

TTR Delivered the Goods for Desert Storm

One good test is worth a thousand opinions, say the folks at Tonopah Test Range (TTR). Their business is making sure that tests produce the data to make them "good" — whether the hardware being tested succeeds or not. Part of that business is making sure tests involving explosives, low-flying aircraft, or fast-moving projectiles don't endanger valuable equipment or anyone's safety.

TTR has been carrying out that mission for DOE and others since 1957. But during the Persian Gulf war, says TTR Dept. 7510 Manager Ron Bentley, TTR truly proved itself a national asset. From December to March, TTR people were squeezing quick-reaction tests into their schedule without disrupting commitments to operations already on their docket. That often meant working extended hours and weekends.

One of the weapons tested was used in Desert Storm: the Air Force's GBU-28 laser-guided penetrator bomb (more in "How TTR Helped the Air

During the Persian Gulf war, TTR proved itself a national asset.

Force Ready a New Bomb"). Other hardware undergoing tests at TTR either was not ready in time for the brief war or has received no public acknowledgment of use.

The Air Force rushed its penetrator bomb through development in six weeks, in time for strikes against Iraqi command bunkers. TTR's part in this swift project brought the range a letter of thanks from the Air Force (LAB NEWS, May 3),

Who May Attend

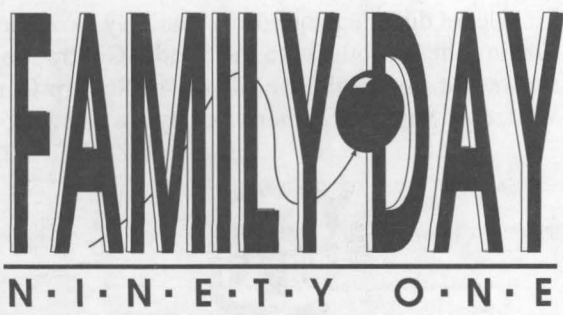
Planning Your Family Day Guest List

If you're already planning to attend Family Day Oct. 19, an event that occurs about once every five years at Sandia, don't prepare your guest list just yet, at least not before reviewing the following guidelines.

Though Sandia's policy is fairly liberal as to which family members may attend, special requests will be necessary for relatives who do not fall within a strict definition of family or who are not US citizens. Special requests must also be submitted to bring close friends, roommates, or significant others who might be regarded as pseudo-family members under a broader definition.

"Q"-cleared employees are permitted to escort up to eight family members at the all-day event, which will feature special exhibits now being planned by individual directorates, including the ever-popular rocket sled demonstrations. Sandians who do not have a "Q" clearance may invite family members, but all must be escorted by another Sandian who does have a "Q" clearance.

Guests will be restricted to family members of Sandia and DOE/AL employees, Q-cleared
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naming several Sandians and contractors as particular contributors. Such recognition makes Ron Bentley proud, but it also disappoints him because of the names that don't get mentioned.

Customers See Just a Few

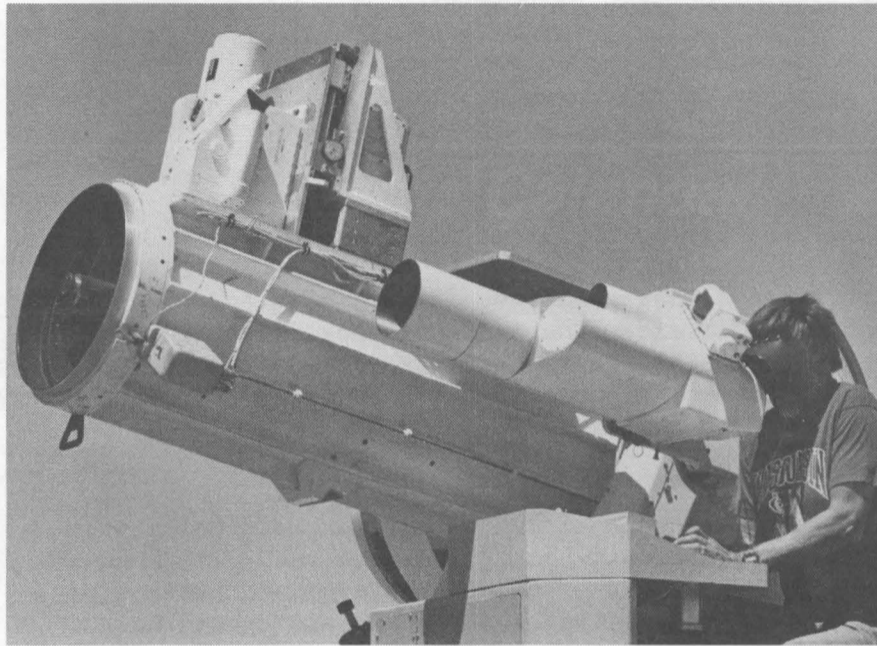
"There are so many whom the customer doesn't see," says Ron, "and I want to take the opportunity to thank them. A successful test takes the efforts of everyone. It's the people out on the tracking camera mounts and the radars, or in the telemetry room — Sandians and EG&G folks. It's the people in the computer room — and I know I'm leaving out a lot myself. Then there are the REECO [Reynolds Electric and Engineering Co.]

people, who take care of our maintenance and construction, the security people with ASI [Advance Security, Inc.], and the Ross Aviation airlift support.

"It's all these who make it happen. My job, and that of the supervisors, is really to facilitate communications with customers and to ensure that customers' requirements are known to our people who do the job."

Some 60 Sandians work at TTR, along with 20 EG&G technicians, 60 to 70 REECO employees, and 60 to 70 ASI employees.

The GBU-28 illustrates the many crafts and disciplines required for a test, especially an un-
(Continued on Page Four)



TRACKING TELESCOPE, operated by Marty Konkel (7514), is trailer-mounted for transport to wherever needed for photographic documentation of tests. Tonopah Test Range also uses radars and cinetheodolites to track test subjects and gather data about their performance. (See page six for more about TTR camera and radar operations.)

Sandia Telemetry at the Olympics? — See Page Nine



LAB NEWS

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JULY 26, 1991

Young People Today, Leaders Tomorrow

Six Groups Reach Out to Minorities, Women, and People With Disabilities

Valuing diversity and individuality is like achieving excellence in ES&H, says Julia Gabaldon, Supervisor of Equal Employment Opportunity and Affirmative Action (EEO/AA) Div. 3511.

"It means not only meeting applicable requirements," she says, "but also actively pursuing programs to increase the roles of underrepresented groups, both at work and in the community. The goal is to create and sustain an environment where everyone has an opportunity to achieve his or her full potential."

Six committees at Sandia plan and perform various "outreach" activities — activities that solicit the involvement of minorities, women, and people with disabilities from the community. Outreach includes participating in career fairs and school science fairs and helping organize educational programs for young people — to encourage them to pursue careers in science and technology.

"Inreach" — dealing with issues and concerns of on-roll employees — is also a major function of outreach committees. "Inreach means finding out how minorities, women, and people with disabili-

ties feel as employees at Sandia," says Julia. "By dealing with their concerns, we discover how they can best contribute professionally."

Leading the Way

Sandia's six committees include the Black Outreach Committee, American Indian Outreach Committee, Hispanic Leadership and Outreach Committee, Women's Program Committee, and two new committees — the Disabilities Awareness Program Committee and Asian Leadership and Outreach Committee. (See "Two Newest Outreach Groups Gear Up" on page seven.) Here are some of the highlights of their activities:

This summer, the outreach groups jointly sponsored weeklong summer science camps for minority students, during which minority students learned through hands-on science demonstrations and field trips. "The camp curriculum is experiential and culturally relevant," says Patricia Salisbury (3511), Black Outreach chair, "meaning it incorporates the important contributions of all ethnic groups in science and technology."

(Continued on Page Seven)

This & That

Today's "This and That" is by Assistant Editor Charles Shirley.

Diamond in the Desert — The more I hear and learn about Sandia's Tonopah Test Range (TTR) in Nevada, the more convinced I become that it's a genuine gem — a true national resource. The folks there can make tough jobs with short deadlines seem almost routine. LAB NEWS Photographer Mark Poulsen and I visited there and came away with information and pictures about TTR and its recent work, including tests on some sophisticated weapons used in the Gulf War. Coverage begins on page one.

* * *

Dictionary Roulette — People in the word business occasionally "help" each other by uttering sentences that begin "Webster says you can't. . ." A recent newsletter for communicators, however, notes that three publishing companies now offer dictionaries with "Webster" in the title. The name is in the public domain, so anybody with enough gall (nerve, cheek, effrontery, or chutzpah) can use it. Next time someone tells you Webster prohibits your favorite spelling or requires theirs, inquire sweetly whether that's Webster No. 1, Webster No. 2, Webster No. 3, or a rerun of the TV show.

* * *

Did I Volunteer? — During the solar eclipse a couple of weeks ago, I walked up to some LAB NEWS staffers clustered around a camera lens, through which they were projecting an image of the sun onto a piece of paper. With ever-ready wit, I said, "The sun's disappearing — let's sacrifice the editor." LAB NEWS Photographer Mark Poulsen retorted, "It's only a partial eclipse — let's sacrifice the assistant editor."

* * *

Landlubbers' Lament — We hope Rear Admiral Gerry Ellis, new DOE Deputy Assistant Secretary for Military Application, will forgive our misinterpreting his Navy rank and previous title in a photo caption in the last issue. First, we referred to him as Rear Admiral Ellis even though he was still wearing his Navy Captain's uniform; at the time of the photo, he was a Rear Admiral (Selectee), meaning his promotion was pending. Also, not being expert at reading military resumés, we incorrectly said he was most recently Commander of the Submarine Force of the US Atlantic Fleet, when he was actually Chief of Staff to the Commander.

We've had calls from at least four "old salts" who noticed our blunder. We'll take a dozen lashes, but please don't throw salt on the wounds.

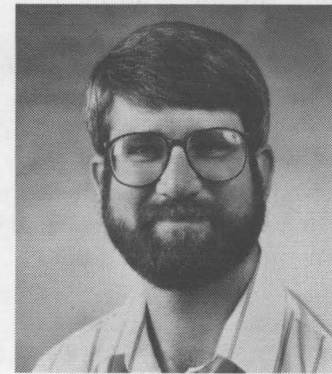
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Sandia Star Is Born — Maybe that's overstating it a trifle, but lots of people are going to see a videotape in which Nancy Russell (6321) shows AT&T and Sandia recruiters how to conduct an initial interview. A graduate of the University of Minnesota, Nancy became the Sandia recruiter for her alma mater when the previous recruiter retired last year. She went to "recruiter school" and was later invited to demonstrate a 30-minute interview in AT&T's recently modified format. Nancy is one of about 1,800 AT&T and Sandia recruiters — congrats to her for standing out in a crowd. ●CS

Computer Security

Pierson Named 'Unsung Hero'

Lyndon Pierson (2934) has been named one of the "Unsung Heroes of Computer Security" by FedSECURITY, a non-profit educational organization that does computer training, for his invention



LYNDON PIERSON

of a technique for analyzing the security environment of a computer network.

Lyndon's technique is a theoretical model for evaluating possible threats to a computer system. It was used in developing Sandia's internal secure computing network.

An electrical engineer, Lyndon was selected from more than 150 nominees to receive the award, notes Craig Jones (2930). The award honors people who have provided advances in computer security for the federal government and its contractors.

Lyndon's work is one of the few new capabilities to come along in computer security in the past five or six years, adds Craig.

feed iiback

Q: It's really great to see so much interest at Sandia in environmental protection and preservation — especially recycling. However, I notice that the paper hand towels stocked in the rest rooms are bleached, and the packaging does not indicate that the towels are made from recycled paper. I've been told that bleaching is very water consumptive, adds to pollution levels, and is expensive. I'm pretty sure that unbleached paper towels (the old brown ones) made from recycled wastepaper are readily available — they might even be cheaper. Could Sandia look into the possibility of using them? Thanks.

A: Thank you for your suggestion. We in Purchasing and Materials Management Directorate 3700 are also concerned about the environment and the use of recycled materials. Your assumption that a paper towel containing recycled materials might be less expensive was correct.

The towels identified that are manufactured by James River (C-Fold 241A) contain no recycled materials. In comparison, a recycled multifold brown towel (Stock Number JNC3399) costs 29 percent less. A recycled C-fold bleached white towel (Stock Number JNC3306) costs slightly more than the James River towel. Both contain up to 80 percent recycled materials and meet the federal standard. However, there is a tradeoff when using recycled paper towels, as they are normally rougher and less absorbent than those towels that do not contain recycled materials.

Notwithstanding, Directorate 3700 is a service organization and purchases those products that are requested by our customers. For this reason, all the towels mentioned above are now available through the JIT system. We encourage the use of recycled products and will again advise our major customers of the availability of these products.

