From Naschitti to Tegucigalpa!

Design Assistance Center Promotes Solar Energy Projects

More than half of the people living on the Navajo Indian reservation are without electricity or plumbing. Homes are often miles apart, making electrification a slow and expensive process.

But now, photovoltaics — solar cells that convert sunlight into electricity — are offering Navajos, and others in remote areas, a cost-effective alternative power source. With the help of Sandia's Photovoltaic Design Assistance Center (DAC), about 100 homes on the reservation in western New Mexico have been equipped with PV power and battery systems for storing the power, and more Navajo houses will soon get the systems.

Elderly Navajo women, who have relied on kerosene lamps for their entire lives, have joyfully embraced workers installing PV systems in their homes, reports Larry Ahasteen, project manager for the Navajo Housing Services Department. "They really like the systems," he says.

(Bell Labs demonstrated the world's first PV cell in 1954; see box on page four.)

Enhancing Quality of Life

Whether it's Navajos in Naschitti, N.M., or villagers near Tegucigalpa, Honduras, all of DAC's work is oriented toward improving people's quality of life and providing basic human needs. For many, something as simple as a PV-powered light or fan can produce a dramatic change in lifestyle. In developing countries, PV-powered vaccine refrigerators and water purifiers are even helping save lives.

By serving as a technical resource, DAC helps promote the proliferation of PV systems and reduce reliance on fossil fuels.

In a village near Tegucigalpa where the water source is a mountain stream, DAC installed a PV-powered water disinfection system, says Rick Chapman (6223). The project, done in cooperation with the Pan American Health Organization and the Honduras Ministry of Health, represents the first time that PV technology has been coupled with a commercially available water disinfection unit.

Integration with the village's water supply will help reduce and possibly eliminate diseases such as dysentery and diarrhea, which play a significant role in the high death rate among children.

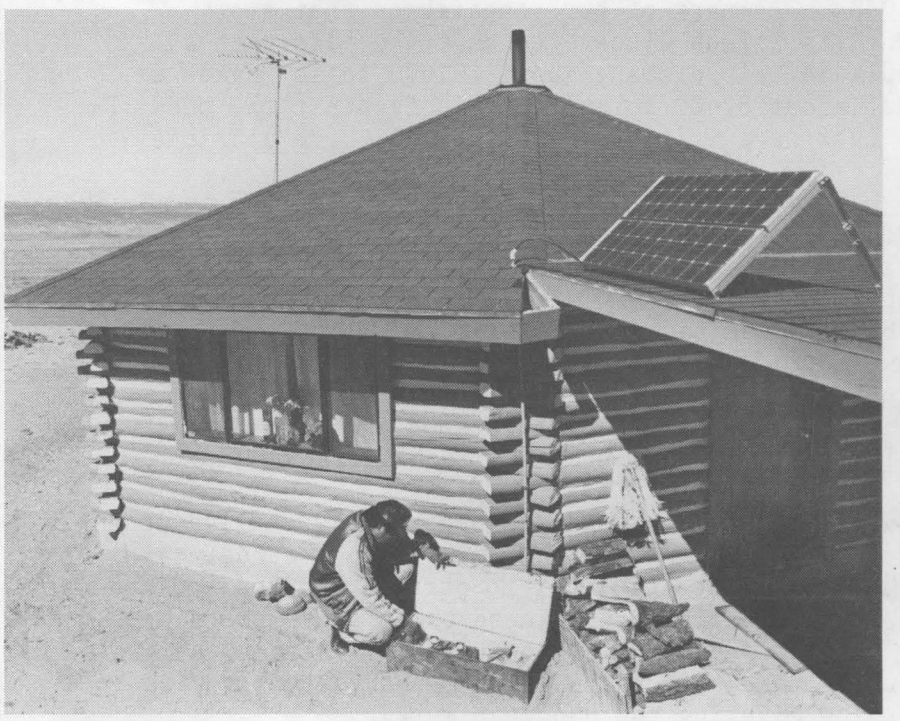
"Photovoltaics is a very important technology for remote power sources," says Mike Thomas, DAC task leader (6223). "It's a technology that's ideally suited for the developing countries and for groups within the US like the Indian nations."

To Sandia staff members, a fringe benefit of their work is its personal rewards.

"Our project is very people-oriented," Mike says. "It involves an emotional investment and not just cold technology."

By expanding the markets for PV power systems, DAC representatives also hope to see prices decline at a far faster rate than would occur through research and development alone. Greater use of renewable energy sources will lessen depen-

(Continued on Page Four)



JASPER PABLO checks the storage batteries for a photovoltaic system on a Navajo home 10 miles east of Naschitti, N.M. He is a member of a Navajo crew that installs PV systems at homes and chapter houses on the reservation in western New Mexico. Sandia's Photovoltaic Design Assistance Center provides technical assistance for the project; project funding is provided by the New Mexico Department of Energy, Minerals and Natural Resources in conjunction with DOE.

LAB NEWS

VOL. 42, NO. 6 SANDIA NATIONAL LABORATORIES MARCH 23, 1990

Mark Your Calendars! "Vision of the '90s" Meetings For All Sandia Employees

Dates have been set for "Vision of the '90s" meetings for all Sandians — April 19 in Livermore and April 25 in Albuquerque. The meetings will last about an hour, with Al Narath and other Sandians discussing the Labs' quality initiative, strategic planning, cultural change, and related topics.

The Albuquerque meeting — one session for all — will be at 11 a.m. on the KAFB parade ground. Sandians are encouraged to BYOL*unch* to the site, bring a blanket/ground cloth to sit on, and wear jeans and other casual clothes all day.

The Livermore meeting will be held in the CRF Auditorium in three separate sessions; beginning times are 7:45 a.m., 10:15 a.m., and 1 p.m.

For those inclined to worry, Al Narath has these words of assurance: "These are *not* 'bad news' forums: We're not, contrary to rumor, announcing layoffs, cutbacks, etc. We'll be discussing Sandia's future, the changes we must make, and our increasing emphasis on quality. Everyone should clear their schedules for these occasions."

Details about these meetings, and plans to involve Sandians at remote locations, will be provided to employees soon.

Health$mart to the Rescue

Triple Threat Wasn't So Bad After All

The prospect of triplets for first-time parents would, under the best of circumstances, be a daunting one fraught with all sorts of real and imaginary problems. However, one Sandian and his wife, faced with exactly this situation, found their lives much less complicated with help from Health$mart, a part of Sandia's Medical Care Plan (MCP).

Petra and Wayne Potter (152) learned they were going to be the parents of triplets in December 1988 when Petra, then two months pregnant, had an ultrasound test.

'A State of Shock'

"Needless to say," says Wayne, "we were at first in a state of shock. Becoming an overnight family of five was something to sit down and think about."

For the next several months, the Potters' life

(Continued on Page Five)

PETRA AND WAYNE POTTER (152) became an "overnight family of five" when their triplets (from left) Caitlin, Scott, and Danielle were born last May.

This & That

Three's A Crowd! – "Parenting," as it's called today, is full of challenges, so just imagine the challenges in "Parenting^3," which might describe what Wayne Potter (152) and his wife Petra are going through with their 10-month-old triplets (see story and photos). Wayne says the Health$mart program, a part of our Medical Care Plan, has been extremely helpful to his wife and him – before and after their three bundles of joy arrived. Sometimes we tend to forget – or take for granted – our many company benefits and the folks who administer them. I'm sure that Wayne would agree – we shouldn't.

* * *

Testing the Odds – As part of her research on that story, Assistant Editor Phyllis Wilson discovered that the odds that a pregnancy will result in triplets are about 10,000 to 1. Makes me wonder how Sandians (about 8,400 folks) stack up against the odds. Does anyone else at the Labs have triplets, or is anyone here a triplet?

* * *

Why We Don't – Someone occasionally takes us to task for not covering Sandia colloquium speakers. We do cover some speakers whose remarks are likely to interest a broad range of Sandians. We provided in-depth coverage, for example, when Secretary of Energy James Watkins spoke here last month. The LAB NEWS once reported on most colloquium speakers, but stopped several years ago after readership surveys showed that the stories generally weren't well read. If you can't attend a colloquium of interest, keep in mind that they're videotaped and that copies can be checked out (even for home viewing) from the Tech Library.

* * *

Park It Elsewhere, Please! – A handicapped Sandian called recently asking that I remind able-bodied folks (that includes me most days) to be especially considerate and careful not to park in handicapped spaces when nasty weather hits. "That's when we need these spots the most," she points out. We may not see another big snowstorm this season, but we need to be extra watchful to make sure that we don't inadvertently park in a space where snow may be covering the handicap markings.

* * *

Texas Zingers – I said last issue that I was wrapping up mentioning unusual school mascots/nicknames unless I heard some real zingers. I heard – from retiree Frank Oswalt of Lometa, Tex. – who sent a list from the book, *Texas High School Football*, by Bill McMurray. Among the more interesting ones: Mesquite Skeeters, Winters Blizzards, Groesbeck Goats, Hamlin Pied Pipers, Frost Polar Bears, and Itasca Wampus Cats. Several Sandians have also mentioned California's Whittier College Poets. If memory serves me correctly – and it often doesn't anymore – former President Nixon is a Poet.

* * *

Just the TRUE Facts, Please! – Near the top of our dental insurance form: "It is a crime to fill out this form with facts you know are false . . ." Bill Fienning (5147) points out that facts are facts, and anything that's false can't be a fact – and that's a fact! Since Bill brought up the subject, I'll chime in with my own observation about this form. I wonder why it has a 4-inch-long space for writing in your office telephone number and a 2-1/2-inch-long space for writing in the dates and details if your dental treatment is the result of occupational illness or injury. Both spaces are about 1/4-inch high. •LP

Expert in Contract Management

Dresser Named Fellow of NCMA

Larry Dresser, senior contracting representative in Purchasing Div. 3716, was recently named a Fellow of the National Contract Management Association (NCMA) at the National Board of Directors Meeting in San Diego. The honor is bestowed "on those few who have made significant and outstanding contributions to the field of contract management," according to NCMA Executive Director James Goggins.

LARRY DRESSER (3716)

Only about 1500 of the association's 23,000 members are Fellows, says Larry.

The award recognizes professional expertise in procuring and writing contracts, along with an individual's understanding of contract law, finance, accounting, and economics.

Larry negotiates contracts for the Labs with prime contractors, research firms, universities, and other groups. A lot of his current work is related to the Waste Isolation Pilot Plant near Carlsbad.

Larry, a certified professional contracts manager (CPCM), currently serves as a national director of NCMA. He has also served as president and vice-president of the 230-member Albuquerque chapter. Before joining Sandia four years ago, he spent 11-1/2 years managing contracts for a large international construction firm. •

Congratulations

To Barbara (5268) and Don (5171) Funkhouser, twin sons, Erik David and Keith Robert, Jan. 25.

To Carmela (22-2) and Tobi Andrade, a daughter, Carmela Mercedes, Feb. 18.

To Linda (5140) and Bill Worden, a son, Matthew Leon, Feb. 22.

To Dolores (7818) and Ben Sisneros, a son, March 1.

To Ann and Kent Meeks (5166), a daughter, Kelsey Ann, March 8.

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DON DAVIS (left), Supervisor of Semiconductor Development Support Section 2131-1, explains the mechanical systems in the Microelectronics Development Lab to a group of AT&T visitors March 8. The group, led by Tom Scurlock (closest to Don), Quality Assurance Director — Network Systems, was in Albuquerque for Corporate Electrostatic Discharge (ESD) committee meetings. The group, made up of representatives from AT&T manufacturing and R&D facilities throughout the country, studies how ESD problems can be avoided and distributes related information throughout the AT&T complex. Henry White (2116), a member of the group, hosted the Albuquerque meetings. Three other Sandians are members: John Jewell (2134), Ernie Roberts (2173), and Larry Powell (9213, seen at extreme right).

From Balloons to Video Projectiles

Sandia Designs Battlefield Reconnaissance Shell

Aerial reconnaissance dates back at least to the Civil War, when balloons carried men aloft to take pictures of enemy territory. In World War I, biplanes were equipped with cameras, and dirigibles and even kites were sometimes used to identify an opponent's strength.

The reconnaissance business has become much more high-flying, now that spy satellites and high-altitude planes can zero in on missile launching pads and military units in the field. But Sandia researchers are bringing reconnaissance technology closer to earth with a relatively inexpensive and simple system that could be used in field operations. The new system might help commanders of field units such as brigades and battalions see over the next ridge or line of trees.

"Intelligence-gathering systems are available for higher-level commanders, but there's a need for short-range and immediate reconnaissance in the field," says John Kraabel (8432).

Under the direction of Arnie Rivenes (8132), John and Marty Abrams (8172) were funded with internal research money to study the problem. The project was a follow-on to one begun six years ago under the direction of Jim Woodard (2140). Investigators in that project examined the feasibility of a fin-stabilized artillery shell to photograph enemy positions.

The new system might help commanders of field units see over the next ridge or line of trees.

