division. In January 1984, he became administrative assistant to Semiconductor Components Org. 2100. He joined the Capital Planning and Control Division in November 1986 as a budget analyst, working on Sandia's construction budget. While in that division, he provided staff support to the Budget Options Group. He was promoted to supervisor of Payroll Section 152-1 in May 1988.

He has a BA in architecture and an MBA in accounting, both from UNM.

Wayne enjoys running, flag football, skiing, and camping. He and his wife Petra have three children (triplets) and live in the NE Heights.

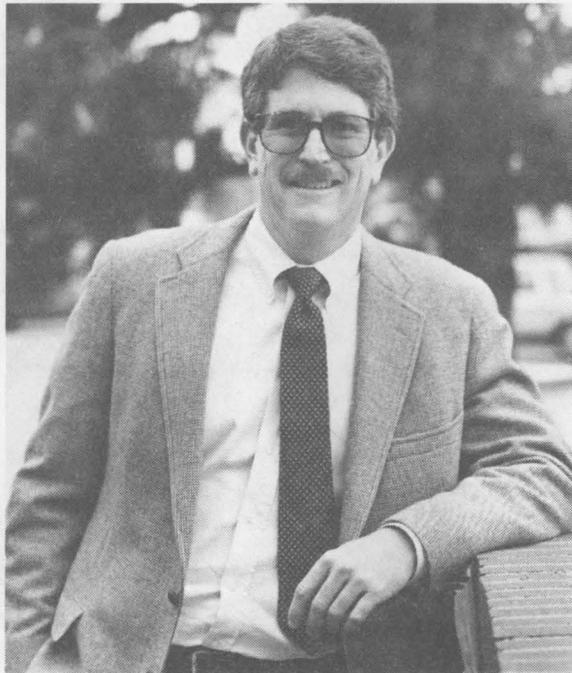


WAYNE POTTER (152)

HAROLD MORGAN to supervisor of Applied Mechanics Div. I 1521.

Hal joined the Labs in January 1980 as a member of the Computational Physics and Mechanics Division I in the Solid Dynamics Department. He did structural calculations supporting the WIPP project, including benchmarking structural computer codes. In 1982, he transferred to the Applied Mechanics Division I, where he continued to provide computational support to WIPP. He also developed and implemented models for creeping materials and low-density foams, for use in structural finite-element codes. Hal performed stress analyses of radars and other electrical components.

He has a BS, an MS, and a PhD in mechanical engineering, all from Southern Methodist Univer-



HAL MORGAN (1521)

sity. Before joining the Labs, he worked for Texas Instruments in Dallas. He's a member of the American Society of Mechanical Engineers.

Hal enjoys basketball, softball, golf, and coaching youth sports. He and his wife Linda have four sons and live in the NE Heights.

JAMES ASAY to manager of Solid Dynamics Dept. 1530.

Jim joined Sandia's Thermomechanical and Physical Research Division in March 1971, where he did materials properties research. In November 1978, he was promoted to supervisor of that division, and was responsible for directing experimental and theoretical research in various areas of shock-compression science.

He has a BS with honors from San Jose State University, an MS from UNM, and a PhD from Washington State University, all in physics. He's chairman of the Aeroballistic Range Association and the American Physical Society's Topical Group on Shock Compression of Condensed Matter, and a member of the Hypervelocity Impact Society's board of directors.



JIM ASAY (1530)

Jim enjoys camping and fishing. He and his wife Pat have three children and live in Peralta.

SHIRLEY RAMIREZ to supervisor of Property Inventory Section 3412-2.

Shirley joined the Labs in October 1966 and worked as a clerk-typist in the Personnel, Purchasing, and Security organizations. In 1980, she joined the Property Management Division as an inventory investigator, and in 1983 became Property Inventory Administrator.

She has completed several Sandia courses on computers, writing reports and procedures, and making effective presentations. Before joining Sandia, Shirley worked for the Bernalillo County Welfare Department.

She enjoys gardening, camping, fishing, and traveling. Shirley and her husband Ernest live in the NE Heights. They have two grown daughters.



SHIRLEY RAMIREZ (3412-2)

(Continued from Page Three)

Four-Wave Mixing

detector, and pictures were taken of the image.

The result was a "snapshot" detailing the molecular distribution of an OH molecule in an area corresponding to one-twentieth of a square inch, all done in less than ten billionths of a second. Such snapshots yield far more information than point measurements, according to David. For example, two-dimensional information can be used for understanding such phenomena as heat transfer from the cylinder walls of engines.

David plans to use more powerful lasers in the future to create larger pictures of the distribution of

molecules. In addition, Larry Rahn and Thomas are working with very-high-resolution lasers to better understand the details of four-wave mixing.

"We're trying to address the problems of American industry by using our strong technology base here," says David. "A lot of the basic research we perform is very difficult for industry to do; the capabilities to develop new techniques there often aren't available. Our goal is to develop useful tools for US industry, and we believe four-wave mixing could prove to be an important diagnostic tool for industrial use."

