

Experimental Photovoltaic Module Achieves Record-Setting Efficiency

Since the late '70s, the efficiency of concentrator modules has nearly doubled. That's equivalent to an increase of about 6 percent a year — a good indication of the steady progress photovoltaics is making toward becoming a practical and reliable alternative power source.

Now, with Sandia's development of an experimental photovoltaic concentrator module offering peak solar-to-electric conversion efficiency of slightly more than 20 percent, Photovoltaic Technology Division 6221 has pushed module efficiencies to their highest level yet.

A photovoltaic concentrator module is an arrangement of cells connected together, mounted on

Next Design Goal:

Further Cost Reductions

Work on the experimental module has contributed to another Division 6221 project, says Eldon Boes, supervisor. "We're also developing a manufacturable module design — a so-called baseline module. Most of the features used in the experimental module have been incorporated into the baseline module design. Our goal is to develop an improved module that can be mass-produced — and meet DOE's near-term energy cost goal of 12 cents per kilowatt hour. The photovoltaic industry has already expressed considerable interest in commercializing the baseline module design."

a surface, and enclosed in a weatherproof unit (see drawing). Concentrating optics, usually Fresnel (Frah-nel) lenses, concentrate the sunlight to varying intensities and focus it on the cells. Modules, in turn, are linked together to form arrays.

The experimental module — an arrangement of 12 silicon cells and 12 lenses that concentrate the sunlight to 100 times its normal level — has an aperture area (light-gathering area) of 1875 square centimeters. Using high-efficiency silicon cells and several Sandia-developed design innovations, the module meets an efficiency goal for concentrator modules set by DOE

(Continued on Page Four)

Turning Art Into Science

New Photovoltaic Device Fabrication Lab Marks New Phase in Solar Cell Research

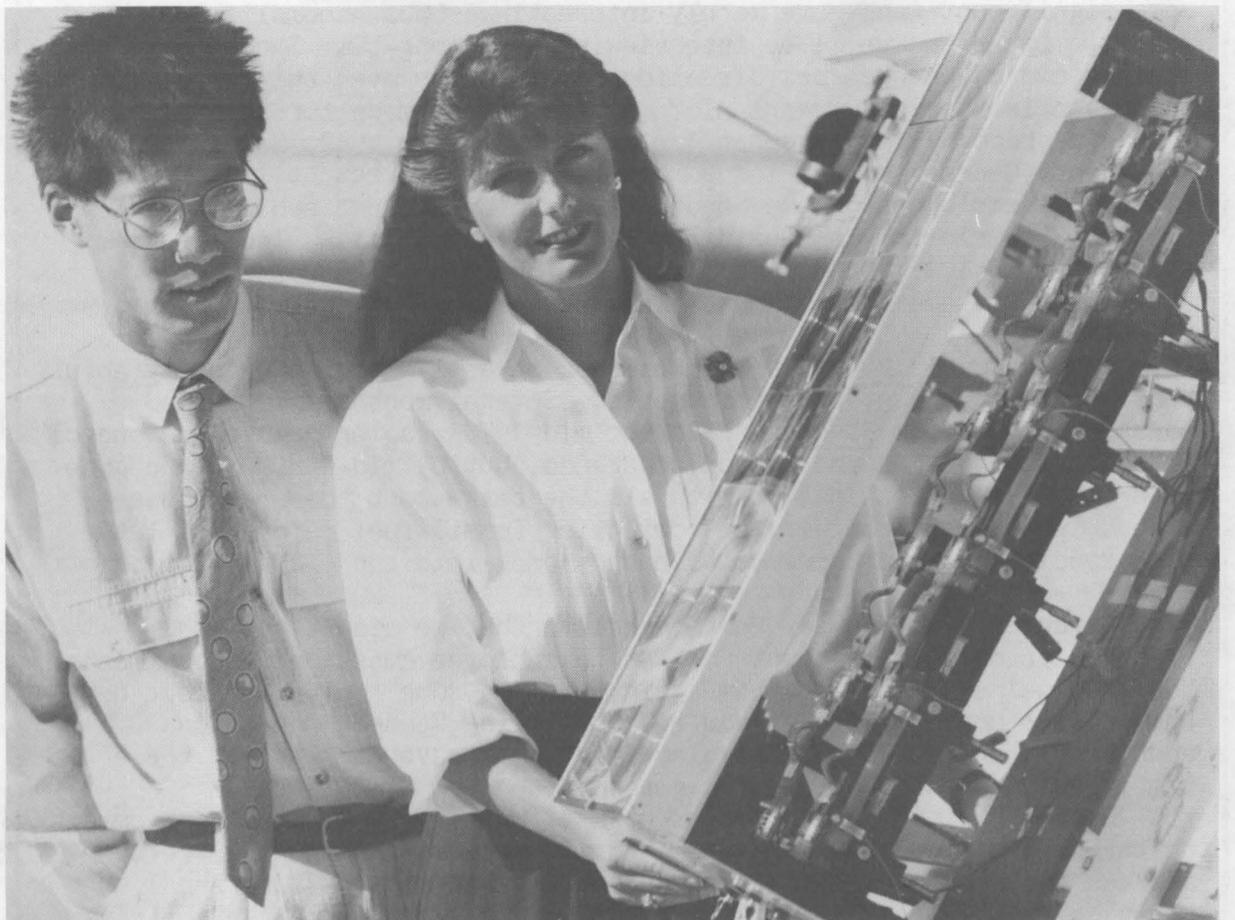
The dedication earlier this month of the Photovoltaic Device Fabrication Laboratory (PDFL) in Bldg. 883 marks a new phase in Sandia's photovoltaic research activities.

"This lab considerably enhances our solar cell research effort," says Virgil Dugan, Director of Advanced Energy Technology 6200. "It greatly expands our in-house research and development capabilities and opens the way for more effective technology transfer that will help the US photovoltaic industry catch up with the latest research developments in solar cells."

The immediate goal, he says, is to demonstrate the ability to sustain a precisely controlled, quality processing environment in which one-sun cells with efficiencies exceeding 20 percent can be routinely fabricated.

Designed and staffed by Photovoltaic Cell Research Div. 6224 (see "History of the PDFL"), the new lab features a 600-sq.-ft., class-100 clean room and extensive data collection equipment. It is fully equipped for precisely controlled and documented processing of solar cells from their beginnings as raw slices of silicon, through various processing sequences — etching, doping, chemical processing, and

(Continued on Page Five)



RECORD-SETTING EXPERIMENTAL MODULE is displayed by developers Clement Chiang (left) and Beth Richards (both 6221). The module includes a fluid cooling system for accurate temperature control and independent three-dimensional cell positioning capabilities. With these features and other Sandia-developed innovations, the module achieved an energy efficiency of 20.3 percent at standard test conditions of 25°C cell temperature and 800 watts per square meter of solar irradiance.



LAB NEWS

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SANDIA NATIONAL LABORATORIES

JUNE 30, 1989



JOHN McBRAYER (6224) demonstrates the loading of silicon disks into the metal evaporator for metal deposition in the new Photovoltaic Device Fabrication Lab. Dedicated earlier this month, the lab is fully equipped to process solar cells from their beginnings as silicon disks to their final testing and packaging as module-ready cells. Reliable cell processing techniques developed in the lab will be transferred to the US photovoltaic industry.

This & That

Countdown to 40 -- Leading up to Sandia's 40th anniversary this fall, we begin in this issue a series of short features to highlight some significant (and some merely interesting) Labs accomplishments and events. Later on, we'll be interviewing some long-time Sandians to get their views on changes/new directions at the Labs over the years.

When is Sandia 40 years old? A case can be made for several dates, but we're recognizing November 1. On that date in 1949, Sandia's first President, George Landry, issued a letter to employees telling them they had become employees of the Sandia Corporation, then a subsidiary of Western Electric (now a subsidiary of AT&T Technologies, Inc.). From 1945 until Nov. 1, 1949, Albuquerque employees on Sandia Base (now Kirtland AFB) were part of what's now Los Alamos National Lab.

A Sunny Outlook? -- We've published several articles recently about Sandia's solar energy accomplishments. Several months ago, I read a phrase in *Photonics Spectra*: "In the mid-1970s, solar energy was one of the hottest items on the photonics agenda, but by mid-1980, it had gone into almost total eclipse." With all the talk about the greenhouse effect, pollution problems, and dwindling fossil-fuel resources, let's hope Sandia can help bring solar energy back into the light of day.

Feedback Procedure -- For several months, we didn't publish Feedback items -- management replies to employee questions and comments. Now that we're publishing them again, we find some confusion about how the process works. Some of you are submitting Feedback questions anonymously and not on the regular form. For several reasons, these simply go in our trash, and you get no response.

Here's how the basic process works: Write your question or comment on the special Feedback form and send it, with your name and a return address (office or home). This guarantees that you get a personal reply. Trust me on this: There are procedures to ensure that only you and the Feedback coordinator associate a question with your name if that is your wish. We don't publish all questions and replies in the LAB NEWS, only those that we think have general interest. Call 4-7841 for additional information or to get a Feedback form.

It's About Time! -- New Mexico finally has a law prohibiting the consumption or possession of alcoholic beverages in open containers in vehicles traveling on public highways. The State Highway and Transportation Department says 60 percent of fatal traffic crashes in the state have some alcohol involvement.

Another Fractured Phrase -- Barry Schwartz (3202) spotted it in a recent ad for an auto service center: "No unauthorized work is ever done on a vehicle without our customer's consent."

Favorite Vacation Spot? -- Another recent newspaper ad caught my eye. It was for an airline, quoting low fares from Albuquerque to "your favorite vacation spot" -- actually a list of destinations. At the top of the list -- Philadelphia. I wonder if W.C. Fields would have been tempted by the offer. His personally written epitaph, most will recall, reads, "On the whole, I'd rather be in Philadelphia." ●LP

'Our Vision'

Small Staff, with input from many Sandians, recently developed this "vision statement" for the Laboratories. LAB NEWS will discuss it in greater detail in a future interview with President Al Narath.

Sandia National Laboratories is challenged by our government to render "exceptional service in the national interest." We serve the nation through the Department of Energy, both in its programs and those of other agencies. We have major research and development responsibilities for nuclear weapons, arms control, energy, environment, and other areas of strategic importance to national security.

Our principal mission is to support national defense policies by ensuring that the nuclear weapon stockpile meets the highest standards of safety, security, control, and military performance. Our commitment to this mission is uncompromising -- through it we help to preserve global peace.

We are, and will remain, a multiprogram engineering laboratory applying a broad spectrum of science and technology to diverse tasks requiring an exceptional commitment to insight, objectivity, responsiveness, and quality. Our standard for all our projects is to fully satisfy performance, schedule, and cost commitments. The problems facing the nation -- now and in the future -- have technical dimensions that are increasingly complex and multidisciplinary, and we are dedicated to applying and adapting our capabilities toward their solution. Through cooperative programs and transfer of technology, we seek to strengthen both the public and private sectors of the national economy.

The nation has placed a profound trust in us. In honoring that trust, we commit ourselves to the highest standards of ethical conduct, to the faithful protection of the environment, and to the safety and health of the public and our fellow employees.

People are Sandia's most important asset. We prize leadership, teamwork, and individual innovation. Each of us contributes to the success of the Laboratories. Together, we create and sustain an environment in which each of us is respected as a person and in which we all can work, grow, achieve, and be recognized for our contributions, both as team members and as individuals.

Sympathy

To Connie Soto (1553) on the death of her mother in Albuquerque, May 26.



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SCIENCE FAIR WINNERS from throughout New Mexico get an introduction to Sandia's 10,000-ft. rocket-sled track. Mark Garrett (7535) explains the kinds of testing done with rocket sleds. As guests of DOE, the group of winners visited Sandia and the Atomic Museum last week.

New Environmental Test Complex

Shake, Whirl, Sear, Freeze, Dehydrate: Recipe for Reliable Weapons

Simulating the conditions that a weapon can face during its lifetime — the stockpile-to-target sequence of temperature, humidity, altitude, vibration, acceleration, and shock — takes a wide array of centrifuges, shakers, drop tables, and environmental chambers.

Sandia's new environmental testing complex in Livermore upgrades and modernizes a three-decade-old capability. The new complex and equipment replace aging hardware that, had it been a Sandia employee, would have been eligible for full retirement benefits.