Please direct any questions you may have concerning these products to the Sandia Contracting Representative, John Beitia, on 4-5863, or Carl Weitzel at Sunland Sanitary Supply, on 247-9555.

Bob Zaeh (3700)

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GERRY YONAS, Director of Laboratory Development 400, received the Peter Haas Award at the IEEE's 8th Pulsed Power Conference. The award is "for outstanding contributions to pulsed power technology through the development of programs of research, education, and information exchange." Haas, now deceased, was a DNA official and supporter of pulsed power research. Gerry, a former Pulsed Power Sciences 1200 Director, will become Vice President of Systems Application 9000 on Aug. 1.



Summer 'Vacation'**High School Science Teachers Become Students at Sandia**

Eight high school teachers from throughout the United States are spending most of their summer "vacation" as students themselves, seeing how science is really practiced at Sandia.

The eight-week program is supported by Associated Western Universities (AWU) as a way of transferring the advanced work being done at DOE national laboratories into today's classrooms.

"Sandia is happy to participate in the program because it supports our emphasis on educational outreach," says Jim Argyle (8522), summer program coordinator at Sandia, Livermore. Another 10 teachers are participating in similar programs at Sandia, Albuquerque — the Summer Teacher Enrichment Program and the Career Guidance Institute, coordinated by Shannon Lytle (3531).

The experience promises to benefit the Teacher Research Associates as well as their students.

Making Concepts Relevant

"You get in a classroom and teach fundamental concepts," explains Steve Giles, who teaches physics and global science at Livermore High School. "In order to motivate the students, you need to make the concepts relevant to their everyday lives."

"When I tell students that I spent part of my summer actually working with a laser, it builds their interest and makes it easier for me and them to talk about what a scientist does and how the subject we're studying can affect their lives."

When Steve returns to the classroom this fall, he'll have developed a new curriculum that describes how lasers and fiber optics work, using materials loaned to him by Sandia. He plans to invite some of his new Sandia contacts into his classroom so students will have a chance to question working scientists.

Besides developing the new curriculum this summer, he is taking measurements of combustion processes, burn rates, and fuel efficiency, under the guidance of Sandia host Bob Carling (8362).

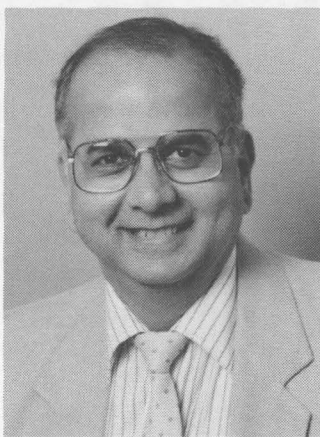


**SANDIA
LIVERMORE NEWS**

Subramanian Named Fellow of ASCE

C.V. "Subra" Subramanian, Supervisor of Facilities Planning Div. 8511, has been named a Fellow of the American Society of Civil Engineers (ASCE).

The first Sandian at Livermore to be so honored, he is one of fewer than 7 percent of the engineering society's 110,000 members who are Fellows. The position of Fellow affords a higher level of professional identification and is conferred upon members who are licensed as Professional Engineers and have no less than 10 years of active experience.



SUBRA SUBRAMANIAN

Subra's career at Sandia began in 1983. Since then, he has worked as project manager in the testing of gaskets and nuclear power plant containment penetrations for severe accident loads. He was project manager for the development of conceptual design of surface facilities for the Yucca Mountain High-Level Waste Repository project before he transferred to Livermore as site facili-

ties planning engineer. He became a DMTS in 1989 as a result of his contributions to nuclear reactor containment research and his seismic work relating to the Yucca Mountain waste repository. He was promoted to his current position last March.

Before joining Sandia, Subra was a principal engineer and division supervisor in the Nuclear Energy Division of General Electric in San Jose. There he was responsible for developing methods and codes for seismic and dynamic analysis and design of the GE Boiling Water Reactor structures and components, as well as for qualifying nuclear power plant components.

For the past eight years, he has been on the Dynamic Analysis Committee of ASCE, which publishes state-of-the-art white papers in the areas of seismic and dynamic analysis and design of nuclear power plants and high-level waste repositories. He was also an active member of the society's working group responsible for the ASCE standard, "Seismic Analysis of Safety-Related Nuclear Structures."

Subra has written more than 30 technical papers and articles in the areas of seismic and dynamic analysis and design of waste repository structures, nuclear reactor structures and components, and reactor containment testing for severe accident loads.

Earlean Collins, a math and computer teacher from Pine Bluff, Ark., on her first visit to California, says she'll return to the classroom knowing how to use computers, software, and scanners more effectively and efficiently. Part of her work involves the development of image processing techniques for enhancing digitized images, and the integration of text and graphics with these images. Earlean already has instructed some Sandia employees about how to use the scanning equipment she is studying. Her summer host is George Thomas (8343).

"Having a break from the classroom definitely improves my attitude, and that will rub off on the students and improve their attitudes. You can feel them thinking that if you can do research, you must really know what you are doing as a teacher," says Earlean.

Second Summer

Gary Pearson, a math and computer teacher from Bonanza High School in Las Vegas, Nev., completed a teaching research program at Sandia, Albuquerque two years ago. He valued the experience enough to apply for a second summer.

Gary explains: "Scientific research is mushrooming. Yet most science teachers haven't been in a scientific community and really don't know what's happening. Someone in class always asks why we are learning this. Up until a few years ago, I didn't have real experience that they could relate to and that could give them a broad overview of why science is important."

Gary's summer project involves computer macroprogramming — data analysis of coal experiments. His science host is Robert Hurt (8361).

Aside from their research projects, the Teaching Research Associates are being given tours of various Sandia facilities. The program allows them enough independence to schedule their own excursions to areas of interest throughout the Bay Area.

Though the teachers make it clear that they are here to learn, they also say the experience at a facility like Sandia is valued as a break from their daily routines.

"There are no bells," says Gary. "I've spent 30 years talking to students who are under 18 years



UP THE DOWN STAIRCASE (from top, left to right) are Sandia, Livermore summer program faculty members Wylie Baker and Charles Lee, Gary Pearson and Dan Rosa, Ann Huffer and Earlean Collins, Steve Giles, and Tug Sezen (bottom).

old. It's refreshing to talk to someone older."

Steve adds, "This environment is stimulating intellectually, but it is still somewhat relaxing. I'm not drained at the end of the day as I am from dealing with the different personalities of students."

The other five AWU teachers, their hosts, and summer research projects are Tug Sezen, John Swett High School, Crockett, Calif., working with Art Pontau (8347) on ion microtomography; Wylie Baker, Morrow High School, Morrow, Ga., working with Frank Tully (8353) on a small-molecular-cluster reactivity study; Charles Lee, Stewart County High School, Dover, Tenn., working with Frank Tully (8353) on a reaction kinetics study; Dan Rosa, Arrowhead High School, Hartland, Wis., working with Dick Steeper (8364) on a data acquisition system for a supercritical toxics experiment; and Anne Huffer, Deland High School, Deland, Fla., working with Mike Colvin (8211) on development and testing of computer models for drug designs and global climate studies.



RECEIVING A COMMENDATION from VP John Crawford (8000, right) is Steve Ikebe (8483), who was called up for two tours of duty during Desert Shield and Desert Storm. An Army Reservist for 14 years, Steve served at the headquarters of the US Army Materiel Command in Virginia.

(Continued from Page One)

TTR Delivers

usual one. Within a matter of days, an old concrete target had to be made ready on a dry lake bed, a 60-foot pole mounted for a guidance laser, protective filters located for the optics (because laser-guided weapons are not normally tested at TTR), security provided for a new weapon of unclear classification status, and details of telemetry and communications worked out.

Tomahawks at Night

The use of the GBU-28 during the last days of Desert Storm is a story that has only gradually become known, after the end of the war. But another weapon — tested at Tonopah about a year ago — was in headlines and on TV news from the start.

Worldwide audiences saw video footage of Tomahawk cruise missiles bursting out of launch tubes and, with incredible precision, striking tar-

Could a Tomahawk missile successfully navigate a course in darkness?

gets in Iraq. Not publicly visible, but certainly vital, were a pair of night flights at TTR. The issue was whether the TLAM-C (Tomahawk Land Attack Missile, Conventional) could successfully navigate a course in darkness.

"We had had Tomahawk tests here earlier," says Carl Smith, Supervisor of Optical Measurement Div. 7514. "But those were all daytime tests using a mobile launcher. The INF [Intermediate-range Nuclear Forces] Treaty banned mobile launchers. So that we could do this test, the gang turned to, removed the old launcher from the truck, and mounted it permanently on a pad with a support structure. Within about a week, we had a permanent ground launcher that's registered under the INF treaty."

The Tomahawk uses navigation systems called

TTR Basics

Tonopah Test Range (TTR) is a DOE facility operated by Sandia primarily for DOE-funded weapon programs. Tests for other agencies — particularly DoD — are conducted on a reimbursable basis.

A major portion of TTR's DOE work is development testing. A typical test might involve dropping a bomb body from a plane to check its aerodynamic characteristics or the operation of its parachute. During such a development test, the plane flies onto the range and the pilot is given a signal for when to drop the test unit — the point is how well the hardware performs, not whether the crew can hit the target.

In another major portion of TTR operations, in support of stockpile testing, both people and hardware undergo tests. A weapon is removed from stockpile, modified for testing, and loaded aboard an aircraft just as if it were a real mission. The plane flies from its base to TTR; once given the go-ahead, the crew releases the weapon without a drop signal. The controller at TTR interferes only if necessary for safety. Both the accuracy of the air crew's drop and the performance of the weapon — such as functioning of parachute and fuze — are then evaluated.

TTR conducts about 250 tests a year, including drop tests and other types of operations such as tests of artillery shells, earth penetrators propelled from downward-firing Davis guns, and rocket launches.

Roving Testers Operate from Albuquerque

One division within Tonopah Test Range Dept. 7510 does work similar to that of the rest of the department, but with a difference — it operates from Albuquerque.

Mobile and Remote Ranges Div. 7515 includes people of whom 7510 Manager Ron Bentley says, "They may be anywhere, next week or tomorrow."

Supervisor Wayne Lathrop explains: "We support Sandia testing at ranges throughout the country and, if necessary, at remote sites where there isn't a range. We have 10 trailers and vans, each of which is a complete telemetry ground station that can receive and record data and do some analysis in the field for a quick look at how the test is going.

"In addition to our instrumentation systems, we have a considerable inventory of general field equipment that can be deployed to provide test support at remote sites. That includes portable generators, communication equipment, tracking antennas, snowmobiles, all-terrain vehicles, and work trailers.

"But our biggest asset," Wayne continues, "is a multitalented group of field testers who

get a real kick out of setting up a remote test site and displaying the Sandia thunderbird at some new location. We sometimes have trouble even keeping our secretary at home."

A Twin Otter research aircraft is also operated by the division, in conjunction with Ross Aviation. This plane can be configured to perform system demonstration, air sampling, or airborne telemetry receiving, recording, or re-radiation (relay of the signal to another receiver). It has been used as a drop aircraft for test operations.

The division has permanent facilities at several major test sites, including White Sands, Vandenberg Air Force Base, Edwards AFB, and Cape Canaveral. But past work has called division members to decidedly non-permanent locations, such as the Arctic, naval ships at sea, beaches at Ft. Lauderdale, mountain tops in Hawaii, and to many other field tests around the world.

Division employees also sometimes join forces with their Tonopah colleagues, sharing both people and equipment when needed to support a test.

Digital Scene Matching Area Correlator (DSMAC) and Terrain Contour Matching (TERCOM) to find its way to a target. Operating these systems at night, in a flight over TTR and Nellis AFB terrain, gave the information needed to predict how the missiles would perform at night.

'Desert Town' Built

"We made a 'desert town' for the tests," says Gary West, Supervisor of Range Operations Div. 7513, "using trailers, truck chassis, and other things available on the range to represent struc-

TTR radars simultaneously tracked a B-1B, an F-16 firing rockets, the rockets themselves, and another F-16.

tures. There were 50 or more objects, all arranged in patterns to test the missile's ability to recognize where it was in relation to a target." The "town" included illumination to simulate street lights and lighted parking lots.

After a flight of more than an hour, each missile hurtled through a target area where arrays of fixed cameras recorded it at the fuze point, which the missile indicated by firing an on-board strobe. On a real mission, the warhead would have exploded there. For the test, however, the Tomahawk flew on, a parachute opened, and the missile

came to the ground intact for recovery.

Rockets at a B-1

In another test, the Air Force checked how well the tail warning radar of a B-1B bomber could pick up a threatening enemy missile in an environment of radar desert clutter. Crucial to this demanding test was TTR's unique method of having radar operators use a video system to supplement automatic radar tracking. An automatic radar can easily become confused about which target to track when an aircraft releases a smaller object such as a bomb or rocket. By following the test on video and overriding the automatic tracking as necessary, the operators can keep the radar pointed at a desired object.