Research on degenerate four-wave mixing is supported by DOE's Energy Conversion and Utilization Technologies Program and Office of Basic Energy Sciences, Division of Chemical Sciences. ●

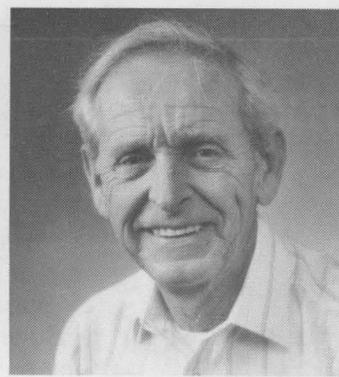
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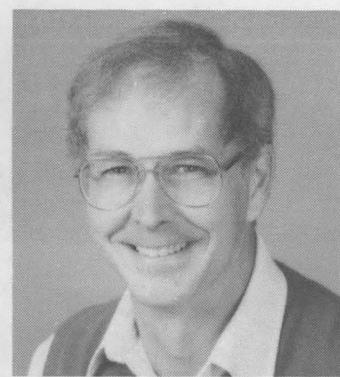
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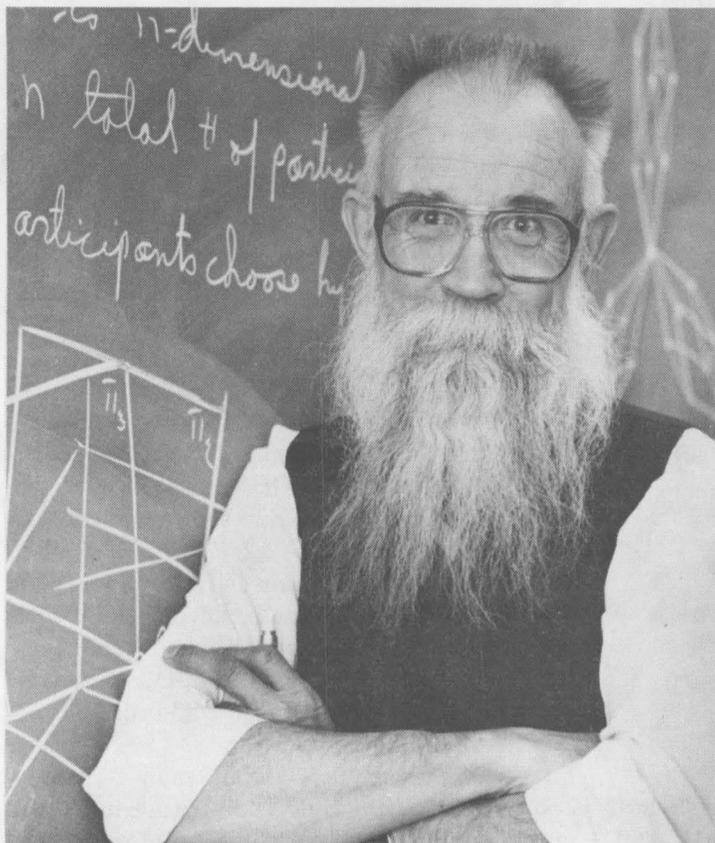
Valla Cowan (8000) 30