Construction was completed earlier this year on the complex, which consists of the 4200-sq.-ft. Environmental Test Facility (Bldg. 955) and the 2550-sq.-ft. Dynamic Test Facility (Bldg. 956). Both are operated by Environmental Test Div. 8283.

More than a dozen climatic test chambers, three vibration systems, and a small centrifuge have been relocated in the new complex, consolidating those activities for efficient operation.

Ready for Retirement

Clyde Taylor (8283), who manages the environmental-chamber lab, says a series of climatic chambers first used to test the Polaris W47 system are being retired after some 30 years of operation. They have been replaced by modern, microcomputer-controlled chambers.

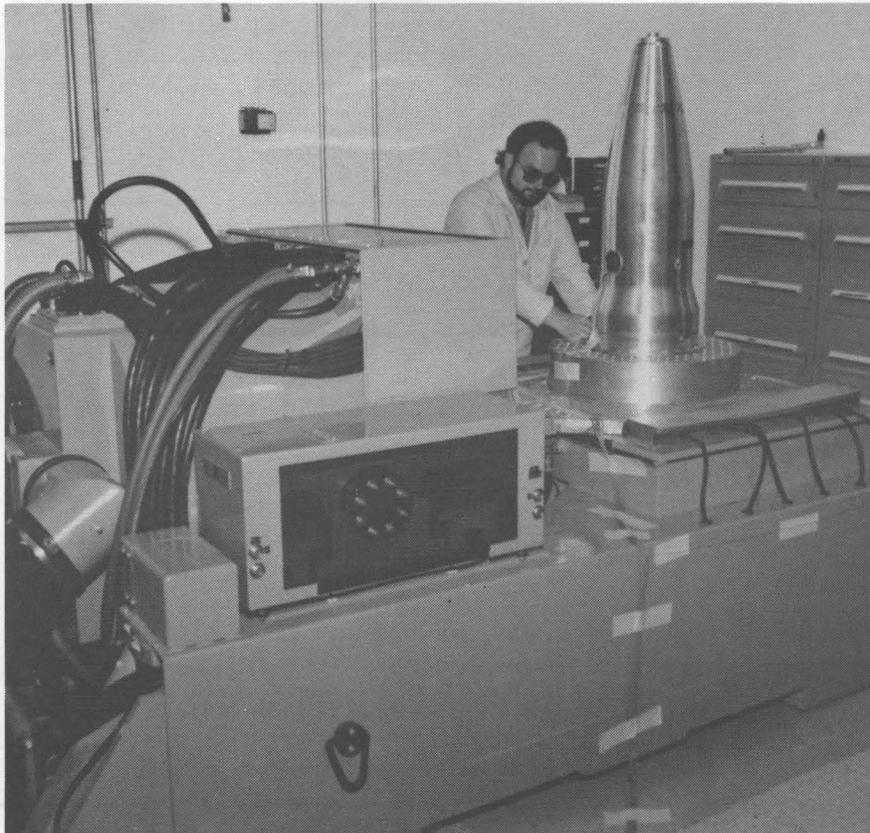
The largest new chamber weighs 30,000 pounds, has interior capacity of 672 cu. ft. (some 250 cu. ft. larger than any of the original units), and can simulate up to 200,000-ft.-altitude conditions, producing a maximum temperature of 350°F and a minimum of -100°F.

"This chamber can accept test units up to four feet in diameter by eight feet long," says Clyde. "The new cylindrical thermal vacuum chamber will allow us to get a pressure as low as 10^{-8} Torr, which simulates an altitude of almost two million feet above the earth. It's larger than any chamber of this type that we've had before."

Cold and Emptiness of Space

"Our principal uses of the cylindrical chamber now are for vacuum tests and leak detection of warhead packages," Clyde continues. "However, in the future, retrofitted inside with a liquid-nitrogen-cooled shroud to dissipate heat rapidly, it can be used to simulate a space environment." Such space simulations can be used for research in strategic defense and other advanced weapon programs.

Some of the environmental testing equipment moved to the new quarters includes thermal shock



CENTERING A WEAPON MOCKUP test unit on the integral slip table of the Unholtz-Dickie shaker is Marty Mikolajczyk (8283).

chambers that can quickly go from extreme heat to extreme cold (405°F to -100°F), a temperature and humidity chamber that can drop to 5 percent humidity, and an oven that heats to 1000°F.

Joining Clyde at the new facility is Marty Mikolajczyk (8283), who manages the Vibration Test Facility previously housed in Bldg. 914. "We've upgraded our control panels and monitoring systems to provide remote capabilities for all four of our test cells," says Marty, "and we've moved three shakers, including our recently acquired Unholtz-Dickie vibration system that has a slip table to provide lateral-type testing by rotating the shaker."

The arrangement previously used in Bldg. 914 has been divided to form the equivalent of two separate labs in the new facility. Although they share the same control room, each lab has separate instrumentation, data acquisition, and control systems. This provides the capability for performing two independent tests simultaneously without interference between the test setups. At the same time, the labs maintain the resources of a larger single facility.

Marty explains that the shaker devices use the same technique as a home stereo system. "In effect,

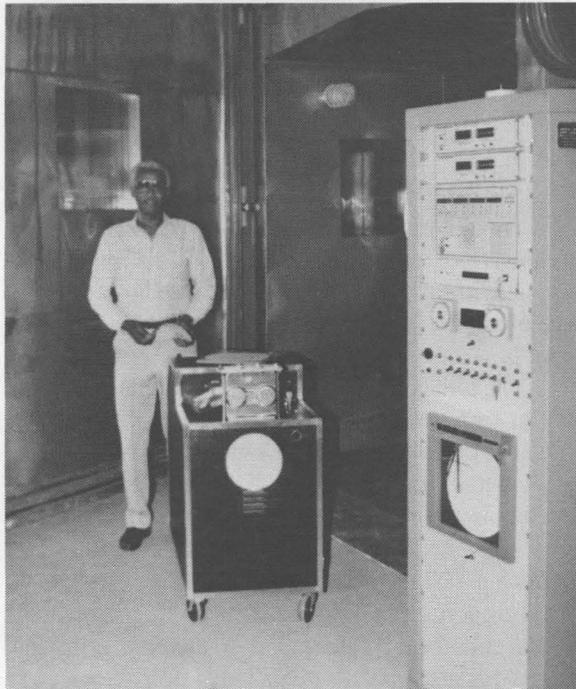
you're putting the test unit on the 'speaker,' which is driven by power amplifiers and programmed to achieve the desired vibration environment," he says. "At over 150 kVA each, they're the ultimate woofers!"

One of the new cells contains the four-foot centrifuge moved from Bldg. 914. All the cells housing dynamic-testing equipment are designed for items

"At over 150 kVA each, they're the ultimate woofers!"

containing up to one pound of high explosive. They provide protection from flying debris in the event of an explosion or breakup of a test unit. The dynamic-testing equipment, as well as some of the environmental-testing equipment, can be operated from the control room in Bldg. 955, remote from the test cells.

A few more months will be required to complete the equipping and installation, but when that's done, says Clyde, "We'll have a first-rate environmental test facility to meet the needs of our weapon, reimbursable, and energy programs for many years." ●BLS



CLYDE TAYLOR (8283) prepares to move a test unit into the 672-cu.-ft. temperature and humidity environmental test chamber.



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Congratulations

To Ilene Mulry (8242) and Gary Stewart, married in Danville, June 24.

Sympathy

To Bob Cattolica (8354) on the death of his father in Walnut Creek, May 21.

To Mel West (8523) on the death of his father in Tracy, June 2.

Maybe They Just Didn't Feel Like Changing the Channel



Researchers at the University of Kentucky recently explored a burning social issue: the television-viewing habits of pregnant women.

The results are in, and they show that pregnant women, at least in the uncomfortable stages of pregnancy, watch an unusually high number of situation comedies.

The study, entitled "Mood-Management During Pregnancy Through Selective Exposure to Television" and published in the *Journal of Broadcasting & Electronic Media*, found that expectant mothers spend up to 70% of their viewing time watching comedies from the 21st to the 24th weeks of pregnancy and from the 33rd week until the birth. Nonpregnant women watch sitcoms only about 40% of the time.

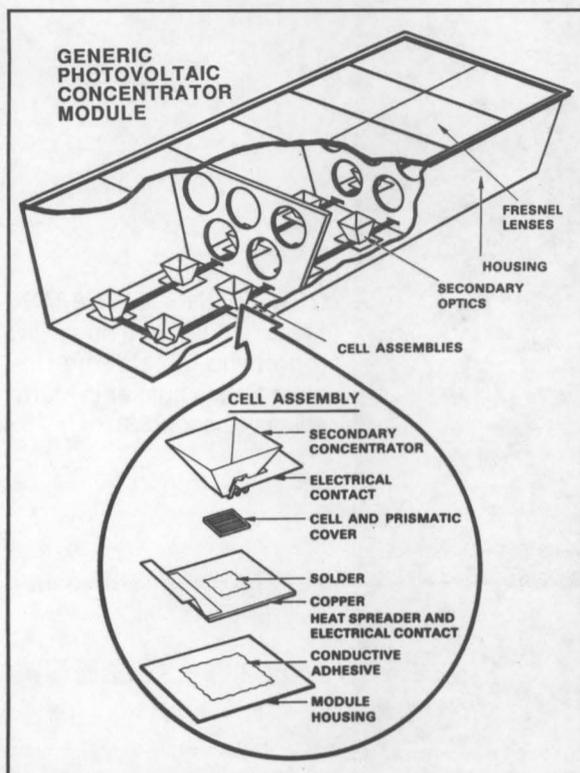
Wall Street Journal

(Continued from Page One)

Module

in 1986. Sandia is DOE's designated lead laboratory for photovoltaic concentrator module research.

"Reaching 20 percent module efficiency with silicon cells is especially significant," says Eldon Boes,



supervisor of Div. 6221.

"We probably could have reached the goal sooner by using more efficient — and significantly more expensive — gallium arsenide cells. But for this particular module, our emphasis is on combining features that are not only efficient but also cost-effective and easily adapted to commercial production."

Concentrator module development — unlike the development of non-concentrating modules — involves the careful selection and integration of cells, special lenses, cell assemblies, interconnects, and other features that contribute to the effectiveness of the module.

Special Features Increase Efficiency

The experimental module sports several special features.

Chief among them, and key to the module's efficiency, is the recently developed high-efficiency silicon cell.

Developed by researcher Martin Green at the University of New South Wales in Australia, the cell — about half an inch square — is up to 25 percent efficient and is essentially module-ready, says Clement Chiang, who teamed up with Beth Richards (both 6221) to develop the successful module.

Sandia, through a series of contracts and consultations, steered the cell to the stage where it can be

"Reaching 20 percent module efficiency with silicon cells is especially significant."

produced by industry. Further development of reliable manufacturing processes for the cell are planned at the new Photovoltaic Device Fabrication Lab (see "New Photovoltaic Device Fabrication Lab Marks New Phase in Solar Cell Research"), and will be transferred to the photovoltaic industry, says David King (6224).

Fundamental Problem Solved

Also contributing to the module's efficiency are transparent prismatic cell covers molded directly to each cell to reduce reflection losses. "The covers provide a solution to a fundamental problem in making cells more efficient," explains Beth.

The problem involves the grid lines — the many narrow metallic "fingers" that spread out to every part of the cell's surface to form electrical contact and

carry current from the cell.

"The larger these lines are," says Beth, "the less current is lost through electrical resistance and the more efficient the cell. But only to a point — if the lines are too large, they block off too much sunlight, and the cell is less efficient. So it's always been a trade-off between the need for larger grids and the need for incoming sun."

The prismatic covers help solve the problem by refracting incoming sunlight away from the grid lines onto the silicon surface, allowing wider grid lines to be used on the cells.

The cover has been used previously by EN-

"The manufacturing techniques we develop will be transferred to industry."

TECH, Inc., (Dallas) on lower-concentrating, line-focus modules. Alex Maish (6221) and Paul Basore (6224) worked with ENTECH and Black & Veatch (Kansas City, Mo.) to adapt the covers to the new cells. Beth and Clement worked with ENTECH to develop a way to mold the covers directly to the cells, a process that is readily adaptable to mass production.

Clement developed another design innovation — a soldering technique — that increases the module's reliability and reduces its cost by eliminating the need for an expensive ceramic insulator ordinarily required between the silicon cells and the copper heat spreader directly beneath them.