During the B-1B test, conducted with aircraft a few hundred feet off the ground, TTR radars simultaneously tracked the B-1, an F-16 behind it firing rockets, the rockets themselves, and another F-16 flying wing for the shooter. This was done about 12 times, with a total of about 30 missiles fired.

"Our way of using manual override for the radar can be the difference between success in tracking something like a tiny rocket blip with aircraft around it and simply not being able to conduct the test," says Gary West. "I don't know that

(Continued on Next Page)



TONOPAH TEST RANGE seen from the southwest. To the right of the water tower is the command post (CP) from which tests are directed. Tests are conducted along the flat ground between the CP area and the mountain range on the horizon. TTR extends roughly 25 miles in both the north-south and east-west directions.

Fast Track to Desert Storm**How TTR Helped the Air Force Ready a New Bomb**

Desert Shield and Desert Storm spurred the undertaking of many developments at Sandia and elsewhere, but only the quickest-moving projects produced results in time for the brief hostilities in the Persian Gulf.

One weapon that was later reported as seeing action there, however, underwent critical testing at Tonopah Test Range (TTR): a "bunker-busting" bomb.

The bomb, formally designated the GBU-28, was a crash project in which the Air Force used sections of 8-inch artillery barrels to create what

The bombs were made from sections of 8-inch artillery barrels.

Aviation Week described as a 4,700-pound, nearly 19-foot-long penetrator that could be used against bunkers sheltering Iraqi senior commanders. Before use in battle, it had to be drop-tested.

"An Air Force captain called me on a Friday in February and said he had a bomb to drop and hit a concrete target. I told him, 'We've done that hun-



RON BUMP (7513) at the test director's console in the command post.

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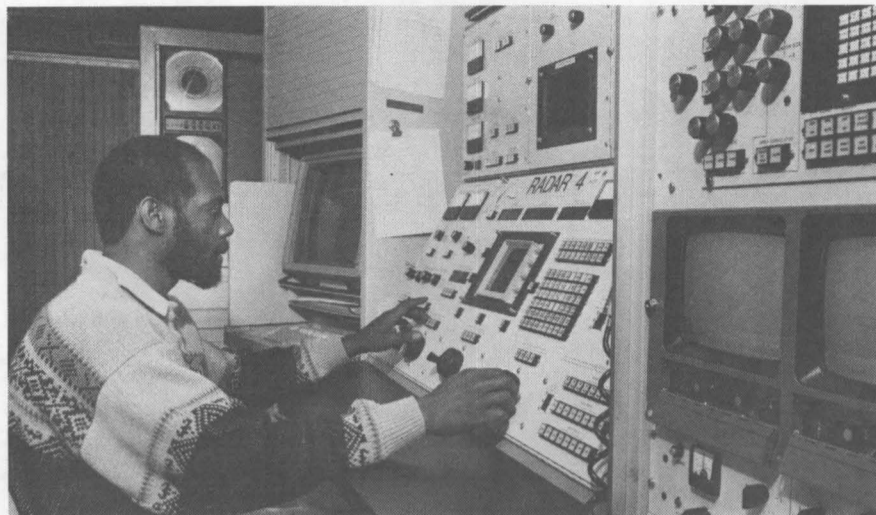
any other range in the country could have handled this one."

In fact, says Howard Gipson (Data Systems Div. 7512), project leader for TTR's radars, this test had been tried unsuccessfully elsewhere. "Other ranges were able to track only about 10 percent of the rockets," he says. "We were successful with about 90 percent." (See "Cameras and Radar Keep Eyes on the Test" for more about radar and camera tracking.)

Ground-Level Tests, Too

Not all testing at TTR involves aircraft or missiles. In January, TTR was one of the sites used for testing fuel-air explosives (FAE) that Sandia was developing as a possible way to detonate buried land mines. A fuel-air explosive works by letting the fuel — propane, in this case — mix with air, then detonating the mixture to cause a large explosion. The tests at TTR (as well as others at Albuquerque) were successful enough to encourage further development, should a sponsor be interested.

Another unusual test was of a countermeasure to be used against an antitank weapon. After short-range tests at Albuquerque conducted by Track and Cables Div. 7535, the test series was moved to TTR for longer-range missiles. The TTR people used one of their own tanks as a target — first removing the valuable hardware from inside, just in case. That turned out to be unnecessary,



RADAR STATION, one of six at TTR, being operated by Parris Holmes (7512).

dreds of times — no problem.' " That's how Ron Bump, of Range Operations Div. 7513, recounts the deceptively routine beginning of a hectic week between learning about the Air Force's need and the successful drop of the bomb on an old concrete target at TTR. Ron is one of four TTR test directors and was in charge of this operation.

Unusual Requests Begin

That first call was the last one that sounded like this would be a normal operation. The next day, working on the weekend, Ron got another call, from a different person. "He told me it was a laser-guided bomb, and the laser was on the way to

The guidance laser got cold and had to be warmed under a truck heater.

the range," says Ron. "I told him, 'You can't bring a laser here. This is an optics range, and lasers and optical tracking don't mix!' He said, 'Well, it's on its way, anyway.' "

TTR uses photographic techniques — as opposed to radar alone — to track test subjects and obtain data. A test typically includes tracking by cinetheodolites that provide trajectory information, telescopes that record general engineering documentation, and arrays of fixed high-speed cameras

though, because the countermeasure worked as intended and made the antitank missile fly into the ground.

Ideal for Optics

Tests such as these emphasize the value of having an available stretch of flat land, located between isolating mountain ranges and furnished with tracking devices. "This is really an ideal setup," says Ron Bentley. "Dry lake beds are strung out along a north-south run-in line, so the optics can be placed with the sun behind them — to either the east or west — for tracking the test units while they're front-lit by the sun. That natural arrangement, plus the precision of the optics we use, plus our really good people, give us some capabilities that other ranges just can't match. So besides our DOE testing, we're called on for DoD work that can't be done on their ranges." (See "TTR Basics.")

The remoteness of TTR — on the north end of the Nellis Bombing and Gunnery Range, about 150 miles northwest of Las Vegas and 30 miles southeast of the town of Tonopah — is also valuable, says Ron. "We have 525 square miles of controlled land area, so there's plenty of space to keep hazardous operations well isolated. That's also true of sensitive tests where you wouldn't want curious eyes looking on."

In sum, the combination of place and people makes TTR perfect for separating opinions from fact. ●CS

that give precise measurements of impact speed and angle. The optical tracking instruments produce data accurate to within about a meter; radar alone can do no better than about 10 meters. Radar is used at TTR to spot targets as they approach the range, and as part of an auto-focusing, auto-pointing system. (See "Cameras and Radar Keep Eyes on the Test.")

The problem with using lasers at TTR is that every tracking station has someone looking through a lens. A stray laser beam that happened to hit the lens could injure the operator's eyes. But because this was an urgent test, TTR people began doing what would be necessary to safely accommodate the laser. That included rounding up filters that could be put over the eyepieces. It also involved some work in the target area — but that comes later.

Airspace by the Minute

Just getting the test scheduled was no routine matter. TTR is part of Nellis Air Force Base, which includes gunnery, bombing, and aerial combat ranges. Time in Nellis airspace, including TTR, is scheduled three months in advance, in 15-minute increments. The schedule is reviewed and adjusted as necessary each month, but that still leaves scant opportunity to squeeze in a test on a week's notice. In the end, the test was conducted the following weekend, when there was less demand for range time.

Another urgent matter was developing a "footprint" — an area, taking into account both the bomb and the laser, from which people would be excluded during the test. For every TTR operation, there is a safety analysis that includes calculating which areas may be hazardous under certain conditions — the failure of a parachute retarding a weapon, a late release by a pilot, and so on. Ron says, "Jim Enlow [7513] and Gary West [7513 Supervisor] did a lot of consulting with people at Albuquerque to find out how to come up with a safe footprint for a laser. We're used to developing the footprint for a drop, but the laser made it extra tricky."

Avalanche of Test Requirements

Nor was this the last curve thrown at the TTR folks. Says Ron, "Because this was such a hurry-up job, we were getting changes all through that week. I got a call telling me there would be telemetry on the bomb — that was after we had first been told there would be no telemetry. So we had to start finding out what their frequencies were, and where they'd want to strip out information, and so on. We managed. But new requirements seemed to keep coming at us at avalanche speed."

The laser being used to guide the bomb was another source of several unusual circumstances. In combat use, the bomb was guided by a laser mounted on the plane. For this test, however, the laser was to be mounted on a pole near the target, the beam reflecting off the target upward toward

(Continued on Page Six)

(Continued from Page Five)

Bunker Buster

the plane. The laser operator would be several miles away, controlling the laser remotely by microwave.

"The laser operator told me he had to have certain microwave frequencies for communication," says Ron. "But the frequencies used here are allocated — you can't just pick a frequency and start transmitting. So we got a list of the frequencies he needed, and Ken Mulkey [Telemetry and Communications Div. 7511] spent that first Saturday afternoon talking to people at Nellis who control the frequencies. Ken came up with enough usable frequencies to control the laser."

The pole for mounting the laser wasn't a trivial matter, either. It had to be 65 feet tall and at a surveyed location. For the pole, Ron relied on the Reynolds Electrical and Engineering Co. (REECO) people who support TTR operations. Says Ron, "I went to the REECO supervisor and told him what we needed. He said, 'Where are we going to get that in the time we have?' I told him I

The idea was to hit the concrete, but anywhere inside the square would be considered a success.

didn't know, but we had to have one. They found the pole and put it in the ground. Then Lloyd Young [7513] surveyed the pole's location."

As the test day approached, the laser pole and the target for the bomb were both ready. The target was a 40-foot square, with a smaller concrete area inside it. The idea was to hit the concrete, if possible, but anywhere inside the square would be considered a success. A black plastic tarp surrounded the concrete to form three-quarters of the target and serve as a laser reflector; the remaining quarter was left earth. Ron says, "It was a whale of an effort that the REECO guys made out here on the target, getting it ready."

Frigid Laser

Finally, the next weekend after Ron got his Friday call, everything was ready for the test. As Ron recounts it, this climax was in danger of being anticlimactic.

"It was a morning test," he says, "and the temperature was pretty low. The cold got to the laser. The aircraft was getting close to the range, and it looked like the laser wasn't going to work. So we used a typical field-test maneuver. We put the laser



CINETHEODOLITE, with Ron Taylor (7514) at the controls, is at a precisely surveyed location and ready for tracking. The cinetheodolites can be moved from location to location for different test requirements and times of day.

Prime Time Means No Worms

Cameras, Radar Keep Eyes on Test

"Prime time" at Tonopah Test Range (TTR) has nothing to do with television. The phrase refers to the best time for optical tracking of test subjects — a half-hour after sunrise, and a half-hour before sunset.

That can mean being out in some frigid Nevada pre-dawns, says Ron Taylor of Optical Measurement Div. 7514. "We use prime time for testing to avoid the worms," he says, explaining that "worms" are the heat shimmers that undulate over the flat desert floor during other parts of the day. "You can completely lose an object in that shimmer," says Ron.

Ron operates one of TTR's nine Contraves cinetheodolites. A cinetheodolite records elevation angle, azimuth angle, and time on each frame of film exposed as an object is being tracked. Operating it is something like sitting in a World War II bomber turret, exposing film instead of firing guns. The film from two or more cinetheodolites can be combined to determine the trajectory of a test object to within about a meter.

Although the cinetheodolites are mobile, they are placed at accurately surveyed locations to provide the necessary precision in calculating trajectories.

Linkup of Radars, Cameras

One thing the cinetheodolite operator doesn't have to worry about is finding the target and focusing on it. The optical trackers — both the cinetheodolites and several telescopes that are used for documenting events of a test but not position — are connected into a system that also includes radars and a computer at the command post (CP). The radars can determine range, as well as azimuth and elevation. That information — from as many as five radars — goes to the CP by microwave and fiber-optic link, along with a time signal for synchronization. From the CP, the data go out to all the tracking stations, each of which has a computer. Each station's computer uses the data from

radars that may be miles away to calculate the direction to point the camera and the correct distance for focusing.

That automation is handy, explains Ron, both for picking up the target when it first comes over the horizon and for keeping it in focus. What he doesn't say — but what is apparent from films of TTR tests — is that the camera operators are truly indispensable links in the system. They have to keep the cinetheodolites and telescopes steady on the test object, even when the unexpected happens, if a test is to yield useful data.

'No Script'

"There's no script for any of this," comments 7514 Supervisor Carl Smith while showing tape footage where the unexpected did happen, such as a bomb's parachute failing to open or a cargo-delivery parachute ripping into useless pieces. "It takes an awful lot of experience for a guy driving a heavy camera mount to react to a failure and get something useful for the engineers," says Carl.

