

## Supercritical Water Oxidation

# CRF Scientists Study New Way to Destroy Aqueous Toxic Wastes

Scientists at Sandia's Combustion Research Facility in Livermore have completed the first series of experiments using a new technology for destroying aqueous toxic wastes. The technology — called supercritical water oxidation — shows promise for detoxifying the wastes in an efficient, cost-effective, and environmentally safe manner.

With a research program combining experimental, theoretical, and computer simulation efforts, Labs researchers are shedding light on the basic chemical mechanisms underlying the supercritical water oxidation process.

"It's a whole new area of chemistry that remains an enigma," notes Sheridan Johnston (8300A), former supervisor of Environmental Technology Div. 8364. "While industry has built a

**"... no one really knows what goes on inside a supercritical water reactor or how to scale up to commercial operation."**

few experimental reactors to demonstrate feasibility of the technology, no one really knows what goes on inside a supercritical water reactor or how to scale up to commercial operation. We hope to change that situation and share our results with industry."

Supercritical water oxidation occurs at low temperatures, but moderate pressures (about 500°C and 300 atm). Under these conditions, water becomes a fluid with unique properties that can be used to selectively destroy organic wastes.

### Discovered at MIT

This technology has been used for a few decades by the food industry to extract various materials such as caffeine from coffee beans and cholesterol from eggs and other dairy products. However, the concept of using supercritical conditions for oxidizing toxic materials — discovered at the Massachusetts Institute of Technology by Professor Mike Modell — is only about 10 years old. "Several qualities make supercritical water oxidation particularly attractive for the destruction of certain classes of toxic waste and preferable over

other techniques such as incineration, storage in sealed containers, or injection into deep wells," says Sheridan.

One advantage, he notes, is that the solubility (ability to dissolve) of water under supercritical conditions is reversed. For example, oils and chlorinated hydrocarbons, a large family of toxics, become soluble for easy oxidation. Also, dissolved salts and metals precipitate out of solution for fast and safe treatment and disposal.

Further, for many aqueous hydrocarbon wastes, the energy released by the oxidation reaction is enough to drive the pumps required to bring the reactants to supercritical conditions while

maintaining the oxidation process between 500 and 600°C. Therefore, an external energy source is not required, realizing considerable savings in fuel compared to a process like incineration.

Oxidation of liquid toxic wastes under supercritical conditions has another major advantage: It generates very little air pollution. The final products are clean water, carbon dioxide, nitrogen, and metals and salts that precipitate out of solution and are collected without becoming airborne.

In addition to low-temperature oxidation of hazardous waste, it is also possible to create a flame in supercritical water without an external ig-

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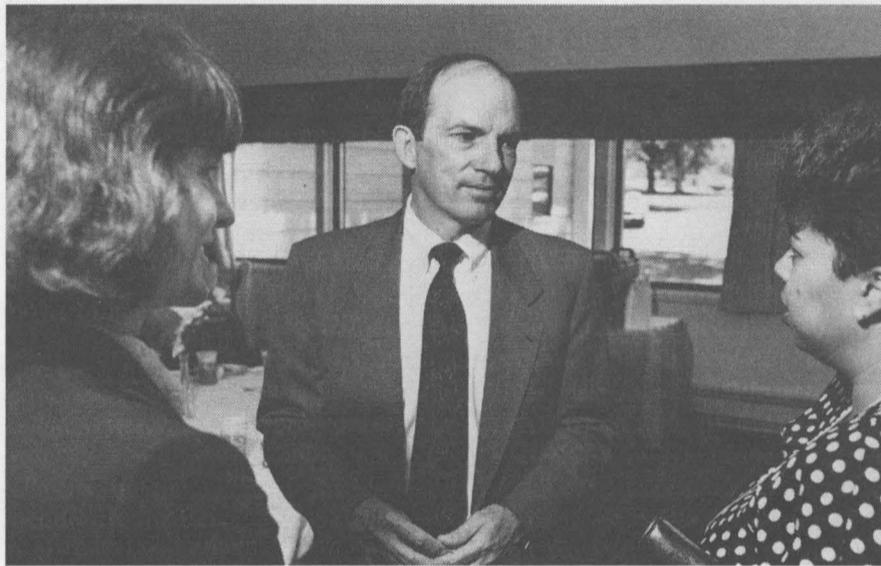


# LAB NEWS

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JUNE 15, 1990



VP DAN HARTLEY (6000) talks with Jane Farris (3544, left) and B.J. Jones (3545, right) after a recognition luncheon honoring Dan for his support of Sandia affirmative action programs and cultural diversity efforts in his vice-presidency. The Women's Program Committee sponsored the event at the Coronado Club.

**Ten Sandians Receive Weapon Awards — Page 4**  
**Revised Feedback & Suggestion System — Page 7**

## Burning the Midnight Oil

# Team Study on Iowa Explosion Culminates With US Senate Testimony

Nationally televised Senate testimony on May 25 culminated an extraordinary six-month study by a diverse team of Sandians into the USS Iowa 16-inch gun explosion last year that killed 47 crewmen.

The testimony by Dick Schwoebel (2500), Paul Cooper (DMTS, 9333), Karl Schuler (DMTS, 1522), and Jim Borders (1823) before the Senate Armed Services Committee summarized the main results and conclusions of a Sandia study for the General Accounting Office (GAO), which conducts investigations for Congress. It was the first disclosure of the findings contained in Sandia's 300-page report.

The study was begun in January at the request of three US senators. It directly involved substantial efforts of at least 30 Sandia scientists, engineers, technicians, and support staff rapidly assembled from a broad cross section of the laboratory — plus dozens of others who helped with certain aspects of the project.

The testimony, like anything to do with the USS Iowa incident, was certain to be of national interest. But the afternoon before, something made it even more newsworthy. The Navy announced that a test being carried out that day at the Naval Surface Warfare Center in Dahlgren,

Va., to check the Sandia scenario of an accidental explosion on the Iowa had resulted in an ignition. The Secretary of the Navy reopened the Iowa investigation and suspended all further firing of 16-inch guns on its battleships.

"I was stunned," recalls Dick Schwoebel,

who heard the news through a phone call from the GAO to his hotel in Washington, where he was making final preparations for the testimony the next morning. He was skeptical at first, realizing that first reports of such matters are often

*(Continued on Page Eight)*



SENATE ARMED SERVICES COMMITTEE heard Dick Schwoebel (2500) testify about results of Sandia's investigation of possible causes for a fatal explosion aboard the USS Iowa. Behind Dick is Jim Borders (1823), who headed the chemical-analysis team. Also visible is some of the artwork prepared for the hearing by members of Illustration and Design Communications Div. 3155. (Associated Press Photo)

# This & That

**Heavy Help for the Lights** - The Ron Light benefit sale (see June 1 article) in Albuquerque early this month raised \$11,750, according to Don Davis (2131). The proceeds, along with contributions being accepted at any First Interstate Bank branch and at the Sandia Laboratory Federal Credit Union, go to the Ron Light Van Fund. The fund, to buy a van with wheelchair lift for the Light family, was up to \$32,000 as of Monday, June 11; \$35,000 is needed. Ron and his family are expected to return to Albuquerque this summer from Dallas, where Ron is undergoing rehabilitation for severe head injuries he received when he and his family were run down by a motorist last spring.