Don't Let It Go Down the Drain

Water: 'An Extremely Valuable Resource'

"Thirsty N.M. Sees Crops, Rivers Die." "It's Not a Drought — But It's Close." So read a couple of headlines in the *Albuquerque Journal* not long ago.

The hot, dry spring of 1989, the driest since 1972, resulted in record water use by Albuquerque residents in April and May — and noticeably higher water bills, as people worked to keep lawns and gardens from drying up and blowing away.

Most Southwesterners know that, in a semi-arid climate such as Albuquerque's, water is a precious commodity not to be taken for granted. Underground aquifers, if not replenished by summer rains and winter snowpacks, can become seriously depleted or even disappear. Prolonged periods of dry weather, year after year, can have a drastic effect on the water supply.

"New Mexico has experienced above-normal precipitation and snowpack runoff for the past 10 or 12 years," notes Bob Peurifoy, VP 7000, whose Facilities organization (7800) maintains Sandia's water system and budgets for water costs. "Under those conditions, we tend to forget that water is an extremely valuable resource and that we need to guard against its waste."

Sandia gets its water from a central water system at Kirtland AFB. Most water comes from a half dozen wells located on the Base. Backup water — for instance, to fight a large fire — is purchased from the City of Albuquerque on an as-needed basis.

According to statistics from the KAFB Engineering Office, Sandians and other Base users have done a pretty good job on water conservation during the last 15 years: Total consumption declined from about 2.1 billion gallons in 1973 to about 1.8 billion gallons in 1988. Part of the decline probably is attributable to many wetter-than-average years during that period, resulting in a need for less irrigation water in the summer.

'Outlook . . . Could Be Bleak'

"Overall consumption decline at Kirtland doesn't mean that we can afford to let down our guard," says Bob. "If we had dry years such as 1989 over a prolonged period, Albuquerque's long-term outlook for water availability could be bleak. So, for the sake of future generations, it's up to all of us to conserve wa-

ter as best we can."

His technique allows the cells to be soldered directly to the heat spreader. Because, with heat, copper expands five times as much as silicon, the connection had to be strong yet flexible. It had to survive repeated thermal cycling — hot during the day, cool at night. It involves specially cleaning the surfaces and then soldering them together with a minimum of flux. "This promotes good solder 'wetting,' and fewer voids, making the connection more resistant to the heating and cooling cycles," says Clement. "It's low-cost, takes no fancy equipment, and can be easily adapted to mass production."

To increase the amount of light transmitted through the module's Fresnel lenses, an anti-reflective layer of magnesium fluoride solution was applied to both surfaces of the lenses. "The increase in transmission measures only about two percent," says Beth, "but at this stage, it's still an experimental process. We'll be exploring more effective and more durable coatings in the future."

Both Clement and Beth emphasize that testing the module and its components during development was an important part of the project. Doing the testing were Jack Cannon (6221), Misch Lehrer, Karl McAllister, Bill Boyson, and Don Ellibee (contractors).

Likely initial uses for these photovoltaic developments are in pilot power plants at utility companies and small, 10- to 1000-kW stand-alone power systems, says Eldon. "By gaining markets like this and starting the manufacturing process, industry will be able to drive down costs and expand the market further."

•DR/WKeener(3161)

ter as best we can."

If you observe dripping faucets, toilets that don't shut off, or standing water (which could indicate an underground leaking pipe), report the problem to the maintenance troubleshooters on 4-4571, advises energy management specialist Ed Hess, a contractor assigned to Operations Engineering Div. 7816.

"One dripping faucet wastes three or four gallons of water a day," says Ed. "A running faucet wastes two gallons a minute; a gushing faucet, five gallons. That's a lot of water down the drain."

Spring-loaded faucets, which must be held "on" during use, and which turn off automatically afterward, have been installed in many of Sandia's newer buildings. Other conservation measures effected at the Labs include timed sprinklers and drip irrigation systems — important additions, because daily water consumption on KAFB about doubles (from 3.1 million gallons/day to 6.3 million gallons/day) during the warm-weather irrigation season, April through September.

Upgraded chilled water systems that recirculate and recool water for air conditioning are installed in new Sandia facilities. (In some older systems, water was circulated once, then discarded.)

16.6 Percent of Base Consumption

Though KAFB water users are not metered separately, it's estimated by Base engineers that Sandia uses 287 million gallons of water a year — an average of almost 24 million gallons a month, or 16.6 percent of Base consumption.

The unit cost of water charged Sandia by KAFB varies from month to month, depending on the cost of water purchased from the city and costs associated with water production from KAFB wells, including system maintenance and energy used for pumping. The Labs' water bill in 1988 was \$272,880 — or 95 cents per 1000 gallons.

"Important as dollar costs may be, the real cost of not conserving water relates to the nitty-gritty fact that when it's gone, it's gone," says Bob. "Somebody once said 'You never miss the water till the well runs dry.' It's important for all of us to keep that sobering thought in mind." •PW

(Continued from Page One)

New Lab

metal deposition — to their final testing and packaging as module-ready cells.

Expanded Role in Solar Research

The enhanced research capability is particularly important in view of Sandia's recently expanded role in DOE's solar program, says Don Schueler, manager of Solar Energy Dept. 6220.

"Since 1976, we've served as DOE's lead lab for conducting research on high-efficiency silicon concentrator cells. Now, after a consolidation of DOE's Photovoltaic Research Program, we're charged with managing all DOE-sponsored crystalline silicon cell research, including one-sun and concentrator cells — a responsibility that requires the strong internal research capability that this lab gives us."

In the past, he notes, most research on high-efficiency cells was carried out via technical research contracts with industry and universities — and, until

"Now, after consolidation of DOE's Photovoltaic Research Program, we're charged with managing all DOE sponsored crystalline silicon cell research ..."

1982, through support from Sandia's radiation-hardened microelectronics processing facilities.

That in-house support was the key factor in raising cell efficiencies from 15 percent in 1976 to 20 percent in 1980, he says. "But over the years, experimental solar cells have become increasingly intricate. They now require a number of processing steps that are considerably different from those for conventional microelectronics." Solar cells, for example, require double-sided photolithography, processes for surface texturing, and unique metallization systems.

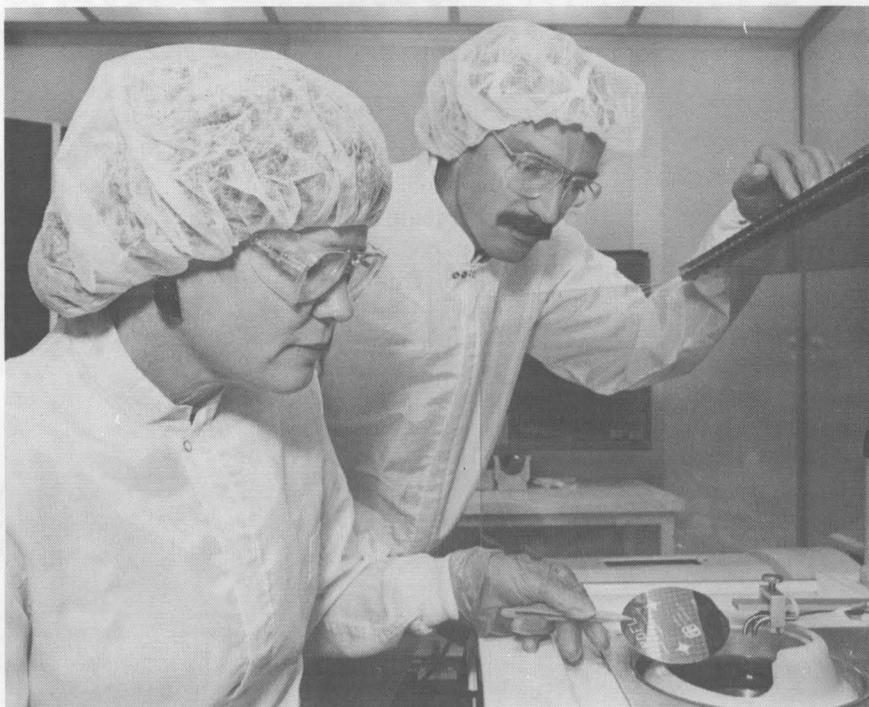
"The new lab, designed specifically for photovoltaics — in combination with our Photovoltaic Device Measurement Lab — gives us the resources we need for renewed progress in solar cell research and development," says Don.

Efficiency Records Not the Goal

Not that the arrangement of awarding, monitoring, and managing technical research contracts with universities and private companies hasn't been productive: "In the last few years, this arrangement has led to several dramatic breakthroughs in achieving higher efficiencies in experimental solar cells," says Dan Arvizu, who headed Photovoltaic Cell Research Div. 6224 until his recent promotion to manager of Technology Transfer Dept. 6110.



PAUL BASORE (6224) demonstrates one of the final steps of cell processing — inspection of the hair-thin metal interconnects, using a special microscope.



THE PHOTOLITHOGRAPHY ROOM of the PDFL. Elaine Buck (left) and David King (both 6224) demonstrate the application of a layer of photoresist, a processing step that prepares cells for photomasking. Lit by an eerie yellow light to which photoresist is insensitive, the room is referred to as the "yellow-light" room.

He points to the 22-percent-efficient nonconcentrating (one-sun) silicon cell and the 28-percent-efficient concentrating silicon cell demonstrated by researchers at the University of New South Wales and Stanford — and to Div. 6224's own demonstration just last year of a 31-percent-efficient multi-junction concentrator cell. The record-breaking cell was constructed by stacking a silicon cell developed at Stanford atop a gallium arsenide cell developed by Varian Associates, Palo Alto, Calif. (Sandia was involved in both developments.)

The problem, he says, is not a lack of progress in

"The problem is . . . that the photovoltaic industry hasn't been able to cost-effectively implement improvements already achieved in research laboratories."

achieving higher efficiencies in experimental cells, but rather that the photovoltaic industry hasn't been able to cost-effectively implement improvements already achieved in the laboratory.

"The best cells from US industrial suppliers currently have efficiencies of about 15 percent for one-sun applications and about 20 percent for concentrator applications. Today's typical commer-

cially produced concentrator systems are still using types of silicon cells first developed at Sandia in the early '80s."

Still More Art Than Science

There are several reasons for this, he says: "While many of the approaches developed by university laboratories just aren't cost-effective, industry has also had difficulty duplicating — in a manufacturing setting — the results obtained in highly specialized research laboratories.

"The truth is that the whole business of processing advanced solar cells is still in its infancy — it's still more art than science.

"That's why, from the beginning, we planned the PDFL for the express purpose of developing consistently repeatable manufacturing techniques for high-efficiency cells."

Once the ability to sustain a precisely controlled processing environment for the routine fabrication of one-sun cells with efficiencies exceeding 20 percent has been established, a variety of investigations will be launched to gain a better understanding of the effects of processing on cell performance.

"Transfer of this information to the US photovoltaic industry should help private companies achieve the higher efficiencies in their commercially produced cells that — so far — have been obtained only in experimental cells in research labs," Dan notes. ●DR

History of the PDFL

In 1985, when Dan Arvizu (now 6110) and David King (6224) began the task of soliciting DOE support and funding for the Photovoltaic Device Fabrication Lab (PDFL), they were acting on an idea first proposed by Ben Rose (now 2531).

Ben had promoted the idea that Sandia needed a dedicated solar cell processing lab because hands-on experience in the lab would make solar researchers better able to direct and monitor the research being conducted through contracts with industry and universities.

"We took Ben's idea and expanded it a bit," says Dan. "Our notion of the lab was that it should be a state-of-the-art facility — open to industry and university participation — that would allow careful and documented studies of innovative, cost-effective methods for processing solar cells. We thought it should also maximize the potential for reliable technology transfer."

In the next year, a location for the proposed lab — Bldg. 883 — was identified, DOE funding came through, and Facility Engineering Div. 7843 became actively involved in planning and sup-

porting construction of the lab.

Construction/renovation began in 1987, and the lab was up and running and cleared for operation early this year.

'Just Plain Hard Work'

"This was a complicated effort that required the support and cooperation — not to mention patience and just plain hard work — of an awful lot of people," says Dan.

He cites the efforts of Facility Engineering Div. 7843, in particular those of Paul Schlavin, Israel Martinez, Marty Nee, and former Sandian Jane Nations.