The same applies to radar operators. Though the radars can automatically track an object such as an aircraft, an aircraft is no longer the object of interest after it drops — for example — a bomb. So at each radar site, one operator handles a control that keeps the radar pointed at the correct object. This manual override is particularly necessary for complex tests, such as one conducted last February involving a B-1B bomber, two F-16s, and small rockets (see "TTR Delivered the Goods for Desert Storm").

The radars are also important for range safety, says Gary West, TTR's safety officer and Supervisor of Range Operations Div. 7513. They confirm that the airspace is clear for the test and that the approaching test aircraft is on course. "To run a range like this," says Gary, "definitely takes a combination of radar and optics."

under the heater of a truck, warmed it up, put a coat over it, and got it back on the pole. It was back up and working just in time."

All the intricate things that happen during a TTR operation then meshed smoothly and normally — radar acquisition, camera tracking, telemetry, computers, fixed cameras. The bomb, dropped from about 20,000 feet, hit the target, missing the concrete by no more than a foot or

so. Assured that the weapon could hit and penetrate a target, the Air Force sent the only two "live" bombs to Saudi Arabia. Both were used during Desert Storm, one of them destroying a deep, hardened bunker occupied by senior Iraqi officers. The Air Force is said to be continuing work on the bomb as a permanent addition to US armaments. ●CS

feed Riback

Q: MBWB (Management By Walking By) — I have heard this phrase several times recently, but I have yet to see it happen. I suggest that Al Narath pick a building at random, walk through it, stop by individual offices and work spaces, and spend 15 to 20 minutes with a cross-section of employees to hear their thoughts about their work and about Sandia in general. Narath could spend half a day every two to three months setting an example; perhaps his action would then encourage vice presidents, directors, and managers to do the same. This would result in significant improvement in communication across the lines.

A: First of all, thank you for your suggestion. I have been trying to reach more and more employees and have done some of what you suggest. Here are some of the things I am doing to try to improve my communications with employees:

- Quarterly employee dialog sessions and all-employee town meetings as needed.

- Frequent breakfasts with approximately 16 employees selected at random.

- Monthly half-day walkthroughs (similar to what you suggest). To date, I have visited the Process Development Lab, the Solar Tower, the Security Inspectors in Bldgs. 956 and 802, the Specialty Metals Processing Consortium lab in Bldg. 6630, Purchasing, Plant Engineering, the Microelectronics Development Lab, the Library, Bldg. 894 Records Management, the Shops in Bldg. 840, and Bldgs. 6715, 6526, and 6750 in Area III. My travel schedule does not permit weekly walkthroughs, even though that is what I prefer.

I have also held separate town meetings with each of the directorates in Org. 1000 and plan to reach other directorates in the same way.

I know some of our vice presidents and directors are doing much the same thing, so I hope that soon you will see one of us strolling through your area.

Al Narath (1)

(Continued from Page One)

Outreach

The Black Outreach Committee's 11 members and other Black employees spend time after work and on weekends teaching courses in electronics, physics, math, and computer science to Black elementary, middle, and high school students, says Patricia. This program, called "Hands On, Minds On Technology," has been nationally recognized and used as a model for similar DOE programs. "The kids and their parents, some of them Sandia employees, benefit from the program," says Patricia.

Patricia says 22 students from the nation's Black colleges are participating in engineering internships at Sandia this summer through the Historically Black Colleges and Universities Program, in which a Black mentor is assigned to each student intern. The committee also hosted a Black History and Culture trivia contest recently for high school students.

The American Indian Outreach Committee, says Chairperson Dean Pershall (3511), reaches the greatest number of young American Indians at career fairs and school science fairs. "It's much more than just giving out literature," he says. "American Indians have the highest drop-out rate of any ethnic group. We try to encourage them to stay in school and pursue a career." The committee also holds a picnic and leaders day, publishes a newsletter for American Indian employees, and participates in "Hands On, Minds On."

Celebrating Culture Contributions

For the Hispanic Leadership and Outreach Committee, Hispanic Heritage Month (Sept. 15 - Oct. 15) is the highlight of the year, says Armando Castorena (3511), committee chair. Speakers from the Hispanic community are invited to Sandia, and visitors are welcome to attend. The committee also hosts a semiannual Science and Engineering Awareness Day. This October, Space Shuttle Astronaut Sid Gutierrez will speak to Albuquerque middle school students in the Technology Transfer Center.

Hispanic community leaders from throughout New Mexico will also be invited to "Hispanic Leaders Day" at Sandia. Sandians will brief the visitors about the Labs' EEO/AA program and

For Asian Americans and People with Disabilities

Two Newest Outreach Groups Gear Up

Sandia's two newest outreach groups — the Disabilities Awareness Program Committee and the Asian Leadership and Outreach Committee — are still planning upcoming outreach and inreach activities.

Sandia's Asian Leadership and Outreach Committee (ALOC), formed in October 1988, is currently compiling results of a survey sent to Sandia's approximately 200 Asian American employees recently. The anonymous survey deals with such issues as communication problems, underrepresentation in supervisory positions, cultural diversity, and desired ALOC goals.

"Because Asian Americans are already well-represented in science and engineering," says Pauline Ho (1126), committee chair, "we thought we should first address other issues, such as whether Asian employees perceive they have problems at Sandia as a result of their ethnic backgrounds."

The committee hopes to establish a mentorship program for on-roll employees in which experienced employees serve as mentors for new hires, Pauline says. Although ALOC now has 15 formal members, non-members are always welcome to participate. "Anyone can work on a special project," she says. "All they have to do is suggest one."

Sandia's Disabilities Awareness Program Committee is gearing up for Disabilities Awareness Month in October, says Geri Albright (3511), committee chair. Students from Albuquerque high schools will visit Sandia to observe science demonstrations and talk to Sandians with disabilities about careers in science.

"We want young people with disabilities to know that there are opportunities for them in science," says Geri. "We want them to ask themselves: 'How do I get from high school to a job at a place like Sandia?'"

In 1985, three years before Sandia's Disabilities committee was established in October 1988, the President's Committee named Sandia one of 20 "Employers of the Year" nationwide, recognizing Sandia's progressive programs and policies for employees with disabilities. "We're ahead of other companies in that way," she says.

As part of its inreach efforts, the committee plans to invite vendors to Sandia in October to demonstrate products for accommodating employees with disabilities. The committee also plans to hold potlucks and sponsor other activities aimed at establishing a coherent Sandia community.

how they can help encourage young Hispanics to stay in school and pursue scientific and technical careers.

Every year, the Women's Program Committee co-sponsors "Expanding Your Horizons," an annual one-day program for middle school girls, says Vickie Rodgers (3511), committee chair. "We try to get young women interested in science and engineering," she says, "fields that women have traditionally been underrepresented in." Women's committee inreach activities include monthly speakers on women's issues such as fetal protection and communication between female and male colleagues.

This summer the Labs also employs 53 students from a variety of ethnic groups through its

SEMY program (Summer Employment for Minority Youths), and all six committees sponsor speakers on diversity-related topics. Sandia's outreach committees welcome new members.

For more information, contact the appropriate chairperson: Geri Albright (3511), Disabilities Awareness Program Committee, 4-9341; Armando Castorena (3511), Hispanic Leadership and Outreach Committee, 6-6251; Pauline Ho (1126), Asian Leadership and Outreach Committee, 4-3759; Dean Pershall (3511), American Indian Outreach Committee, 4-0370; Vickie Rodgers (3511), Women's Program Committee, 4-9482; and Patricia Salisbury (3511), Black Outreach Committee, 5-8715. ●JG

feed niback

Q: I am confined to a wheelchair, and when I use the cafeteria I have to exit through the same door that everyone else uses to enter. This is not only inconvenient but hazardous, as people are not accustomed to looking down when entering and often trip over me as I exit. It would be much better for everyone if the exit could be ramped so that wheelchair users could exit through the same door as everyone else, thus avoiding traffic conflicts.

A related problem is the lack of aisles in the cafeteria. There are no wide aisles to the fire exit in the south room. Also, the tables are mostly set at an angle, which may be aesthetically pleasing but makes it very difficult for a person in a wheelchair to maneuver. If those of us who use wheelchairs come in and all the limited aisle seats are taken, we have few alternatives but to "bump" our way to a table, moving chairs, tables, and people as we go.

A: Thank you for your suggestion regarding an exit ramp for wheelchairs in the cafeteria — we have relayed it to the facilities organization.

Because of limited floor space in the cafeteria, it is difficult to maintain wide aisles to accommodate your second request. This factor is compounded by the fact that our patrons con-

stantly move the tables to suit their needs. However, we will endeavor to keep the main aisles at the cafeteria open and unobstructed so that wheelchair patrons can find a place to sit with minimum effort. If at any time you need help, please contact one of the Marriott employees. The cafeteria manager, Cary Glasgow, has assured me he will do all he can to assist wheelchair patrons in finding a place to sit.

Ralph Bonner (3500)

Q: Since ES&H excellence is a Sandia priority, the Labs could demonstrate a commitment to environmental protection beyond its own back yard by assuming a leadership role in the community. One way to do this might be to start a corporate-sponsored program similar to United Way with the recipient being, for example, a land acquisition fund of the Nature Conservancy. (The United Way fund does not allow a participant to select an environmental group as a donor option.) Can this be investigated?

A: Thank you for your suggestion — this is an idea worthy of consideration in the future. However, corporate resources are already severely restrained by several community,

Sandia, and ES&H programs. The Community Relations Division, which would likely administer such an effort, is engaged in rapid implementation of a Community Action Plan related to the Labs' environmental restoration program, and it will be some time before it is ready for additional activities.

It's probably also well to note that many ES&H endeavors, including land withdrawal and use, are not universally supported by taxpayers. We would want to give such efforts a great deal of thought before proceeding.

Herb Pitts (3100)

Employee Death



Milton George, Jr., of Maintenance Operations Planning Div. 7815, died June 23 after a long illness. He was 51 years old.

He had been at the Labs since 1966.

Survivors include his wife, two daughters, and a son.

Unexpected Change Brought Success

Sandia Parachute Designer Receives Honor

At a recent technical conference, parachute designer Don Johnson (1552) found himself accepting an international award in a field he didn't imagine being part of 34 years ago.

The American Institute of Aeronautics and Astronautics presented Don the 1991 Aerodynamic Decelerator Systems Award in recognition of his many contributions to aeronautical and aerospace systems through the application and development of parachute technology. Don's achievements in ribbon parachute development, rocket recovery, and applications of Kevlar™ to parachute design all began with an unexpected change in career plans.

An aeronautical engineering graduate of Purdue University, Don visualized a career in advanced aircraft aerodynamics. He came to Sandia in 1957 because, he says, it had an impressive aerodynamics department, judging from the little that could be revealed about it at the time.

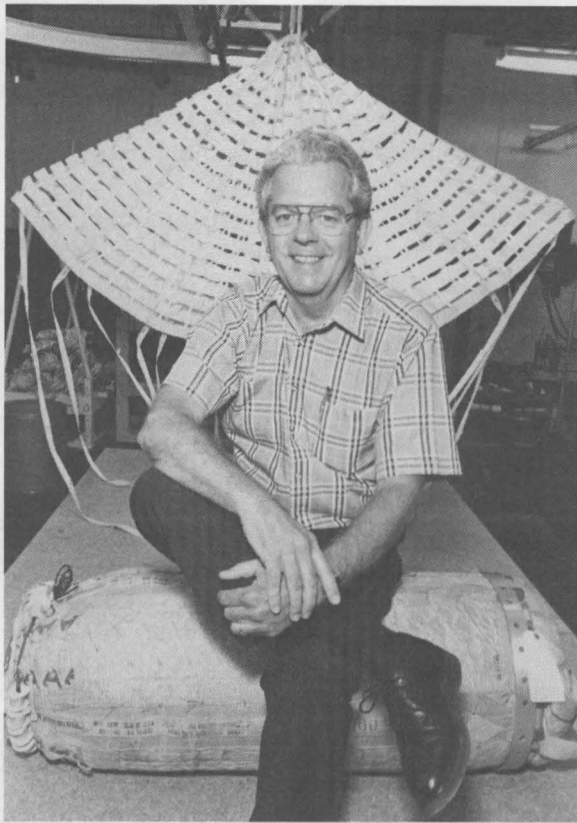
"When I interviewed in the Aerodynamics Department, parachutes were not even mentioned," Don recalls. "However, when I reported to work, the manager told me I was assigned to the parachute group. I told him I couldn't even spell it. He told me I'd learn."