Howard Lehman (5131) 30



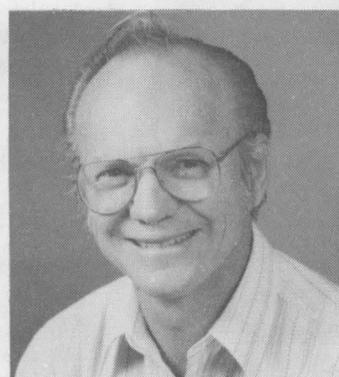
Steve Robinson (8314) 15



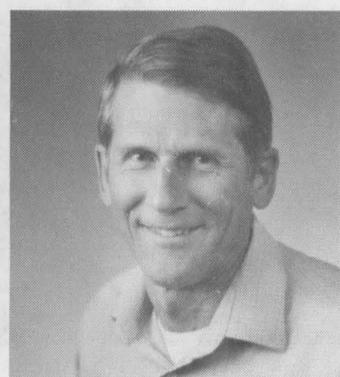
Gus Simmons (200) 30



James Hinson (3425) 40



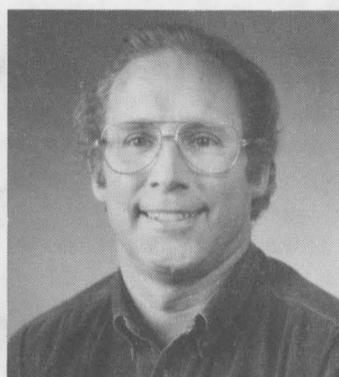
Don Stoner (8452) 30



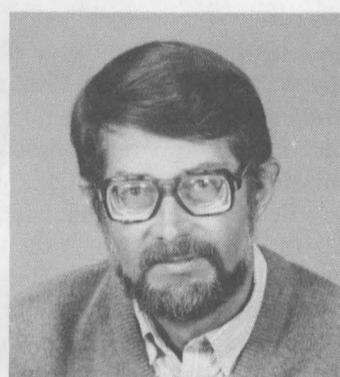
John Kelly (6454) 25



Jill Schwegel (8272) 15



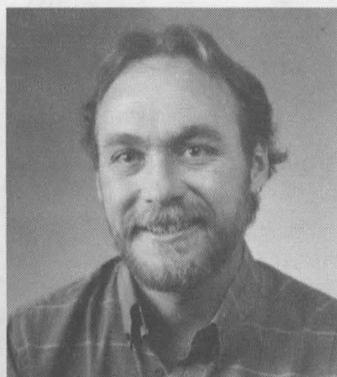
Ron Hartenberger (7412) 15



Dan Dawson (8243) 15



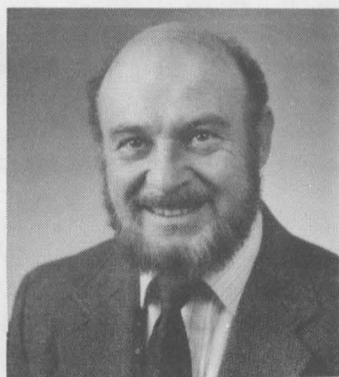
Dwayne Mohrman (8165) 30



Pat Drozda (6258) 15



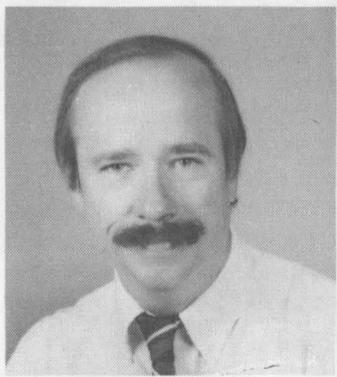
Nancy Hunt (8535) 25



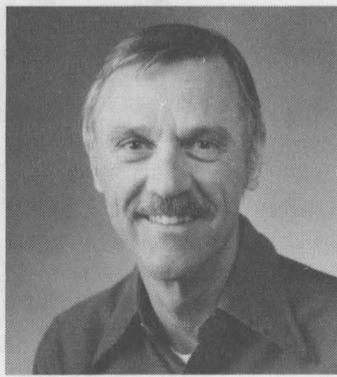
Paul Cooper (DMTS, 9333) 25



John Vitko (8430) 15



Ken Wilson (8347) 15



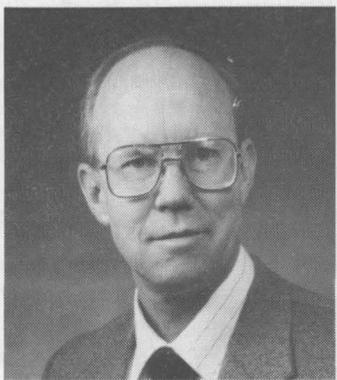
Fred Wymer (DMTS, 9211) 30



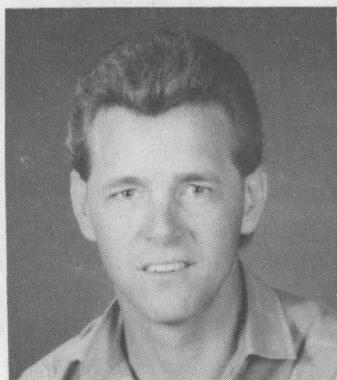
Sharon White (8162) 15



Gerald Quinlan (2821) 20



Archie Farnsworth (1533) 20



John Wheeler (8286) 15



Roy Palmer (2635) 25

Take Note

The Mountain/Western Regions Electronic Warfare Technical Symposium, "The Test and Evaluation of Advanced EW Technologies," will be held April 17-19 in Albuquerque. The symposium will be presented by the Association of Old Crows and sponsored by the Air Force Test and Evaluation Center. Headquarters will be in the Holiday Inn Pyramid, and classified technical sessions will be held at Sandia. Transportation and other area activities are planned. Call Jack Hahn on 848-5781 for information.

Hogares, Inc., a United Way agency providing residential treatment for adolescents, is expanding its program to provide continued care for adoles-

cents through foster parenting. Hogares needs single adults and families interested in emergency, temporary, and long-term care for teens 13-18. Training and continuing staff support will be provided to all families. Adults interested in participating in this program should contact the foster-care coordinator at Hogares on 345-8471.

An old house owned by Jim Asher and Jo Anna Arnett Asher of Santa Fe is the showpiece of Public Television's "This Old House" in programs airing on KNME-TV, Channel 5, March 1 (8 p.m.) and 15 (7 and 7:30 p.m.). Host Steve Thomas leads viewers through the renovation of the Ashers' circa 1930 adobe house as the original four

rooms are gutted and a library is added between the main house and the attached studio. Sharon Woods, coauthor of the book *Santa Fe Style*, also shows Steve some examples of Santa Fe's local architecture.