Staff in Photovoltaic Cell Research Div. 6224 formed a "Facility-Fabrication Team" and, in addition, took individual responsibility for various tasks necessary to complete the PDFL, he says.

On the team were Paul Basore, Barry Hansen, David King, James Gee, Doug Ruby, John McBrayer, Elaine Buck, Jeff Tingley, Len Beavis (now 7471), Paul Quesenberry, Herb Tardy, and Rod Mahoney.

Supervisory Appointments

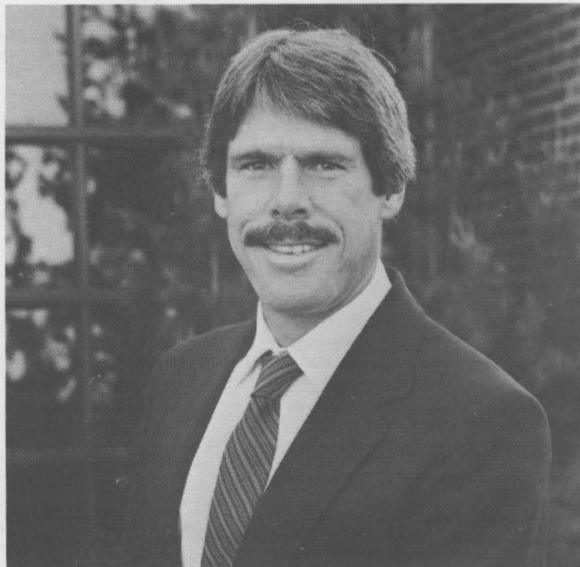


SYLVIA TSAO to supervisor of Interfacial Chemistry and Coatings Research Div. 1841, effective March 16.

Sylvia joined Sandia in July 1984 as a member of the Microelectronics Materials and Processes Division, where she did research and development of porous silicon materials. Her work also included development of silicon-on-insulator (SOI) materials and processes for radiation-hardened microelectronic circuits, including materials characterization on various types of SOI materials.

She has a BA in physics from Rutgers University and an MS and a PhD in applied physics (materials science) from Harvard University. She's a member of the Materials Research Society. She received the outstanding paper award at the 1988 Hardened Electronics and Radiation Technology Conference. Her paper was also voted best paper in the November 1987 issue of *IEEE Circuits and Devices* magazine.

Sylvia enjoys family activities in her spare time. She and her husband Jeff (1141) have one son and live in the NE Heights.



THOMAS MEHLHORN to supervisor of Diagnostic Theory Div. 1262, effective March 16.

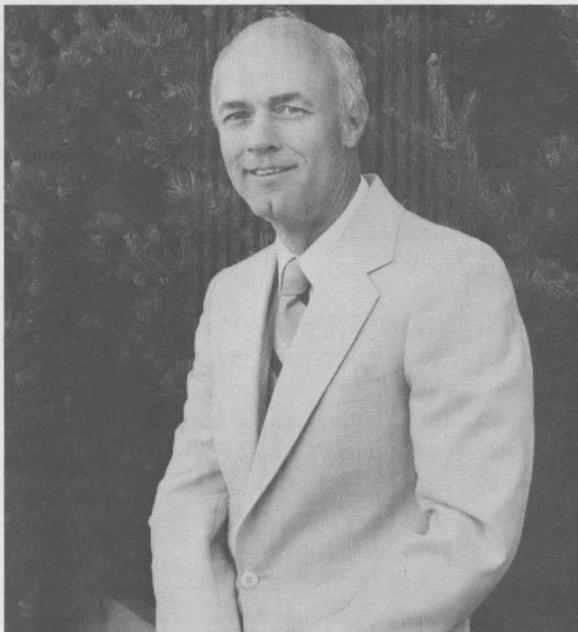
Tom joined Sandia's Plasma Theory Division in April 1978, where he worked on target- and system-related aspects of electron-beam fusion and did early research on the utility of ion beams versus electron beams. In 1979, Tom became a member of the Target Interaction Theory Division, where he studied ion-beam stopping power under ICF (Inertial Confinement Fusion) conditions.

In 1981, he joined the Simulation Theory Division, where he was involved with computer transport codes. He returned to the fusion program in 1982, and continued work on ion-beam stopping power, transport, and diagnostics. From 1985 through 1986, he was the chief theorist on Particle Beam Fusion Accelerator (PBFA) I ion-diode experiments. He was part of the PBFA II ion-diode team that achieved record ion-beam intensity last March.

He has a BS, MS, and PhD from the University

of Michigan, all in nuclear engineering. He's a member of the American Physical Society's plasma, computational, and beam physics divisions. He's been a member of Sandia's PhD recruiting team to the University of Michigan for the past ten years and has been team captain since 1983. He was a member of the Coronado Club board of directors and was its president in 1986 and 1987.

In his spare time, Tom enjoys tennis, basketball, gardening, and music. He and his wife Noelle have two children and live in the NE Heights.



RONALD WILLIAMS to supervisor of Project Design Definition Div. III 2853, effective April 1.

Ron joined Sandia in July 1957 as a member of the Drafting Division. He's done drafting on handling equipment, firing sets, Phase 1 & 2 weapon proposals, Joint Test Flight, major components, motion sensors, safeguards (safe secure trailers [SST] and weapon storage vaults), solar tower experiments, and pulsed power projects. He did initial drafting layouts for the SST in January 1971, and was drafting project leader with Safeguards projects until January 1982.

From 1985 until his promotion, Ron was senior drafting project leader in Area IV, where he oversaw various pulsed-power projects including Hermes III, Saturn, and PBFA-II.

He has an AS in drafting and mechanical technology from Purdue University. Before joining the Labs, he worked for an electric company in Marion, Ind.

Ron's spare-time activities include gardening, camping, fishing, travel, woodworking, and singing in his church choir. He and his wife Marian have three grown children and live in the NE Heights.

PETER ESHERICK to supervisor of Advanced Laser and Optoelectronic Technologies Div. 1164, effective April 16.

Peter's work has been in laser spectroscopy since



PETER ESHERICK (1164)

he joined Sandia's Advanced Laser Physics Technology Division in May 1977. He worked with Del Owyong (1160) on ultra-high-resolution stimulated Raman spectroscopy of gas-phase molecules (see *Sandia Technology* May 1982). His recent work was on the development of diode-laser-pumped solid-state lasers.

He has an AB in physical chemistry from the University of California at Berkeley, a PhD in chemical physics from Harvard University, and a post-doctoral degree in chemistry from the University of California at Los Angeles. He's a member of the Optical Society of America.

Before coming to Sandia, Peter worked for IBM Research in Yorktown Heights, N.Y.

In his spare time, Peter enjoys chasing and videotaping hot-air balloons, country/western and Serbo-Croatian dancing, bicycling, and skiing. He and his wife Trylla have two daughters and live in the SE Heights.

JULIA GABALDON to supervisor of EEO/Affirmative Action Div. 3511, effective May 1.

Julia joined the Labs in August 1981 as a member of the Community Relations Division, where she was the Employee Contribution Plan executive secretary, conducted tours, coordinated the Speakers Bureau, and was an instructor in the Effective Presentation Skills Course. In 1985 she transferred to the Management and Staff Training Division, where she worked with the 1986 Department Managers' Conference and led the project team for the Supervisors' Management Development Course.

She joined the Equal Employment Opportunity and Affirmative Action Department in April 1988, where she conducted EEO management training,



JULIA GABALDON (3511)

handled internal employee complaints, and chaired the Hispanic Leadership and Outreach Committee. Julia led Dept. 3510's "Valuing Diversity" effort, including arrangements for directorate meetings, management briefings, Cultural Diversity Colloquia, and International Day.

Julia has a BA in Spanish/English with a teaching certificate and an MA in secondary education with emphasis in bilingual education, both from UNM.

Before coming to Sandia, she worked for the Albuquerque Public School System as a Spanish/English teacher at West Mesa High School from 1973 to 1977 and master teacher in the APS cross-cultural program from 1977 to 1981. She's a member of the local Muscular Dystrophy Association executive board and the *Albuquerque Tribune* Distinguished Teacher Award Committee. She was nominated for YWCA Women on the Move in 1985 and 1987.

Julia's spare-time activities include reading and various television appearances. She will be a local co-host for the Jerry Lewis Muscular Dystrophy Association Telethon on Labor Day weekend.

She and her husband John have two children and live in the NE Heights.

Supervisory Appointments

PATRICIA CHILDERS to assistant to the Vice President 9000, effective May 1.

Pat joined Sandia at Albuquerque in November 1962 as a file clerk in the Drawing Control Division. In 1968, she moved to Livermore and did clerical work in the Personnel and Security divisions, and for the LAB NEWS.

In 1979, Pat was promoted to supervisor of the Mail Services and Document Control Section. She returned to Albuquerque in 1983, where she provided administrative support for the Future Options Group and then the Systems Research Department. In 1984,

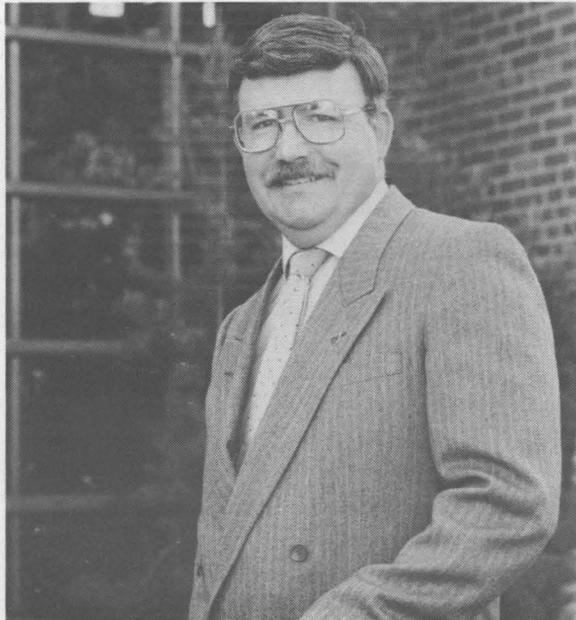


PATRICIA CHILDERS (9000)

she was named administrative coordinator for the Systems Research Directorate. She joined the Exploratory Systems Directorate in 1986.

Pat has an AS from Chabot College and a BS from the University of Phoenix, both in business administration.

Her spare-time activities include gardening, fishing, and travel. Pat and her husband Bill (9110) live in the North Valley. They have four children and four grandchildren.



DAVID WALLACE to supervisor of Purchasing Div. 3745, effective May 1.

Dave joined the Labs in March 1984 as a member of Purchasing Division E, where he was responsible for placing and administering complex research and development contracts. Since then, he's done the same kind of work in various Purchasing divisions.

In August 1988, he transferred to the Supplier Relations and Purchasing Information Division on special assignment to develop a cost/pricing function for the Purchasing and Materials Mgmt. Directorate.

He has a BS in business administration from the University of Nebraska (Lincoln) and an MS in procurement management from the Air Force Institute of Technology. He's a member of the National Contract Management Association (NCMA) and is an NCMA Certified Professional Contracts Manager.

Dave enjoys golf, racquetball, and woodworking in his spare time. He and his wife Evalene have two sons and live in the NE Heights.

B.J. JONES to supervisor of Benefits Systems and Health Care Planning Div. 3545, effective June 1.

B.J. joined Sandia in March 1984 as a member of the Benefits Administration and Employee Services

Division, where she administered various employee services.

In 1985, she transferred to the division she now heads. She initiated and directed the start-up of Health\$mart, handled various duties for the Medical Care, Dental Expense, Vision Care, and Long-Term Disability Plans and Livermore health maintenance organizations, and developed the *Sandia Benefits Digest* and other communication pieces.

She has a BS in medical microbiology and an MBA, both from Stanford. Before joining the Labs, she worked for American Scientific Products in Sunnyvale, Calif., and Southwest Community Health Services in Albuquerque.

B.J. is vice-president of the Stanford Club of New Mexico and a member of the Medicine Business



B.J. JONES (3545)

Coalition and All Faiths Receiving Home Auxiliary. She's a graduate of the 1989 Greater Albuquerque Chamber of Commerce "Leadership Albuquerque" Program.

In her spare time, she enjoys gourmet cooking, gardening, bicycling, cross-country skiing, and entertaining at home. She and her husband Orlando Lucero live in the NE Heights.