PRINCIPALS INVOLVED in the design of the Video Imaging Projectile are shown holding the test unit. From left are John Kraabel (8432), Phil Zablocki (8451), and Chuck Pignolet (ret.).

Howitzer Fires VIP

In the new concept, a 155-mm howitzer fires a Video Imaging Projectile (VIP). The VIP contains a photodiode and lens for forming images, which are transmitted back to a ground station. A single silicon photodiode "looks" outward, perpendicular to the projectile's axis, through a prefocused telephoto lens.

As the artillery shell spins, the photodiode and lens sweep the ground. Electronic hardware in the shell sends back a signal to the base station one line at a time, much the way a television image is produced. The ground-station video-image receiver reconstructs lines, creating an accurate picture of what's on the ground below the shell.

"You wouldn't need specially trained people to interpret the image."

"A commander can fire a round from field artillery and get a picture of what's ahead almost immediately," John explains.

"The system is fast, relatively inexpensive, and expendable," says John. "Our goal is for each VIP shell to cost $5000 or less.

"You wouldn't need specially trained people to interpret the image," he continues. "We envision a Macintosh-sized computer at the ground station where the operator can look at the image on a video screen, using a joy stick to move it back and forth and buttons to zoom in and out on any particular section that needs closer study. The resolution on the screen would be adequate to enable quick decision-making by the field command."

Two test units have been built and shot from a howitzer at the Tonopah Test Range. Jim Barham (8450) decided the concept was good enough to flight test, and Phil Zablocki (8451) was assigned to lead the effort.

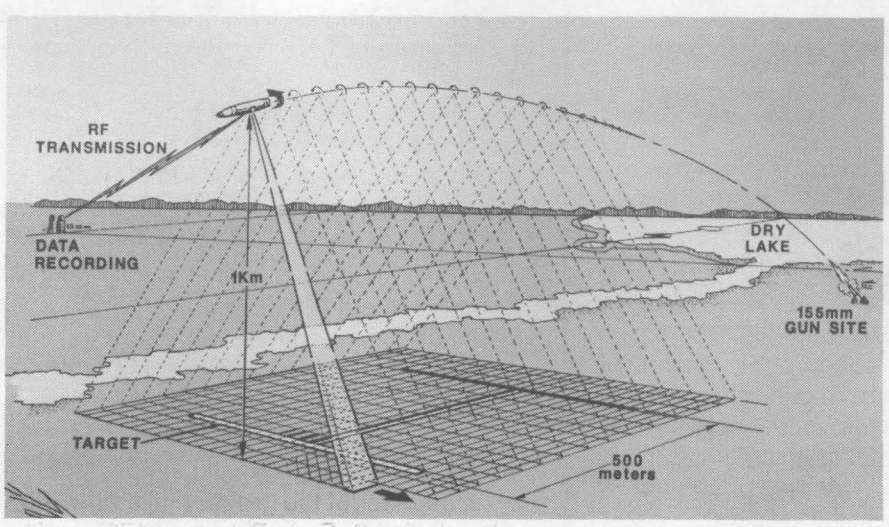
Good Pictures at Tonopah

"The first VIP, which was fired in August 1989, got good results," says John. "After some fine-tuning, we fired a second in late October — we got even better results than expected. Chuck Pignolet [ret.] had designed the artillery shell so well that the only component damaged by the ground impact was the antenna, which is built into the nose of the projectile. An operational unit would probably be loaded with an explosive charge, which would detonate upon impact."

Now that the Sandia team has shown what is referred to as "proof of concept and feasibility," the next step is talking to the various military services to see how the VIP might fit their needs. If there is a match, further funding will be sought for advanced development work.

John credits several Sandia staff members with activities related to the development of the VIP. Among them are Scott Carichner (8452) for the design of the photodiode pre-amp and amplifier; Bill Shreeve (8453) for the design of the transducers, amplifier boards, and some auxiliary instrumentation; Max Schell (8452) for transmitter design; Les Jones and Doyle Baker (both 8451) for their telemetry work; Len Napolitano (8435) for image formation; Rene Bierbaum (8164) for her infrared sensor research; and Mike Chiesa (8241) for his structural analysis efforts. •BLS

SANDIA LIVERMORE NEWS



PROJECTILE FIRED at the test range picks up a video image of the target from an altitude of a kilometer (about six-tenths of a mile).

Congratulations

To Zia James and Dan Telfair (8531), married in Livermore, March 11.

(Continued from Page One)

Photovoltaic DAC

dence on fossil fuels and improve US energy security, they say.

However, demand for photovoltaic systems is so high right now that prices are actually rising, says project leader Hal Post (6223). "We're hoping to get to a point where supply keeps pace with demand."

Interest Grows

Since it was established in 1984 with DOE support, DAC has provided free technical assistance to nearly 100 government agencies, utility companies, and businesses across the country and abroad. In 1987, DAC expanded to include assistance with other renewable energy technologies — for example, wind and small-scale hydroelectric. Its assistance ranges from helping prepare proposals and reviewing system designs to conducting workshops and analyzing potential applications for feasibility and cost effectiveness.

The center publishes various technology transfer publications and has distributed some 7000 copies of its booklet, "Photovoltaic Systems for Government Agencies." Hundreds attend DAC seminars each year, which are held throughout the country. And interest in DAC is increasing, says Gary Jones, 6223 supervisor.

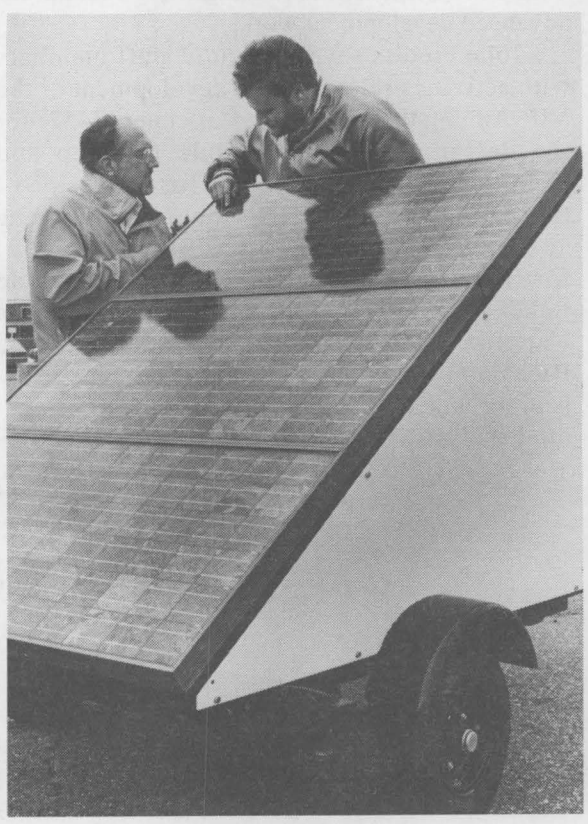
"Requests have been increasing 40 to 50 percent per year, and the size of potential projects is also growing," says Gary.

But DAC staff members don't just sit by the phone. DAC actively seeks out state and federal agencies, private volunteer organizations, and international assistance agencies with the clout and funding to bring new technologies to developing countries. The assistance center works extensively with the Pan American Health Organization, Organization of American States, and US Agency for International Development.

"Third World countries have the greatest needs, especially in their remote villages where there are no electrical systems," Hal says.

DAC's Backyard Work

DAC staff members also do a lot of work closer to home. Both remote and populated areas of the US present numerous opportunities.



HAL POST AND JEFF ZIRZOW (both 6223) stand beside a portable remote photovoltaic power source built by Jeff that is similar to one being used at the Cholla Campground in Arizona to power a host motor home. DAC is helping equip the 350-unit campground with PV power for electric lighting, recycling toilets, and water-pumping systems.

For example, DAC recently assisted with a joint SunTran and City of Albuquerque General Services Department proposal to purchase and install PV-powered lights in 24 bus shelters around Albuquerque. It also helped the Parks and Recreation Department prepare a proposal to install PV lighting along walking paths, bike trails, and underpasses. Both proposals were awarded contracts by the New Mexico Department of Energy, Minerals and Natural Resources (EM&NR).

While electrical lines are in the vicinity of both projects, Hal says that PV power proved to be a more economical alternative. DAC is helping the EM&NR evaluate a number of proposals on various renewable energy projects around the state that will be funded by oil restitution monies. (To date, New Mexico has received about $29 million in these overcharge monies, which arose from oil company infractions of federal pricing and allocation regulations.)

Worth Its Weight in Gold

The projects include PV systems for airport taxiway lighting, a radio transmitter network to provide visitor information at locations around the state, and irrigation gate controls. "Sandia's Design Assistance Center has been worth its weight in gold in promoting PV technology in New Mexico," says Charles Wood, EM&NR program manager. "Most of the projects wouldn't have been possible without Sandia's assistance."

Another regional project is a campground in Arizona's Tonto National Forest. DAC is helping the Bureau of Reclamation and the National Forest Service develop a PV system to power the 350-unit Cholla Campground near Roosevelt Lake. Using photovoltaics eliminated the need to extend a utility power grid, which could cost up to $700,000, says John Stevens (6223).

Photovoltaics will power electric lighting, recycling toilets, and water-pumping systems. The campground will become a model for PV-powered campgrounds across the country, Hal says.

While DAC is charged with helping others learn about renewable energy, its expertise sometimes comes full circle.

DAC recently provided technical assistance on the conservation and renewable energy options for two new day-care centers to be located at DOE Headquarters in Washington and at the Germantown facility in Maryland. The centers will include solar hot water systems and lighting systems that take advantage of daylight. PV systems may be incorporated later.

Provides Assistance All Over World

In 1987, the US Fish and Wildlife Service needed to replace an aging diesel generator on Tern Island 500 miles northwest of Honolulu. DAC assisted the agency in developing a photovoltaic /diesel hybrid system that achieved a two-year payback based on the cost of imported diesel fuel alone. This system recently received a Federal Energy Efficiency Award from DOE.

DAC also is participating with the Army Corps of Engineers in evaluating renewable energy resources on US Pacific island nations such as American Samoa, Palau, and the Commonwealth of Northern Mariana Islands.

An Urgent Need

Sometimes DAC involvement arises from an urgent need. In November, Gary was part of a seven-person DOE technical team sent to St. Croix in the Virgin Islands in the wake of Hurricane Hugo.

The storm knocked down almost every power pole (some 14,000) on St. Croix, destroying the island's power distribution and communication networks. While the Virgin Islands Energy Office (VIEO) already had plans to explore renewable energy for the area, severe storm damage hastened its efforts.

Beth Richards (6221) is helping the VIEO evaluate electrical and water needs of the island and to launch a Renewable Energy Center. The center will explore and develop alternative energy sources and gradually reduce the islands' dependence on imported oil.

Provides Jobs, Too

A major goal of the center is to develop the infrastructure for a local renewable energy industry and thereby boost the local economy. Local residents will be hired and provided with technical education and training in renewable energy.

On the Navajo reservation, an added benefit of PV power has been training and jobs for some local people. The contractor selected for the work hired about a dozen Navajos and taught them to install the PV systems in homes.

"Not only does it give the Navajo people train-

(Continued on Next Page)

Bells Labs Demonstrates First Practical Solar Cell in 1954

The first semiconductor solar cell for converting sunlight into useful electric power was demonstrated in 1954 by three Bell Laboratories scientists — Gerald Peterson, Daryl Chapin, and Calvin Fuller. The demonstration at Murray Hill, N.J., came just seven years after their Bell Labs colleagues invented the transistor.

The first application for the solar cell was in 1955, when solar cells were tested in Georgia as power sources for rural telephone poles.

PV May Be Boon to Rural Areas

Severe winter storms frequently rip through rural eastern Colorado, making the K.C. Electric Association's (KCEA) job of maintaining power to ranchers an uphill — and expensive — battle. Strong winds often topple remote electrical lines necessary to deliver water to livestock.

Though the KCEA had previously considered the idea of PV-powered systems, it took encouragement from Sandia's Photovoltaic Design Assistance Center (DAC) before the electrical cooperative decided to pursue the idea.

The DAC is paying for necessary hardware for the system in return for data from KCEA. While the center routinely provides information, it's going a step further in this case. DAC wants to see the project get off the ground because of its potential application to hundreds of other electrical co-ops and private utilities.

"We look at this one project as something where we can get a lot of leverage," says John Stevens (6223).

Photovoltaics could result in significant savings for KCEA, and probably hundreds of other co-ops, John says. At $9500 a mile, it costs KCEA about $47,500 to install the average five-mile electrical line to a livestock water pump and another $200 a mile for annual maintenance and operating costs. But the annual revenue from that line is only about $60, John says.

On the other hand, he says, it's estimated that a typical PV pumping system costs between $5000 and $10,000 to install, depending on well depth. Maintenance costs can add to that, but the overall cost for a PV system remains less than that for an electrical line.

John says many other electrical cooperatives are eagerly awaiting the outcome of KCEA's experience.

(Continued from Page One)

Potter Triplets

was turned upside down. For instance, their furniture-buying plans changed dramatically: three cribs instead of one, three high chairs instead of one, and so on. "We went to a lot of garage sales," recalls Wayne.