Chutes for Bombs and Rockets

Don's early achievements include the successful design and flight-test of a 120-ft.-diameter ribbon parachute that remained the largest ribbon parachute ever fabricated until the recovery chutes for the Space Shuttle Solid Rocket Boosters were developed in the 1970s. In the 1960s he developed parachutes for an 8,500-lb. bomb and the B-58 aircraft pod bomb.

Working with the Air Force, Don helped in the development of a 22-ft.-diameter ribbon parachute capable of deployment at Mach 1.2 for the low-altitude delivery of a 2,200-lb. bomb. Don patented an all-radial-construction ribbon parachute that can slow a bomb weighing up to 2,400 lbs. moving at 600 miles per hour down to about 50 miles per hour in less than three seconds.

When Sandia routinely used sounding rockets for sampling studies during the Atmospheric Testing Program, Don developed a family of parachute systems for recovering their payloads. These systems include flotation gear for over-water recovery;



DON JOHNSON (1552) sits on a packaged ribbon parachute he developed for the low-altitude deployment of a 2,400-lb. B-83 laydown bomb. In the background is a smaller ribbon chute used for such purposes as high-speed delivery of supplies to troops. Don was awarded the 1991 Aerodynamics Deceleration Award for his contributions to parachute technology.

ery; they have been used to recover more than 200 rocket payloads since 1963. NASA now uses these designs for all of its sounding rockets.

The sounding rocket recovery systems force the payload into a flat (sideways) spin from reentry speeds as high as Mach 10. The resulting high drag allows subsonic deployment of the parachute. Also adopted by NASA, Don's flat spin recovery technique is used to decelerate Space Shuttle Solid Rocket Boosters after reentry to subsonic speeds before parachute deployment.

Don most recently worked on the development of a new recovery system for the F-111 crew escape module. The F-111 escape system

removes the complete cockpit from the aircraft. Don's decelerator design used a new parachute configuration of his own creation. Optimal use of nylon and Kevlar™ materials achieved twice the drag area of the original escape system without increasing either parachute weight or volume. Although the system has not been placed in service, a considerable amount of technology was proven for other uses.

A Leader in Technology Development

Don's designs of a large number of successful parachute systems were all at the forefront of decelerator technology, says William Garrard, Associate Department Head of Aerospace Engineering and Mechanics at the University of Minnesota. "I have always been impressed with his systematic and scientific approach to design," he says.

Garrard was one of many members of the parachute community to support Don's nomination for the AIAA Aerodynamics Decelerator Award. Carl Peterson (1550), in a letter to the AIAA Awards Subcommittee, says of Don, "He is the best parachute designer in the country. People call him from all over the free world for his advice and assistance with their design problems."

A previous recipient of the AIAA Decelerator Award, Theo Knacke, credits Don with "extensive consulting" in Knacke's work, including the Earth Landing Systems for Gemini, Mercury, and Apollo. Don and Knacke also served as members of a US Army Advisory Committee for the development of an advanced parachute for Army paratroopers.

"I do a lot of advising and consulting both here and for other organizations," says Don. He is currently engaged in work with NASA on the landing deceleration chute that will be used on the next shuttle orbiter system.

The trend of future parachute production includes an emphasis on analysis. The ability to analyze parachutes in great detail will be a major focus before better parachutes can be designed, says Don. Though he may have misjudged his aeronautical career directions in the past, Don seems pretty sure of what lies ahead: "Parachutes, parachutes, parachutes - I'm not even sure I could still design a plane." ●DT

Take Note

Retired Sandian Sadie Knight is co-chair of the "Taos Tree in DC" 1991 Committee. The Taos Tree, which will be dug from Northern New Mexico's Carson National Forest and shipped to Washington, D.C., will be the first living (not cut) tree to be selected as the US Capitol's Christmas tree. The project is privately funded. Donations may be mailed to the Taos County Chamber of Commerce, Drawer I, Taos, NM 87571.

Brenna Dotson, director of the Alzheimer's unit at Manor Care Heights Nursing Center, will conduct a seminar about "Caring for the Aging Parent" Friday, Aug. 23, from 7 to 9 p.m. at the Montgomery Blvd. Church of Christ Family Center. For more information, contact Tommy Woodall (9411) on 822-0060 or Linda McEwen (3545) on 291-9355.

The dice will roll Friday, Aug. 2, at the Second Annual "Your Lucky Nite" Casino Event to benefit the Cystic Fibrosis Foundation. The event starts at 7:30 p.m. at the Holiday Inn Pyramid. Tickets are \$20 each or \$35 a pair and include hors d'oeuvres, \$500 worth of free gaming chips, and a chance to win a trip to Atlantic City. For information, call the Foundation on 255-7507.

The Cystic Fibrosis Foundation will also

hold the Third Annual Holiday Inn Pyramid Corporate Chile Cook-Off Aug. 18. Five-member company/organization teams will compete in four chile categories: green, New Mexico red, Texas-style, and salsa. Entry fee is \$125 per team for the first category and \$75 for each additional category. For more information, call 255-7507.

The Council of Albuquerque Garden Clubs is offering lectures and workshops on "Floral Design" Aug. 4, 11, and 18, from 1 to 4:30 p.m., at the Garden Center (10120 Lomas NE). The cost is \$5 per lecture, \$5 per workshop, or \$25 for three lectures and three workshops. Reservation deadline is July 31. For more information, call 296-6020.

"How to Be a Smart Car Shopper" will be the focus of a free seminar Saturday, Aug. 17, at 10 a.m. at Sandia Laboratory Federal Credit Union. Topics include how to determine how much you can afford, how to be an educated shopper, negotiating your best price, and financing alternatives. The seminar will take place in the First Floor Meeting Room of the Credit Union Center at Juan Tabo and Comanche. For reservations, call 293-0500.

Sympathy

To Leo Griego (1143) on the death of his father in Tijeras, June 26.

To Carol Kaemper (21-1) on the death of her brother in Corpus Christi, July 2.

To Bob Longoria (5219) on the death of his father in California, July 3.

To Edwina Lopez (5217) on the death of her mother in Maryville, Tenn., July 3.

To Bernice (7841) and Vance (6471) See on the death of her mother and his mother-in-law in Espanola, July 5.

To Marti Schoeffler-Cobb (2331) on the death of her mother in Chicago, July 7.

To David Williams (2337) on the death of his father in Lake Helena, Fla., July 8.

To Bernice Lucero (2331) on the death of her father-in-law in Belen, July 14.

To Theresa Olecksiew (3437) on the death of her mother in Albuquerque, July 16.

Retiree Deaths

| | |
|-----------------------|---------|
| Douglas Bruce (78) | June 7 |
| Richard Dyer (80) | June 7 |
| Jerry Kostka (88) | June 8 |
| Andrew Jacob Max (77) | June 11 |
| Sally Ann Moore (81) | June 17 |
| James Leonard (86) | June 23 |
| Stuart Browning (78) | June 26 |

Shaving Away Seconds, Adding Inches**Labs Telemetry May Help US Athletes Prepare for '92 Olympics**

Whether it adds up to a few extra millimeters for a US pole vaulter or the length of a bicycle for a US cyclist, one thing is certain — in Olympic competition, where many of the world's greatest athletes gather, one inch or one-tenth of a second can be the difference between a medal and nothing.

At the 1992 Olympic games, a little bit of Sandia will be behind many US athletes as they leap, roll, and glide for gold. Sandia's contribution will be its telemetry expertise in a new kind of Performance Measurement System that will help US athletes achieve optimal performance as they train.

"This is an opportunity to help the Olympic team and show that some of the Labs' technical expertise can be useful outside the weapon complex," says Dave Trapp of JTA Telemetry Div. 5145.

Measuring Remotely

Telemetry — the encoding, transmitting, and receiving of information obtained by remote sensors — is used at Sandia predominantly in weapon programs. Telemeters measure the aging of weapons in the stockpile, for instance, says Dave.

A simple telemetry system consists of a sensor, typically attached to a component or vehicle being tested, which measures certain parameters (such as temperature, force, altitude, or any other measurable parameter of interest to a test

Electronics carried on the athlete's body or equipment must not hinder the athlete.

designer). An adjacent transmitter encodes and transmits the information, which is received by a remote, often ground-based receiver or data acquisition station.

The Labs has been using telemetry systems in rockets, rocket sleds, airplanes, and balloons since the 1950s to measure how various weapon components perform as they encounter extreme, real-world environments. More recently, the Labs has developed telemetry systems for reentry vehicles, energy programs (including underwater instrumentation), and NASA programs such as the gamma-ray imaging spectrometer flown on high-altitude balloons. Today, Labs telemetry researchers are helping develop systems useful for climate studies and other environmental programs.

Meeting of Minds

In January, Dave and 10 other sensor and human performance experts convened at a US Olympic Committee (USOC) meeting at the Olympic Training Center (OTC) in Colorado Springs, Colo. The meeting's purpose was to provide the committee with information about developing a Performance Measurement System that could measure, transmit, and receive information about individual athletes and their equipment while they train or compete.

Telemeters would provide information about the athlete (such as a runner's heart rate or blood pressure), about equipment (such as forces on a rower's oar), or about the connection between the athlete and the equipment (such as a cyclist's muscle strain or forces in a pole vaulter's grip).

This information — physiological, biomechanical, and psychological — could be used immediately, between trials for instance, to improve the athlete's form or grip on equipment. It could also be stored in a data base for each athlete, providing useful long-term information to OTC sports scientists and trainers about the athlete's physiological and psychological patterns.

The meeting attendees agreed that such a system should be applicable to a broad range of sports, reports Dave. They also agreed that, regardless of the particular sport, the system must include



UNM HEPTATHLETE and student track assistant Darcy Ahner runs the hurdles as Dave Trapp (5145) observes. Dave is providing Labs telemetry expertise to the US Olympic Committee, which plans to develop a telemetry system that measures performance as athletes train and compete. The system will eventually be applicable to a number of sports, including track. Darcy will compete for a spot on the US Olympic team early next summer. (Photo by Randy Montoya, 3162)

three basic features: a capability to gather information from sensors or transducers attached to an athlete's equipment (such as a bicycle) or the athlete's body; an on-board recording or data transmission feature (telemetry); and an ability to provide useful information to athletes and coaches. All on-board electronics carried on the athlete's body or equipment must also be small and light enough not to hinder the athlete.

"It's amazing that the vast majority of telemetry expertise is right here in the US," says Dave, "yet the German Olympic team is ahead of us by almost a decade in terms of using it to improve athletic performance." The Italian and Bulgarian Olympic teams have also used telemetry systems, he says.

Some Catching Up To Do

Dave says the group so far has defined an initial first system and set milestones for the three-phase project. The prototype of the system should be completed four to eight months from now. It will be used by 1992 Olympians in a limited number of sports, namely "vehicular" sports such as rowing, cycling, canoeing, kayaking, bobsledding, and the luge. (The 1992 summer games will be held in Barcelona, Spain.)

In phase two, the system will be miniaturized for use in "on-athlete" sports. In phase three, integrated circuits will be customized for individual sports, making the systems even smaller and more sport-specific.

When complete, the system should be applicable to cycling, rowing, yachting, fencing, canoeing, kayaking, skiing, figure skating, gymnastics, track, and team sports such as volleyball, hockey, team handball, basketball, and soccer, says Dave. Other applications may follow.

He says that because the USOC is largely a volunteer organization, Sandia's contribution will have to be in the form of sporadic part-time volun-

tary assistance and a possible temporary transfer of surplus telemetry equipment. ●JG

(Continued from Page One)

Family Day '91

contractors and consultants, and Sandia retirees. The definition of family includes spouses, children, parents, grandparents, siblings, in-laws, aunts, uncles, nieces, nephews, and any relative who's part of the household.

Before Family Day, employees will receive a guest list form that must be completed and presented upon arrival at the event along with their badges or retiree ID cards. Uncleared employees must be included on a cleared employee's guest list form in order to attend. The guest list form will be published in an upcoming issue of the *Weekly Bulletin*.

Pets will not be allowed under any circumstances.

To invite close relatives or live-in exchange students who are not US citizens, special forms must be completed and submitted to Tim Lucero, Access Control and Administrative Support Div. 3437. Guidelines will be published as soon as approved by DOE. All requests will be considered on a case-by-case basis.

Requests to bring more distant relatives, non-family friends, or live-ins will be handled on a case-by-case basis by Ray Chavez (3437-1) and his staff in the Badge Office. Watch for the special access form in future issues of the *Weekly Bulletin*. ●LD



Sandia News Briefs

Improved Methods of Chemical Analysis

Sandia scientists are exploring and developing a new branch of analytical chemistry that is based on computer-aided analysis of the colors that are absorbed or emitted by certain materials.

Known as chemometrics, the technique is used to design experiments and to obtain useful information about unknown samples of material, says Dave Haaland (1824). Typical information might be the identification of chemical components and the quantity of each one.