WOULDN'T YOU JUST LOVE to have this on the freeway next time a wild driver tries to cut you off? It's one of several armored personnel carriers used by Safeguards and Security Services Dept. 3430. Lt. Ray Page (3435) is seen with it here at the May 20 Law Enforcement Appreciation Day at Kirtland AFB. Area law enforcement units display and demonstrate all types of enforcement and security hardware at the annual event, sponsored by the KAFB Security Police. Other Sandians who participated this year included Capt. Bill Wolf, Lt. Greg Seymour, Lt. Art Salazar, Sgt. Louie Trujillo, Sgt. Dale Van Dongen (all 3434), Capt. Conrad Carrington, Lt. Steve Heaphy, and Inspector Ruben Garcia (all 3437).

feed i n b a c k

Q. Sandia's smoking policy seems to be working in most cases. It has been publicized fairly well among employees, but visitors to the Labs are not aware of it. Occasionally, therefore, visitors are embarrassed.

Why not print a brief summary of Sandia's smoking policy on a small piece of paper, to be distributed to visitors when they pick up their badges at the Badge Office?

A. Thanks for your comments and suggestions on communication of Sandia's smoking policy to visitors. We've discussed the matter with the Security organization and are exploring a variety of alternatives to provide information to visitors.

Larry Clevenger, M.D. — 3300

Q. I've noticed the Air Force guards looking in two different places on each car to locate base decals. On snowy days, guards sometimes even have to brush snow off bumpers to locate the decal. I remember the "old days" when I first came to Sandia; the decal was allowed in only one place—the center-top of the windshield. Perhaps Sandia could suggest a return to that system. It would help the guards and probably shorten lines at the gates.

A. I think you are right. We will suggest this to the Air Force.

Jim Martin — 3400

Unusual Vacation**Dave and Ginny Williams Rub Shoulders With Penguins**

Lots of people head south for a winter vacation. Mexico . . . Hawaii . . . Tahiti. Going to Antarctica would seem to defeat the purpose.

But the Williamses — Dave (DMTS, 6429) and Ginny (2833) — traveled to the Antarctic Peninsula last February, during the southern hemisphere's summer.

"It was near the end of the nesting season for penguins," says Dave. "That's comparable to mid-August here, except that mid-August in New Mexico isn't on the threshold of winter as mid-February is there. The air temperature was in the high 30s, maybe 40."

The trip was sponsored by the Harvard alumni association — Dave's a Harvard graduate. "We get brochures about association-sponsored trips several

"Where there's ice, it's usually in hundred-foot ice cliffs."

times a year," says Dave. "Usually we just laugh at the prices and throw the brochures away. But this one intrigued me, so I left it lying around. One day Ginny picked it up and said, 'The alumni association is going to Antarctica — want to go?'"

"It was appealing. I've been fascinated by the Antarctic for a long time. It was also pricey — I won't say how much — but we thought we might do it by scrimping on some other things. After a while, we talked ourselves into it."

Dave and Ginny first went to Miami, then flew with the tour group from there to Santiago, Chile. The



GINNY WILLIAMS (2833) on an Antarctic shore to visit the penguins.

next leg of the trip took them to Punta Arenas (also now called Magallanes), known as "the world's southernmost city." That's where the cruise began.

Wave Smashed Ship Door

After sailing among the islands at the southern tip of South America, the ship crossed to the Antarctic via the Drake Passage. That body of water divides the Atlantic from the Pacific, and South America from the Antarctic Peninsula. "It's notorious for being rough," says Dave, "and it was. The first night, a wave smashed a door on an intermediate deck of the ship. Quite a bit of water came in and ruined some people's camera equipment."

At some point in the Drake Passage, the Antarctic begins. Dave explains: "You cross the Antarctic Convergence, where south-moving ocean currents from South America meet colder north-moving currents from Antarctica. In about ten miles, the sea temperature drops from between 40° and 45°F to near freezing. That's considered the ecological boundary of the Antarctic. From there on, you may see icebergs any time."

Ice and Fire

The group's first of seven Antarctic landings was in the South Shetland Islands, to see the expected scenery: seals, penguins, and vast amounts of ice. The ship didn't stop at a dock — there are none. Instead, the tourists went ashore in inflatable (but hard-bottomed) rubber rafts powered by outboard motors.

"One of our landings was at Deception Island," says Dave. "It's actually a caldera — a collapsed volcanic cone. In one place the wall is broken down far enough that the caldera is flooded and ships can sail in. At Pendulum Cove — which is named for an experiment in gravitational anomalies conducted there — are hot springs. We sat in a spring, looking for some point permitting human survival between the boiling-hot spring and the freezing ocean."

They also landed on the continent of Antarctica itself — on the long peninsula that juts out toward South America.

Both the Williamses' expectations about ice turned out to be wrong — but in different directions. "I expected it to be all white," says Ginny, "but in most of the places we landed, we had just snow patches."

"Where there's ice," says Dave, "it's usually in hundred-foot ice cliffs. Or else it's steep rock, and you can't land there, either. I had actually expected the land to be less ice-covered than it was. It was over 90 percent ice, even though our southernmost landing was a hundred miles north of the Antarctic Circle."

The small barren patches suitable for people to

"We could get to within a few feet of the penguins."

walk on are also good for penguins and seals. That's where most of the penguins lay their eggs and the seals bear their young.

"We could get to within a few feet of the penguins," says Ginny. "We walked right through the rookeries."

"They were pretty unconcerned," Dave adds. "A few clucked at us, and some waddled away a few feet, but that was about all."

The group had been instructed to get no closer to a nesting penguin than 15 feet. But because it was late summer, most of the penguin chicks were adolescents that had left the nest. The few brood chicks in the nests so late in the summer, say Dave and Ginny, might not have survived when this year's cold weather came.

Beware of Seals

They watched seals from farther away. "You wouldn't want to fool with the seals," says Ginny. "We were specifically warned not to get between a seal and the water. It might start feeling nervous and go right over you to get back to the water."

"And maybe take a bite out of you as it went, was my impression," says Dave, "though I'm not sure we were actually told that."

Dave and Ginny got a lot of information from the

"In about ten miles, the sea temperature drops from between 40° and 45°F to near freezing."

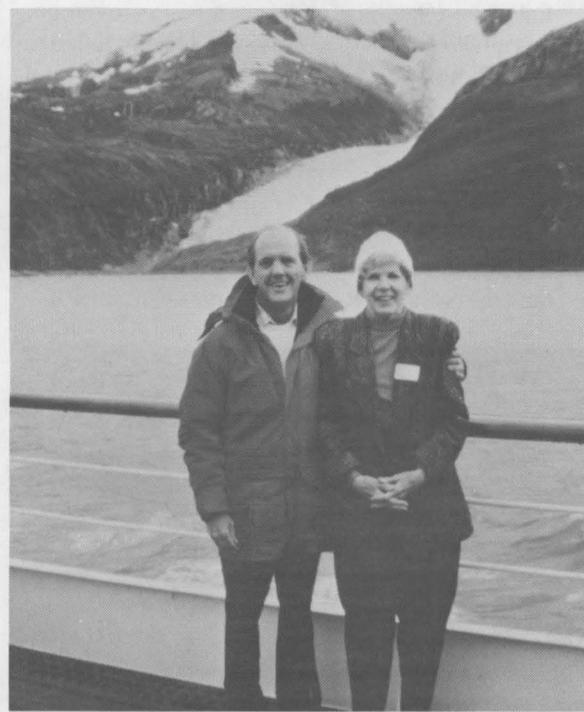
tour staff. "The group had five naturalists along," says Ginny, "plus a head naturalist and two professors, one each from Caltech and Harvard. So we did learn a lot about the natural history of the area. Dave once took a course from the Harvard professor — that was one reason the trip attracted us."

Blue Bergs

Dave and Ginny also remember the icebergs — not just the large size, but also the fantastically carved shapes and, in some cases, the color.

"The blue of some of the icebergs was impressive," says Ginny.

"That may be what surprised me most," says Dave. "It wasn't blue reflected from the sky — most of the time we had clouds — and it wasn't transmitted light. Some of the icebergs were actually blue. I had



GINNY (2833) AND DAVE (DMTS, 6429) WILLIAMS on board ship, with the rocks and ice of Tierra del Fuego behind them.

heard that, but I was skeptical until I saw it."

"The biggest one we saw," says Ginny, "was maybe 100 feet above the water."

Dave adds, "Standing on an upper deck of the ship, we were only up to that iceberg's knees! But it wasn't big by Antarctic standards. We heard about one piece of the ice sheet that broke off and formed an iceberg the size of Rhode Island."

The greatest disappointment was the weather. Dave and Ginny say that they had one clear morning and a few hours' clearing another day during their five days in the Antarctic. They had some rain, and snow once or twice. "It was appropriate to be snowed on in the Antarctic," says Dave, "but still . . ."

Advice: Expect Clouds

Their major piece of advice for prospective Antarctic tourists is to be psychologically prepared for clouds. "You can be disappointed if you go expecting to see everything that's there — all the mountain peaks, and so on," says Dave. "A lot of the mountains were fogged in, and we never saw them. Still, we saw an awful lot."

Ginny agrees, and adds, "If your main interest is wildlife, the weather doesn't matter so much. We got a look at whales and many kinds of birds. There were both seals and penguins everywhere we landed. It's easy to see penguins from 15 feet away! It was a spectacular trip. All that white. All those icebergs." ●CS



HOW THE TRAVELERS got from ship to land: A raft-load of Dave and Ginny's shipmates head for shore amid floating ice.

Take Note

The Albuquerque Section of the American Institute of Aeronautics and Astronautics, the National Atomic Museum, and the New Mexico Museum of Natural History are sponsoring a Space Exploration Exposition July 1 through Aug. 31 in commemoration of the 20th anniversary of the Apollo 11 lunar landing. Exhibits at the National Atomic Museum include an Apollo-era space suit and models of a Saturn V, space shuttle, a Pioneer 10/11, and Apollo Soyuz. The Natural History Museum exhibits will compare and contrast the geology of the Earth, Moon, and Mars. Samples of moon rocks will be displayed. Astronaut Mike Mullane will speak. Contact Terry Jordan (1555) on 4-1899 for information.

Sandia Colloquium

Paul MacCready of AeroVironment, Inc., will talk about "High-Efficiency Vehicles" July 14, 9:30 a.m., at the Technology Transfer Center (Bldg. 825). He is the designer/developer of human-powered airplanes Gossamer Condor and Gossamer Albatross. Contact host Stan Roeske (2322) on 4-2384 for information.

It's "Think Thanksgiving in July" at the Storehouse during a July 1-23 campaign to encourage donations of food (or money to buy food) for the homeless and the working poor. The Storehouse is a nonprofit, church-sponsored agency that provides food, clothing, and household items to those in need. If you can help, call 842-6491.



GETTING READY TO RIDE cross-country are Dr. Ed Cazzola (left, formerly of Sandia Medical) and Wayne Young (9123), with the 1929 Model A Ford that Wayne restored. He actually restored it twice, he says: once about 12 years ago, and again (mainly mechanical parts) about a year ago, when he decided to enter the 1989 Great American Race from Norfolk, Va., to Disneyland. The race began June 26 and ends July 7. Wayne has restored about 15 classic cars, including Model A's, Mustangs, and MG's. Ed and Wayne are a rookie team in the competition, which is actually a special road rally for old cars. With their car's odometer either removed or covered, they'll be trying to cover each day's specified route within 15 or 20 seconds of the prescribed time — the level of precision necessary if they are to finish among the best. Deborah Cazzola (2854) and Pat Young, Ed and Wayne's wives, are driving the team's support vehicle, loaded with spares ranging from clothes to an extra engine.



COLLEAGUES of Don Burns (dec.) in Electromechanical Subsystems Dept. 2540 donated funds in his memory for this exhibit — on display earlier this month at St. Joseph Hospital. Don's wife, Virginia, was on hand last week to get a close-up look at the exhibit, which featured new equipment being used at the hospital for radiation therapy treatment. Don died in March 1988 after a long bout with cancer.

Congratulations

- To Mary (5268) and Mat (9123) Sagartz, a son, Mathias, May 17.
- To Jayne Ward (5268) and Steve Williams (5245), married in Albuquerque, May 13.
- To Petra and Wayne (152) Potter, a daughter, Danielle Christine; a son, Scott Charles; and a daughter, Caitlin Renee, May 21.
- To Linda and Hal (1521) Morgan, a son, Brooksher Lee, May 27.
- To Katherine Myers (9213) and Robert Morris (9213), married in Las Vegas, Nev., May 30.
- To Marcia and Gary (1555) Polansky, a daughter, Kara Lynn, June 10.
- To Pat (2821) and Jim (2631) Tempel, a son, Bryan Paul, June 15.
- To Joann Danella (7266) and Peter Alden, married in Albuquerque, June 17.
- To Cynthia (2854) and Dan (2312) Caton, a son, Aaron David, June 18.