"Welcome the Ron Light Family Home" buttons are still on sale (for \$5 or more) by Dept. 2130. We also have them available in the LAB NEWS office in Bldg. 814. This money also goes into the van fund.

\* \* \*

**Recycling at Sandia** - As our environmental consciousness grows, many employees have a growing interest in recycling and conservation. Sandia has recycled certain items for years, and management is interested in increasing our recycling and conservation efforts. We're planning an article soon that will discuss what's being done now and what's planned, including a computer-paper-recycling pilot project. In the meantime, call Don Schubeck (3412) on 4-4936 if you have recycling questions.

\* \* \*

**Muchas Gracias to Org. 7800** - With the early-June heat wave and the hot air I generate personally, we'd have been in a near meltdown at the LAB NEWS if it weren't for lots of helpful folks in Org. 7800. They encouraged several contractors installing our new air conditioner to move quickly and even brought us a bunch of loaner fans while the work was going on.

\* \* \*

**Watch Your Rears, 9334!** - It sounds like Sandia's version of "Believe-It-Or-Not." Pat Hoffman of Field Support and Logistics Div. 9334 says four of the nine Albuquerque-based employees in the division have been hit from the rear in auto accidents within the past two months (no personal injuries of consequence). The unlucky include Lisa Polito, Fred Pfeffer, Alex Griego, and Supervisor Pete Seward.

\* \* \*

**Even More Fitting Names** - I keep getting 'em, so I'll keep passing 'em along. Phyllis White (5122) says her dentist's last name is Fillmore. Linda Wilson (3150) points out that Sandian Joe Honest has a fitting name as a buyer in Purchasing Div. 3718 (even better when his name is listed alphabetically with last names first - Honest Joe). Jim Leonard (400) remembers that a retired Sandian who worked in purchasing also had an appropriate name: William Purchase. Dennis Pfeiffer (7476) says he once worked with a metallurgist named Steele Irons.

\* \* \*

**Now I Remember Why I Left** - The banner headline in the *Tulsa Tribune* on May 15 - the day after I returned to Oklahoma for a brief visit with family: "Tornadoes Race Across State."

\* \* \*

**"Critical Mess"** - Speaking of Okies, I was at a four-person meeting recently when my boss observed that we were all native Okies and then quipped that four probably constituted a critical mass. Someone else said "critical mess" might be closer to the truth. ●LP

## APD Sergeant to Discuss Youth Gangs



Spanky's gang was cute, enterprising, and wholesome. But Alfalfa and the rest of the kids from the vintage film series bear no resemblance to the gangs Sgt. Ralph Kemp and his Albuquerque Police Department (APD) Youth Gang Unit deal with every day.

A 17-year veteran of APD, Kemp oversees the unit, which was created just over a year ago as a pilot project with four officers. He will talk about "Youth Gangs in Your Neighborhood" June 22 at noon in the Technology Transfer Center. Seating for the Community Focus lecture is on a first-come basis.

The youth gang unit is now permanent, and three more officers have been added. Kemp plans to bring all his officers to the lecture to help answer audience questions.

### No Neighborhood Is Immune

"No section of the city is immune to the problems associated with youth gangs," Kemp says. "The intimidations, violence, and drug dealing by gangs affect the quality of life in our city. Gang graffiti is the most visible evidence of gang activity in our community, but that's the most minor offense they're involved with. If you've got graffiti in your neighborhood, you have gangs. If you have graffiti that has been crossed out, you've got a gang problem. That means one gang is challenging another."

Kemp says neighborhoods should paint over gang graffiti as soon as it appears on walls. It may appear again, but neighborhoods should not fear retaliation. Eventually, the graffiti will stop when gangs realize the neighborhood is serious and organized.

There may be as many as 5000 members of 65 identified youth gangs in Albuquerque. Only about five percent of the total membership is considered "hard core," however.

"Our strategy is to take away the hard-core gangsters who set the level of violence and criminal activity for the gangs," Kemp says. "The hard-core members live and die for the gang. The gang is everything to them. There is little chance of rehabilitation for the hard core. They tend to either end up dead or in the penitentiary. We're trying to take away that leadership role."

### Community Awareness Needed

The other end of the gang unit's strategy is to make the community aware of gang-membership indicators so parents, relatives, friends, educators, and neighbors will recognize when a young person is mimicking or becoming involved with a gang.

"We want to deny the gangs their recruitment base," Kemp says. "But the community has to provide alternatives for these kids. We can't just tell them not to belong to gangs. We have got to get them involved in community centers, sports, arts, and part-time jobs. Ninety-five percent of these kids are not hard core. We tell people not to allow gangsters on their blocks. The kid you know as Johnny is welcome, but 'Mad Dog' isn't. Accept them as kids, not gangsters."

Kemp and his officers don't want to be known simply as gang busters who arrest people. They try to keep current on gang activities and understand what problems may be developing. They also work with parents, school administrators, and teachers. If a student is suspended from school for wearing gang colors, Kemp's officers will even appear at suspension appeal hearings to underscore the seriousness of denying gang members the opportunity to advertise their membership.

"Gangsters consider themselves as businessmen in their criminal activities," Kemp says. "Anything we can do to adversely affect the environment in which their business survives will contribute to their demise." ●AStotts(3163)



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## Voters Reject 'Nuclear-Free Zone'

A ballot initiative declaring California's Alameda County a "nuclear-free zone" was rejected last week in the June 5 primary by the county's voters, who voted 2-to-1 against the measure that could have affected operations at both Sandia and Lawrence Livermore labs. Unofficial returns showed 145,674 people against Measure A and 71,047 for it.

Sandia officials were pleased with the defeat of the measure. In a prepared statement, VP John Crawford (8000) said, "We respect the will of the people of Alameda County. Sandia will continue to be a good neighbor to our surrounding communities and operate in a responsible manner as we perform our mission for the US Department of Energy."

Intended to halt nuclear weapon research, the nuclear-free zone ordinance would have required DOE contractors to phase out nuclear weapon work over a five-year period, barred the county from doing business with companies that support the nuclear industry, mandated public hearings on shipments of radioactive materials into the county, and limited the power of authorities to arrest demonstrators who block access to nuclear-material handling sites. ●

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## Destroying Aqueous Toxic Waste

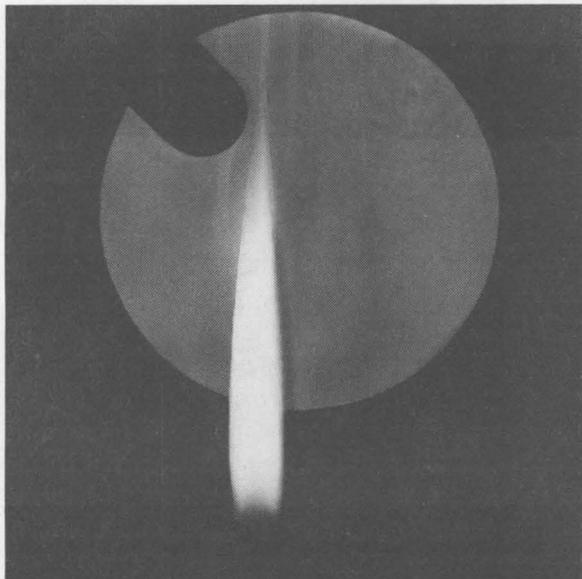
nitration source. The existence of such "hydrothermal" flames was first demonstrated two years ago at the University of Karlsruhe in West Germany. A supercritical water reactor designed by Sandia to investigate hydrothermal flames has been built and was the focus of the recent series of experiments. Called the Supercritical Flame Reactor, it is designed to investigate the spontaneous formation of high-temperature (3000°C) flames that can occur during supercritical water oxidation (see "Potential Applications Are Many").