Retirement Seminar

Guy Trujillo of SunAmerica Securities, Inc., will present "What You Should Know about Retiring Before You Retire" on Wednesday, Feb. 28, at the Coronado Club, 5-6 p.m. For information, call him on 294-6655.

UNCLASSIFIED ADVERTISEMENTS • UNCLASSIFIED ADVERTISEMENTS • UNCLASSIFIED ADVERTISEMENTS • UNCLASSIFIED ADVERTISEMENTS

Deadline: Friday noon before week of publication unless changed by holiday. Mail to Div. 3162.

Ad Rules

1. Limit 20 words, including last name and home phone.
2. Include organization and full name with each ad submission.
3. Submit each ad in writing. No phone-ins.
4. Use 8 1/2 by 11-inch paper.
5. Use separate sheet for each ad category.
6. Type or print ads legibly; use only accepted abbreviations.
7. One ad per category per issue.
8. No more than two insertions of same "for sale" or "wanted" item.
9. No "For Rent" ads except for employees on temporary assignment.
10. No commercial ads.
11. For active and retired Sandians and DOE employees.
12. Housing listed for sale is available for occupancy without regard to race, creed, color, or national origin.

MISCELLANEOUS

SANDIA T-SHIRTS, caps, \$7; *Ski Touring Northern New Mexico*, \$10; other books. South Highway 14 Village Project, LAB NEWS, Bldg. 814.

ATARI 2600, w/21 games, extra controllers and paddles, \$75; 50' three-rail wood corral, \$60, you remove. Jackson, 836-1013.

TWIN BED, Ethan Allen, dark pine; Atari w/games; 26" color TV, make offer on TV. Lippis, 898-8429.

GO-CART, never used, \$650; TV/VCR stand, \$80; cartop carrier, w/racks, \$60; barbecue grill, \$25; all OBO. O'Toole, 828-9260.

'89 MISTRAL SAILBOARD, one design, Mastfoot daggerboard skeg, \$695; steel workbench, heavy-duty, w/vise, \$75. Schuler, 821-8944.

GENERAL ELECTRIC REFRIGERATOR, 21 cu. ft., \$135. Gallegos, 294-0233.

SCUBA EQUIPMENT: tank, buoyancy compensator, weight belt, regulator w/octopus, console, knife, \$250 OBO. Cotter, 897-1470.

KING-SIZE SOMMA WATER BED, individual water tubes, sits on regular king-size frame and box spring, 4 yrs. old, cost \$1000, sell for \$500. Bercaw, 275-1691.

ORTHOPEDIC WHEELCHAIR, \$210; sun lamp, new, \$10. Horton, 883-7504.

GARFIELD WALL PHONE, \$25; mobile-home skirting, \$250. Schalles, 865-3075.

BRASS HEADBOARD, double; Mexican carved-wood headboard, king or smaller, nightstand, lamp table; 6-drawer chests; hutch. O'Keefe, 843-7501.

COLLECTOR'S ITEMS: 2 hand-signed, numbered lithos by John Lennon, framed and matted, "Erotica" series, valued in 1988 at \$3000 ea., make offer. Nielson, 247-8612.

TIRES: P235-75R15 on white steel rims, 5-hole pattern, 3 at 50% tread, 1 new, \$100. Striker, 299-7276.

SUBARU AM/FM STEREO RADIO,

never used, \$75 OBO. Berman, 296-5640.

SKIS, 160s, Tyrolia 260-D bindings, Scott poles, 48", \$60; woman's Nordica boots, 9xN, \$50. Blankenship, 822-0516.

SWING SET, \$70. McEwan, 275-7715.

PRAM-STYLE BUGGY, \$50; iron weight set, \$75; traditional walnut credenza, \$550; electric typewriter, \$100. Siegrist, 293-4148.

TWO CHOWS, full-blooded, registered, make offer. Chavez, 892-4374.

SLEEPER COUCH, Early American, earth-tone colors, floral print, \$230. Castillo, 294-5182.

MAYTAG WRINGER WASHER, \$60; Tom Young's spa, \$800; Toyota louver, \$50. Lucero, 345-5501.

HARD-DISK CONTROLLERS FOR PCs: MFM, \$45; RLL, \$50; cable set, \$5. Flesner, 265-2136.

HIDE-A-BED, queen-size, brown/gold plaid, \$75. Benedict, 883-2785.

DAY BED w/mattress, off-white metal frame, \$125. Mosman, 891-8880.

AT&T 6300 COMPUTER, 640K RAM, 2 floppies, green monitor, \$600. Butler, 299-5626.

BABY CLOTHES; other baby items. Naranjo, 291-0991.