On the advice of her doctor, Petra wore a monitor at home that kept track of premature labor indicators. As a precautionary measure, based on data from the monitor, the doctor recommended bed confinement at home for Petra some five months into her pregnancy.

Several weeks later, because the pregnancy was considered high-risk, the Potters received an additional recommendation from the doctor — that Petra be hospitalized until the babies were born. The reasoning: She could be regularly observed and monitored in a setting where, if it became necessary, emergency treatment was close by.

About that time, Health$mart was implemented as part of the MCP. "We really didn't know how the changes in the MCP would affect us," says Wayne, "since some of the procedures — for instance, the advance review requirement [ReviewPLUS] for hospitalization and other medical procedures — were brand-new. However, it turned out that Health$mart made our lives much less complicated and smoothed the way for us in several instances between the time Petra was hospitalized and the time the children had all been home from the hospital for several months."

Health$mart Case Management

Health$mart's case-management review provision kicked in for the Potters when Petra was admitted to Presbyterian Hospital in early April. Case management is implemented after a potentially high-risk, high-cost medical case is identified. It's designed to ensure quality health care, while at the same time reducing medically unnecessary, inappropriate, and/or harmful services, according to Jann Levin of Benefits Systems and Health Care Planning Div. 3545.

"I have nothing but good things to say about Health$mart and how the system worked for us."

"Case managers from Health Risk Management [HRM], Inc., in Minneapolis are assigned to monitor and assist throughout the duration of potentially large cases," explains Jann.

Julie Shoemaker, a registered nurse at HRM, was assigned as case manager for the Potters. "Julie's help during those many months was invaluable to us," says Wayne. "I can't begin to count the times we called on her for assistance, and she never let us down."

When the triplets — Danielle, Caitlin (the heavyweight at 3 pounds), and Scott — were born eight weeks prematurely on May 21, they were placed in the Newborn Intensive Care Unit (NICU). "Julie, because of her RN training, was well qualified to monitor the children's progress with the three NICU doctors and later with our pediatrician," notes Wayne.

"After the babies had made some sufficient progress toward release from the hospital, Petra and I discussed the possible options with Julie: when each of the children could — and should — come home, what medical equipment we'd need at the house, and that sort of thing."

Coming Home

As a result of Julie's discussions with the doctors and subsequent talks with the Potters, the children were released one at a time — based on their medical condition — beginning with Caitlin, who came home when she was five weeks old. Danielle and Scott arrived a week and two weeks later, respectively.

"The 'timed-release' approach was a blessing in disguise for Petra and me," says Wayne. "If all three had arrived at home at the same time, it would have been utter chaos. We had our hands full with just one that first week!"

Once at home, the triplets all wore devices that monitored their heart rates and breathing patterns for some three months. The smallest, Scott, was also hooked up to an oxygen supply at home for four months.

"Once all three children were at home," says Wayne, "we found ourselves in a nearly impossible situation. They were on different feeding schedules — one would be ready to eat at 8, the next at 9, and the third at 10. Their sleeping patterns differed too. Translated, that means that Petra and I weren't getting much sleep.

THE POTTER TRIPLETS — (from left) Caitlin, Scott, and Danielle — weighed in at 3 pounds or less when they were born last May 21. Now they're all a strapping 15+ pounds.

"That's when Julie came to the rescue. We explained our dilemma to her, and she saw a need for some home-care help — someone who would come in part of each day to assist with the monitoring and care of the triplets. She explained that the MCP would cover home care if it was arranged and approved by ReviewPLUS as part of the overall case-management plan; that's something we'd never have known if she hadn't told us."

'We Jumped at the Chance'

"Naturally, we jumped at the chance to obtain some help," Wayne continues. "Julie did the scheduling and made arrangements to have a nursing assistant at the house between 11 p.m. and 7 a.m. weekdays. Petra and I finally caught up on our sleep. That's when we decided Julie was worth her weight in gold!" (The home-care help continued until mid-October, when the triplets' condition no longer required extensive monitoring.)

Besides arranging for home care and her liaison work with the doctors, Julie also worked with the company that supplied Scott's home oxygen and administered oxygen saturation tests to monitor his progress. And, Wayne reports, since all medical treatment was arranged and approved by ReviewPLUS, he didn't have to worry about benefit-coverage concerns. "Any time I had a question concerning coverage, Julie volunteered to do the liaison work," says Wayne. "My not having to spend a lot of time on things like that was really helpful.

"As the babies become better crawlers, our lives become more and more interesting."

"Thanks to Julie's help through all those months before and after the triplets were born, our lives were much less complicated and confused than they could have been. I have nothing but good things to say about Health$mart and how the system worked for us."

Ten months after their birth, Danielle, Caitlin, and Scott are happy, healthy babies weighing in at better than 15 pounds each. "Now that Petra and I are a little more used to being parents, and the children are on a more reasonable schedule — they all eat and sleep at pretty much the same time! — we're really enjoying the whole experience," says Wayne.

"As the babies become better crawlers," Petra adds, "our lives become more and more interesting. If we're not pulling Caitlin out of the dog's water bowl, we're trying to find Danielle, who's under the living-room end table gumming a newspaper to death — or Scott, who's just discovered how to tip over the diaper pail."

Back in Minneapolis, Julie Shoemaker, RN, smiles as she looks at the picture on her desk — of three giggling babies whom she's never seen in person. •PW

(Continued from Preceding Page)

Photovoltaic DAC

ing, at the same time the homeowners get better quality of work," says Ahasteen. If something goes wrong, these trained workers can be summoned to pinpoint the problem, he says.

The homes are the second PV project the Navajos have undertaken. The first, a solar-powered hogan for public use, was also completed with DAC's assistance.

With the homes 90 percent completed and the $150,000 project under budget, Ahasteen says enough money remains to install PV systems on about 30 more homes. The two chapter houses, which act much like a city hall, are so pleased with the results that they're submitting more proposals, he says. •JClausen(3163)

CHOW TIME at the Potter home is a two-parent operation. Here, Wayne entertains Scott (rear) and Danielle, while Petra dishes out a delicious beef/carrot combination to Caitlin.

Don't Just Fix the Symptoms

Tiger Team Training at PBFA II Gives Lessons for All Sandia

Perhaps no other Sandia program is currently under as much pressure to show results as Particle Beam Fusion Accelerator II (PBFA II). Sandia has made a commitment to produce a high-power lithium-ion beam by the end of July 1990, in time for a review by the National Academy of Sciences. Otherwise, support for the program could decline.

Even under those circumstances, results are not wanted at the expense of safety. That's one message of a recent week-long postponement of experiments on PBFA II, ordered by the Director of Pulsed Power Sciences 1200, Pace VanDevender, when DOE "Tiger Cubs" — trainees using PBFA II to prepare for environment, safety, and health (ES&H) Tiger Team audits — reported 44 deficiencies needing correction.

Milestones Track Progress

Like many R&D programs, PBFA II must meet a series of technical milestones to show satisfactory progress. Last December, a National Academy of Sciences (NAS) panel accepted the milestones that Sandia had proposed for PBFA II. The NAS panel is chartered by Congress to review DOE's Inertial Confinement Fusion Program.

PBFA II experimenters and crew have for some time been working intensely on the series of milestones. An important one was reached last spring when a proton beam with power density of more than five trillion watts (5 TW) per square centimeter was focused onto a target.

Though there are other intermediate milestones, the next major one, according to Regan Stinnett, Supervisor of Beam Experiments Div. 1264, is to produce a high-power beam of lithium ions (rather than protons). The beam's quality must be sufficient for producing a focused power density of 10 TW per square centimeter. This milestone is scheduled for July. Focusing a lithium beam to the required power density is scheduled for September 1990.

Another message is that it's not easy — especially in facilities like Sandia's, where complex activities are routine — to ensure that everyone follows ES&H procedures to the letter. PBFA II, a relatively new facility and generally considered to be well run, had already undergone an internal audit last fall, during which 277 problems were found and corrected.

Urgency With Safety

Sandia's history and culture have always encouraged and rewarded a "can-do" attitude, a belief that obstacles are to be overcome or worked around as quickly as possible, not contemplated or agonized over while time ticks away. That attitude reaches back to the Manhattan Project, when each passing day marked the deaths of men in battle.

"We still have a sense of urgency," says Pace. "We cultivate that in our people — not just for one milestone, or just in 1200, but Labs-wide. But we don't want even one person to believe that work toward a milestone ever takes precedence over safety and health. Unfortunately, at least one person — a contract technician — did believe that we considered progress toward the milestone more important than safety, and did not believe that his management responded satisfactorily when he expressed his worries about safety.

"What concerns me most is not the specific observations made by the Tiger Team trainees — we corrected three-quarters of those within a few hours. Rather, it's that those observations are symptoms of a need for further changes in procedures and attitudes."

"The comments of the DOE team, and our own assessment of underlying root causes," says Doug Bloomquist, Supervisor of Accelerator Experiments Div. 1266, "might be summed up as a call for deliberate intent in the way we do things. We've always had the attitude that we're skilled, we're well qualified, and we do things in a real-time way to meet the needs of research. We've assumed that we're well enough qualified and smart enough to be both spontaneous and safe. Spontaneity is valuable in research — it lets you adjust quickly to get around a problem or take advantage of an unexpected result. But when it comes to safety, spontaneity can kill you.

"So," Doug continues, "an auditor legitimately points out that if an empty box is set down somewhere without thought — that is, without deliberate intent — it may indicate that too much randomness is tolerated in the operation and can extend to safety matters.

"All Sandians need to understand that the DOE Tiger Teams will be thinking like that," says Doug. "As an example at PBFA II, some gauges give readings that aren't important, so they don't need to be calibrated regularly. But they aren't tagged as not being for precise measurements and not requiring calibration. We didn't make a deliberate decision to tag them or not to tag them. We knew that the readings didn't matter, but we didn't *say* that they didn't — and the inspectors took the position that any instrument is assumed to require regular calibration unless otherwise marked."

Root Causes Count

A DOE-approved plan for the restart and continuing operation of PBFA II — a document for which Pace gives major credit to Don Cook, Manager of Fusion Research Dept. 1260 — lists five "root causes" of symptoms (along with a caution that it's too early to be sure the list is definitive): lack of formality throughout operations; lack of critical self-assessment; lack of adequate time for training, education, and ES&H; production vs. safety; and lack of job ownership.

The two conditions for resuming experiments on PBFA II — which happened on schedule March 19 — were to have a plan of action for addressing root causes and to correct all the uncontested deficiencies (two of the 44 are being contested because they represent approved Sandia procedures).

Don says, "The plan includes generating more written procedures or checklists — not formality for formality's sake, but as a way of helping ensure sufficient 'rigor' in operations. Necessary formality evolves out of the deliberate intent Doug described. Formality for its own sake wouldn't increase safety — it would encourage mindlessness."

"That's one misconception I've been working with our people to correct," says Doug. "Generally they've participated enthusiastically. But a few felt that more written procedures meant we didn't want them to think about their jobs. That's not the point at all — in a place like this, there's always room for ideas about better ways to do things."

Sample of Observations

Following are some of the observations made in PBFA II by the Tiger Team trainees, as summarized by Ted Simmons (3212). This list was extracted from Ted's by taking the first, fourth, seventh, etc.; every third item was then deleted to meet space constraints.

- There is no tag and lockout program for work on electrical equipment .
- The facility access-control lights are burned out in the -25' level.
- Two fire extinguishers in the facility lack inspection tags.
- The Maxwell capacitor banks in the -25' level have no posted high-voltage rating as required by OSHA.
- Empty 55-gallon drums were not labeled as such.
- A warm, but unplugged, electrical coffeemaker sat on an upholstered chair.
- The PBFA II crew uses empty Freon-TF cans to catch fluids dripping from copper tube lines. The cans had no labels showing the nature of the fluids.
- The technical-water processing system training is strictly on-the-job training.
- The crew stores Freon-TF near ignition sources such as welders throughout the building. (Freon-TF decomposes into toxic phosgene gas at high temperatures.)
- There was a dirty half-face respirator at the -12' level. The respirator bore no employee name.

About the topic of critical self-assessment, Don says, "In discussing the findings with us, the Tiger Team trainer said we must go through more levels of criticism on our own, and do it 'with the eyes of an outsider.' He emphasized the need not to accept the unacceptable — we have to have the same high expectations of our own operation that the most critical outsider could. At the same time, he pointed out that we could fix every deficiency, but more would spring up until we saw and addressed the root causes."

To help provide time for training, education, and ES&H activities, one day every three weeks will be an "engineering day," during which no experiments will be run on PBFA II. This day will be used for crew training and education and for engineering and maintenance tasks, such as making safety-related improvements or updating procedures.

"Last week's activities while experiments were postponed," says Don, "is itself a statement that safety has priority over production."