Dave and David Melgaard (contractor) recently received a SEMATECH Inventor Recognition Award for the development of chemometrics software for personal computers. The original software was developed by Dave Haaland and Ed Thomas (7223) for use on VAX systems. The PC-compatible format makes the technology more universally available to US industry.

Chemometrics allows researchers to sift through vast quantities of data and extract meaningful, quantitative information. Sandia has adapted chemometrics to analyze data from spectral measurements, which are quick, non-destructive, easily automated, and don't require chemical separations.

Sensors Detect Industrial Chemicals

A prototype sensor system developed at Sandia is expected to improve chemical sensing in industrial environments and make it less expensive.

The system can be used to monitor chemicals present in industrial environments, help engineers reduce wastes and emissions, and help prevent worker exposure to unsafe substances, says chemical engineer Greg Frye (1846).

The system incorporates a simple, solid-state sensor and detects and measures gaseous chemicals almost instantaneously by measuring the behavior of acoustic waves in solids, liquids, or gases. It has been called a "mass spectrometer on a chip" because of its ability to identify chemical species without the need for multiple sensors.

Seismic Device Improves Oil Field Imaging

Sandia engineers have successfully tested a seismic device that fits deep inside a well and could help geoscientists get a better underground picture of an oil or gas field.

Like traditional surface instruments, the device receives seismic waves reflected from underground rock formations, but it is located much closer to the underground petroleum-bearing formations being mapped and therefore provides a more accurate picture. In a typical application, seismic waves are generated by detonating an explosive; the waves are detected by geophones and processed by computer to produce a picture of the subsurface.

"The disadvantage of surface methods lies in the fact that the target formation may be several miles beneath the surface," says Gerard Sleaf (6258). "That's a long way for a wave to travel, so by the time it is reflected and recorded on the surface, the wave is attenuated and the higher frequencies are lost."

New Advances Increase Airborne Computational Capabilities

New capabilities developed for the Sandia Airborne Computer (SANDAC) provide at least five times greater computational throughput, better programming flexibility, resistance to electromagnetic interference, and other improvements.

SANDAC is a high-performance, rugged, miniaturized, parallel-processing computer about the size of a kitchen toaster. It is tough enough to fly on missiles and run on batteries while computing for such things as high-speed navigation, guidance, and control.

"We can see up to 30 times improvement in some floating point operations," says Ed Nava (2336). One operation that previously took 4.5 millionths of a second now takes only 150 billionths of a second.

SANDAC is used by Sandia and defense agencies in the testing of experimental missiles, reentry vehicles, complex space experiments, advanced aircraft prototypes, and other systems. Sandia also uses it in robotics, data gathering, and image recognition.

SANDAC weighs only 7 pounds, uses just 35 watts of power, can operate in temperatures from minus 4 degrees F to 160 degrees F, and can resist vibrations of 18 g's and shocks of 1,200 g's.

Low-Energy Igniter May Improve Auto Air Bags

A low-energy explosive igniter invented at Sandia could make it easier for automobile manufacturers to install multiple air bags in their vehicles.

The igniter, being adapted by private companies for use as an air-bag igniter, uses a silicon chip called a semiconductor bridge (SCB), invented by Bob Bickes (2515) and Al Schwarz (ret.). The SCB makes multiple air-bag and restraint systems more feasible because it requires much less energy than traditional hot-wire igniters.

Engineers design air-bag safety systems to meet the demands of a worst-case scenario, even when an automobile's battery is nearly depleted. Hot-wire igniters currently in use require nearly all of the battery's remaining output. Because the SCB is about 100 times smaller in volume than a conventional hot wire, it can be heated much faster and with less energy. This makes it possible to activate multiple air bags with the same battery output.

Air bags are inflated by nitrogen gas released during the rapid deceleration of a crash in a process that takes only a few thousandths of a second.

Molecular Engineering Codes Aid Polymer Design

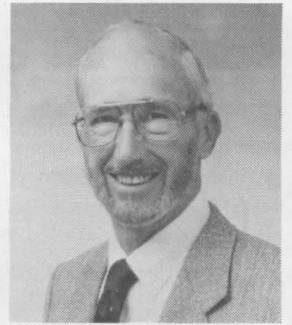
New computer codes developed at Sandia could guide chemists in the development of novel polymer blends and copolymers before going into the laboratory to produce them.

A polymer chemist can use the codes, which are based on a theory developed at Sandia, to infer the approximate solubility and phase behavior of hypothetical polymer mixtures.

Most polymer blend development work in the past has been done on a trial-and-error basis, notes John Curro (1813). The new theory, which allows quantitative calculation of average intermolecular packing and thermodynamic properties, has the potential to change that.

BIOSYM, a San Diego company, is collaborating with Sandia to develop a commercial software package based on the new polymer theory.

Recent Retiree



Fred Deber
2853

43

Fun & Games

Volleyball — Fall volleyball leagues are being formed. Roster forms are available at the SERP Office and are due back with team fees by 5 p.m. Friday, Aug. 16. Those not on a team can sign up on SERP's free-agent list. A volleyball meeting will be held Aug. 6 at 5 p.m. at the Coronado Club. League play begins in September at a KAFB gymnasium. Cost per team is \$175. For information, call the SERP Office on 4-8486.

Bowling — SANDOE Bowling Association April/May Bowlers-of-the-Month are: Scratch — Dominic Bellino, 555; Helen "Charlie" Husa, 562; Handicap — Fred Gunckel (2543), 542, 617; Marti Morgan (3540), 496, 652. An awards presentation and sign-up meeting will be held Aug. 7 at Fiesta Lanes at 6 p.m. For information, contact Dora Gunckel (6400) on 299-4867.

A Tri-Cultural Fest honoring Native American, Spanish, and German cultures will be held on the Balloon Fiesta Field Aug. 2-4. Entertainment includes traditional music, folk dancing, and food. Times are 4-11 p.m. Friday, noon to 11 p.m. Saturday, and noon to 10 p.m. Sunday. For information, call the Rio Grande German-American Club on 888-4833.

Sandia Golf Association — Winners of the Mountain Classic in Los Alamos July 12 were Reynold Tamishiro (7487) and Terry Hutchinson (7485), first place; Joey Gutierrez and Dennis Gutierrez (9925), John Garcia (6423) and Luis Abeyta (7531), second-place tie; Mark Smith and Ed Thuman (ret.), fourth; and Jim Salas (2512) and Terry Witt (2513), Howard Cilke (7483) and Bob Wood (3712), Charlie Salazar (7482) and Jake Gonzales (7485), fifth-place tie. Charlie Adams (1544) won the "President's Flight" in the Albuquerque City Golf Championships July 5-7.

Congratulations

To Tamara and Ed (1813) Russick, a son, Stephen Edward, June 28.

To Agnes (7341) and Donald Fragua, a daughter, Brianna, June 30.

To Jeannie and Kent (1163) Pfeifer, a son, Nathaniel Bryant, June 23.

To Jana and Jay (2362) Hammond, a daughter, Jorja Lee, June 27.

To LaArnie and Bert (2335) Tise, a son, Steven Gregory, July 5.

To Tabitha Jeantette (6429) and Anthony Valdez, married in Taos, July 6.

To Milissa (3522) and Russell Fellers, a son, Ryan David, July 5.



This newspaper can be
recycled with
Sandia office paper

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.
13. "Work Wanted" ads limited to student-aged children of employees.

MISCELLANEOUS

REVOLVER, .357 magnum Smith and Wesson, L-frame, 6-in. barrel, nickel. Montoya, 296-4268.

BABY ITEMS: crib w/mattress, converts to youth bed, \$200; high chair, \$100; car seats, \$30; crib sets, handmade, \$95. Simpson, 298-1277.

AIRLINE TICKET, Albuquerque/Los Angeles round-trip, July 28 - Aug. 7, paid \$157, asking \$100 OBO. Myers, 899-1523, leave message.

LAPTOP COMPUTER, Zenith 181, w/carrying case, \$450. McKinney, 828-1251.

POOL EQUIPMENT: 15'x30' solar cover, 15'x30' winter cover, 1-hp pump, filters, jacuzzi filter housing, 30' hose, chemicals. Cassell, 298-5262.

BASSET CRIB, with Simmons mattress and bedding, \$115; child's "Clip Clop Wonder Horse" w/sound mechanism, \$25. Ukena, 275-7275.

FOUND ABANDONED, 7 kittens and mother, free to good home(s). James, 265-4015.

HOT TUB, Dimension One, seats 6, redwood sides, 5 jets, w/cover, \$2,500. Whinery, 281-8635.

BASS GUITAR, Yamaha RBX550M, blue, w/hardshell case, PJ pickups, 8 mos. old, \$400. Hammond, 823-9619.

REFRIGERATOR/FREEZER, Whirlpool, 18-cu.-ft., \$250; single mattress and box spring, \$40. Nagel, 243-5708.

SINGLE-PANE WINDOWS, aluminum-frame, most w/o screens, various sizes, 6 total, free. Van Deusen, 291-8196 after 5 p.m.

KITTENS, black and white, 2 males, 2 females, have first shots, free to good homes. Orear, 344-3460.

CONSTRUCTION MATERIAL, electrical, Gullistan carpet, antiques, hobby equipment, new CB, sports, tools, plumbing, fencing, sports coats. Pickering, 268-2134.

SHREDDER, Mantis "Chipmate Bio-shredder," 110VAC, \$150. Yingst, 884-3812.

RV PROPANE FURNACE, forced-air, 12-volt, w/manual, Duo-Therm model 66117, \$30; clay pigeon spring trap thrower, new Hoppes, \$20. Demos, 294-6492.

BALDWIN CONSOLE PIANO, light wood, \$1,100. Beeler, 822-9463.

SEWING MACHINE, \$75; typewriter, \$25; cradle, \$10; high chair, \$20; child's bicycle seat, \$5; car seat, \$20; tricycle, \$15; spring horse, \$10. Coleman, 299-8321.

JET SKI, Kawasaki 550, cart, stand, ramp, oil, \$2,900 OBO. Striker, 296-8206, leave message.

BLACK LANDSCAPE PLASTIC, 6-mm, 20' x 70', free; skateboard/roller blade ramp, 4' high, free. Kersch, 821-2848.

CARPET, 12' x 20', peacock-blue, w/padding, cost \$15/yard. retail, sell for \$5/yard. Rockwell, 884-4206.

WHIRLPOOL ELECTRIC RANGE, gold, \$125; Anne Klein lined raincoat, tan, size 12, never worn, \$40. Maloney, 828-9610.

KING-SIZE WATERBED, 12-drawer underdresser, semi-wave mattress, bookcase headboard w/mirrors and etched glass, rails, \$200. Snyder, 898-5962.

CAPTAIN'S CHAIRS, 4, Ethan Allen, honey maple, \$100. Trembl, 265-3507.

KENMORE MICROWAVE, programmable, \$100 OBO; mini-truck tool box, black plastic, never installed, \$60 OBO. Baird, 891-5497.

SOFA, love seat, coffee table, 2 end tables, \$400/all. Baca, 293-8710.

BEDROOM SET, dark wood: headboard, king-size bed, 2 nightstands, dresser, mirror; 8-piece sectional couch. Rightley, 293-9780.

BABY BED, w/mattress, bumper pad, \$30 OBO; toddler car seat, \$20 OBO. Mooney, 281-2612.

NIKON CAMERA, Model EM, w/f1.8 lens, case, & instructions. Henry, 266-6467.

KING-SIZE WATERBED, complete, etched mirror headboard, mattress never punctured, 6 drawers, \$200 OBO. Martinez, 877-4744.

YARD SALE: multifamily, stroller, bicycles, household items, baby items, July 20, Mulberry Loop, Pinon Ridge. Chow, 281-9235.

UNM BASKETBALL SEASON TICKETS, '91-'92 season, Section 14, Row 7. Iverson, 293-5139.

NORDIC TRACK PRO, w/electronic workout computer, \$625/both. Matthewson, 883-6649.

CRIB, \$40; stroller, \$35. Heald, 281-8826.

NINTENDO, \$50; portable CD player, \$60; Kenwood dual cassette deck, \$50; oak desk, \$350 OBO; Smith-Corona typewriter, \$20. Edwards, 275-7611.

TWIN-SIZE BED, box spring, mattress, frame, \$75 OBO. Whelan, 265-2836.

YAMAHA TENOR SAXOPHONE, Yamaha Model YTS-21, 2 mouth pieces, \$700. Aragon, 888-3473.

GIRL SCOUT UNIFORM, size 12, with hat. Wagner, 823-9323.

WASHER & DRYER SET, heavy-duty Whirlpool, avocado green, electric dryer, \$100/ea. Smith, 271-1959.

MATCHING SHELVES, 2, 71" x 30" x 15", one w/light & doors on lower shelf, other w/pull-down shelf door, \$100. Moonka, 291-9266.