MOVING SALE: king-size water bed, dining-room set, exercise bike, sewing machine, lawn mower, weed cutter, more. Rael, 345-2084.

BUNK BEDS, light-color wood; skis for small children. Nimick, 281-3148.

GATELEG TABLE, solid maple, w/leaves, 4 chairs, \$120; twin beds (complete), chest of drawers, \$30/ea. or \$80/all. Hines, 821-8592.

MEDICAL EQUIPMENT: Everest & Jennings electric wheelchair, \$800; Amigo motorized 3-wheel wheelchair, \$800; electric stair-glide, \$800. Maldonado, 821-5041.

WEIGHT MACHINE, DP GymPac 1000 Fitness System, all accessories and manuals included, \$150. Carlson, 892-5645 after 6.

TELESCOPE, 8" Meade Newtonian, 2-axis equatorial electric clock drive w/joystick, illuminated reticle, \$600. McDowell, 281-1509.

PUPPIES, cairn terrier/poodle cross, free to loving home, available at 7 wks. old (March 19). Walkington, 839-9662.

SYLVANIA COLOR TV, 19", w/metal swivel stand, \$80; 2 swivel bar stools, brown leather, \$57.50. Allen, 298-9833.

TWO AM/FM STEREO CAR RADIOS, \$15/ea. Schuster, 822-8969.

RUGER SECURITY SIX, .357, stainless, 6", \$250; Winchester 30-30, Model 94, \$94; H&R 20-ga., 3", single-shot, \$60. Shapnek, 281-5913.

MICROWAVE, Litton Go-Anywhere, .7 cu. ft., \$95; moving boxes, all sizes, dish packs, wardrobes, \$1 to \$3/ea. Burstein, 821-6688.

MARLIN 30-30 RIFLE, complete handloading equipment, saddle scabbard, gun-cleaning kit, \$200; bucket seats for '80 Scout, \$50. Nichols, 821-8213.

STEREO CABINET, dark wood, glass doors, \$50; nightstand, ranch-style, \$25; 12 unfinished shutters, 1' x 2', \$20. Anderson, 294-8451.

ANTIQUA EAGLE-CLAW TABLE, 3-ft-diam., dark wood, 90-100 yrs. old; chandelier, cut glass & brass.

Nordeen, 296-7898.

JENNY LIND HIGH CHAIR & CRIB, mattress, bedding, \$200; super-single water bed, w/drawers, padded rails, \$200; queen-size water bed, w/drawers, \$350. Daut, 255-2529.

IBM-COMPATIBLE PC, Commuter, dual floppy drives, monochrome monitor, Hercules card, 512K, DOS, Basic, \$425 firm. Schofield, 292-7220.

TWO WALKERS, \$25/ea.; 3 recliners, \$50, \$75, \$150. Daniel, 268-8335.

BATHROOM ITEMS: toilet & sink w/faucet, tan marbling; vanity, w/matching medicine cabinet, lights, \$90/all. Lachenmeyer, 268-7818.

RIFLE BRASS FOR RELOADERS: 89/30-30s, 30/30.06s, 20/45-cal. bird shot, 16 misc. rifle; 10 boxes gummed black pasters, make offer. Harris, 255-6577.

KAR KADDY II, 1-1/2 yrs. old, \$875. Heckman, 884-4542.

LIVING ROOM SET: sofa, love seat, ottoman, \$100. Minor, 275-9752.

ELECTRIC TYPEWRITER, Royal Administrator, model 9000, soft plastic cover; car service manuals: GM '77 and '78 w/'78 Cadillac supplement, \$25; Pfeiffer, 299-3951.

CURTAINS, for patio door, woven material on wooden slats, w/valence and traverse rod, beige/cream, \$75. Ricco, 828-1997.

RUGER SPEED SIX .357-MAGNUM REVOLVER, stainless steel, 2-3/4" bull barrel, custom trigger work, leather holster, cost \$400, sell for \$315. Montoya, 296-4268.

FISHER-PRICE CAR SEAT, one-step, gray fabric, cost \$65, sell for \$30. Barr, 822-0671.

MICROWAVE OVEN, 1 cu. ft., \$100; VCR, 4-head, remote, \$150. Brewer, 831-5031.

SCHWINN AIRDYNE, \$550; Sofa Block entertainment center, \$200; Charles France framed prints: "Uno," \$150; "White Tiger," \$300. Harris, 892-6281.

CRIB AND MATTRESS, \$30; wooden closet doors, free. Trellue, 292-7369.

FURNITURE: desk-model sewing machine, tables, kitchen cabinet w/formica top, chairs, chain saw, misc. Pilat, 292-4727.

MAKITA TABLE SAW, 8-1/4", model 2708, \$100. Hesch, 268-6122.

ADC EQUALIZER, 10 bands, graphic display, \$75. Herther, 298-4823.

MIXED-BREED PUPPIES, 3 months old, free. Halbgewachs, 268-1584.