On the issue of job ownership, Pace says, "We find that our people — Sandians and contractors both — are ready to do the job correctly and safely. However, management at all levels defines 'the job' by how they spend their time. By walking around our facilities and pointing out places where a lack of deliberate intent has compromised our operation in small ways, management can define the job and prevent big problems. Our people are often relieved to find that management cares. Lack of job ownership is mostly a management problem, rather than an employee problem.

"We have benefited by being evaluated," he sums up. "We've been put temporarily into an uncomfortable situation, but what we've learned will help us reduce future problems. I hope that all of Sandia can learn from our experience." •CS

Inspection Hints for Sandians

A memo from Pace VanDevender (1200) to Large Staff conveys lessons learned from Tiger Team training on PBFA II. These excerpts may help all Sandians prepare for future evaluations:

Correct the root causes, not just the findings. Observations or findings are considered symptoms of problems, not problems themselves.

Housekeeping and safety are intimately connected. The team looks for poor housekeeping as an indicator of problems, on the premise that being lax about taking out used boxes and sweeping the floor is similar to being lax about safety procedures.

Informality is unacceptable. There is no credit for procedures that are in place, only demerits for those that are not formalized, approved, and followed with checklists in the records. We had worked hard to have a complete set of Safe Operating Procedures in common for all Area IV accelerators. The Tiger Team saw in a glance that the SOPs were in good shape and did not waste their time on them.

Lack of critical self-assessment is a root cause. The Tiger Team looks for continual and critical self-assessment to find root causes to problems. Team building has to include critical self-assessment as a team value or the members may become defensive.

Lack of job ownership is a root cause. People will keep their activity and environment safe and productive if management sets that standard and empowers the person.

People are the key. The reactions [of the PBFA II crew] contained frustration over their not getting credit for what they did well, e.g., the new SOPs, and featured sober realization that we need to change our way of doing business to meet the implied standard. The people must work through their frustrations before they can develop the new mode of operations and buy into the changes.

Correcting symptoms is quick and inadequate. Go for root causes. We can correct the identified symptoms this week. We will be working hard for a very long time to address the root causes by educating and training our prople. If you have been preparing for the Tiger Team by addressing symptoms instead of root causes, you will need a lot of luck.

Improved Methods for Testing Computer Chips

Sandia Papers Win Top Honors From IEEE

For the sixth time in as many years, Sandians have won awards for outstanding papers on the effects of radiation and extreme temperatures on integrated circuit performance. Most recently, two groups of researchers in Semiconductor Technology Dept. 2140 were honored by the Institute of Electrical and Electronic Engineers (IEEE) for the best papers submitted at two different conferences in 1989.

One of the papers, by Dan Fleetwood (2147), Peter Winokur (2147), and Jim Schwank (2144), describes practical, short-term laboratory tests for evaluating the response of memory chips — essentially, the brains of a computer — to sudden bursts of radiation or to radiation over extended periods of time.

The other paper, by Paul McWhorter (2146), Sam Miller (2144), and Ted Dellin (2146), provides a model for predicting when nonvolatile memory chips — the kind that retain data even in the event of a power loss — will fail because of prolonged exposure to extremes in temperature along with harmful radiation.

THE RADIATION CHAMBER is open, ready to test packages of microcircuits held by Dan Fleetwood (2147) and observed by, from left, Jim Schwank (2144) and Peter Winokur (2147). The trio was honored recently for an IEEE paper.

Surviving Harsh Environments

Every military or space microelectronics system contains tiny chips about a quarter-inch square, also known as integrated circuits, that store information and perform electronic functions, explains Dan. Each chip contains tens or hundreds of thousands of micron-sized transistors that act as electronic floodgates or switches. Working together, the transistors perform various functions, such as add, subtract, or multiply; analyze digital images; or retrieve, send, or store data.

However, high levels of radiation or temperature extremes can wipe out the data stored in the electronic memories of the components or even cause them to fail entirely. For example, an orbiting spacecraft could be exposed to solar flares, or a ballistic missile to nuclear radiation from other warheads. In either case, radiation and harsh temperatures could damage the circuits, eroding their memory and causing the entire system to lose track of its position or target.

To prevent such disasters, researchers rely on radiation-hardened memory chips that have been designed to withstand the rigors of harsh environments. Sandia provided more than 2000 such chips to NASA, fabricated in conjunction with Allied Signal, that are now guiding the path of the Galileo spacecraft to Jupiter, a planet with threatening radiation belts.

Such chips also are used to control the arming and firing of a nuclear weapon or the emergency shutdown of a nuclear reactor. They will be used in the instrumentation of the superconducting supercollider, the giant state-of-the-art particle accelerator planned in Texas.

Improved Approach to Quality Assurance

The goal of any radiation hardness assurance program is to predict the response of components to harsh environments on the basis of practical laboratory measurements, explains Peter, Supervisor of Radiation Technology and Assurance Div. 2147. For space and strategic applications, this task has proved very challenging, he says.

The paper written by Dan, Peter, and Jim for the 1989 IEEE Nuclear and Space Radiation Effects Conference predicts, on the basis of a simple laboratory test, how a silicon chip will respond to sudden or prolonged exposure to radiation. The test determines, for example, whether a memory chip on a satellite will survive a typical radiation dose of several hundred kilorads over a lifetime of seven to 10 years, without having to wait 10 years to get the results.

The paper is titled "Using Laboratory X-ray and Co-60 Irradiations to Predict CMOS [Complementary Metal Oxide Semiconductor] Device Response in Strategic and Space Environments."

"We can screen for the radiation-caused defects that are responsible for the failure of the integrated circuit by simulating the radiation environment in the lab," says Dan.

Together with other researchers in industry, universities, and government, he adds, the Sandia team has been working on improving radiation testing of integrated circuits for several years.

In fact, the Defense Nuclear Agency, one of the sponsors of the Sandia research, is now in the process of adopting the new test methods, which are less expensive than previous methods, as standard procedures for military applications, says Peter. This is a strategy that would help make the US more competitive in the world market by reducing production costs and promoting greater confidence in the quality of the final product.

Peter points out that such improved testing is an integral part of a new government-sponsored program called Qualified Manufacturer's List (QML), in which the need to test each integrated circuit is reduced by "building in" quality through control of the manufacturing process.

Predicting When a Chip Will Fail

There are two kinds of memory chips, volatile and non-volatile, explains Paul. A volatile memory chip needs a power source to function; a nonvolatile chip retains information even if the power fails or is turned off.

The paper written by Paul, Sam, and Ted discusses a computer model for predicting when a nonvolatile memory chip — the kind that retains information even if the power is turned off — will fail because of prolonged exposure to radiation and extreme temperatures. They presented it at the IEEE Nonvolatile Memory Workshop in August. The paper is titled "Simple Model for Predicting the Data Retention Characteristics of SNOS [Polysilicon Nitride Oxide Silicon] Devices in a Varying Thermal Scenario."

"The challenge we face is to have these integrated circuits in the lab for a very short period of time and yet predict how they'll behave over a period of many years," says Paul.

To develop the model, the researchers studied the behavior of specific components, such as individual transistors, that were exposed to a wide range of temperatures and radiation levels. Using the results, they developed a predictive physical model.

"We've looked at hundreds of devices, and in all cases, the model has predicted accurately when a component will fail," says Sam.

"Once you understand the physics of the problem, then the same physics applies over a wide range of conditions," he adds.

The model has been used to answer hypothetical questions about Strategic Defense Initiative applications, eliminating the need to spend thousands of dollars testing each component.

Much of the work that led to the development of the computer software for the prediction model was a result of last year's quality initiative headed by VP Glen Cheney in Org. 2000, notes Paul. A major theme of the quality training is meeting the needs of the customer, he adds. The customer for this particular effort was Mike Knoll, Supervisor of Nonvolatile Memory Products Div. 2173, who needed a way to test memory chips to ensure their quality before delivering them to a customer.

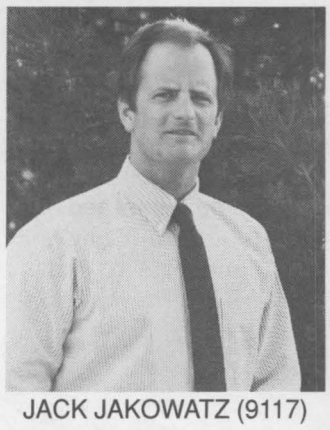
Such cooperative efforts demonstrate Sandia's commitment to extending research beyond the experimental stage to include the development of a final product that is useful to a customer, says Paul. •LD

MEMORY CHIPS are prepared for radiation testing by, from left, Paul McWhorter (2146), Sam Miller (2144), and Ted Dellin (2146), whose paper describing a computer model that predicts when a nonvolatile memory chip will fail was honored by the IEEE.

Supervisory Appointments

CHARLES (JACK) JAKOWATZ (DMTS) to Supervisor of Systems Research Div. VII 9117.

Jack has been a member of Sandia's Systems Research Department since he joined the Labs in August 1976. His work has included applications of statistical decision and estimation theory, digital signal/image processing, and special processing algorithms for synthetic aperture radar data.


JACK JAKOWATZ (9117)

He has BS, MS, and PhD degrees in electrical engineering from Purdue University.

Jack enjoys running and swimming. He and his wife Carol have two children and live in the NE Heights.

* * *

WILLIAM BOYER to Supervisor of NTS Instrumentation Development Div. 9321.

In February 1969, Bill joined Sandia's Sensor Systems Division, where he developed unattended ground-motion sensor systems for the COIN (COunter INsurgency) program for use in Vietnam.

From January 1971 to April 1972, Bill was assigned to the Defense Communication Planning Group in Washington, D.C. He was project officer for various surface-to-air missile countermeasure projects.


BILL BOYER (9321)

Bill returned to Sandia's Solid State Science Research Division, where he developed high-power glass lasers and instrumentation systems for the Labs' laser fusion program. He transferred to the Electron Beam Research Division in November 1974 and developed computer-controlled data recording and processing systems for several pulsed power accelerator facilities.

From December 1987 until his promotion, Bill was a member of Exploratory Systems Development Division II, where he was project leader for an automatic target recognition system.

His degrees are all in electrical engineering: a BS from the University of Missouri, an MS from the University of California, and a PhD from UNM. Before joining Sandia, Bill was a co-op student at the NASA Manned Spacecraft Center in Houston. He's a member of IEEE.

Bill enjoys skiing and other sports, off-road motorcycling, gardening, and landscaping. He and his wife Olga live in SE Albuquerque.

* * *

PAUL HOMMERT to Manager of Geoenergy Technology Dept. 6250.

Paul joined Sandia in August 1976 as a member of the In Situ Technologies Division. He did experimental design and data analysis on underground coal gasification and oil shale field programs. In 1981, he was promoted to supervisor of that division, which later became the Advanced Technology Division, responsible for developing instrumentation for geophysics applications in oil and gas.


PAUL HOMMERT (6250)

He has a BS in mechanical engineering from Rensselaer Polytechnic Institute and an MS and PhD in the same field from Purdue University. He's a member of the Society of Explosives Engineers and the Society of Exploration Geophysicists.

Paul enjoys jogging, skiing, and officiating at swim meets. He and his wife Beth have two children and live in Corrales.

* * *

LARRY BUSTARD (DMTS) to Supervisor of Advanced Nuclear Power Technology Div. 6521.

Larry joined the Labs in September 1978 as a member of the Applied Physics Division, where he helped improve understanding of neutron tube manufacturing processes.

In 1980, he transferred to the Adverse Environment Safety Assessment Division, where he tested and analyzed safety-related electrical equipment for nuclear power plants. He participated in numerous Nuclear Regulatory Commission inspections at manufacturing and test laboratories, and provided staff training to NRC inspectors. His NRC-sponsored work included cooperative research efforts with the French nuclear community. For the last several years, he has participated in efforts to extend commercial nuclear power plant licenses. He is also a member of an American Society of Mechanical Engineers Code group that is evaluating whether nuclear power plant life extension will necessitate substantial code modifications.


LARRY BUSTARD (6521)

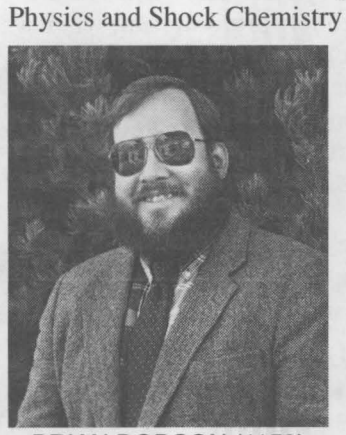
Larry has a BS in physics and mathematics from Dickinson College and a PhD in physics from Cornell University. He's a member of the American Nuclear Society and the American Physical Society.

He enjoys skiing, hiking, gardening, and music. Larry and his wife Gloria have two children and live in the NE Heights.

* * *

BRIAN DODSON to Supervisor of Structural Physics and Shock Chemistry Div. 1153.

In May 1980, Brian joined Sandia's Shock Wave and Explosives Physics Division, where he did experimental and theoretical research in shock-wave chemistry and explosives. In 1986, he transferred to the Semiconductor Physics Division and researched theoretical structural physics of semiconductor heterostructures.