KIMBALL PIANO, 3 pedals, \$1,300; Commodore 128 system, AMX color monitor, GE printer w/adaptor, disk drive, \$200. Griggs, 892-4152.

SNOW TIRES, 2, E78-14, \$50; external door w/diamond-shaped window, \$15; wooden shelves, \$1/ea.; homemade pine bed-frame, redwood-colored, \$20. Haaker, 298-7415.

AMIGA 500 COMPUTER, 1MB, 2 disk drives, monitor, printer, software, \$700 OBO. Kubas, 899-2774.

SOFA SLEEPER, queen-size, beige & brown, \$250. Jogi, 275-0610.

UPRIGHT FREEZER, 21 cu. ft., \$100. Anderson, 281-5086.

IRISH WOLFHOUND, 7 yrs. old, needs loving family, free to good home. Jones, 296-3998.

5-PIECE DRUM SET (Tama), w/hardware & 2 Zildjian cymbals, \$1,000. Tidwell, 275-0966.

METAL DESK, grey, \$40. Ahr, 883-0459.

TRUCK TOOL BOX, full-size, lockable, \$50 OBO. Fleming, 888-0744.

CAMERA, Pentax K-1000 SLR, recently overhauled, 180-day warranty, 50mm F2.0 & 28mm F2.8 lenses, strobe, filters, bag, \$185. Moore, 345-4030.

RADIO-CONTROLLED CAR, 1/10 FROG, battery pack, trigger control, battery charger, \$150. Benham, 881-2593.

COLOR TV, RCA XL-100, 25-in., console, \$55. Norwood, 292-0072.

'87 ALFA GOLD TRAVEL TRAILER, 29-ft., Queen Island bed, loaded, \$13,995 OBO. Fisher, 298-0526.

WASHER/DRYER, Frigidaire, 18-lb. size, full-featured, \$250 set. Youngman, 266-1405, evenings/weekends.

SANDIA T-SHIRTS, caps, coffee mugs, new shipment, all \$7. South 14 Project, LAB NEWS office, Bldg 814.

FREE KITTENS, need homes, 2 tabbies, 1 black, outdoor or indoor, 10 weeks old. Martinez, 877-4744.

SLINGERLANDS DRUM SET, 6 pieces, w/snare drum, metallic gold. Trussell, 293-7732.

COMPUTERS: DEC Rainbow w/MS-DOS, CPM, monochrome, 5MB hard disk, word processor and dBASE; Commodore 64 w/disk drive, printer, software. Dawson, 298-9508.

MOWER, 20", 3-hp, \$70; sewing cabinet, \$55; oak & cane bar stool, \$25; hamster pen w/accessories, \$15. Levan, 293-0079.

PUPPY, miniature long-haired dachshund, AKC-registered, male, black and red, born June 30, \$200. Snell, 298-3977.

COMPUTER, Commodore 64. Roberts, 255-9527.

DISHWASHER, GE model GSD400W, \$10. Bodette, 275-9722.

CAR SEATS, two Strolees, 5-point harness, \$30 each. Mastin, 292-2086.

SAILBOARD, 9'4" custom, 115-118 lbs., \$265; Aitken 8'10" 90-ltr., \$110. Healer, 298-6967.

TONYHAWK SKATEBOARD, \$50; sofa table, brass and glass, \$30. Cooper, 881-1329.

TWIN BED, 1930s antique, black iron, box spring and mattress, \$150. Martinez, 344-1334.

ELECTRIC TYPEWRITER, portable Olivetti CX440+, extra ribbon, correction tape, \$100. Stamm, 255-2640.

LARGE ARTIST EASEL, oak, new, \$165 OBO. Ramel, 821-0475.

LOVESEAT, chair, beige with ducks, new, \$125/both; antique walnut dresser with mirror, make offer. Gately, 271-1344.

COMPUTER, 10 MHz Packard Bell, 640Kb RAM, 40 Mb hard drive, 5-1/4" floppy, CGA monitor, \$540. Love, 294-1632.

COCKATIEL/PARAKEET CAGE, 14x16x17-in., chrome w/accessories, \$20. Edmunds, 293-3503.

TRANSPORTATION

SAND RAIL DUNE BUGGY, 2017 VW engine, dual Weber carburetors, 3 pairs tires, Centerline rims, tow bar, lights. Apodaca, 294-5525.

'69 MUSTANG CPE, white, AT, 30K on factory rebuilt 302 engine, \$3,950 OBO. Hole, 293-4653.

'71 VW SUPERBEETLE, red, \$2,200. Aldrich, 255-4885.

'88 MOBILE TRAVELER CLASSIC MOTORHOME, 24-ft., 8,300 miles, 1-ton Chev. chassis, 350 engine, \$24,500. Conklin, 268-3258.

BICYCLES: Schwinn, 3-spd., 15-in.; Nishiki, 10-spd., 20-in.; 10-spd., 23.5-in.; window air conditioner; 4KW heavy-duty Onan generator. Wawersik, 884-7690.

'80 MAZDA RX-7, black, 5-spd., 30K miles on new V-6 engine, needs some cosmetic work, \$2,000 OBO. White, 271-1053.

'89 CHEV. 1500 PICKUP, extended cab, 351 V-8, AT, AC, cassette, matching fiberglass shell, w/carpet conversion kit. Aurand, 281-4027.

'78 PORSCHE 924, alpine white, 46K on '82 engine, AC, new tires, brakes, upholstery, stereo, extras. Dawson, 298-9508.

'83 TOYOTA 4x4 SR5 WAGON, AC, new struts, new brakes, 114K miles, \$2,700. Nagel, 243-5708.

'77 BUICK ELECTRA 225 LIMITED, \$1,000. Hammond, 294-2045.

10-SPD. BICYCLE, Nishiki Sport, red, 19-in. frame, \$85; women's 3-spd. bicycle, Schwinn, 21-in. frame. Benham, 881-2593.

'89 FORD PROBE GT, 5-spd., AC, anti-lock disc brakes, new tires, \$9,000. Mauldin, 293-3763.

'88 FORD BRONCO II, Eddie Bauer edition, options, running boards, \$10,400. Miller, 822-8733, leave message.

'84 FORD ESCORT GT, bronze, 5-spd., new tires, \$2,000 OBO. Lee, 888-4728.

'78 MOTOBECANE MOPED, running when parked, \$60; '80 Ford 351M engine, complete, \$350. Minor, 877-7313.

'89 FORD PROBE, \$9,000. Fitzpatrick, 275-3422.

'52 MORRIS MINOR, \$300; '58 Morris Minor, \$100; '50 MG YA, rare, \$6,500. Campbell, 889-0961.

'80 HONDA ACCORD LX, hatchback, 5-spd., PS, AC, FM cassette stereo, \$1,000. Andersen, 292-2256.

'76 MIDAS MOTORHOME, 20-ft., 350 GMC, w/new tires, upholstery, & awning, \$7,995. Vand, 293-1249.

'78 DATSUN 280Z, 5-spd., AC, 105K miles, \$2,000. Doremus, 275-2491.

'68 TRIUMPH SPITFIRE, \$1,575; '84 Civic DX, 35K miles, wrecked, \$450 OBO. Anderson, 281-5086.

'73 240Z, 4-spd., \$2,200 OBO. Payne, 888-0425.

BOY'S BICYCLE, Roadmaster RMX, 16-in., \$35. Cheng, 275-7008.

WOMAN'S 10-SPD. BICYCLE, KHS Winner, wheel size 27x1-1/4-in., \$150. Sanchez, 291-9625.

ALUMINUM BOAT, 12-ft., 9.9 Johnson, swivel seats, oars, extras. Baca, 293-8710.

'89 CAMARO SPC, 20K miles, T-tops, take over payments, \$8,900. Gallegos, 344-3290 or 345-5202.

'84 NISSAN MAXIMA STATION WAGON, 52K miles, all records, RWD, STR-6 engine. Boyd, 298-4712.

'83 NISSAN STANZA, 4-dr., hatchback, 5-spd., 55K miles, AC, AM/FM cassette, \$2,500 or trade for pickup. Wienecke, 292-5368.

'61 CHEV. SCHOOL BUS, '72 350 engine, 34K miles, 75A alternator, sleeps 2, CB, AC, \$6,000 OBO. Stamm, 255-2640.

'82 HONDA V45 MAGNA, needs clutch work, \$850. Leslie, 299-4159.

'76 CAMARO LT, 350 V-8, AC, PS, PB, PW, AM/FM, 94K miles, 2 owners. West, 891-9231.

'76 INVADER BASS BOAT, 19-ft., 85-hp Johnson outboard, w/front electric trolling motor, trailer, and boat cover. Trussell, 293-7732.

'72 BUICK SKYLARK, Sandian-owned, new parts, \$1,750 OBO. Downs, 266-8254.

24-IN. BICYCLE, Hutch Trickster, extra tires, cost \$500, sell for \$110. Cooper, 881-1329.

FUJI 'TEAM' BICYCLE, 58-cm, less than 800 miles, cost \$550, sell for \$270 OBO. Healer, 298-6967.

TANDEM BICYCLE, Motobecane, 21-in. f x 20-in. b, Mixtie rear, 15-spd., \$500. Bodette, 275-9722.

'88 LINCOLN TOWNCAR, Signature series, loaded, options, dark blue, \$13,000. Levan, 293-0079.

'88 FORD RANGER, 4x4, 5-spd., supercab, PS, PB, PDL, PW, AC, bed liner, extras, 40K miles, \$9,950 OBO. Youngman, 266-1405.

'86 FORD LTD II WAGON, V6, AC, PS, tilt, AM/FM cassette, tinted windows, luggage rack, new tires, 49K miles, \$3,300. Carroll, 839-4713.

'84 BUICK SKYHAWK, one owner, AC, PS, PB, 4-spd., new clutch, 82K miles, \$2,150. Henfling, 869-4119.

'90 AUDI, 10K miles, black, tan interior, ABS brakes, BOSE system, ski sack, \$24,000. Davis, 275-0779.

'84 MERCURY MARQUIS BROUGHAM, loaded, Michelin tires, V6. Summers, 881-7763.

'89 PONTIAC GRAND AM, 43K miles, AT, AC, cruise, AM/FM cassette, new tires, \$7,500. Mills, 839-0120.

REAL ESTATE

PATIO HOME LOTS, NE Heights, Osuna Place (near Moon/Osuna), all city utilities to property line, average size 42'W x 75'L, \$16,000/ea. McClaffin, 292-3543.

3-BDR. HOME, River's Edge, views, 2 baths, 2-car garage w/opener, auto sprinklers, enclosed yard, custom shades, \$89,900. Baird, 891-5497.

4-BDR. HOME, custom-built, 2,350 sq. ft., split-level, 2-car garage, vaulted ceilings, 1-3/4 baths, fireplace. Cheng, 275-7008 evenings & weekends.

3-BDR. HOME, Cedar Crest, 1,600 sq. ft., 2 baths, 2-car garage, 1/2-acre, \$110,000. Chow, 281-9235.

2-BDR. CONDO, Purgatory Cascade Village, 2 baths, view, unit, sleeps 6, \$115,000. McCoy, 821-2509.

LOTS near new Petroglyph National Park in Volcano Cliffs area, three, REC possible. Pruet, 293-6244.

4-BDR. HOME, mountain living, 2,175 sq. ft., 2 baths on 1.2 acre, large decks, views, 20 minutes east of Albuquerque, \$158,900. Lyons, 281-9283.

1-BDR. TOWNHOME, Eubank & Academy, garage, fireplace, clubhouse, pool, mountain views, \$63,900. Papenfuss, 822-9099.

3-BDR. HOME, 1-3/4 baths, 2,000 sq. ft., study, new roof, double windows, 2-car garage, near Indian School & Pennsylvania, \$85,000. Park, 298-9630 or 294-5679.

3-BDR. HOME, large lot with sideyard access, 1,830 sq. ft., O'Keefe, Eisenhower, La Cueva schools, \$109,500. Gruer, 296-8163.

PATIO HOME LOT, east of Tramway off Lomas, near open space, views, \$49,500. Halbleib, 268-6571.

WANTED

MALE SINGERS, to join championship barber shop chorus, all voices needed. Brooks, 275-0056.

TEXTBOOK, for Business Math I at College of Santa Fe, Introductory Math Analysis, 5th Edition by Haessler. Malcomb, 294-6975.

HAPPY HOLLISTER BOOKS, by Jerry West, partial or complete set. Torczynski, 292-7191.

LITTLE TIKES PLACE (miniature playhouse), with or without accessories. Turpin, 281-5933.

ROOMMATE, to share 4-bdr. home in NE Heights, sauna, jacuzzi, pets OK. Irwin, 294-4644.