MACINTOSH 512 COMPUTER, w/external drive, ImageWriter printer, modem, software. Furaus, 293-9799.

'84 CELEBRITY, AT, tilt, cruise, AC, \$3650. Baker, 294-3334.

'75 CHEV. CAMARO LT, 350 V-8, 4-spd., PS, PB, leather, 120K miles, one owner, passed emissions, \$1200. Hohimer, 821-1459.

'72 DODGE DART SWINGER, 318 V-8, AC, PS, AT, original owner, \$750. Werling, 298-5842 after 5.

'84 VOLVO GL, one owner, all records, \$8000. Hamilton, 294-5850.

TRANSPORTATION

'83 OLDS TORONADO DIESEL, 50.4K miles, Bose sound, loaded, below blue book, \$3900. McEwen, 821-1374 after 5.

'83 PACE ARROW MOTOR HOME, 31', 47K miles, new Michelins, storm windows, awnings, non-smokers, below NADA, \$27,500. Klopolsky, 299-4110.

YAMAHA BAYOU 4-WHEELER, new, automatic clutch w/reverse, single/dual traction, extras, \$2900 OBO. Chavez, 839-9830.

CANNONDALE R-300 BICYCLE, white, 12-spd., includes Scott DH triathalon handlebars, rear disc wheel, saddle pack, Suntour components. Tillotson, 883-0756.

'77 VOLKSWAGEN SCIROCCO, white, sunroof, fuel-injected, 1.6 liter, 4-spd., AC, Michelin MVX radials, \$1200. Henderson, 884-8309.

'87 TOYOTA TERCEL, 4-spd., AC, AM/FM cassette, 56K miles, drink stand, hatchback, \$5500. Hovorka, 268-8693 leave message.

'85 BRONCO II, 6-cyl., AC, 4x4, 93K miles, 5-spd., AM/FM, PS, white exterior, \$5000 OBO. Muirhead, 281-2925.

18-SPD. MOUNTAIN BIKE, bottle, lock, warranty, \$100. Eley, 255-2617.

'86 MERCEDES 300E, anthracite, gray, leather, 24K miles, always garaged, under warranty. Bennett, 298-1142.

'81 CHEV. CAMARO, PB, PS, AC, new tires and battery, passed emissions test, \$2200. Caton, 281-9420.

'89 NISSAN MAXIMA SE, loaded, 19K miles, \$16,000. Terry, 897-4481.

'79 HONDA/CVCC, AT, AC, radio, 2-dr., new muffler, 78K miles, \$1600. Burstein, 821-6688.

RALEIGH BICYCLE, 12-spd., 22", \$100 OBO. Wetzel, 296-7570.

'87 TOYOTA CELICA, gray, 2-dr. coupe, 5-spd., stereo cassette, cruise, AC, complete service record. Gallegos, 899-0824.

'74 JEEP CJ-5, 6-cyl., 3-spd., cloth top, new tires, \$2800. Weatherbee, 869-2849.

'83 EL DORADO MOTORHOME, Class C, 23', 460 engine, sleeps 6, \$16,000. DeHerrera, 892-3535.

'80 BOAT, Hawaiian Shallow V, 21', 200-hp Mercury Black Max tilt power, tandem trailer, \$6250 OBO. Lopez, 884-8461.

'84 DODGE RAM, 360 V-8, 3/4 ton, AT, AC, PS, \$4000 OBO. Lucero, 299-6643.

BOY'S BICYCLES: Sears 10-spd., 24", new tires & tubes, \$50; Huffy, 20", coaster & caliper brakes, \$45. Anderson, 294-8451.

'79 JEEP CHEROKEE CHIEF, 4-WD, V-8, AC, AM/FM, CB, 83K miles, \$3800 OBO. Fleming, 899-8876.

'86 FORD F-150, 4x4, LWB, 4-spd., AC, 302 V-8, auxiliary tank, PS, PB, heavy-duty package, 21K miles, \$9200. Draelos, 296-3078.

REPOS: '87 GMC Sierra 1500 truck; '81 Chev. K10 pickup, bids accepted through March 6, we reserve the right to refuse all bids, subject to prior sale. Sandia Lab FCU, 293-0500.

'84 MERCURY LYNX, 4-cyl., 5-spd., 2-dr., radio, 86K miles, \$2000 OBO. Berg, 296-2695.

'85 PLYMOUTH VOYAGER, blue, AT, PS, AC, 50K miles, \$6500. Robbins, 256-9320.

'76 FIAT X1/9, new tires, clutch, and

brakes, \$1000 firm. Moss, 299-5149.

'75 OPEN ROAD MOTORHOME, 23', Class A, 2 roof ACs, dash AC, rear dinette, best offer. Belarde, 877-4697.

REAL ESTATE

5.6 ACRES, Timberlake Ranch, within sight of Ramah Lake, heavily wooded, 7200-ft. elevation, 2-1/4 hours from Albuquerque. Jones, 888-1564.