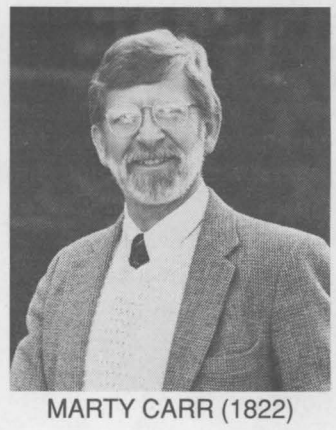

BRIAN DODSON (1153)

He has a BS from the University of Nebraska, and MS and PhD degrees from the University of Illinois, all in physics. He's a member of the American Physical Society and the Materials Research Society.

Brian enjoys singing and acting, and has performed with the Santa Fe Opera, New Mexico Symphony Orchestra, and the Albuquerque Civic Light Opera. He's also performed at the Vortex Theatre and with other Albuquerque area groups. He lives in the NE Heights.

MARTIN CARR to Supervisor of Electron Optics Div. 1822.

Marty has been a member of Div. 1822 (then known as Electron Optics and X-ray Analysis) since he joined Sandia in January 1983. His work has been in transmission electron microscopy, especially electron diffraction analysis, and thin film x-ray microanalysis.


MARTY CARR (1822)

He has a BS in mechanical engineering from General Motors Institute in Flint, Mich., and MS and PhD degrees in materials science from Rensselaer Polytechnic Institute. Before joining the Labs, he was at Rockwell International, Rocky Flats Plant. He's a member of the Electron Microscopy Society of America, Microbeam Analysis Society, American Society for Metals, International Metallographic Society, and the American Physical Society.

Marty enjoys greenhouse gardening, judo, beekeeping, flying kites and radio-control gliders, and Scouting activities. He also teaches a Sandia "Introduction to Materials Science" Out-of-Hours course. He and his wife Beth have three children and live in the East Mountain area.

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ALBERT CHABAI (DMTS) to Supervisor of Ground Motion and Seismic Div. 9311.

Al joined Sandia in December 1958 as a member of the Underground Physics Division, where he studied potential peaceful uses of nuclear explosions under Project Plowshare. He was promoted to Supervisor of the Advanced Systems Development Division that researched x-ray hardening of reentry vehicles. He transferred to the Computational Physics and Mechanics Division in 1971, working on hydrodynamic code applications.


AL CHABAI (9311)

In 1982, he joined the Test Planning and Diagnostic Division as a member of the technical staff, where he became test director for nuclear explosions in underground cavities. In 1989, he joined the division he now heads.

Al has a BS in engineering physics from Montana State University, and an MS and PhD, both in physics from Lehigh University.

He enjoys skiing and dry-fly fishing. Al and his wife Ann have six children and live in NE Albuquerque.

Fun & Games

Golf — A golf-rules clinic presented by Jim Sweeney of Sun Country Golf Association will be held Thursday, April 12, at the Coronado Club, Conquistador Rm., at 5:30 p.m. The clinic is sponsored by the Sandia Women's Golf Association. All golfers are invited; you don't have to be a member of either the men's or women's golf association to attend. For information, contact Teri Carpenter on 256-0614.

Honored for Dynamic Yielding, Fragmentation Studies

Grady Named American Physical Society Fellow

A Sandia physicist whose theoretical work in material fragmentation is widely applied in weapon, energy, and space programs has been named a Fellow in the American Physical Society (APS). Only about one in ten APS members become Fellows.

Dennis Grady (DMTS, 1534) was cited for "his creative leadership in carrying out constitutive property measurements and his incisive modeling of dynamic yielding and fragmentation of earth materials."

Dennis is perhaps best known for his theory of fragmentation, developed with Sandia colleagues, which predicts the ratio of small particles to large particles when a material is impacted, based on the amount of energy involved and the fundamental physical properties of the material.

For more than 15 years, he has studied the fragmentation of a wide variety of materials, from underground oil shale to atomic particles to tiny meteors that can tear into the side of an orbiting spacecraft.

The fragmentation theory is important in both weapon and energy research. Dennis' initial work at Sandia involved the response of geologic materials to shock waves, such as oil shale being blasted for petroleum.

Though it's currently more expensive to extract and process than imported oil, the US has an immense energy supply locked up in solid form in underground oil shale. This "solid oil" must be heated before or after it is mined in order to be useful. Underground blasting of the shale results in cracks and fissures through which oxygen can be injected to facilitate burning.

Dennis' fragmentation work is also applicable to nuclear-reactor and nuclear-weapon safety. Fuel rods inside a reactor or the uranium and plutonium charge inside a weapon are subject to the same rules of fragmentation as other materials.

DENNIS GRADY (DMTS, 1534) stands beside the breech end of a high-velocity launcher used in experiments that subject materials to extremely high pressures and temperatures lasting only millionths of a second. He is Sandia's newest Fellow of the American Physical Society.

Theory Has Many Applications

As it turns out, the theory applies to any material that is being fragmented. It's just as accurate for predicting the distribution of galaxies, star clusters, and solar systems following the "big bang" as the distribution of nuclear particles when an atom is impacted by a high-energy particle.

Interesting applications of the theory include a mathematical model to explain the mysterious existence of meteorites in the Earth's polar ice cap that appear to have come from Mars. One explanation of the origin of the rocks is that a meteor struck the surface of Mars, forming a large impact crater and sending pieces of its crust flying earthward.

At first, many scientists doubted that the fragments could have sufficient velocity to escape the gravitational pull of Mars, until H.J. Melosh, a planetary scientist at the University of Arizona, used Dennis' theory to demonstrate that, if the meteor packed enough punch, such a feat was indeed possible.

Geology and Weapons Research

Much of Dennis' recent work has involved analyzing the response of quartz-like rock in the Earth's crust to underground nuclear testing, an example of dynamic yielding. (Quartz-like rock, he points out, makes up about 80 percent of the Earth's crust.)

Those studies have been important in the verification of nuclear testing because different kinds of rock respond differently to the shock waves of a nuclear explosion.

In fact, two years ago, Dennis played a role in arms negotiations with the Soviets, as one of a group of experts from Sandia who met with Soviet scientists at the Nevada Test Site to compare data after both nations had agreed to cut back on the yield of such tests. The Soviets had previously allowed a contingent of American scientists to check their underground testing facility in Siberia, and several of the Soviet scientists were already familiar with Dennis' work.

Dynamic yielding studies expand geologists' understanding of materials within the Earth. Minerals that are recognizable on the surface as having a certain form and appearance, such as sand on an ocean beach, have an entirely different composition when subjected to the immense pressures and temperatures deep within the Earth's crust, notes Dennis.

"So in understanding the workings of our planet or neighboring planets, we use studies like this to access and understand different states of matter under high temperature and pressure," he says.

In laboratory experiments, Dennis and his Sandia colleagues get a closer look at the response of materials under impact by subjecting samples of rock or other matter to momentary, intense pressure from fired projectiles. The impact lasts only millionths of a second and simulates pressures hundreds of thousands of times greater than that of the Earth's atmosphere.

Meanwhile, sophisticated instruments such as high-speed cameras, laser interferometers, and flash radiography devices measure the impact and tell physicists more about the magnetic properties, phase changes (changes in the crystalline structure), strength, and viscosity of materials and material mixtures.

Dennis holds a PhD in physics from Washington State University and bachelor's degrees in physics and math from Lewis and Clark College. He was a staff scientist at Stanford Research Institute before joining Sandia in 1974. •LD

Sympathy

To Jennie Scales (5173) on the death of her brother-in-law in Derby, Kansas, Feb. 3.

To Michael (6517) and Gina Rightley (6413) on the death of his father and her father-in-law in Albuquerque, March 3.

To Iona (2612) and Del (2852) Klinetobe on the death of her brother and his brother-in-law in Atlanta, Ga., March 4.

To Neil Horton (9221) on the death of his mother in Boise, Idaho, March 6.

To Sylvia Thomas (152) on the death of her father in Albuquerque, March 7.

To Eddy McClain (3426) on the death of his sister in Georgia, March 7.

To Turk Levy (7243) on the death of his mother in New Orleans, March 10.

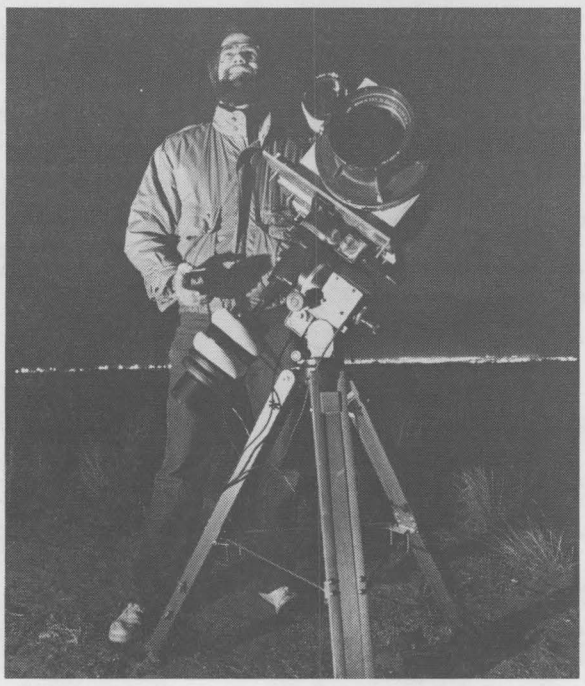
Retiree Deaths

Willam Thompson (76)	Jan. 4
Norman Ollman (70)	Feb. 7
Manuel Silva (74)	Feb. 8
Hollis Elledge (69)	Feb. 10
Frank Anderson (72)	Feb. 13
Michael Ryanczak (69)	Feb. 14
William Thomas (64)	Feb. 14

Welcome

Albuquerque — Michael Bode (1834), Patrick Herring (3211), Katherine Lopez (3211), Lucille Roybal (7845), Donna Wilt (3714); *Other New Mexico* — Gregory Madrid (5219); Robert Pierce (7242).

Elsewhere: *Arizona* — Russell Goebel (1266); *Oregon* — Dennis Hart (7811); *Texas* — Richard Griffith (6429), James Peery (7242).



A SHOT IN THE DARK — George Dulleck (2534) is credited with assists on two photos that appear in the March issue of *National Geographic* magazine. He used special equipment — some of which is shown here — to provide star-fill backgrounds for the photos, used in an article titled "America's Ancient Skywatchers." Shooting the stars is nothing new for George; he's vice-president of the Albuquerque Astronomical Society.

For Your Benefit

PDP Additions, Deletions Noted

Sandia's Preferred Dental Program (PDP), implemented in 1988, is designed to lower participants' out-of-pocket expenses for dental care. The PDP is a network of dentists who have agreed to provide dental services at a set fee.

The following updates should be made to your directory of participating dentists — "Your Metropolitan Life Preferred Dentist Program" — issued in April 1989. (A new directory listing these and other changes made during the last year will be issued next month.)

Call Louise Louden (3545) on 4-3882 with specific questions about the PDP or the updates listed below.

Newly Enrolled Providers

Dr. S.E. Holbrook, General and Family Dentistry, 7111-A Prospect Pl. NE, Albuquerque, N.M. 87110. (505) 881-1159

Dr. J.H. Noskin, General and Family Dentistry, Oak St. Dental Clinic, 200 Oak St. NE, Albuquerque, N.M. 87108. (505) 243-226. (Alternate location: Allied Dental Service, 142 Truman NE, Albuquerque, N.M. 87108)

Dentists No Longer Enrolled

Dr. B. Galbreth, 11005 Spain NE — Suite B, Albuquerque, N.M. 87111. (505) 298-8103

Dr. C.D. McCollough, 1140 East Idaho St., Las Cruces, N.M. 88001. (505) 522-8920

feedback

Q. MTS reclassification decisions now rest with the line vice-presidents. Will this option be extended to MLSs as well? It appears that the line organization is in the best position — in terms of knowledge and job function — to reclassify its own people.

A. Possible changes in MLS reclassification procedures are being reviewed for implementation in 1990. MLS classification is structured differently from that of MTS, and the procedures governing it will reflect those differences.

Ralph Bonner — 3500

Take Note

Sandia Corporation Board Member Sol Buchsbaum (Senior Vice-President, AT&T Technology Systems) was recently appointed to the 13-member President's Council of Advisers on Science and Technology, created by President Bush earlier this year. The Council reports directly to the President. Sol was VP of Research at the Labs from 1968 to 1971; he received Sandia's first Award for Excellence at the fortieth anniversary celebration last October.

Cultural Diversity Colloquia

On March 30, Prof. Yuan T. Lee will present two colloquia in the Technology Transfer Center (Bldg. 825). Prof. Lee received the Nobel Prize for Chemistry in 1986 for his work on crossed-molecular-beam studies of chemical reaction dynamics. He teaches at the University of California, Berkeley. The first colloquium, at 9 a.m., is "Reaction Dynamics in Combustion Chemistry." At 1:30 p.m., he'll present "Experiences of a Naturalized American Scientist." For information, contact Mike Robertson (9300) on 4-8844.