The goal of continuing experiments is to determine fundamental information concerning how variations in temperature, pressure, waste concentration, chlorine amount, and input rates affect the generation of hydrothermal flames. This data is particularly important because "hot spots" caused by the flames could weaken a supercritical reactor vessel and lead to pollution through high-temperature oxidation.

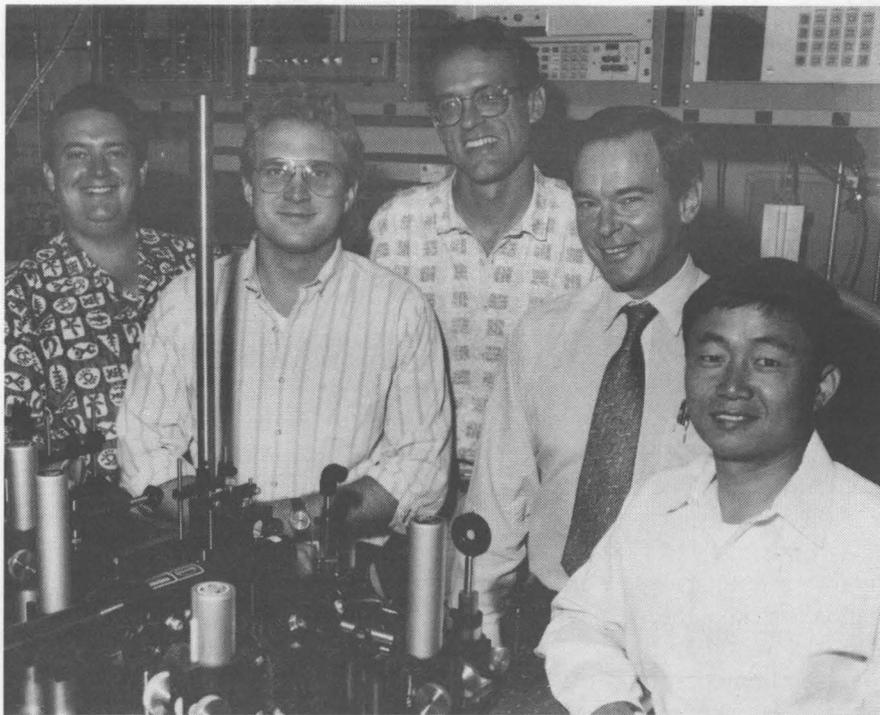
### Shortening Reaction Times

Alternatively, such information will also show how a hydrothermal flame could be used to generate high temperatures to shorten reaction times, thereby allowing higher flow rates (and lower residence times) in the experimental reactor or more compact reactors.

The Sandia Supercritical Flame Reactor holds about 15 cubic centimeters of material. The reactor was constructed of a special nickel-based



HYDROTHERMAL FLAME obtained in the Sandia Supercritical Flame Reactor from the spontaneous ignition of oxygen injected into a mixture of 70 percent water and 30 percent methane at a pressure and temperature of 5000 psi and 500°C.



SUPERCritical WATER OXIDATION participants are (from left) John Hunter (1273), Mike Brown (contractor), Dick Steeper (8364), Sheridan Johnston (8300A), and Kwan Kim (summer student from Las Positas College).

alloy called Inconel 718. This material permits the reactor to withstand the unusually harsh environment of supercritical solutions, such as high or low temperatures and pressures and corrosion from chlorinated compounds.

The research team — Michael Brown (contractor), Dick Steeper, Steve Rice, Carolyn Childress, Kwan Kim, Steve Margolis (all 8364), John Hunter



(now 1273), and Carl Melius (DMTS, 8353) — received help from Sandia materials specialists.

For example, Sandia experts recommended that viewing ports be manufactured of sapphire crystal because supercritical water dissolves quartz glass. These ports permit direct viewing and video recording of supercritical oxidation reactions. They also allow laser diagnostic measurements to be made while reactions proceed. Also, conventional analytical chemistry techniques are being used by Inorganic and Physical Chemistry Div. 8313 to determine reaction products.

The research group, with the help of Engineering Technology Dept. 8440, is also designing a "supercritical flow reactor" to study high-flow, low-temperature (500°C) supercritical combustion reactions. "Laser-based diagnostic techniques will be used to determine temperatures, concentrations of reactants, and the chemical kinetics of the reaction," says Steve Rice, who leads this project.

Complementing the experimental research is mathematical work to better understand the chemistry and reaction pathways of supercritical oxida-

tion. Intermediate products that don't exist in normal reaction pathways have already been identified by Carl Melius. Carl has also used quantum-chemistry methods to develop the thermochemistry of a number of chlorinated hydrocarbon molecules that play an important role in supercritical water oxidation of hazardous waste.

### Crays and CHEMKIN

There is a plan to model supercritical water oxidation using Sandia's Cray supercomputers and CHEMKIN computer software. (CHEMKIN is a code developed at Sandia in 1980 and now used worldwide for chemical kinetics calculations.) Computer simulation also could become an important tool for designing full-scale supercritical water oxidation reactors.

"Modeling supercritical oxidation processes is a particular challenge," says Sheridan, "because most combustion models are based on ideal gases in which molecules aren't influenced by one another. In supercritical environments, molecules are squeezed so close together that they begin to interact. Thus, many assumptions on which combustion models are normally based may have to be reworked."

Sheridan notes the strong partnership among Sandia, Los Alamos National Lab, and American companies interested in commercializing supercritical water oxidation. To help share its knowledge and promote the technology to industry, Sandia sponsored a workshop in June 1988. Since then, several industry representatives have visited Sandia. The research effort, funded with DOE and internal research and development monies, is coordinated by Environmental Technology Div. 8364.

"Our role is to bring the best scientific tools to bear on the problem and work with industry to transfer our computer models, ideas, and experimental data," Sheridan says.

Notes Peter Mattern, Director of Combustion and Applied Research 8300, "Some time ago, Sheridan helped us realize that we had the expertise and tools to make a real contribution toward tackling the nation's waste problems. With a range of research efforts such as supercritical water oxidation, we're helping both industry and government find solutions." ●BLS

## Potential Applications Are Many

There are many potential applications for supercritical water oxidation of hazardous wastes generated by industry and government — concentrating wastes containing both radioactive and hazardous materials, for example.

This so-called "mixed waste" is particularly difficult to manage because it cannot be burned in an environmentally benign way in an incinerator. Supercritical water reactors would oxidize the organic molecules into safe compounds, leaving the nuclear material to precipitate out of solution and be disposed of using standard treatment methods.

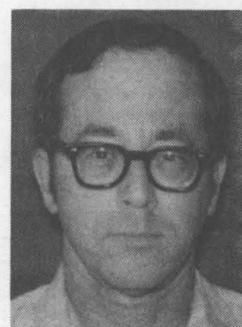
Supercritical water oxidation could also be useful to the DoD for environmentally sound disposal of organic compounds resulting from obsolete solid-rocket fuels, chemical warfare agents, and other munitions. Burning these substances in the open would pollute the

air with oxides of nitrogen and other toxic compounds.