4-BDR. TAYLOR RANCH HOME, 1920 sq. ft., landscaping, sprinklers, FR, RV parking, 9-1/2% assumable, no qualifying, \$100,000. Garcia, 898-2605.

FOUR-PLEX, NE, \$27,500 equity, assume 8-1/2% loan, no qualifying, \$200/mo. positive cash flow. Cook, 266-6088.

4-BDR. HOME, Four Hills, 3000 sq. ft., 2-3/4 baths, \$159,000. Ahrens, 294-8986.

3-BDR. MOBILE HOME, Vineyard MH Retirement Park, 2 yrs. old, FP. Rael, 345-2084.

2-BDR. TOWNHOUSE, NE Heights, 1-1/2 baths. Koepp, 294-7136.

2-BDR. TOWNHOUSE, 1-3/4 baths, garage, refinance or take over payments, \$38,000. Schindwolf, 831-1940.

3-BDR. TOWNHOME, Tramway/Copper, 2 baths, great room, next to park, views, 1500 sq. ft., \$95,000. Graham, 298-9454.

3-BDR. HOME, Southwest near I-40, 1150 sq. ft., VA assumable, 9-1/2%, \$54,900. Brewer, 831-5031.

WANTED

5TH-WHEEL CAMPING TRAILER and F-150 pickup, like new. Baker, 294-3334.

HOUSEMATE, share 3-bdr. NE Heights home, 2 baths, nonsmoker, \$250/mo. plus 1/2 utilities. Levin, 299-0891.

GOOD HOME for a happy, healthy, cross-breed dog (golden retriever & terrier mix), outside dog, good w/kids. Miller, 292-5634.

WHEELCHAIR, reasonably priced, needed immediately for use in nursing home. Hines, 821-8592.

GERMAN FIELD GLASSES (Steimer), old composition dolls, antiques. Lucero, 294-1104.

ELECTRIC LAWN MOWER, small, in good shape, prefer rear-bagger, reasonable. Cooper, 883-7494 after 5:30.

BAND-SAW-BLADE WELDER. Kurowski, 881-1859.

SOFTBALL PLAYERS: upper-division men's slow-pitch team needs outfielders, shortstop, and 2nd base, all expenses paid by sponsor. Simmons, 298-5248.

WORK WANTED

HOUSESITTING, responsible 17-yr.-old girl, has references. Caskey, 294-3218.

HOUSESITTING, care for plants/pets/older children OK, UNM student. Vandewart, 298-4741.

Coronado Club Activities

Attention, Barbecue Fanatics: Tonight's the Night

IF YOU HANKER for barbecue, join the chow line at the BBQ buffet this evening. Ribs, chicken, sausage, and beef are included, as well as grilled halibut (the latter sans BBQ sauce, thank goodness!). Dinner is \$8.95/person; afterward, dance to the country/western tunes of Billy Glenn & Texas Sand from 8 p.m. to midnight. If you make a dinner reservation (265-6791), there's a free bonus: c/w dance lessons from 6 to 7.

AN ALL-YOU-CAN-EAT BUFFET is in the works for next Friday night (March 2) at Family Fare. Food selections available starting at 6 p.m. are spaghetti, fried chicken and fish, corn- and chile-dogs, pizza, french fries, and a salad bar. Pyro, a comic juggler, demonstrates his skills from 7 to 7:30. Supper costs just \$4.50/adults and \$2.50/children under 12. Reservations recommended.

BRUNCH-BUNCH BARGAINS are available next month, with discount prices in effect for the Sunday brunches scheduled March 4 and March 18 (10 a.m. to 1 p.m. both days). The goodies include baron of beef, Virginia baked ham, Denver omelets, Belgian waffles, and much more; each adult meal also includes a complimentary glass of the bubbly. March prices: \$5.95/adults, \$3.50/children ages 4 through 11, and free/kiddies 3 and under.

TAKE NOTE, THUNDERBIRDS — T-Bird card sharks go back to the fun and games on Thursday, March 1, starting at 10 a.m. Join the crowd for all kinds of card games, inspiring conversation, and free refreshments.

A Thunderbird town meeting on March 6 at 3 p.m. in the C-Club ballroom examines the pros and cons of awarding the franchise for supplying Albuquerque's electricity to the lowest bidder. To kick off the meeting, speakers representing both sides will each speak ten minutes; then, folks in attendance get a chance to voice their opinions during an open discussion.

THE GOOD OLD SUMMERTIME isn't far off, and pool/tennis season passes are now on sale at the SERP office at the C-Club. A word to the wise: Passes can be purchased at 1989 prices through April 30 (\$20/individual, \$40/couple, \$55/family of three, \$5/each additional dependent family member). As of May 1, those costs increase to \$30, \$50, \$70, and \$10, respectively.