ISE '90 (the annual Ideas in Science & Electronics Exposition and Symposium) will be held May 8-10 at the Convention Center. Free advance registration is open now. Both exhibit and technical program admissions are free, but there are charges for the technical *Proceedings* ($15) and for the May 8 luncheon ($20) with keynote address by DARPA director Lee Buchanan. The local IEEE Section and Rio Grande Chapter/Electronics Representatives Assn. are ISE '90 cosponsors. For information, contact exposition manager Becky Rouse on 262-1023.

* * *

The 12th Symposium on Applied Surface Analysis and the 26th Annual Symposium of the New Mexico Chapter of the American Vacuum Society will be held April 12-27 at the Holiday Inn Pyramid in Albuquerque. Topics include electronic devices, energy conversion, corrosion and oxidation, adhesion and composites, thermionic emission, basic surface science, data treatment, catalysis, lubrication and wear, ceramics, metallurgy, environmental studies, and measurement techniques. The ASTM-E42 Subcommittee will hold an "Analysis of Small Particles" workshop during the symposium. For information, contact Kathleen Mays at LANL on 667-1180.

* * *

The annual used-book sale sponsored by Friends of the Albuquerque/Bernalillo County Public Library started Wednesday and continues through tomorrow (March 24). Proceeds support library programs for children and adults. The sale is held at the Main Library basement, 6th and Copper NW. Hours are from 10 a.m. to 4 p.m.; admission is free. Featured tomorrow: a sack of books for $1, or a box for $3.

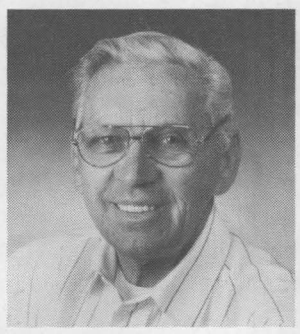
Fun & Games

Bowling — Winners of the Five-Person Team No-Tap Tournament held at Fiesta Lanes Feb. 17-18 were: Fidel Perez (7485), Grace Ortiz, Romeo Sanchez, Jr., Romeo Sanchez, Sr., and Ronald Sanchez with a team handicap series of 3716. Second place went to Danny Cordova (contractor), Bea Gallegos, Jerry Gallegos, Evelyn Luciani, and Mona Luciani with a team handicap series of 3689.

January Bowlers-of-the-Month: Scratch — Fidel Perez, 676; and Sally Frew (3523), 488; Handicap — Reyes Chavez (7412), 662 and 695; and Dorothy Castro (DOE/AL), 478 and 643.

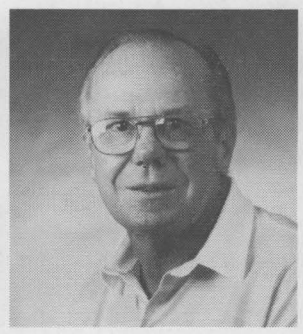
Canoeing — A free canoe clinic will be held at Cochiti Lake tomorrow (March 24) from 10 a.m. until 4 p.m. Canoes designed for general recreation, cruising, whitewater, and fishing will be available for hands-on experience. The day's agenda includes topics on water safety and how to paddle a canoe, as well as demonstrations of canoe versatility. The clinic is sponsored by Mountains and Rivers in cooperation with the Cochiti community, Mad River Canoe Company, and American Rivers, a national conservation group that works to preserve free-running rivers and their landscapes. For information, contact Mountains and Rivers on 268-4876.

Recent Retirees

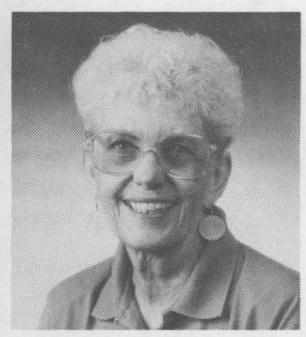


Dick Zaluga (2522) 37

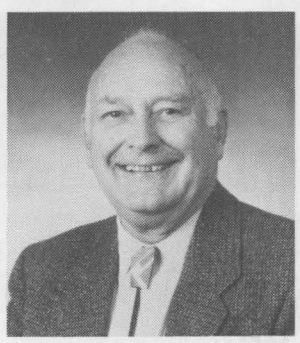
Jo Davis (7531) 42



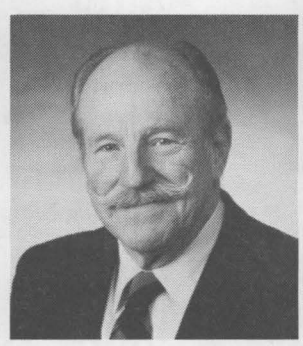
Paul Fjelseth (9143) 32



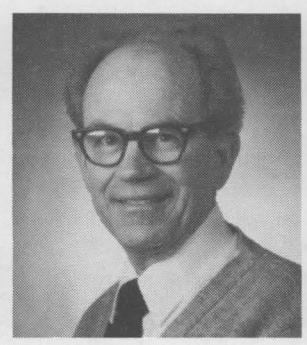
Alice Vancil (152) 31



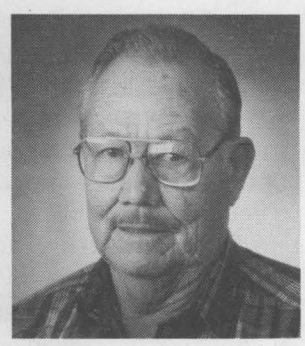
Robert Mottern (5211) 38



William Meahl (7531) 36



Muriel Iverson (7522) 34



Frutoso Gurule (7814) 27

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 8½ by 11-inch paper.
5. Use separate sheet for each ad category.
6. Type or print ads legibly; use only accepted abbreviations.
7. One ad per category per issue.
8. No more than two insertions of same "for sale" or "wanted" item.
9. No "For Rent" ads except for employees on temporary assignment.
10. No commercial ads.
11. For active and retired Sandians and DOE employees.
12. Housing listed for sale is available for occupancy without regard to race, creed, color, or national origin.

MISCELLANEOUS

TRACTOR MOWER, Wheel Horse, 40" cut, 11-hp, headlights, 5-spd., extra battery, dump-bed trailer, 150 hours, $1000. Kaiser, 828-1660.

KING-SIZE BRASS HEADBOARD, w/frame, $50; Ford AM/FM cassette, $25; Tunturi rowing machine, $50. Evans, 265-5229.

IBM SELECTRIC I, non-correctable, $50. Cronin, 265-5229.

TWIN-SIZE ELECTRIC BED, adjustable, $465; 48" bed, w/frame, casters, box spring, mattress, $165; bar refrigerator, $165. Horton, 883-7504.

AIRLINE TICKET, round-trip from Albuquerque to Pittsburgh, Cincinnati, or Louisville, any time before October, male, $290. Barr, 821-5870.

SOFA SLEEPER; chair; kitchen table; Ping-Pong table, w/paddles; weight bench, w/weights. Gallegos, 294-0233.

DAYTON COMMERCIAL EXHAUST FAN, 36" blade, w/reversible motor, $135. Chavez, 842-6374.

LOWREY FIESTA ORGAN, $900 OBO. Gauna, 828-2048.

QUEEN-SIZE WATER BED, solid oak, 6-drawer pedestal, mirrored bookcase headboard, complete bedding, dual-control heated mattress cover, $350. Daut, 255-2529.

BOY'S AND GIRL'S TOYS, ages 2-10. Witek, 296-5198.

XT-TURBO COMPUTER, 2-floppy, $375 w/monitor and keyboard, $275 without; floppy drives, cases, and 1 hard drive. Hayward, 292-6284.

SHOTGUN, 20-gauge, bolt-action, 3-shell clip, leather carrying case, cleaning kit, $150. Case, 293-5466.

LAWN MOWER, gas-powered rotary, 20", w/side catcher, $110; Scott spreader, model 35-3, $30; cordless shears, w/charger, $20. Stang, 256-7793.

DINING ROOM FURNITURE, cherry, Ethan Allen, table, 6 chairs, extensions, pads, $1000; Queen Anne buffet, $850. Kerley, 298-1271.

FISHER-PRICE CAMERA for children, in original box. Wagner, 823-9323.

COUCH, $50; washer, $30; dryer, $30; mattress, box spring, $10; oak dining table, $70; drafting desk, $10; chairs, end tables, $10/ea. Klarer, 344-0612.

KING-SIZE WATER BED, $100; electric stove, $110; four rims, tires, 15", from Nissan Pathfinder, approximately 2000 miles, $275. Krumlinde, 898-6965.

SOFA, Kroehler sleeper, beige/neutral colors, $75. Kipp, 883-8880.

IBANEZ ROADSTAR II GUITAR, w/case, $225; Crate guitar amp, $275; Sharp dual-cassette deck, $75; Apple IIc computer, $500; all OBO. O'Toole, 828-9260.

BLUE COUCH, $90; beige/white striped love seat, $95. Sherlin, 299-1005.

UTILITY TRAILER, made from LW truck bed, w/radial tires mounted on 8" x 15" rims, spare tire, wired, primed, $295 OBO. Snelling, 294-5751.

QUEEN-SIZE SOFA SLEEPER, colonial, brown tweed, bed never used, $350. Strascina, 299-2285.

UPRIGHT PIANO, Kohler & Campbell, 3 yrs. old, light wood. Cianciabella, 268-7150.

HOUSEHOLD ITEMS: end tables and coffee table, pine, set/$100; lamps, $10 or less. Weagley, 821-4263.

CHAIN-LINK FENCE GATE, 3' x 6', never used, latch & hardware available, cost $36, make offer. Zeuch, 296-4969.

DATSUN SERVICE MANUALS, '80-'85 pickup, $5; 2 oil filters, Fram PH2850 for '80-'85 Datsun pickup, $1/ea. Brewer, 831-5031.

SOFA & LOVE SEAT, golden brown, $150; chest freezer, $200; bar refrigerator, $50; 2 matching bar stools, $40/ea. Stevenson, 299-3510.

KONICA FS-1 35mm AE CAMERA, extra zoom lens, electronic flash, automatic advance, cases, $415. Thorp, 292-0169.

S&W 9mm SS, 14-round mag., $350. Anderson, 897-3701.

WESTINGHOUSE REFRIGERATOR, 22 cu. ft., side-by-side, frost-free, $50. Shane, 294-4920.

FOUR ANTIQUE PICTURE FRAMES, wood and combination wood/gilt, $75 and up. Freyermouth, 299-2053.

MODINE CEILING-MOUNTED FURNACE, 50,000-Btu, $100; hydraulic lift, trolling motor bracket, used once, cost $160, sell for $60. Skogmo, 292-2773.

FULL-SIZE FUTON SOFA-SLEEPER, $125. Eley, 255-2617.

FOUR CUSTOM WHEELS, American Racing, 14x8 multi-fit, $100; Holley 650 CFM spreadbore carburetor, model 4165, mechanical secondaries, divorced choke, $60. Rackley, 275-1276.

TWO LOCKING FILE CABINETS, 2-drawer, letter-size, $20/ea. Kallenbach, 293-6916 leave message.

TIME-OUT TENT TRAILER, can be pulled by small car or motorcycle, $1195 OBO. Brock, 865-4055.

KAYPRO II COMPUTER, w/WordStar, dBASE, misc. software, manuals, Epson dot-matrix printer, $450. Pasterczyk, 255-2066.

DUAL ELECTRIC/WOOD RANGE, Monarch, harvest gold. Vigil, 768-1425.

CANON AE-1 CAMERA, 50mm lens, $140; Vivitar 35-105mm zoom lens, 2x converter, $130; strobes, $50; 20" lawn mower, rear bag, $50. Mehlhorn, 823-1437.

BEN FRANKLIN STOVE, $150 OBO. Marquez, 836-5153.

DESK, w/pull-out typing shelf, $45; 4-drawer credenza, $40; stained-glass supplies, best offer. Van Deusen, 291-8196.

COMPAQ PORTABLE II PERSONAL COMPUTER, 2 floppies, 40-Meg. hard drive, wide-carriage Epson LQ 1000 printer, $2500. Chou, 294-4213.

SEARS ROUTER, 1.5-hp, w/case & light, never used, $65 OBO. Schaub, 865-9581.

EXERCISE BIKE, Schwinn Air Dyne, $500. Harris, 299-4559.

GREGORY INTERNAL-FRAME BACKPACK, cost $237, sell for $150; low-profile cot, $20; Coleman Peak 1 camping stove, $30. Edwards, 275-7611.

STUHR CONCERT CELLO, w/case & bow, $3600 value, sell for $3000. Stone, 298-4641.

MACINTOSH COMPUTER 512, complete, keyboard, mouse, external drive, ImageWriter printer, all manuals plus software, $1200 OBO. Hughes, 265-1698.

AMIGO ELECTRIC WHEELCHAIR, battery charger, extra battery, $500. Cochrell, 298-2068.

TWIN-SIZE BED, mattress, box spring, rails, headboard, sheets, bedspread, $65. Wilcoxen, 296-8295.