Fun & Games

Bowling — SANDOE Bowling Association April Bowlers-of-the-Month are: Scratch — Ron Van-Theemsche (2854), 700, and Trinie Chavez, 600; Handicap — David Norwood (7411), 640 and 706; Bess Campbell-Domme (1821), 498 and 672.

Golf — Sandia Golf Association members won the SGA Open Golf Tournament held June 3 and 4 at the Arroyo Del Oso and Los Altos golf courses. The format was individual-stroke play. Winners were: Flight A — Mike Gray (9121), low net champion, and Phil Fagan (DOE), low gross champion; Flight B — Daryl Dew, low net champion; Flight C — Joe Ehasz (5142), low net champion.

SGA members also competed in the Southern Classic Golf Tournament May 20 at the Socorro Golf Course. Format was two-man best ball. There were two flights with team champions for each flight. Team champions were: Flight A — Larry Seamons (DMTS, 7823) and Jim Wilson (1245); Flight B — Ken Ronquillo (1552) and Bill Lutgen (2853).

Soccer — The Strikers took first place in the Albuquerque Soccer League third division (10 teams) with a record of 13-2-3. In 18 games, starting last fall, they scored a total of 57 goals and allowed 24. Team members include Lance Thompson, Bill Wampler (1112), Greg Frye (1846), Eric Brock (2813), Dan Abeyta, Ed Holling (2853), Mark Howard (2853), Kevin Carmichael (2854), Gary Nez (3411), Larry Ritter (5245), Mark Rumsey (6225), Doug Stamps (6427), Channy Wong (6427), Steve Letourneau (7532), Kevin Marbach (9212), Norman Day, Randy Simons (9224), Kirk Archuleta, Ed Cole, and James Manning. The team is coached and managed by Gilbert Quintana (5245).

Windsurfing — SERP is sponsoring a windsurfing course July 12 and 16, covering water starts, jibes, equipment, and high-speed tacks. Cost is \$40. Participants meet July 12 at Action Sports for ground school, then July 16 at Cochiti Lake. For information, call Stan Ford on 4-8486.

Getting a New Handle on the Game



A new tennis racket handle with only six sides, rather than the usual eight, is being tested by biomechanics researchers at the University of Massachusetts at Amherst. Preliminary experiments with high-speed photography indicate that, using the new handle, beginners automatically hold the racket at the same angle when hitting the ball as expert players using the so-called Western grip, says Frank Katch, chairman of the exercise science department.

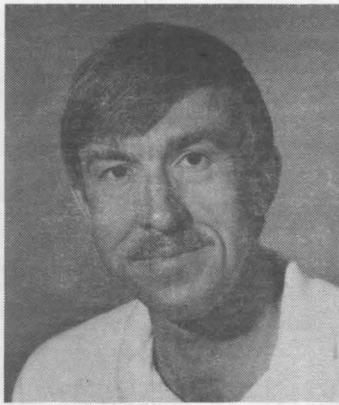
The Western grip, in which the racket head is at a slight angle to the palm instead of parallel as in the Eastern, or "handshake" grip, is favored by some pros because it gives more topspin to the ball and doesn't require turning the racket in the hand when changing from forehand to backhand. "The first two balls I hit with it were real John McEnroes," Mr. Katch says.

Jerry Bishop, *Wall Street Journal*

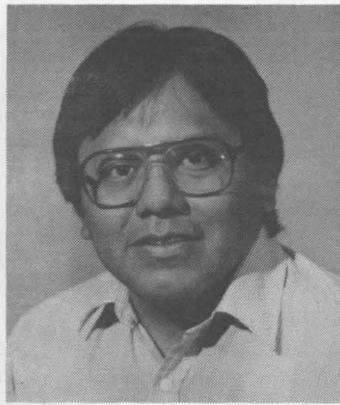
MILEPOSTS

LAB NEWS

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Carl Seager (1143) 20



Larry Yellowhorse (6216) 15



Willie Servis (3144) 25

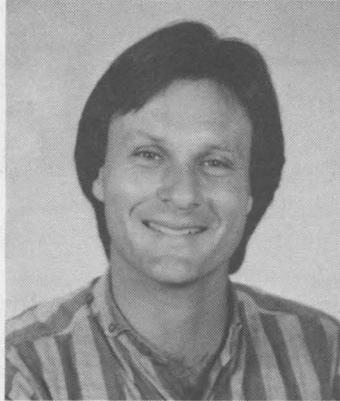


Wilma Dansby (3412)

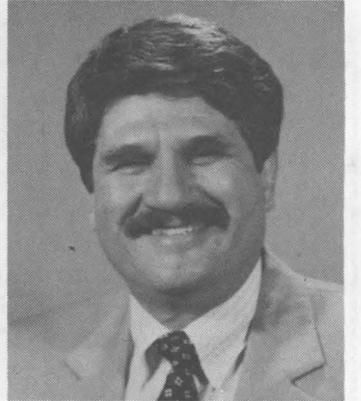
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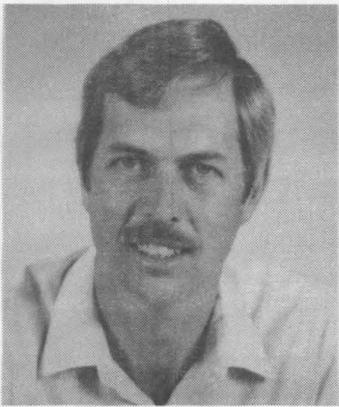
Eva Leong (8534) 15



John Dolce (8513) 15



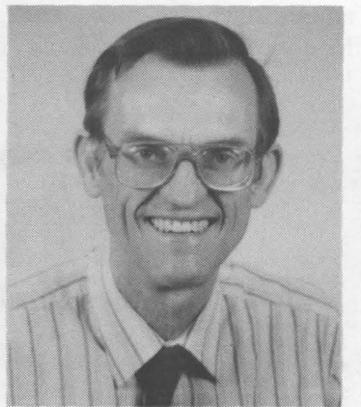
Mike Robles (8520) 20



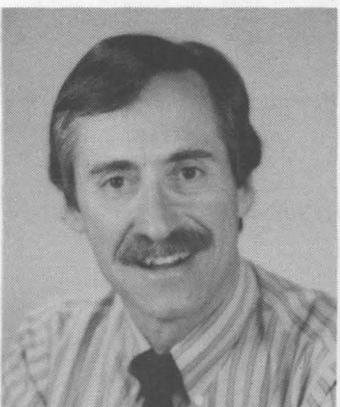
Dan Tichenor (8441) 20



Cook Story (8165) 20



Ken Marx (8363) 20



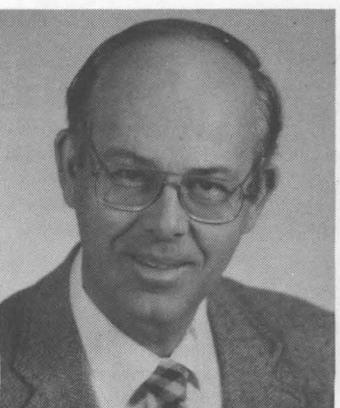
Bob Green (8362) 20



Spike Leonard (8274) 25



Von Madsen (8445) 30



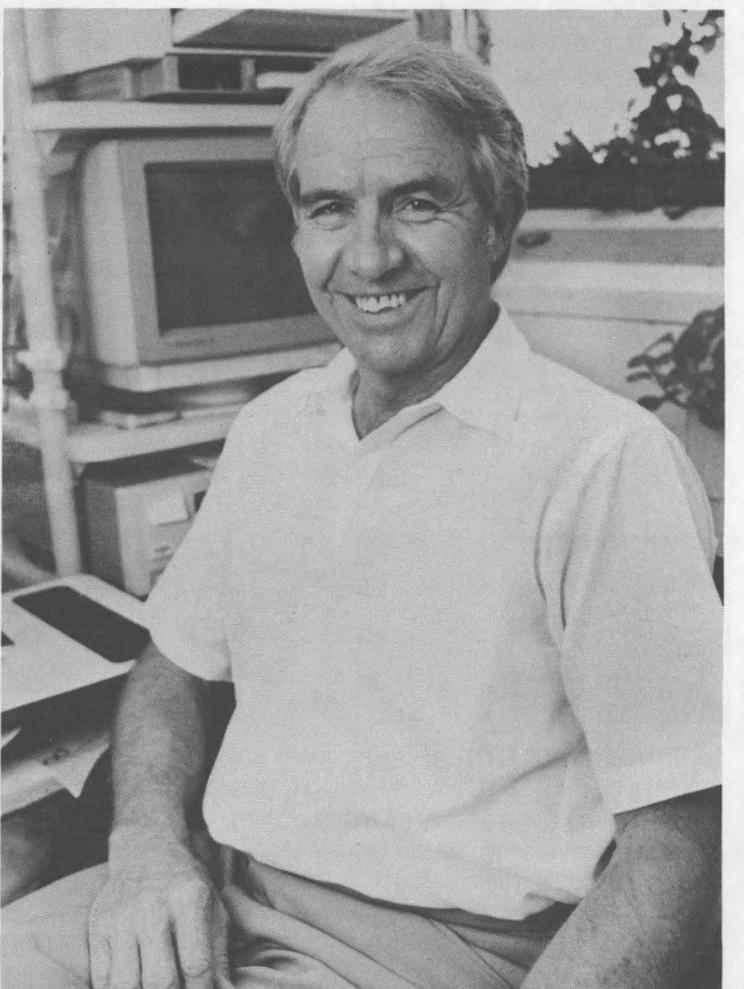
Dick Finn (8271) 30



Glenn Dietel (8162) 30



Arny Andrade (8451) 30



Reuben Weinmaster (2512)

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UNCLASSIFIED ADVERTISEMENTS • UNCLASSIFIED ADVERTISEMENTS • UNCLASSIFIED ADVERTISEMENTS • UNCLASSIFIED ADVERTISEMENTS

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

Ad Rules

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

MISCELLANEOUS

- SUNROOM/PORCH SET (bentwood mahogany and cane): love seat, 2 chairs, coffee table, \$40. Robertson, 299-7561.
- TWO ORGAN SPEAKERS, \$55/ea. Montoya, 883-9115.
- SWAG LAMP, antique brass and crystal; 144 sq. ft. white grass-cloth wallpaper; assorted clay and ceramic flower pots. Myers, 294-7316.
- OAK ENTERTAINMENT CENTER, \$100; oak coffee table, \$50; antique oak buffet, \$100. Goodson, 294-4953.
- WOODEN FRAME w/plexiglass cover, 2' x 3'. Walker, 281-9587.
- RANCH OAK FURNITURE: 2-piece couch, rocker, 3 end tables, \$400; Kenmore side-by-side refrigerator, copper tone, \$175. Morgan, 897-2445.
- WRIGHT WINDOW COOLER, for double-hung window, 3000 cfm, needs motor, \$25. Denish, 256-1559.
- COLEMAN LANTERN, \$10; folding picnic table, \$10; executive desk chair, \$22. Horton, 883-7504.
- COMMODORE 64 COMPUTER, disk drive, accessories; portable multi-band radio; portable AM/FM radio w/8-track; other estate items. Jones, 255-7924.
- BETA VCR, w/wireless remote, \$100; secretarial swivel chair, casters, adjustable, \$20. Robinson, 293-7231.
- QUEEN-SIZE BEDROOM SET: bed, dresser, chest, nightstand, \$500; couch, \$50. Kramer, 298-3903.
- BROWN CARPET, w/pad, 3' x 7'. Sedillo, 255-0669.
- SIBERIAN HUSKIES (AKC-registered): 1 male, has shots, 2 years old, \$100; 1 female, has shots, spayed, 3 years old. Zarick, 836-5703.
- IBM CORRECTING SELECTRIC TYPEWRITER, \$275; 12" monochrome composite computer monitor, \$40. Hudson, 821-3968.
- SOLAR HEATING SYSTEM, includes four 3-1/2' x 8' panels, heat exchanger, blower, 2 temperature controllers, 65-gal. tank, \$999. Rodriguez, 873-2391.
- FIREPLACE WOOD from newly cut tree, free if you haul. Brigham, 293-6914.
- TWO CAR RAMPS, \$10. Barr, 821-5870.
- GAS DRYER, \$50; ski boots, size 8-1/2, \$15; beanbag chair, \$15. Kelly, 266-2142.
- RYOBI 10" MITER, w/carbide blade, \$150; stereo, \$50. Baker, 294-3334.
- TWIN BEDS, Bradford-made cherry antique reproduction, cannonball style, complete, \$1000. Willis, 255-3860.