BACKPACKING EQUIPMENT, in good condition: tent, stove, etc. Douglas, 281-9843.

TWO RABBIT CAGES OR HUTCH, w/feeders, will pay \$15 for cage or \$25 for hutch, must be clean & solid. Rockwell, 884-4206.

TELEVISION, 25-in. to 27-in., table-top model. Davis, 294-1048.

OWNERS' MANUAL, for '89 Ford F-150 Custom 6 pickup. Pierce, 268-6057.

NON-SMOKING PROFESSIONAL, to share 2-bdr. apartment, NE Heights, furnished except one bedroom, leave message. Boyd, 294-6948.

TRUNDLE BED, in good condition, with or without mattresses. Hogan, 292-8879.

BED RAIL for single bed. Hammond, 294-2045.



Coronado Club Activities

After a Hot Week, Cool Down at the Club

COOL OFF at the C-Club pool and patio tonight, July 26, and Friday, Aug. 2. The pool and patio are open from 5 to 10 p.m., and a reasonably priced patio buffet is served from 5 to 7. The cost: free for members with pool passes, \$1 for Club members without passes, and \$2 for non-member guests.

BINGO FOR BEGINNERS — Bring your bingo beginners to the Club Sunday afternoon, July 28, where kids-only bingo begins at 1 p.m. An a la carte buffet will be served beginning at noon.

A MIGHTY FINE MENU and a great band are on the agenda Friday night, Aug. 2, from 6 to 11. Dinner is served starting at 6; menu items include prime rib or poached halibut (two-for-one price \$16.95), steak Neptune (\$9.95), Cajun-style

catfish (\$9.95), and chicken teriyaki (\$7.95). At 7, the Isleta Poor Boys take the stage. Make reservations early (265-6791).

SWIMMING HOLE CLOSED — The pool and patio will be closed Aug. 3 and 4 for the Sundance swim finals. On Aug. 5, the pool and patio are open from 4 to 8 p.m. only.

HE'S NEVER BLUFFING when group organizer Jim McCutcheon says the T-Bird Card Group welcomes new members. August meetings take place Thursday, Aug. 8, and Thursday, Aug. 22, from 10 a.m. to 3 p.m.

MOVIEGOERS, discount tickets for United Artists and General Cinema theaters are now available for \$4.25.

**Earnings Factors
May 1991**

| Long-Term Savings Plan for Management Employees (LTSPME) | Earnings Factors |
|--|------------------|
| AT&T Shares | .9932 |
| Government Obligations | 1.0060 |
| Equity Portfolio | 1.0421 |
| Guaranteed Interest Fund | 1.0072 |
| South Africa Restricted Fund | 1.0475 |
| Long-Term Savings and Security Plan (LTSSP) | |
| AT&T Shares | .9933 |
| Guaranteed Interest Fund | 1.0073 |
| South Africa Restricted Fund | 1.0486 |
| Equity Portfolio | 1.0423 |
| Employer Stock Fund | .9936 |

Events Calendar

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

July 26 — Zoo Music Series: Eliza Gilkenson; 6:30-9:30 p.m., Rio Grande Zoo, 843-7413.

July 26-28 — "The Magic of Color and Light," hands-on exhibit for children and the child in all adults; call for times, free, South Broadway Cultural Center (1025 Broadway SE), 848-1320.

July 26-Aug. 3 — "Nonsense," musical comedy by Dan Goggin, Albuquerque Civic Light Opera; 8:15 p.m. Fri. & Sat., 2 p.m. Sun.; Popejoy Hall, 345-6577 or 277-3121.

July 26-Aug. 11 — "The Bad Seed," drama by Maxwell Anderson about a young girl who seems innocent at first meeting, but is less innocent than she seems; 8 p.m. Fri. & Sat., 6 p.m. Sun.; Vortex Theatre, 247-8600.

July 26-Aug. 18 — Exhibit, "Treasures of the Tar Pits," ice-age fossils from the Rancho La Brea Tar Pits in Los Angeles, produced by the Natural History Museum of Los Angeles County, features complete skeletons of dire wolves, a coyote, a giant ground sloth, and a cast from the skeleton of a 9,000-year-old La Brea woman; 9 a.m.-5 p.m. daily, New Mexico Museum of Natural History, 841-8836.

July 26-Sept. 20 — Exhibit, "Impressions of Nature," features the work of F. G. Hochberg, co-founder of the Nature Printing Society and curator of Invertebrate Zoology at the Santa Barbara Museum of Natural History, images printed directly from natural subjects including plants, fish, and shellfish; 9 a.m.-5 p.m. daily, New Mexico Museum of Natural History, 841-8837.

July 26-27 — "The Shoemaker and the Elves," written and directed by Sue Ann Gunn; 10:30 a.m. & 1:30 p.m. Fri., 1:30 & 3:30 p.m. Sat.; UNM Rodey Theatre, 898-6679.

July 27 — Summerfest: Asian Night, food, entertainment, exhibits, arts & crafts; 5-10 p.m., Civic Plaza, free, 768-3490.

July 27 — Iris Guild Sale, 10 a.m.-noon, Albuquerque Garden Center (10120 Lomas NE), 296-6020.

July 27 — Children's Hospital Charity Gala: entertainment, live & silent auction, food, \$40 tickets benefit Children's Hospital; 7 p.m.-midnight, Miller Pavilion, State Fairgrounds, 843-2656.

July 27 — "Paso Doble," sixth in a series of two-hour cultural extravaganzas featuring Hispanic and Latin music, song, and dance, presented by UNM and Baila! Baila! International Dance Studios, guest appearance by concert keyboardist Steven Woodbury; 7 p.m., UNM Continuing Education Conference Center (1634 University Blvd. NE, at Indian School), 265-1858.

July 27-28 — Sandia Mountains Discovery Days: displays, activities, storytelling, demonstrations, discounted ski lift rides, appearances by Smokey the Bear and Woodsey Owl, bring a picnic or eat at the Lodge; 9:30 a.m.-5 p.m., Sandia Peak Ski Area, 243-3696.

Aug. 1-17 — Invitational Art Show for Albuquerque High School 1961 Alumni to coincide with 30th class reunion; exhibit 8:30 a.m.-5 p.m. Mon.-Sat., South Broadway Cultural Center (1025 Broadway SE), 898-4760.

Aug. 2-4 — Tri-Culture Fest: German, Hispanic, and Native American entertainment, yodeling, dancing, food, games, rides, toys, clothing, tourist information; 4-11 p.m. Fri., noon-11 p.m. Sat., noon-10 p.m. Sun.; Albuquerque Balloon Fiesta Park (I-25 north, Alameda exit west), 294-3735 or 888-4833.

Aug. 2 — New Mexico Dance Coalition presents "The Best of New Mexico Dance 1991," a melange of works by 11 New Mexico choreographers featuring jazz, modern, ballet, belly dance, and dance theater; 8 p.m., UNM Rodey Theater, 268-1918.

Aug. 3 — "Flor de Cana," contemporary traditional Latin American music; 8 p.m., South Broadway Cultural Center (1025 Broadway SE), 848-1320.

Aug. 3-4 — Summer Festival at El Rancho De Las Golondrinas: costumed villagers demonstrate colonial ranch life, entertainment, food; call for times, I-25 north to La Cienega exit, 1-471-2261.

Aug. 4 — Sunday Jazz: The "Albuquerque-Austin Connection," featuring Cadillac Bob and Native Sun; 3-7 p.m., Huber Memorial Ballpark (Madrid, NM), 255-9798.

Aug. 4 — Santo Domingo Feast Day, corn dance

at Santo Domingo Pueblo; I-25 north 24 miles, west 6 miles, 843-7270.

Aug. 5 — Lecture on Pueblo Arts and Crafts, 10 a.m., Indian Pueblo Cultural Center, free, 843-7270.

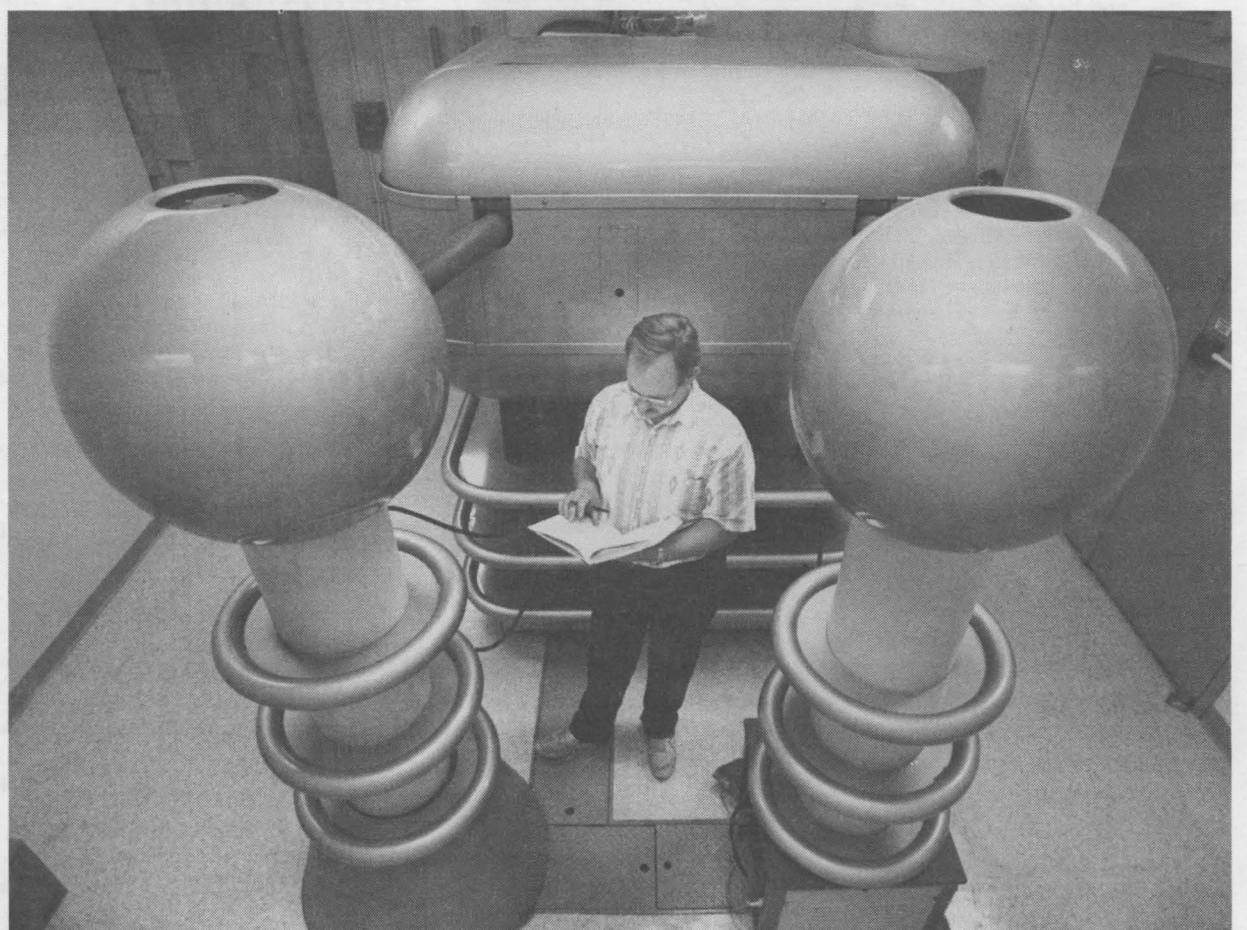
Aug. 6 — Senior Citizens Day: games, competitions, arts & crafts, Indian dances by Native American senior citizens; 9 a.m.-3 p.m., Indian Pueblo Cultural Center, free, 843-7270.

Aug. 9 — Zoo Music Series: Watermelon Mountain Jug Band; 6:30-9:30 p.m., Rio Grande Zoo, 843-7413.

Welcome

Albuquerque — Albert Alarid (3435), William Cleland (100), Juan Delgado (3435), James Goodnight (3435), James Hipp (6461). Other New Mexico — Howard Kercheval (3163), Ray St. John (3435).

Iowa — Mark Ekman (7232); Massachusetts — James Park (1423).



BIG MACHINE, but its effects are atom-size. Ken Minor (1111) uses this 400-kilovolt ion implanter in a new technology called heavy-ion backscattering spectrometry, one of the most sensitive methods for measuring tiny amounts of surface contaminants on microelectronic materials. Other uses include modifying thin-film superconductors to improve their performance and studying the effects of radiation damage in minerals. The large sphere on the right generates high voltage that accelerates ions electrostatically. Because the hardware in the box behind Ken is "floating" at 400,000 volts, a special power supply — the sphere on the left — is required to provide 220-volt current to vacuum pumps, a plasma ion source, and other components of the implanter. (Photo by Randy Montoya, 3162)