KENMORE REFRIGERATOR, 18 cu. ft., glass shelves, 2 yrs. old, $425; picnic-style dining table, w/benches, $75; Whirlpool built-in dishwasher, $25. Blaine, 275-9002.

BARBECUE, rectangular, for built-in service, w/electric rotisserie, $35. Barham, 298-7304.

SOFA, new, 3-cushion, opens into queen-size bed, blue w/floral print, $375 OBO. MacCallum, 255-3034 or 883-2919.

KERMA RUN SAILBOARD, complete, 5.6-meter sail, aluminum mast, $400. Imbert, 294-8176.

MACINTOSH COMPUTER, 512K enhanced, 800K internal drive plus 400K external drive, $600; Mastertracks music software, MIDI interface, $75. Humphreys, 292-5819.

KENMORE WASHER/DRYER, heavy-duty, $600; Sears microwave, 1.4 cu. ft., $350; queen-size waveless water bed, w/headboard & 6 drawers, $175. Breeze, 275-9002.

HEATHKIT EQUIPMENT: dual-trace scope, $300; counter, $150; generators: function, $80, signal, $45, audio, $40; other items, $10-$100. Levan, 293-0079.

FITNESS SYSTEM: DP-Trac-20, free-standing, folds for storage, 20 exercises without cable changeover, cost $420, never assembled, sell for $315. Schkade, 292-5126.

POP-UP TRAVEL TRAILER, '74 Skamper, 19', w/tandem axles, includes refrigerator, stove, dual sinks, and outside awning, $1995. Vernon, 293-8197.

RV ACCUMULATOR TANK, $13; aluminum windows, 4' x 6', 4' x 3', 2' x 5'; mirror tiles, 10¢ ea.; child's bike seat, $8. Bentz, 299-3448.

VINYL FLOOR COVERING, new, light beige, 12' x 13'; gold/antique-white king-size headboard; Tempo boat tank, 30-gal., 26" x 16" x 12". Dollahon, 298-1151.

LANE HOPE CHEST, $75; Lowrey Skylark organ, $125; early 1950s baby crib, w/mattress, $75. Reich, 281-3521.

BABYLINE CRIB, w/mattress, $50. Martin, 822-9940.

RIM, size 5-JX14, w/balanced radial tire 185/70SR14, replaces dummy spare, $40. Huebner, 256-0978.

TRS-80 COLOR COMPUTER, disk drive, 2 printers, cassette, tape eraser, desk, TV, manuals, $650/all. Shock, 881-8534.

CAMPER SHELL, fits older Chev., GMC, or Ford full-size long bed, steel frame, sliding windows, boot, $175. Mills, 823-4484.

YELLOW LABRADOR PUPPIES, AKC-registered, born Feb. 2, ready to take home, $150. Garcia, 293-3937.

RUGER SPEED SIX .357-MAGNUM, 2-3/4" bull barrel, stainless steel, custom trigger work, leather holster, quick loader, $260. Montoya, 296-4268.

PORT-A-CRIB, w/mattress, $10. Lowe, 299-7725.

HOPS for making beer, approx. 75 lbs., $25; Atomic 195 downhill skis, $30. Golden, 299-1274.

TRANSPORTATION

'80 FIAT X-19 CONVERTIBLE, 50K miles, $2000. Porter, 268-0287.

'70 HONDA TRAIL 90 MOTORCYCLE, $60. Skogmo, 292-2773.

'88 CHEV. 1/2-TON PICKUP, Silverado package, customized, loaded, PB, PS, PW, tilt, 34-gal. tank, two-tone, $14,500. Kassicieh, 292-4054.

MOUNTAIN BIKE, 19", 15-spd., Strongman, Suntour, Mountaintech, Schwinn components, 5 miles, $125. Roth, 344-7060.

'84 CHEV. CELEBRITY, V-6, AT, tilt, cruise, AC, 59K miles, $3450 OBO. Baker, 294-3334.

'75 VOLVO 245DL, rebuilt engine w/warranty, new gas shocks, all-season radials, anti-locking brakes, AT, AC, $4000 OBO. Allen, 898-9209.

'87 TOYOTA TERCEL, 4-spd., AC, AM/FM cassette, 56K miles, hatchback, $5000. Hovorka, 268-8693 leave message.

'89 CHRYSLER NEW YORKER, 1.1K miles, climate control, full power, warranty transferable, $16,500. Williams, 884-4184.

CATAMARAN SAILBOAT, 18', blue sails, 4 trapeze rigs, custom trailer w/2 cargo carriers, $1975. Blewer, 268-9019.

'79 MUSTANG COBRA-TURBO, 4-spd.; '77 Buick Skylark, 231, AT, AC, needs work; '73 Plymouth Cuda, 318, AT, mags, RT package. Bray, 293-4079.

'84 PONTIAC SUNBIRD, FWD, AT, AM/FM cassette, rear window defogger, rack, brown interior. Krumlinde, 898-6965.

WOMAN'S/GIRL'S BIKE, 3-spd., fenders, basket, rear hub brake, $30. Kipp, 883-8880.

'84 CORVETTE, loaded, $13,000. Pullen, 291-0666.

GIRL'S HUFFY BICYCLE, 10-spd., 24", $40. O'Toole, 828-9260.

'80 DODGE OMNI 024, 70K miles, one owner, $950 OBO. Gregory, 299-7940.

'88 MUSTANG LX, 2-dr., 4-cyl., 5-spd., AC, cruise, PS, PB, PL, AM/FM tape, more, 11K miles, $7500. Evans, 299-7105.

REPO: '86 Dodge Ram minivan, 4-cyl., AT, AC, 63.3K miles, bids accepted through March 28, we reserve the right to refuse all bids, subject to prior sale. Sandia Lab FCU, 293-0500.

'87 TOYOTA CELICA GT COUPE, gray, 5-spd., stereo, cruise, AC, complete service record, more. Gallegos, 899-0824.

SPORTCRAFT BOAT, 15', semi-tri-hull, open bow, canopy top, w/trailer. Cianciabella, 268-7150.

BOY'S BICYCLE, 16", $20. Weagley, 821-4263.

'79 PORSCHE 911 SC TARGA, 74K miles, red, $15,500 OBO. Roberts, 299-5671.

'89 MERCEDES BENZ 190E, 2.6L, $24,000. Pulos, 256-7197.

'75 DODGE PICKUP, 4-spd., short wide bed, w/camper shell, 5K miles on new engine, $1650. Cumiford, 877-6498.

'84 ISUZU PICKUP, 40K miles, 9K on rebuilt engine, roll bar, sunroof, new tires, $3700. Berman, 296-5640.

'87 CHAMPION-LaSALLE MOTORHOME, 18K miles, never smoked in, consider trade for 5th-wheel rig. Himes, 869-2856.

ALUMINUM BOAT, 16', closed bow, 35-hp Johnson outboard, Dilly trailer, $850 OBO. Gibson, 344-8056.

'77 GMC 3/4-TON PICKUP, 454 V-8, AC, cruise, 95K miles, Benson, 268-9727.

'88 CORVETTE CONVERTIBLE, flame red, leather seats, Delco/Bose stereo, 24K miles, all options, $29,300. Arnold, 299-2345 after 6.

'83 HONDA XL600R, $695 OBO; '85 Yamaha Tri-Z, 250cc, 3-wheeler, $800. Brock, 865-4055.

MAN'S BICYCLE, Trek 12-spd., $300. Pasterczyk, 255-2066.

'77 PLYMOUTH ARROW, red, 2-dr. hatchback, 1.6L, 4-spd., AC, 50K miles, original owner, $850. Buckalew, 299-6394.

'82 TITAN BOAT, 15', tri-hull, 50-hp Johnson, w/trailer, open bow, extras, $4100. Radigan, 299-8345.

'60-'61 FORD FALCON SWs, in restorable condition, $500/ea. OBO. Silverman, 298-1308.

'79 CHEV. IMPALA, one owner, AC, PS, new paint, brakes, shocks, & tires, $3200 OBO. Garcia, 266-4015.

PEUGEOT PSV-10 BICYCLE, 21 lbs., entry-level racer, 56cm, $450. Van Deusen, 291-8196.

TOURING BICYCLES, Centurian Super LeMans, alloy wheels, 23" & 19", $165/ea. or $300/both. Schaub, 865-9581.

MAN'S 10-SPD. RACER BICYCLE, Sears Free Spirit, $65. Barham, 298-7304.

'86 TOYOTA TERCEL, 4-spd., 2-dr. hatchback, 69K miles, $3275 OBO. MacCallum, 255-3034 or 883-2919.

'84 DODGE B150 PASSENGER VAN, new tires, running boards, $3650. Haill, 256-3705.

'87 SUZUKI GSXR-1100, custom paint, 2.1K miles, includes Bates leathers, Shoei and Arai helmets, $5300. Gonzales, 296-4704.

'89 HONDA ACCORD LXI, 2-dr. coupe, loaded, 5-spd., 3-year warranty, 5K miles, $13,500. Shope, 293-7697.

MOUNTAIN BIKE, 18", Exage and Shimano components, rear rack, pump holder, 1 yr. old, $300 OBO. McConnell, 831-0471.

'83 BASSTRACKER BOAT, 17', 50-hp Merc. motor, all extras, $5995; '72 GMC van, 80K miles, new paint, AT, PB, stereo, $1895. Fleming, 293-9421.

'89 JEEP CHEROKEE, 4-WD, 4.0L V-6, 5-spd., AC, AM/FM, tinted windows, extras, $15,500. Langdon, 822-0184.

'71 OLDS., 4-dr. hardtop, $500. Bentz, 292-2544.

'79 FORD F-250 PICKUP, 4x4, 4-spd., V-8, cruise, Travel Queen 10' camper, monomatic, refrigerator, stove, heater, CB radio, $4300. Norris, 299-4717.

RALEIGH 12-SPD. BICYCLE, 22" frame, alloy rims, $85 OBO; Fuji 12-spd., 22" frame, index shifting, quick-release front and back. Wetzel, 296-7570.

'70 FORD F-100 PICKUP, 8' long, wide bed, 6-cyl., 300 cu. in. Myers, 294-7316.

'85 FORD F-150 XL, w/custom topper shell, 302 V-8, EFI, AT, AC, cruise, $7500 OBO. Garcia, 293-3937.

'83 BUICK LeSABRE, 4-dr., one-family-owned car, 88K miles, all power options, below NADA. Moore, 345-4030.

'71 JEEP COMMANDO, V-6, 3-spd., 4-WD, 56K miles, hardtop, steel doors, $2900; 10-spd. bike, $20. Golden, 299-1274.

'84 FORD BRONCO, XLT package, 4-WD, AC, AT, 302 V-8, 4-speaker stereo system, $6000 OBO. Martinez, 888-3067.

REAL ESTATE

4-BDR. HOME, 2 baths, formal LR & DR, study, 2300 sq. ft., 2-car garage, below appraisal. Fellerhoff, 275-7415.

3-BDR. CUSTOM PUEBLO, Corrales, 2 baths, 2174 sq. ft., mountain & city views, 1 acre. Hays, 897-1335.

3-BDR. HOME, Belen, corner lot across from Tierra del Sol Golf Course, refinance, $107,000. Jortner, 821-9684.

2 ACRES, East Mountain area, water, power, covenants, view of Sandias, $24,000. Fulcher, 296-7149.

TOWNHOME, views from every room, 1715 sq. ft., 9-1/2% FHA, assumable, no qualifying. Roberts, 299-5671.

12.8 ACRES, near Ski Rio and Valle Vidal, 35 miles to Red River, 55 miles to Taos Ski Valley, $7000. Stone, 298-4641.

3-BDR. TOWNHOUSE, NE, 1050 sq. ft., corner lot, insulated, all-electric, FHA assumable, no down, $56,000 ($606.03/month). Spiller, 298-3594.

3-BDR. HOUSE, double garage, pitched roof, landscaped, sprinklers, 1/2-acre, $73,500. Tafoya, 865-9816.

3-BDR. DUPLEX, Las Cruces, approx. 900 sq. ft. each, fully fenced backyard, 1 mile from NMSU campus. Golden, 299-1274.

3-BDR. HOUSE, NE, 1-3/4 baths, pool, solar rooms, heat, and water, $108,900. Long, 889-9130.

3-BDR. HOUSE, Four Hills Addition, 1740 sq. ft., 1-3/4 baths, 2-car garage. Martinez, 296-9035.

3-BDR. HOME, east of Tramway, north of Lomas, 2000+ sq. ft., 2-1/4 baths, $128,000. Nagel, 299-8463.

WANTED

SKI BOAT, older model, 16', 70-hp, $1500 to $3000 range. Porter, 268-0287.

CHRISTMAS PLATES, Bing and Groendahl, dated before 1962. Clark, 298-1831.

HOUSEMATE, to share 3-bdr. NE Heights home, separate baths, nonsmoker, $250 per month plus 1/2 utilities. Levin, 299-0891.

BABYSITTER, mature woman to love and play w/our toddler daughter, 4 days weekly. Cieslak, 294-2383.