- POWER TOOLS and accessories, for cabinet- or furniture-making. Granfield, 268-1942.
- DINETTE SET, w/5 padded wingback caster chairs, \$145. Brewster, 884-8312.
- GRECO STROLL-A-BED, teal and gray, swivel wheels, \$75. Ray, 294-7720.
- PERSONAL COMPUTER, Tandy 1000 EX, color monitor, printer, 640K, table, DOS, other software, cost \$1600, sell for \$1000. Carr, 294-7609.
- CAMPING TRAILER, '72 Apache, solid-state, forced-air furnace, stove, refrigerator, sleeps 8, \$1350. Markowitz, 294-0332.
- AMIGO REAR-WHEEL-DRIVE CART, for handicapped, 2 months old, chairlift included, \$2400. Nichols, 296-8259.
- FLASH UNIT, Canon Speedlite 155A, w/case & manual, never used, \$35; fiberglass kayak, \$50. Shunny, 265-1620.
- MARANTZ RECEIVER, Model 2245, collector's item from the early '70s, \$35. Guilford, 255-6294.
- SLEEPING BAGS: 1 long, 1 standard length, Slumber Jack, 20' F. rating, w/pads and stuff sacks, \$20/ea. Dipold, 821-5750.
- CRIB w/mattress, playpen, high chair, stroller, car seats, other baby accessories and clothes, negotiable. Kawka, 299-1216.
- LAWN MOWER, 20", 3-hp, \$45; Kohler parchment bar or bathroom sink, w/fixtures, \$40; new 4-hole spare tire and wheel for Nissan, \$5. Iman, 299-6500.
- SEARS CHEST FREEZER, \$250; couch set, \$100; Eureka vacuum, \$90; Zenith TV, \$125; misc. items. Widner, 294-2014.
- BABY WALKER, Greco Tot Wheels II, w/detachable play gym, \$22. Barrette, 292-5186.
- TREES, you remove, \$60/ea. or 3 for \$150; landscaping gravel, 1-1/2" and cobblestones, free, you haul. Vogel, 275-0774.
- IBM PC/XT, 640K, 10 MEG HD, 8087 coprocessor, modem, CGA & Hercules card and monitors, printer, \$1300 OBO. Armistead, 842-0381.
- KITCHENAID DISHWASHER, portable or can be converted for permanent installation, \$75. Heald, 292-1614.
- POWERWHEELS JEEP RIDING TOY, w/charger and documentation, \$75 OBO. Macha, 298-6583.
- SCULPTURED PLUSH CARPET, 86 yds., \$50 firm. Freshour, 256-9168 after 6.
- CAMPING MEMBERSHIP, Sandia Crest and coast-to-coast, sell or trade for used car. Wilson, 821-1570.
- PLAYER PIANO, 1920 Windsor w/restorable Baldwin mechanism, mahogany, w/matching bench, plus music-roll cabinet, \$1300. Nordeen, 296-7898.
- FIVE-PIECE DINETTE SET, round table w/leaf; Zuni inlay jewelry. Little, 883-9329.
- YARD SALE: mattress sets, children's books, clothes, etc., June 30-July 1, 9 a.m.-4 p.m., 11517 Morenci NE (Juan Tabo/Candelaria). Widman, 293-7279.
- FORD RIMS; tires, 78-14s; Sears clothes line, reel-in cylinder, plus accessories; gold double sink. Long, 294-4591.
- PICKUP-BED RAIL-PROTECTORS, Ford, \$35; single bed frame, \$25; 2 tires w/wheels, 13", \$35; gas heater, \$25. McFarland, 292-3129.
- QUEEN-SIZE WATER BED, mirror headboard, \$100; coffee tables, \$15/ea.; dining table, 5 chairs, \$75; stereo w/24" speakers, \$30. James, 298-6779.
- CARPET KIT for LWB, \$225. Benton, 877-2473.
- AIRLINE TICKET, Albuquerque to Oak-

- land, Calif., leave July 15 and return Aug. 5, cost \$134, make offer. Rosul, 281-4114.
- PET DOOR; gate; 2 glass doors, 22" x 26"; cafe rods, 83"-86"; divider/planter; fluorescent light; automatic closet lights. Campbell, 889-0961.
- QUEEN-SIZE SOFA SLEEPER, black/gold/white tweed fabric, \$50. Pfeiffer, 299-3951.
- OAK LEGACY TABLE, solid oak, pedestal base, 48" x 72", 4 fabric side chairs, 2 fabric arm chairs, new, \$950. Baca, 296-6985 or 265-2881.
- SOFA AND LOVE SEAT, diamond-tufted, traditional style, gold velvet, \$500. Drebing, 266-6688.
- HARDWICKE 4-BURNER GAS STOVE, new, \$250; dining set, chrome/upholstered, new, \$275; colonial captain's chair, \$50. Sons, 294-3953.
- TWO STEEL GARAGE DOORS, 7' x 8', w/hardware, \$30; plate-glass mirror, 5' x 5' x 1/4", \$10; Tektronix 214 portable 2-channel storage oscilloscope, w/manuals, \$500. McEwan, 275-7715.
- SERVICE MANUAL, new tune-up parts, and 1 tire for '85 Colt. Robertson, 881-2544.
- BLUE NYLON PLUSH CARPET, 75 sq. yds., \$2.50/sq. yd. OBO. Moss, 298-2643.
- FIVE SWIVEL BAR STOOLS, chair height, green, \$10/ea.; white porcelain kitchen sink, double basin, \$30. Randall, 299-3935.
- BABY CRIB and mattress, \$35; camper shell for LWB truck, \$50; closet doors, free. Trelue, 292-7369.
- SOLID-PINE RUSTIC-STYLE DEN FURNITURE: Herculon sofa, chair, cocktail table, end table, ottoman, \$250 OBO. Tidmore, 884-1870.
- UPRIGHT FREEZER, 20 cu. ft., shelves in door, cost \$600, sell for \$285. Marron, 345-4006.
- DIRT, free, you haul. Gorman, 255-4431 or leave message on 292-7719.
- ANTIQUA ORIENTAL RUG, 6' x 9', \$1250; computer-loom Kharastan rug, \$1150; estate sale. Hayes, 298-9396.
- NETHERLAND DWARF MINIATURE RABBITS, pet and show quality. Sharp, 243-1498.
- GE BUILT-IN DISHWASHER, microwave hutch, patio sofa, Sears packa-potty, Sears exercycle, vertical lawn mower engine. Stixrud, 298-0478.
- APPLIANCES: washer/dryer, \$500; electric stove, \$300; refrigerator/freezer, 19 cu. ft., \$400; freezer, 16 cu. ft., \$450; 9' x 5' pool table, \$1200. Aragon, 294-4275.
- TWO TENNIS RACQUETS, Wilson Tour Ceramic 93, w/full covers, one w/4-1/2" grip, one w/4-3/8" grip, \$25/ea. Montoya, 296-4268.
- 66 OLDS. TORONADO, black, new tires and battery, AM/FM radio, engine needs work, \$1000. LeMaster, 877-4884.
- '84 LINCOLN TOWNCAR, \$6995; '84 Ford Tempo, \$2495. Goodson, 294-4953.
- CENTURION LeMANS BICYCLE, 10-spd., 21", alloy accessories, Araya 27" x 1-1/4" rims, specialized tires, \$125. Joseph, 299-6989.
- '76 VW CAMPER, fuel-injection engine, \$3200. Bowland, 256-1861.
- ALL-TERRAIN BICYCLE, Sears Tourney, 10-spd., thumb-operated Shimano shifters, 26x1.5 dual-pressure tires, cost \$115, sell for \$85. Schkade, 292-5126.
- '85 SUZUKI GS700ES MOTORCYCLE, \$1250 OBO. Garcia, 268-3848.
- '39 FORD 4-DR. DELUXE, Chev. 283-powered, 3K miles on new engine,

- \$8000. Campbell, 299-9195.
- '73 WINNEBAGO, 20', 1-ton, sleeps 6, dual AC, generator, radio, dual battery, stove, refrigerator, shower, regular gas, \$10,500. Salazar, 262-0344 or 255-3152.
- TWO BICYCLES, \$25/ea. Kelly, 266-2142.
- '85 HONEY MOTORHOME, 26', Class C, self-contained, sleeps 8, \$20,985. Laney, 299-2903 after 5.
- TWO CANNONDALE ROAD BIKES, aluminum frames: 9R600 14-spd. Shimano 105 Group, \$600; SR400 12-spd. Suntour Group, \$300. Patrick, 293-4796.
- '78 CHEV. CAPRICE, \$1000; '73 Honda Civic, \$375. Magnuson, 821-5330.
- '80 CHEV. SUBURBAN, 4-WD, 3/4-ton, 350, Valley receiver hitch, \$4800. Nichols, 821-8213.
- '82 VOLVO, diesel, 4-dr., sunroof, silver, AT, 63K miles, \$4500. Graham, 292-0109.
- '70 VW CAMPER, rebuilt engine, Weber carb., headers, oil filter, and gauges, \$1300. Poore, 266-7609.
- '73 WINNEBAGO INDIAN, 24', 57K miles, power station, AC, sleeps 7, full bath, \$7500. Bauer, 266-8480.
- '83 TOYOTA COROLLA SR-5, liftback, AC, cruise, 5-spd., tilt, maintenance records, garaged, \$3650 OBO. Heald, 292-1614.
- '80 CHEV. SCOTTSDALE PICKUP, 3/4-ton, rebuilt transmission and clutch, set up for fifth wheel. Pryor, 298-3788 or 294-6980.
- '87 AEROLITE MOTORHOME, on Astro chassis, 20', 3.5K miles, awning, microwave, AC. Taggart, 881-3864.
- WOMAN'S 10-SPD. SCHWINN BICYCLE. Little, 883-9329.
- '82 CAMARO BERLINETTA, V-6, AC, 4-spd., cassette, 71K miles, \$3295 OBO. Healer, 298-6967.
- '80 DIESEL RABBIT, new radial tires and battery, \$800. Garner, 299-6134.
- '58 CADILLAC, hardtop. Haynes, 296-8132 or 296-4690.
- '75 VW VAN, AC, dual tanks, 4-spd., 32K miles on new motor, Legend tires, \$3500 OBO. Clark, 242-9627.
- '84 MERCEDES-BENZ 300D, turbo diesel, below book, \$16,150. Bujewski, 291-9340.
- '87 HONDA CRX Si, silver, 5-spd., sunroof, \$1200 stereo system. Hill, 291-8952.
- '73 WINNEBAGO, 21', self-contained, 4K generator, \$7200; '85 Honda Nighthawk 450; '83 Yamaha 490, \$825. Himes, 869-2856.
- '81 BMW 320i, AC, PB, standard shift, luggage rack, sunroof, mag wheels, more, champagne color, \$5200. Hall, 299-0009.
- '78 HONDA CX-500, Windjammer fairing, \$700. Babicz, 299-5938.
- '81 BMW 528i, leather, sunroof, alloy wheels, 5-spd., 75K miles, below book, \$6900. Babb, 296-7955.
- '84 CAMARO Z28, red, T-tops, loaded, \$6200. Knight, 892-9420.
- '69 CHEV. C-10 STEP-SIDE PICKUP, 4' x 8' bed, new engine/brakes/paint, will consider 4' x 8' trailer as trade-in, \$1000. Bray, 292-2410.
- '77 OLDS. CUTLASS SUPREME, V-8 engine, 4-dr., tilt, AC, radio, steel-belted radials, \$900. Mason, 281-3052.
- BICYCLE, Nishiki 10-spd., w/upright handlebars and standard seat, \$100 firm. Foltz, 291-0051.
- '73 BUICK LeSABRE, AC, AT, PB, PS. Greenway, 299-1104.
- '85 NISSAN PICKUP, standard bed, 56K miles, \$4000. Jones, 255-7924.
- 13' BOSTON WHALER BOAT, 40-hp Johnson, complete, extras, \$2000 OBO. Hogan, 292-8879.
- '80 KAWASAKI MOTORCYCLE, 750cc, Ltd. model, \$1500 OBO. Aragon, 294-4275.
- '84 MAZDA TRUCK, needs body work on right door, below book, \$1650. Chavez, 265-3933.