Industries that generate large amounts of aqueous hazardous wastes, such as chemical and pharmaceutical companies, could benefit from supercritical water oxidation technology. Also, this technology might someday enable the electric power industry to generate power from oxidizing coal. Coal can contain many metals, inorganics, and sulfur-based substances, which together require today's coal-burning plants to install costly equipment to combat air pollution.

Sandia researchers, together with scientists from Modell Development Company, a Massachusetts-based company, have recently demonstrated that supercritical water oxidation can remove organic components from mixed wastes and cleanly oxidize coal.

## Employee Death



MIKE GUSINOW, Supervisor of Telemetry Systems Div. II 8452, died suddenly May 17.

He was 50 years old.

Mike joined Sandia in July 1967 at Albuquerque and transferred to Livermore in 1979.

Survivors include his wife, a son, and a daughter.

**Weapon Program Awards**

# Sandians Recognized for Outstanding Contributions

Ten Sandia, Albuquerque employees received 1989 DOE Weapon Recognition for Excellence Awards in ceremonies late last month. The awards, recognizing outstanding contributions to the US nuclear weapon program, are one of DOE's highest honors. They were presented by Rear Admiral Mike Barr, DOE Deputy Assistant Secretary for Military Application.

Three Sandia, Livermore employees will be recognized for similar achievements this month at Livermore. Coverage of those awards will be included in a future issue of the LAB NEWS.

During preliminary remarks at the awards ceremony, Adm. Barr stressed the importance of maintaining a strong national defense and nuclear deterrent, noting that the combination has "kept the peace for 45 years." The absence of a major war over that many years is unprecedented in modern times, he added, crediting that accomplishment in part to the award winners.

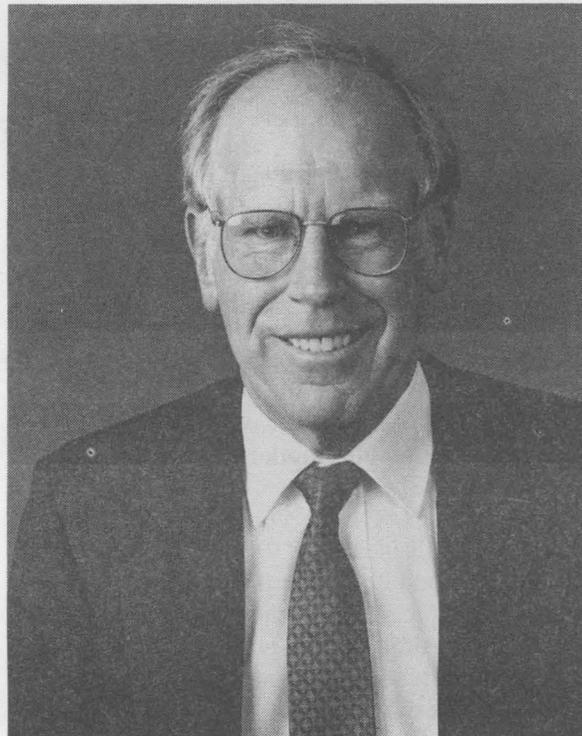
Executive VP Orval Jones (20) says of the awards, "The excellence represented by our award winners is symbolic of what our strategic plan calls for. It's the kind of excellence upon which this laboratory will depend if it is going to continue its proud record of accomplishments in the future."

Some of the awards are for individual achievements, and some are for team efforts. The 1989 excellence awards recipients are:

**KEN PRESTWICH (1240)**, for leadership of the team that developed the *Hermes III* gamma-ray simulator.

*Hermes III* is a gamma-ray simulator developed for testing weapon electronics systems to nuclear threat environments. The goal of the *Hermes III* project was to provide higher-fidelity testing — five times the dose, one-third the pulse width, and one-fourth the pulse rise time of its predecessor, *Hermes II*.

To accomplish the goal, a new pulsed-power technology was developed, combining induction cavities and a magnetically insulated transmission



KEN PRESTWICH (1240)

line voltage adder that allow high accelerator voltages at extremely high currents (20 million volts at a current of 730 kiloamperes).

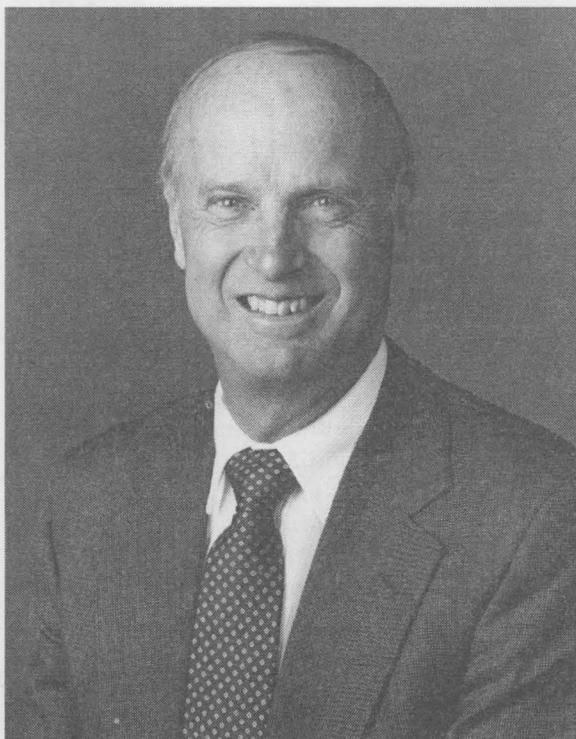
Construction of *Hermes III*, part of the Simulation Technology Laboratory Project, was completed ahead of schedule and within budget. It was first operated in March 1988. The simulator is now fully operational — a year ahead of schedule. Its high-fidelity radiation environments allow more accurate aboveground testing of weapon components, thus reducing the risk of cost overruns and schedule slips of major weapon systems.

**JOHN KANE (5220)**, for exceptional contributions and innovations that have uniquely furthered the technology of nuclear weapons access delay and denial.

Since 1975, John has investigated, developed, and evaluated various mechanisms that delay or deny unauthorized access to nuclear weapons. Among the systems he's worked on are weapon storage concepts, "sticky" and aqueous foams, and a chemical (nonpyrotechnic) smoke system.

John independently initiated the development of a system designed for installation in existing weapon storage igloos. The Igloo Access Delay System is designed to delay a competent and determined adversary intent on laying hands on a weapon.