ROOMMATES at NMSU, beginning June 1990, new townhouse 2 miles from campus; coral for a saltwater aquarium. Cropp, 296-1877.

KRAMER GUITAR, w/Floyd Rose system, Marshall guitar amp; Jeep rims, aluminum, late model, good condition only. O'Toole, 828-9260.

WORLD BOOK ENCYCLOPEDIA. Kelly, 293-2475.

JAPANESE SWORDS and sword fittings. David, 293-2322.

NATIVE NEW MEXICAN FAMILIES with 3 generations of Spanish speakers, for study of Hispanic culture by UNM student. Schubeck, 821-3133.

ROOMMATE, to share 2-bdr. house, Indian School & Pennsylvania area, $230/mo. plus 1/2 utilities. Golden, 299-1274 leave message.

WORK WANTED

YARD MOWING & TRIMMING on regular schedule in NE Heights, by responsible high-school student. Perrine, 293-1429.

LOST AND FOUND

LOST: class ring, sentimental value, accidently left in Medical's men's room March 7 between 2 & 3 p.m., reward, no questions asked. Morris, 268-3431.

LOST: 16-oz. plastic container w/white twist cap and gray inner seal, on Wednesday, March 14, probably in or near parking lot north of Bldg. 887. McConnell, 883-6073.

SHARE-A-RIDE

FULL-TIME VANPOOL SEATS AVAILABLE, along N-14, Frost Rd., Tijeras, ride every day. Yelton (281-2893) or Burns (281-3922).

VANPOOL SEATS AVAILABLE, full-time and part-time, from Santa Fe to Albuquerque and Sandia. Hawthorne, 1-473-2798.

Coronado Club Activities

Needing Some Comic Relief? Head for the Fun House Tonight

LAUGHTER'S THE BEST MEDICINE, and those who show up at Comedy Night this evening receive a bigger dose than usual. Comedian Tom Becka — former Albuquerque DJ now living in Arizona — will have you rolling in the aisles between 7 and 7:45 p.m. Enjoy dinner ahead of time (T-bone steak/$8.95 or fried shrimp/$7.95). Afterward, Eva & The Cast play dance music from 8 until midnight. Reservations recommended (265-6791).

"PRIME/MOVER NIGHT" is a good way to describe the action next Friday night (March 30). Chow-line selections are prime rib ($8.95) and chicken teriyaki ($6.95). Now here's the "mover" part: a country/western dance contest, starting at 9 p.m., with the finals at 11. Emcee Mike Coughenour, C-Club c/w dance-lesson instructor, awards first, second, and third prizes afterward to the couples judged the best at sagebrush-shuffling. Enter the contest by signing up with the hostess when your arrive. If you're not into contests but still want to shake a leg, you can — the Isleta Poor Boys strum their special c/w tunes from 8 until midnight.

TAKE NOTE, THUNDERBIRDS: The card sharks get together for more fun and games on March 29, starting at 10 a.m. — a civilized time of day if there ever was one. Join this gregarious group for all kinds of card games, free goodies, and convivial conversation.

"ECONOMIC EVALUATION," a four-session short course about pocketbook items, will be presented by Bob Butler (ret.) on April 9, 11, 16, and 18 in the Sandia room (each session 1-3 p.m.). Free to all C-Club members (including T-Birds), the course will cover such basics as simple and compound interest, annuities, balloon payments, and lease vs. purchase. Classes are limited to 20 participants, but there are some openings as we go to press. Sign up at the Club office.

THE T-BIRD MONTHLY MEETING on April 2 (1 p.m. at the C-Club) features Al Chavez & Co. (Benefits Administration and Employee Services Div. 3543) discussing financial benefits available to Sandia retirees and/or their survivors. All retirees and their spouses, T-Bird members or not, are invited to attend.

AN EGGSTREMELY GOOD TIME for youngsters is set for Saturday, April 7, when members' kids get together for their annual Easter egg hunt. Festivities start at 9 a.m. and include, besides the egg hunt at 10:30, cartoons on the big-screen TV and a visit from Mr. and Mrs. Peter Cottontail. Breakfast specials (for both kids and their parents) are available from 9 on; children's specials include pancakes and sausage/$1 or scrambled eggs, hash browns, and bacon/$1.50.

EGGSTRA! EGGSTRA! An egg-coloring contest for kids (ages 1-8) is scheduled next month, with first and second prizes in three age categories: 1 to 3 years old, 4 to 5 years old, and 6 to 8 years old. There's also a grand prize for the best-decorated egg, from *any* of the age categories. Contest entries (hard-boiled, of course!) should be delivered to the C-Club office no later than Wednesday, April 11. The eggs will be displayed at the Club until Easter (April 15); winners will be announced at noon during the Easter Sunday brunch (more on *that* next issue.)

Events Calendar

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

March 23-24 — "The Marketplace," arts and crafts show, more than 70 local crafters; 9 a.m.- 6 p.m., Menaul at Juan Tabo (old Revco store on SE corner).

March 23-31 — "The Wind in the Willows," Theatre-in-the-Making presentation of children's classic, performed by the Youth Performance Workshop; 8 p.m. Fri. & Sat., CenterStage, 260-0331.

March 23-25 & 29-31 — "Singin' in the Rain," based on the MGM film, presented by the Albuquerque Civic Light Opera Assn.; 8:15 p.m., 2:15 p.m. Sun.; Popejoy Hall, 345-6577.

March 23-April 1 — "Fences," New Mexico Repertory Theatre performance of August Wilson play about the quiet collapse of an ordinary black family in the '50s as individual family members seem unable to fulfill seemingly ordinary aspirations; 8 p.m. Tues.-Sat., 2 p.m. Sat. & Sun. matinees; KiMo Theatre, 243-4500.

March 23-Aug. 5 — Exhibit: "From the Land of Dragons," collection of rare fossils, mostly from China; supported by the American Museum of Natural History (New York City) and the Institute of Vertebrate Paleontology and Paleoanthropology in Beijing, China; 9 a.m.-5 p.m. daily; New Mexico Museum of Natural History, 841-8837.

March 24 — La Compañia de Teatro de Alburquerque presents twin billing: "Lola's Last Dance," last day in the life of an aged prostitute; "I Say Chaqueque, You Say Shaqueque," collection of New Mexican folktales adapted for the stage; 8 p.m., South Broadway Cultural Center, 848-1320.

March 24 — "I Love the New Mexico Symphony Day," Symphony members present solo and ensemble performances; 10 a.m.-6 p.m., Coronado Center Mall, free, 881-4600.

March 25 — Concert: "Rock Meets Classical," San Francisco guitarist Ricardo Griego performs works by J.S. Bach, Villa-Lobos, Leo Brouwer, and Joaquin Rodrigo, sponsored by UNM Continuing Education Series for the Arts and the International Classical Guitar Institute; 3 p.m., UNM Conference Center (1634 University Blvd.), 277-2527.

March 25 — Chamber Players Series V: "Back in the USSR," New Mexico Symphony Orchestra — in conjunction with UNM Composer's Symposium — presents the music of Achnittke, Part, and other post-glasnost composers, conducted by Neal Stulberg; 3 p.m., Keller Hall, 842-8565.

March 25 — Lecture: Bilingual writer Jim Sagel illustrates lecture on "Folklore and Folk Literature Traditions of New Mexico" with readings from his work, funded by the New Mexico Endowment for the Humanities; 2 p.m., free, Albuquerque Museum, 242-0434.

March 25-28 — UNM Composer's Symposium: major ensembles, chamber ensembles, soloists; call for times, Keller Hall, 277-4402.

March 27 — Tuesday Evening Garden Class: "Organic Soil Preparation," with Robert Bickham, president of the Organic Growers, speaking about organic fertilizers and where to find them in Albuquerque; 7 p.m., Albuquerque Garden Center (10120 Lomas NE), 296-6020.

March 29-31 & April 5-7 — "All New Works," UNM Contemporary Dance Ensemble directed by Bill Evans, premiere performance of the third of three newly created dance ensembles, introducing five newly choreographed works in the tradition of American theatre dance; 8 p.m., Rodey Theatre, 277-4402.

March 31 — "Springtime! It's Magic," Uptown Garden Club's flower show featuring spring bulbs, including Ikebana International presentation of Japanese flower arrangements; 1-4 p.m., Albuquerque Garden Center (10120 Lomas NE), free, 296-6020.

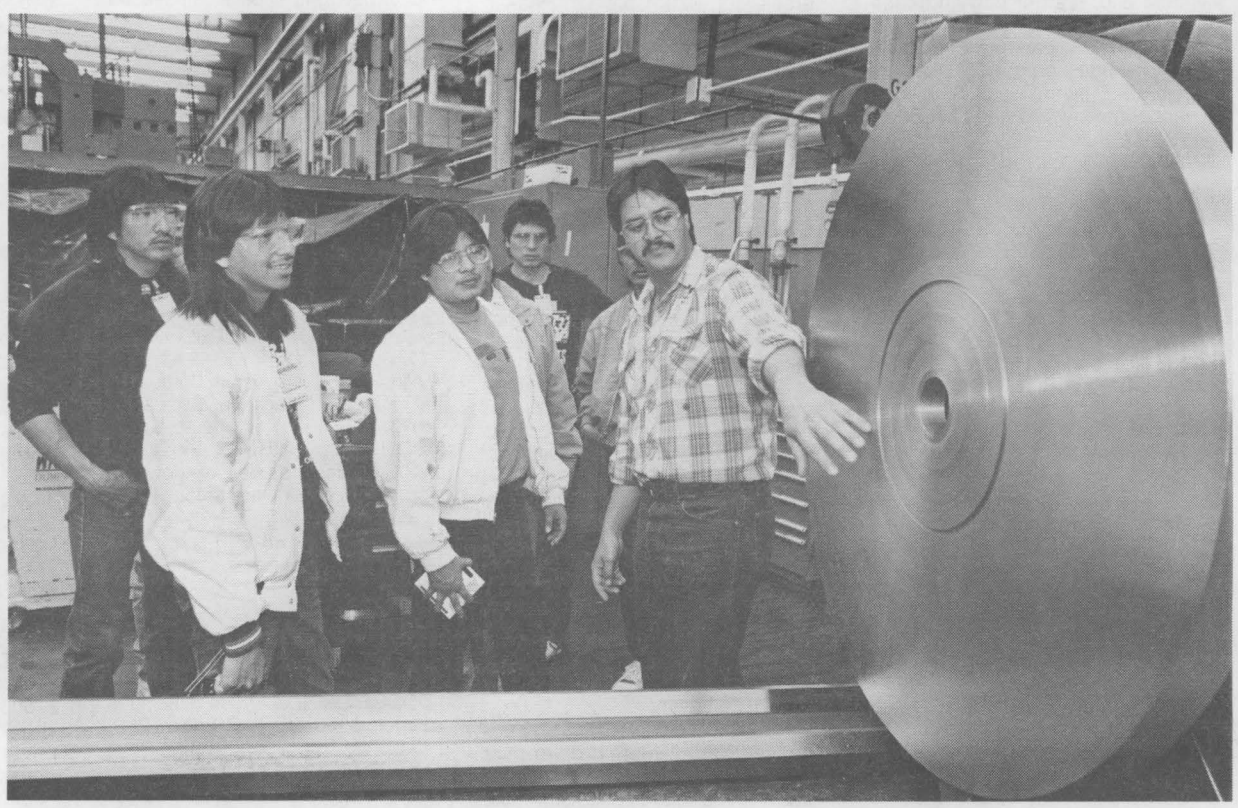
March 31-April 27 — Exhibit: "Traditional Arts of Saudi Arabia;" 9 a.m.-4 p.m. Mon.-Fri., 10 a.m.-4 p.m. Sat., UNM Maxwell Museum of Anthropology, free, 277-4404.

April 1 — Chamber Players Series VI: "A Passover Commemoration," New Mexico Symphony Orchestra and Chorus perform Handel's "Israel in Egypt;" 3 p.m., First United Methodist Church (4th & Lead SW), 842-8565.

April 1 — Explorations! class: "Chinese Paper Folding," in conjunction with "From the Land of Dragons" exhibit, create prehistoric animals from paper, for children ages 9-12; 2-3 p.m., New Mexico Museum of Natural History, 841-883.

April 6-7 — Classical Concert VIII: New Mexico Symphony Orchestra, music by Franck, Ravel, Stravinsky; 8:15 p.m., Popejoy Hall, 842-8565.

April 6-8 — "La Fille Mal Gardee," (The Unchaperoned Young Girl), pastoral tale of life and love among the country folk, presented by the Southwest Ballet Company; 8:15 p.m., 2 p.m. Sun.; KiMo Theatre, 294-1423.



MACHINE SHOP TOUR — Students from the Southwestern Indian Polytechnic Institute, guided by Henry Romero (7481, right), get a close-up look at a giant lathe in Sandia's machine shop during a recent tour. The students also toured Sandia's sheet metal facility and foundry. The lathe is used to machine huge metal parts like nose cones. Sandia hires some SIPI graduates.