SPEAKING OF SWIMMING SEASON, the Club is looking for lifeguards and instructors for this summer. Lifeguards must be lifeguard-training certified; instructors must be current on newly revised Water Safety Instructor materials. Pick up applications at the office.

Medical Corner

Coping With Pain

By Arlene Price (3300)

Perhaps the most universal form of stress encountered by human beings is pain. More than \$900 million is spent annually in over-the-counter analgesics and soothing salves, with \$100 million spent just on aspirin. Americans swallow 20 tons of aspirin a year, as well as undergo all kinds of medical/surgical procedures to relieve pain.

Recorded references to pain remedies, which go back to 1550 B.C., reveal that people have tried many pain-relief remedies, including purging, poisoning, puncturing, blistering, bleeding, freezing, heating, and having leeches applied to their bodies. We've come a long way since ancient times, but the quest to unravel the mysteries of pain continues.

This observation reminds us of how complex human beings are. Early explanations of pain suggested that the amount of pain people experienced was directly proportional to the amount of tissue damage they sustained. Mental and emotional responses were considered to be secondary reactions to pain. More recent explanations suggest that — in addition to tissue damage — thoughts, feelings, and motivations contribute significantly to sensations of pain. Pain varies tremendously in terms of its dura-

tion, intensity, the meaning it has to people, and the way people experience it. Even though we still have much to learn about pain, we are fortunate that psychological and medical approaches have been developed to help people manage it.

In an effort to help us learn more about it, Medical is sponsoring three noontime Mental Health Roundtable discussions (see box) about coping with pain: how to manage chronic illness; how to deal with medical and dental procedures; and medical approaches to dealing with the pain of cancer.

Tuesday Programs

Medical is sponsoring three programs on pain management. The first program is "How To Avoid the Illness Rut in Chronic Illness," by Al Fedoravicius, clinical psychologist, on Tuesday, Feb. 27, 12 noon to 12:45 p.m. The second is "Coping with Stressful Medical and Dental Procedures," by Celia Michael, clinical psychologist, on Tuesday, March 6, 12 noon to 12:45 p.m. The third is "Barriers to the Control of Cancer Pain," by Dr. Walter Forman, on Tuesday, March 13, 12 noon to 12:45 p.m. All programs will be held in Building 815 outside the Tech Area.

Events Calendar

Events Calendar items are gathered from various sources. Readers should confirm times and dates of interest whenever possible.

Feb. 23-24 & March 1-3 — "Arms and the Man" by George Bernard Shaw, UNM's College of Fine Arts presentation of classic humorous play ridiculing military romanticism and simple-minded nationalism; call for time, Rodey Theatre, 277-4332.

Feb. 23-March 4 — "Stumps," New Mexico Repertory Theatre production of world premiere of Mark Medoff play about two Vietnam veterans, character of Stephen from "When You Comin' Back, Red Ryder?" reappears; 8 p.m. Tues.-Sat., 2 p.m. matinees Sat. & Sun.; KiMo Theatre, 243-4500.

Feb. 23-March 18 — "The Beggar's Opera," John Gay's classic adapted to the Southwest in the 19th century by director Derek Davidson; music, comedy, and dancing girls galore; 8 p.m. Fri. & Sat., 6 p.m. Sun.; Vortex Theatre, 247-8600.

Feb. 23-March 25 — Exhibit: "Landscape, Portrait, Still-Life — Through the Camera Lens," overview of UNM photographic works; 9 a.m.-4 p.m. Tues.-Fri.; 5-9 p.m. Tues., 1-4 p.m. Sun.; UNM Art Museum, 277-4001.

Feb. 24 — Chamber Player Series Four: "The Thief of Baghdad," silent film starring Douglas Fairbanks, Sr., New Mexico Symphony Orchestra performs Mortimer Wilson score as the movie plays; 3 p.m., Highland Theatre, 842-8565.

Feb. 24 — "Top That," celebration of American music: jazz, rock, and country; 8 p.m., South Broadway Cultural Center, 848-1320.

March 5 — Hungarian State Folk Dancers, 8 p.m., Kiva Auditorium, 848-1374.

March 6 — Lecture, "Matachines," by Adrian Travano; 7:30 p.m., Indian Pueblo Cultural Center, 247-4907.

March 9 & 10 — Classical Concert Seven: New Mexico Symphony Orchestra and Chorus perform Mendelssohn's "Elijah"; 8:15 p.m., Popejoy Hall, 842-8565.

Congratulations

To Liz and David (7482) Schroeder, a son, Kevin, Jan. 21.

To Joan and Randy (9213) Kreinbrink, a son, Brian Michael, Jan. 24.

To Martha and Kip (1260A) Stanley, a son, Matthew Ryan, Jan. 30.



IN CELEBRATION of Black History Month, the Howard University Jazz Ensemble recently played a noontime concert to a full house at the Technology Transfer Center. Here, the Ensemble's saxophone section does its stuff during one of the numbers. The concert was sponsored by Sandia's Black Outreach Committee.