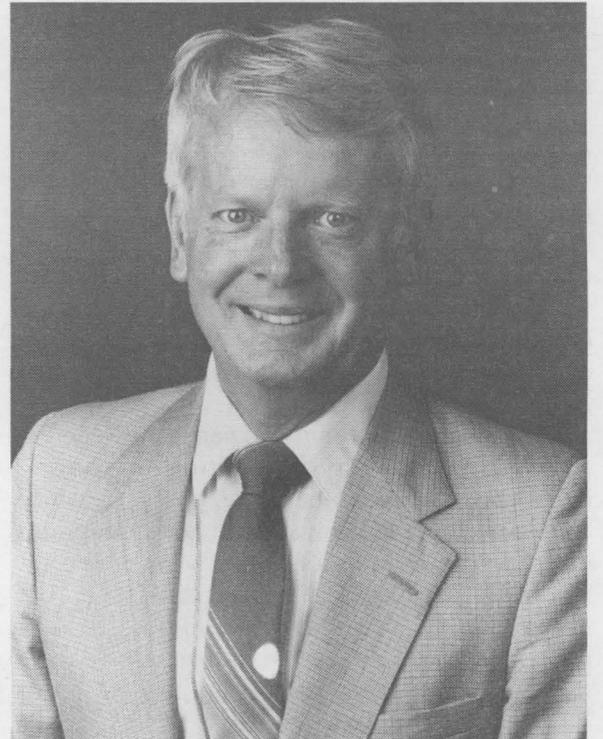
His other work in access delay and denial includes vehicle barriers and special wall/door technology. The results of his efforts are used worldwide by the Departments of Energy, State, and Defense.



JOHN KANE (5220)

**T.J. WILLIAMS (2361)**, for significant contributions to electronic subsystem quality and firing set design.

During his 35 years at Sandia, T.J. has been involved in the design, development, and production of transverters, high-voltage switches, energy



T.J. WILLIAMS (2361)

storage capacitors, and numerous types of firing sets. He has also served as Org. 2300 directorate quality coordinator and co-chairman of the Packaging Advisory Board, which specializes in materials, packaging, and analysis that results in an improved product.

T.J. pioneered the use of many modern nuclear safety concepts, including innovative design features for the B61-3,4, W80, B83, and W87 firing sets. Over the past several years, he has worked with Allied Signal/Kansas City Division to develop firing set designs that are manufacturable with high quality. In 1988, he received a DOE/AL quality award.

**JIM AUBERT (1813)**, **ROGER CLOUGH (1811)**, and **DAN DOUGHTY (1846)**, for development of a major new material for the x-ray laser program.

This team developed a new material for the x-ray laser program and transferred the technology to the production agencies. The material offers major improvements over its predecessor, in that it allows the accurate match of critical physics parameters and significantly increases part yield.

Two other members of this team were not present at the awards ceremony. Bill Even (8311)

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DAN DOUGHTY (1846), ROGER CLOUGH (1811), and JIM AUBERT (1813)

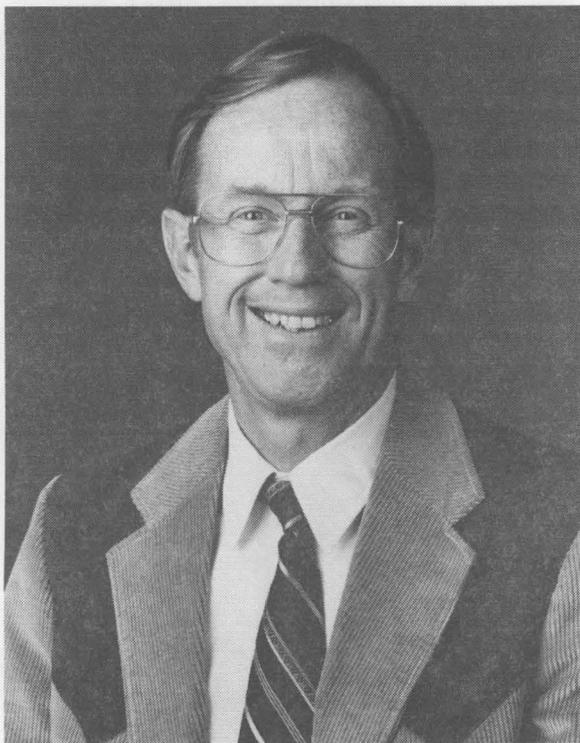
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will receive his award at Livermore later this month. Don Adolphson (DMTS, 400) is on temporary assignment in Washington, D.C.

**BOB RIEDEN (2314)**, for leadership in the development and procurement of semiconductor products for weapon systems.

Bob heads Digital Subsystems Division II, with semiconductor product engineering responsibility for both internally built integrated circuits and commercially procured semiconductor devices and circuits. He has managed the development, certification, and qualification of hundreds of high-reliability, weapon-grade components in support of all weapon systems as well as Sandia satellites.

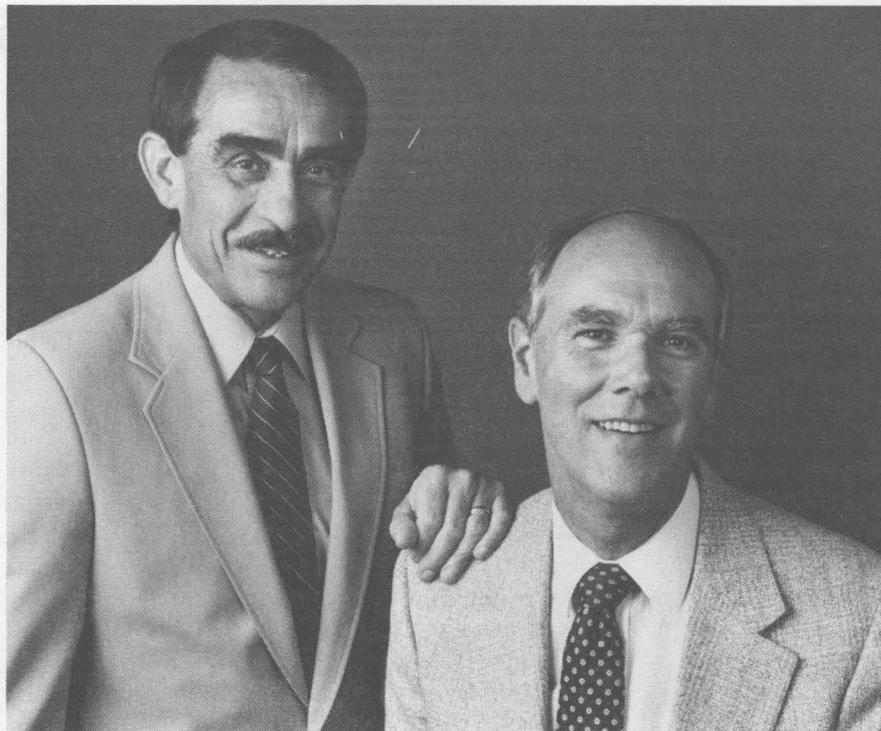
Bob's award recognizes his innovative approaches to component procurement and to solving semiconductor failure problems in a timely manner. He also led an effort to provide an alternate source for the Sandia microprocessor family used in various weapon systems; this project provided the necessary hardware for maintaining Trident II schedule support in 1989.



**BOB RIEDEN (2314)**

**BOB CLARK and JIM GILBERT (both 2522)**, for achievement of zero defects in the MC3948 thermal battery.

Bob and Jim, nominated for their award by General Electric Neutron Devices (GEND) Department, worked with a GEND team to solve serious produc-



**JIM GILBERT and BOB CLARK (both 2522)**

tion problems encountered in Lot 01 production of the MC3948. GEND cited Bob and Jim specifically for their design engineering contributions.

The team's work included redesigning the weld groove in the header and redefining weld parameters to prevent leaks occurring at the final weld. The success of the effort was demonstrated when GEND completed shipment of the MC3948, Lot 02, thermal battery with 100-percent yield — a first for thermal battery production.

According to the GEND award nomination, "the GEND Power Sources Team is committed to making zero defects the production norm."