REAL ESTATE

- 2-BDR. MOBILE HOME, '79 Flamingo, 14' x 70', 2 full baths, extras. Graham, 836-2752.
- FURNISHED MOUNTAIN HOME, Pagosa Springs, riverfront property, road open year-round, \$59,500. Pryor, 294-6980 leave message.
- 2-BDR. HOME, Ridgecrest, 1 bath, FP, garage, trees, views, remodeled, 7.8% assumable, \$73,500. Rutledge, 265-5229.
- 2-BDR. TOWNHOME, NE, 2-1/2 baths, landscaped yard, FP, 1100 sq. ft., \$62,000. Ashment, 293-2295.
- MOSSMAN HOME, upgrades, recently carpeted, new roof, 2561 sq. ft., 6312 Mossman Pl. NE, \$118,800. Beller, 881-4047.
- 3-BDR. HOME, all brick, 2 baths, 2-car garage, FP, 1700 sq. ft., Belen golf course area, \$125,000. Accardi, 821-9684 leave message.
- 3-BDR. HOME, 2 baths, new carpet and vinyl flooring throughout, landscaped, patio addition. Cutchen, 292-6593.
- 2-BDR. MOBILE HOME, 14' x 70', '80 model, den w/FP, \$8000. Chavez, 877-1304 days, 877-4787 after 4.
- 3-BDR. HOME, pitched roof, near Eubank/Constitution, \$59,500. Foltz, 291-0051.
- 3-BDR. HOME, NE, 1-3/4 baths, 2-car garage, den w/FP, dishwasher, double oven, refrigerator, 1460 sq. ft., no qualifying, 9.5%, \$77,800, \$640 PITI. Babb, 296-7955.
- 3-BDR. MOSSMAN HOME, 1-3/4 baths, 1860 sq. ft., 2-car garage, workspace, NE Heights, \$107,000. Delnick, 298-5276.
- 3-BDR. HOUSE, Four Hills addition, 1-3/4 baths, 2-car garage, 9 years old, 1470 sq. ft., \$86,500. Martinez, 296-9035.
- '79 CENTURION MOBILE HOME, 14' x 52', awning and 10' x 12' shed, below book, \$5850. Stefoin, 821-8819 after 6.
- LOT overlooking city, mountain view, La Cueva and Piedra Larga NE. Stixrud, 298-0478.
- 2450-SQ.-FT. HOUSE, north of Sandia High School, updated, brick, \$124,900. Baack, 822-8299.

WANTED

- STEREO SPEAKERS, portable B&W TV. Boslough, 294-3907.
- TRAILER, for 14' boat. Hartenberger, 268-2792.
- UNIVERSITY OF ARIZONA ALUMNI interested in starting a New Mexico chapter, no commitments required. Schofield, 292-7220.
- VAN OR TRUCK CAMPER. Baker, 294-3334.
- DISTANCE RUNNER/NAVIGATOR, to run with search-dog team, must know/learn first aid and basic survival skills. Foster, 281-3975.
- AKC-REGISTERED PUREBRED MALE AIREDALE seeks companionship, object puppies. Shunny, 265-1620.
- HOUSEMATE, nonsmoker, to share 3-bdr., 2-bath home in NE Heights (Indian School/Eubank), \$300/mo. + share utilities. Hueller, 296-0976.
- HOST FAMILIES for French students, ages 15-20, Aug. 2-23. Macha, 298-6583.
- ALUMINUM BACKPACK FRAME, adult size, in good condition. Greene, 299-4163.
- INFANT CARRIER, backpack; large-wheel mountain stroller; computers, working or not; modem, printer. Stixrud, 298-0478.

LOST AND FOUND

- PARKER PEN found in Tech Area. Schubeck, 821-3133.

Coronado Club Activities

It's Flag-Waving Time: Celebrate Your Independence Tuesday

JOIN YOUR PATRIOTIC PEERS next Tuesday, July 4, at the pool/patio area for an old-fashioned Independence Day celebration from 12 noon to 6 p.m. Sousa-style marches and other stirring songs of that ilk from the Albuquerque Concert Band get things off to a roaring start between 12 and 1 p.m., and the Sandia Brass — a talented group of Sandians led by Chuck Guthrie (2852) — takes center stage when the band takes a break. While you're enjoying the music, grab a plateful of picnic food from the buffet featuring goodies like hamburgers, hot dogs, BBQ sandwiches, ranch-style beans, potato and macaroni salads, and more. Nonstop gaming starts at 2 — the same time that non-stop sagebrush-shuffle music from Trio Grande begins. Festivities are free for Club members, and \$3 for guests.

SHUCK SOME SHRIMP or savor some sirloin tonight at the Friday night dinner (\$8.45 and \$7.45, respectively). Afterward, dance the night away (8-11 p.m.) to the variety tunes of Together.

BINGOPHILES BLAST OFF again the next two Thursdays (July 6 and 13), beginning at 6:45 p.m. with the early-bird game. Card sales start at 5:30 both nights. You can concentrate on gaming and chuck the culinary chores because there's always good food available at reasonable prices.

CHECK IT OUT — "it," in this case, being all kinds of sports equipment available from the pool office for patio play. Use of equipment for basketball, volleyball, badminton, table tennis, shuffleboard, and horseshoes is free for the asking. Now what's your excuse for not exercising?

A PRIME-TIME OPPORTUNITY awaits Friday-night diners next week (July 7), because prime rib is one of the elegant entree selections that evening. The other choice, for seafood lovers, is halibut; both selections are \$8.95. Then enjoy Big Band sounds for dancing — courtesy of the Roland De Rose Orchestra — from 8 to 11 p.m.

T-BIRD CARD SHARKS are doing their thing again July 13, starting at 10 a.m. Rumor has it they're once again working on a scheme to outwit those crafty Las Vegas dealers. (We hear tell that top-dealer Jim McCutcheon has a plan in mind, but you'll have to show up to learn what it is.)

THOSE LAZY, CRAZY DAYS OF SUMMER are finally here, and nothing beats the heat like a cool swim. Here's a reminder of pool hours: Saturday and Sunday — 12 noon to 5 p.m.; Monday, Tuesday, and Thursday — 11:30 a.m. to 6 p.m.; Wednesday and Friday — 11:30 a.m. to 8 p.m. And don't forget that every Wednesday night is Family Night, when extra entertainment is on tap.

OTHER POOL PONDERINGS: Children 2 years old and under are now admitted free, thanks to some changes in the price structure. If you've purchased pool passes for kids in this category, contact the Club office for a refund.

You're reminded, also, that children under age 12 must be accompanied by an adult at all times in the pool/patio area, and that anyone without a pool pass (except kids 2 or under) must pay to enter the area.

Countdown to 40

Happy Anniversary to Us

Sandia Corporation will be 40 years old on Nov. 1, 1949. Among other notable and not-so-notable events that year: The North Atlantic Treaty Organization (NATO) was created, the breeder reactor was developed, the USSR began its first atomic bomb tests, the Volkswagen came to the US, prepared cake mixes appeared on store shelves, and Silly Putty was invented.

Until the 40th anniversary date, the LAB NEWS will publish articles featuring assorted Labs accomplishments and events during these 40 years and let you know what else was happening in the world.

Thirty years ago: Sandia engineers and scientists were conducting low-yield underground conventional explosives tests in Nevada to obtain scaling data for use in Plowshare, an Atomic Energy Commission program for investigating peaceful applications of nuclear explosives. The Mercury Seven astronauts were selected. The first transparent bags for clothing appeared in 1959, as did movies with scent.

Twenty years ago: Western Electric (predecessor to AT&T Technologies) celebrated its 100th anniversary. Laminar flow clean rooms developed at Sandia were installed in a Texas hospital, Sandia completed crash testing for the Apollo project, and research was begun on thick-film hybrid microcircuits. In 1969, terms such as *headhunter* (for employee seeker), *noise pollution*, and *hunk* (for handsome man) came into use in America, and Neil Armstrong became the first man to walk on the moon.

Ten years ago: PBFA I (particle beam fusion accelerator) was under construction in Area IV and Sandia and UNM developed an insulin pump for diabetics. In 1979, the US and China established diplomatic relations, a fusion reactor at Princeton achieved a temperature of 60 million degrees F, and controlling mild hypertension was found to greatly reduce the incidence of heart attack. ●

Events Calendar

June 30, July 6-7, & 15 — "An Evening of One-Act Plays," fantasy and fancy, one-acts by George Bernard Shaw, David Hwang, and John Guare; 8 p.m., Theatre-in-the-Making (3211 Central NE), 260-0331.

June 30-July 16 — "Albuquerque by Six," exhibit of works by Albuquerque photographers with commentary by V.B. Price; 9 a.m.-5 p.m. Tues.-Sun., Albuquerque Museum, 242-4600.

June 30-Aug. 31 — Exhibit, "The Dinosaur Portfolio," 33 mixed-media and oil paintings and drawings by University of Maine art professor Philip Carlo Paratore; 9 a.m.-6 p.m., New Mexico Museum of Natural History, 841-8837.

June 30-Sept. 15 — "Raymond Jonson Cityscapes," exhibit featuring drawings and paintings by Jonson from the 1920s to 1940s; 9 a.m.-4 p.m. Tues.-Fri., 5-9 p.m. Tues. evening; Jonson Gallery, UNM Art Museum, 277-4967.

June 30-Sept. 17 — "Art Since 1945," exhibit featuring paintings, sculpture, and prints from the permanent collection, highlighting later twentieth-century art (realism, geometric abstraction, and expressionism); 9 a.m.-4 p.m. Tues.-Fri., 5-9 p.m. Tues. evening, 1-4 p.m. Sun.; upper gallery, UNM Art Museum, 277-4001.

July 1 — Annual Daylily Show, judged exhibit presented by the Daylily Society; 2-6 p.m., Albuquerque Garden Center (10120 Lomas NE), free, 296-6020.

July 1-4 — Seventh Annual July 4th Arts and Crafts Fair: displays, sales, and demonstrations by Southwestern Native Americans, Indian dances at 11 a.m. & 2 p.m. on all days; 9:30-4 p.m., Indian Pueblo Cultural Center, free, 843-7270.

July 1-8 — 42nd Annual National Championship Appaloosa Horse Show, most events free, call for times, NM State Fairgrounds, 882-5578 or 265-1791.

July 1, 8, & 15 — "Humpty Dumpty, Over Easy," story-theatre with audience participation, pre-

sented by Youth Performance Workshop; 2 p.m., Theatre-in-the-Making (3211 Central NE), 260-0331.

July 2 — Arts in the Parks Concert: Queen Ida & Bon Temps with the Zimbabwe ensemble, presented in conjunction with South Broadway Cultural Center; 6:30 p.m., Tiguex Park, free, 764-1525.

July 4 — Spirit '89: entertainment, activities, and fireworks sponsored by KGGM TV-13, and KAFB; 5-10 p.m., KAFB (enter through Carlisle and Truman gates only), 243-2285 or 844-5420.

July 4 — Nambe Waterfall Ceremony; Bow & Arrow, Buffalo, Corn, Harvest, and Snake dances; call for times, Nambe Pueblo, 843-7270.

July 7-9 — Taos Powwow, call for time and details, Taos Pueblo, 843-7270.

July 8 — "Lone Star" and "Laundry and Bourbon," night and day in Texas, recommended for mature audiences; 8 p.m., Theatre-in-the-Making (3211 Central NE), 260-0331.



SENIOR-HIGH-SCHOOL STUDENTS (from left) John Funderburg (Albuquerque), Elizabeth Callahan (Eldorado), Monica Manzanera (Valley), Tim Covert, and Morinne Laughlin (both West Mesa) are participants in the Career Exploration Program sponsored by Personnel and General Employment Div. 3533. Soila Brewer is program coordinator. The Albuquerque Public School System selects five gifted students who gain hands-on experience in engineering while working 20 hours a week with Sandia engineers.