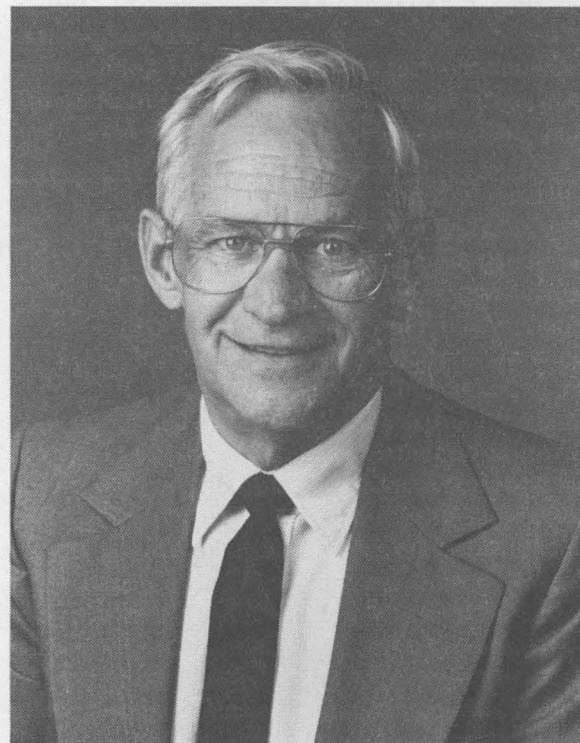
**LLOYD MERRELL**, a Sandia retiree, though unable to attend the awards ceremony, also received a 1989 excellence award for exceptional performance in leading the team that designed and fielded the B53 SIP [Stockpile Improvement Program] retrofit kit.

In October 1986, the Strategic Air Command announced its intention to return the B53 from inactive reserve to active status and resume alert operations. Sandia recommended to DOE that 24-hour alert operations with this weapon not be resumed until certain safety upgrades were made. DOE agreed; in January 1987, a program was begun to accomplish the upgrades through a field retrofit, with first kit shipments scheduled for January 1988.

Lloyd managed the program, which was accomplished on schedule. It involved defining a new bomb/aircraft interface, developing several

new components and cables, several kinds of testing, and developing a Joint Test Assembly and procedures for field retrofit.

**DON BICKELMAN (7213)**, for significant and continuous contributions to the nuclear weapon program in the area of nuclear weapon system safety.



**DON BICKELMAN (7213)**

Don has spent his entire Sandia career — more than 23 years — working on weapon safety concerns. During the '60s, he was a member of the Sandia teams responding to several accidents involving nuclear weapons. He has also been an active planner and participant in exercises to ensure the adequate preparation of the DOE Accident Response Group (ARG).

For many years, Don was the technical advisor to the DOE/AL member of the joint DoD/DOE Nuclear Weapon System Safety Group (NWSSG) for all Navy systems. During the past four or five years, he's been responsible for directing all of Sandia's support to the DOE for NWSSG studies, ARG activities, and nuclear explosive safety studies at both Pantex and the Nevada Test Site.

●PW

## Earlier Excellence Award Winners

**1982** Jack Marron (7415), Jim Craig (ret.), Dick Damerow (2564), Ed Kjeldgaard (6321), Dick Brodie (25), Harold Vaughn (ret.), Al Hodapp (DMTS, 1551), Bob Thompson (1420), Larry Bertholf (2600), Ruth Whan (dec.), Tom Massis (2515), Don Sharp (1841), and Fred Villa (2551).

**1983** Stan Spray (7231), Bob Graham (DMTS, 1153), Dan Tichenor (8446), Ken Henry (8316), Wilbur Jorgenson (8442), Tom Martin (1290), Ken Prestwich (1240), and Bill Chambers (1821).

**1984** Vic Roh (ret.), Peter Rand (DMTS, 1813), Rod Quinn, Jim Searcy (2523), Arlen Baldwin (2523), Jim Jorgenson (2116), Wayne Corbett (2172), Won Kim, Keith Treece (DMTS, 2118), Tom Mnich, Rich Anderson (2142), Doug Weaver (2130), Ron Light (2130A), Terry Nordstrom, Fred Sexton (2147), Frank Neilson (dec.), Bill Sundt (ret.), Ed Williams (ret.), Curt Franklin (ret.), and Russ Miller (8155).

**1985** Bill Stevens (ret.), Bob Luna (6321), Paul Longmire (2360), Steve Burchett (DMTS, 1521), Gordon Boettcher (DMTS, 2565), Cook Story (8165), and Morris Mote (ret.).

**1986** Gus Simmons (Senior Fellow, 200), Bob Moyer (DMTS, 7242), Ray Alls (2341), Walt Dalby (5113), John Sharp (2825), Randy Harrison (2811), Ben Benedetti (8241), Dick Jorgensen (5113), and Don McCoy (2800A).

**1987** Carl Peterson (1550), Randy Maydew (400), Don Johnson (DMTS, 1552), Hal Widdows (ret.), Chuck Williams (ret.), Andy Lieber (5290), Ted Schmidt (6450), Herman Mauney (7200), Jay Gilson (8130), and Wayne Young (9123).

**1988** Jim Powell (9300), Arnie Rivenes (8132), Von Madsen (8445), Paul Yarrington (1533), Bill Davey (ret.), Archie Farnsworth (1533), Mike Heck (2334), John Andersen (DMTS, 5161), Bob Cover (DMTS, 5268), John Portlock (7234), Bob Courtney (9242), and Larry Harrah (ret.).

### Messages From the Sands of Time

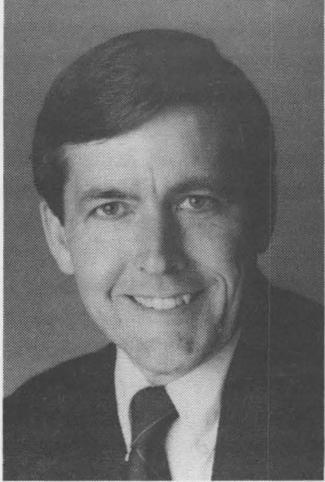


Some theoretical physicists are staring at hourglasses, hoping to understand from the randomness of the sand's flow such natural events as weather formation, stock market gyrations, the spread of epidemics, and the path of a hurricane. Sand flows with a complex randomness, and the forces involved model those that mold nature's chaotic events, says Robert Behringer of the American Physical Society.

Wall Street Journal

## Dennis Hayes Named Director of Special Projects

Dennis Hayes has been named Director of Special Projects 400B and has assumed the position of scientific advisor to Rear Admiral Mike



DENNIS HAYES (400B)

Barra, Deputy Assistant Secretary for Military Application at DOE Headquarters.

"This is an exciting time of change in DOE. I'm glad I'm in Washington," Dennis says. "I like to be part of the change process and not be just swept along by it. It's a big system, and the issues are momentous — safety of our stockpile, environment, safety and health, modernization of the complex, and future of the GOCO [government-owned/contractor-operated] system. My hope is to nudge the

system in the right direction from time to time. If I can do that, I will feel that my stay in Washington has been worthwhile."

Dennis joined Sandia in 1957 as a file clerk. Under Sandia's Educational Aids Program, he worked nights in the print shop while attending UNM during the day. He received his BS in physics in 1965, and was promoted to staff member. He did research on the shock response of materials in intense radiation environments. Dennis later got his master's degree in physics from UNM. In 1972, under Sandia's Doctoral Study Program, he received his PhD in physics from Washington State University.

In 1974, Dennis was promoted to Supervisor of the Detonating Components Division. He was promoted to Manager of the Fluid and Thermal Sciences Department in 1978. In 1983, he transferred to the Solid-State Components Dept. 2530. He was Acting Director of Components 2500 from 1988 to 1989, and was head of Solid Dynamics Dept. 1530 when he was promoted to Director.

Dennis's research includes developing theo-

retical models for shock initiation of high explosives and theoretical and experimental proof of a magmatic model for explosive volcanism. He's published papers on shock physics, shock-induced phase transitions, shocks in high explosives, constitutive behavior, and continuum mechanics. But Dennis believes his principal contributions have been in the area of management — improving, restructuring, or building organizations and capabilities.

He's a member of the American Physical Society and a senior member of IEEE.

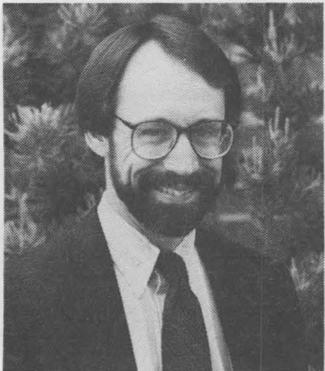
Dennis and his wife Jan have two grown children and two grandchildren.

"Washington is a great place to be on temporary assignment," Dennis says. "We live in Rosslyn, Va., across the river from downtown Washington, D.C., close to everything except work. I commute to Germantown, about a 30-minute drive. Jan (an artist) has temporarily mothballed her career and is getting to see the area in depth. We go several places every weekend. Friends are made easily among the Sandia crowd. It reminds me just a little of graduate school; everyone feels temporary and new." ●JW

## Supervisory Appointments

PAUL SHOEMAKER to supervisor of Business Planning Div. 114.

Paul joined Sandia in September 1981 as a staff member in the Salary Administration Division, where he did programming support for the Tiers system of salary administration for technical staff. In 1983, he became administrative liaison between Sandia and DOE Headquarters for Sandia's Storage Battery Program. He then transferred to



PAUL SHOEMAKER (114)

Electronic Subsystems Directorate 2300 as administrative assistant. In 1988, Paul joined the Weapon Program Integration Division, where he helped plan and coordinate development of the Code-Activated Processor. In 1989, Paul joined the group he now heads.

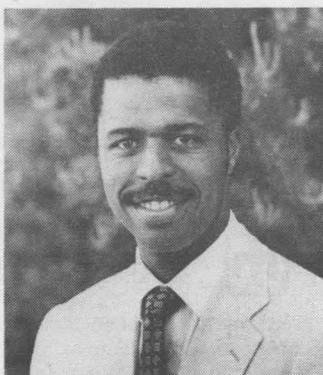
Paul has a BS in physics from the New Mexico Institute of Mining and Technology and an MS in public administration from the University of Texas. Before joining the Labs, he worked for the New Mexico Department of Corrections, Planalysis, Inc., the Texas State Comptroller of Public Accounts, and the Texas Judicial Council. He is president of the board of directors for Christina Kent Day Nursery.

He enjoys golf, fly-fishing, and church activities. Paul and his wife Marissa live in the NE Heights.

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KENNETH WASHINGTON to Supervisor of Containment Modeling Div. 6429.

Ken has been a member of that division since joining the Labs in February 1986. His work has been in modeling and code development for CONTAIN, a detailed mechanistic code for integrated analysis of nuclear-reactor containment



KEN WASHINGTON (6429)

phenomena. CONTAIN is sponsored by the Nuclear Regulatory Commission and is being used by more than 40 research institutions in 12 countries.

Ken was project leader for the direct containment heating version (DCH) of CONTAIN and also coordinated a joint project with Sandia, Livermore to adapt a finite-difference fuel spray/particle transport code to study the DCH problem.

He has a BS, MS, and PhD, all in nuclear engineering, from Texas A&M University. He recruits for the Labs at Texas A&M and participates regularly in Black Outreach activities, including Hands-on/Minds-on teaching and student-hire mentoring.

Ken enjoys personal computing, basketball, and racquetball. He has one daughter and lives in the NE Heights.

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GORDON SMITH to manager of Environmental Programs Dept. 3220.

Gordon joined Sandia in October 1979 as a member of the Industrial Hygiene Division, where he did occupational health protection surveys and consultation and modeled human incapacitation times following exposure to toxic chemicals.



GORDON SMITH (3220)

In April 1984, he was promoted to supervisor of the Environmental Protection and Hazardous Waste Management Division, leading an effort to prepare for and respond to a DOE/HQ environmental survey of Sandia.

Gordon has a BS in biology and an MS in public health, both from the University of Hawaii. He is the founding president of the New Mexico Hazardous Waste Management Society and is a member of the Health Physics Society and the New Mexico State Emergency Response Commission. He is certified in the comprehensive practice of industrial hygiene by the American Board of Industrial Hygiene.

Gordon enjoys family activities, hiking, and photography. He and his wife Gail have two children and live in Taylor Ranch.

JUAN RAMIREZ to Manager of Pulsed Power Advanced Concepts Dept. 1230.

Juan joined Sandia's Pulsed Power Development Division in February 1974, where his work included mega-volt gas switch research and development. He transferred to the Pulsed Power Applications Division in 1976 and did research on electron beams for high-power gas lasers. From 1973 until 1976, Juan was project leader in charge of R&D activities supporting the Hermes III accelerator.



JUAN RAMIREZ (1230)

In 1976, he was promoted to supervisor of the Pulsed Power Development Division, with responsibility for designing many of the accelerator subsystems during Hermes III construction. He also led the Phase II team that brought the Hermes III accelerator to a self-supporting status one year ahead of schedule, with Hermes demonstrating reliable performance that exceeded original specifications.

Juan has a PhD in nuclear physics from the University of Florida. Before joining Sandia, he was a post-doctoral fellow and then worked at the nuclear-structure research laboratory of Western Michigan University. He is a member of the American Physical Society and Fusion Power Associates.

He enjoys gardening, woodworking, reading, and racquetball. Juan and his wife Linda have two children and live in the NE Heights. ●JW

### Sympathy

To Louise Chavez (9127) and Reynaldo Chavez (7471) on the death of their grandmother in Cleveland, May 12.

To Gary Shepherd (DMTS, 2613) on the death of his father-in-law in Fresno, Calif., May 28.

To Michael Hannah (2615) on the death of his father in Lansing, Mich., May 29.

To Amy Tapia (3411) on the death of her mother in Albuquerque, June 2.

To Facilitate Fast, Open Communication

# Feedback and Employee Suggestion Systems Revamped

By Larry Perrine, Editor

Statement from the executive summary of the 1989 Sandia employee communication survey (LAB NEWS, Oct. 9, 1989): "Communication, especially with higher management, is seen neither as open nor 'straightforward and honest.'"

As LAB NEWS editor and supervisor of the Employee Communications Division, I find that statement extremely troubling. So do many other Sandians, including the "higher management" mentioned in the statement. I know. The highest one — Al Narath — visited us recently to express his concerns and to discuss ways to encourage more open, honest, and quick communication throughout the Labs. Some changes are taking place.

"We must learn to listen more carefully to what employees are saying," Al says. "I don't take it as a sign of weakness to admit that many of our practices and procedures can and should be improved."

Already in place is the "Brown Bagging With Brass" luncheon series featured in our June 1 issue. Coordinated by Community Relations Div. 3163, the program involves randomly selected nonsuper-

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## "We must learn to listen more carefully to what employees are saying."

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visory Sandians meeting with vice-presidents for candid discussions at informal luncheons.

With support and help from lots of other Sandians, we're also making changes in the Employee Communications Div. 3162 to encourage better communication — to make it easier and faster for all employees to communicate their concerns, suggestions, and questions to management and nonsupervisory employees and for them to respond.

### New Wrinkles

It involves some new wrinkles and some streamlining of existing procedures. We've dubbed the new wrinkles "Electronic Suggestion Box" and "Feedfax." Both involve using telefax (fax) machines, which more and more of us have access to. (If you don't have access, however, follow the same procedures, using the mail.)

**Electronic Suggestion Box** — Got a suggestion for reducing bureaucracy, cutting costs, minimizing waste, improving efficiency, making the Labs safer or healthier, or any other improvements? Send it to the Employee Communications Div. 3162 fax machine (844-0645), and we'll get it to the right person right away — no dilly-dallying. If you're sure who should receive the suggestion, include that person's name and organization number with the suggestion. (Employees are also welcome to submit suggestions directly; there's no requirement to submit them through Division 3162.) If you're unsure who should get it, then send it to us and we'll forward it to the most logical person. Include your name, organization, and fax number if you want a reply to your suggestion. We'll forward all legitimate suggestions — with or without your name — and even fax it to the proper person if he/she has a machine.

**Feedfax** — This variation on the traditional Feedback system is intended to speed the process of getting employee questions answered. Fax your question to us (844-0645), and we'll forward it to the appropriate person — via fax if the person has one — or immediately forward it by mail and ask that it be answered as soon as possible. When you submit your question, indicate if you prefer a written answer (via fax or mail) or by phone. Include your name, organization number, telephone number, and fax number if you have one.

Some Sandians — for various reasons — prefer submitting suggestions and questions anonymously. If it's a suggestion that you want to pass along and don't need an answer, send it directly to an appropriate manager (remember, you're empowered) or nonsupervisory employee. If you have a suggestion, but don't know who should get it, mail it or fax it to us, and we'll forward it immediately to an appropriate person.

If you have a question, but don't want your name associated with it, there's a way, but it takes a little longer. Use the traditional Feedback form and indicate at the proper place that you don't want your name associated with the question. When you do that, only two people know that you submitted the question — you and Feedback coordinator Janet Walerow (3162). She forwards your question to an appropriate employee, who answers it in writing and returns it to Janet. She then sends the answer to you at your home address. Forms are available in common areas throughout the Labs. If you cannot locate one or otherwise need a form or more information about how the system works, call Janet on 844-7841.

### Streamlining the System

Nearly all Sandians have access to an electronic instrument that's been around for years — the telephone — and it can often be used to get questions answered quickly.

"Opening the communication process at the Labs and speeding it up is something we're absolutely serious about," says Herb Pitts, Director of Information and Communication Services 3100. "We sometimes need formal, written communications, but we can often offer suggestions and get questions answered much faster by simply using the phone.

"In my own areas of responsibility, I much prefer that Sandians call me with suggestions and

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## "Opening the communication process at the Labs and speeding it up is something we're absolutely serious about."

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questions instead of writing," Herb continues. "In most cases, a call instead of a letter or note saves us both time, and it facilitates 'real communication.' We can get a dialogue going and get into the whys and wherefores of issues."

Others who frequently answer Feedback questions agree: Human Resources (formerly Personnel) Director Ralph Bonner (3500), Security and Facility Support Services Director J. D. Martin (3400), Facilities Director Ward Hunnicutt (7800),

and Controller Paul Stanford (100). These folks and Herb traditionally answer about 95 percent of the Feedback questions, and all say they don't mind — or even prefer — telephoned questions and suggestions to written ones.

All questions can't be handled by phone, though — particularly some involving benefits and other personnel matters. "In some cases, the questions and answers are so detailed or tailored to individual situations that written correspondence is necessary," says Ralph Bonner. "But we're now using the phone for quick responses whenever we can."

### Fixing an Outdated Idea

When the Feedback system was set up in the early '70s, the idea was that Sandia directors would answer all questions so employees would feel that the answers were from authoritative sources.

"We need to change that notion — that an answer isn't authoritative unless it comes from a director," says Paul Stanford. "Now that we're adopting the 'empowered employee' concept, all of us should realize that good answers — often better and more thorough answers — can come from employees down the line who are the real experts."

In line with that, directors will refer more questions and suggestions to their employees who are most familiar with the subject — whether they're supervisory or nonsupervisory employees.

"This definitely isn't 'buck-passing,'" Herb explains, "and I hope everyone understands that. It's an attempt to get better, quicker responses to employees. If a Sandian isn't satisfied with a response, he or she is welcome to ask for clarification or response at a higher level."

### Answers Should Reflect New Climate

Sandians who answer Feedback questions are asked by Al Narath to ensure that their responses reflect the new, open-communications climate. "Feedback responses should be thoughtful and constructive, and avoid the common bureaucratic tendency to be defensive," he notes.

Communication within any large organization isn't easy. And it can be doubly tough in an organization like Sandia that's charged with protecting classified information. Speaking about the need for better communication (in the April 20 LAB NEWS), Executive VP Lee Bray said, "We've done a lot of things well at Sandia, but vertical communication isn't one of them. We need to get better at it, and we're going to."

We're trying to help with that, but the changes we're announcing now are just a beginning. Your ideas and suggestions for further changes are welcome. Get in touch with me at Division 3162, telephone 844-1053, fax 844-0645. ●



**BABY TALK** — Jana and Jay (2362) Hammond, with four-month-old son Jory, were among the approximately 400 Sandians attending the Sandia-Cariño Child-Care Information Fair on May 23 at the Technology Transfer Center. One-year-old Rasheda Lord, with mom Margo, handed out pamphlets about services available at one of the child-care facilities offering information at the Fair. Child-care information is available from Dorothy Baird, Sandia-Cariño representative at the Labs, on 6-2258.

**'Eliminated Blind Alleys'****Sandians Praise Work of Navy Technical Team**

For the most part, the Sandians investigating the fatal explosion on the *USS Iowa* did not work directly with Navy investigators, but they remained aware that the Navy had already carried out a broad-ranging investigation and had produced vast amounts of data. The Sandians have high praise both for the technical work done by the Navy and for the freedom of access that they were granted.

Sandia's final report says, "The USN investigation of the accident was extensive and included a variety of studies that were conducted in considerable depth. Our studies drew heavily on that work. It served as a valuable basis on which to extend certain elements of this investigation, and made our studies more productive than they would otherwise have been."

In discussing his experiments suggesting an accidental cause for premature detonation of a gun, Paul Cooper (DMTS, 9333) says, "The Navy had many, many more issues to look at than we did. We were able to build upon what they in-

vestigated first and confine our work to a few narrow areas. Capt. Miceli [Joseph Miceli, USN, director of the Navy technical investigation team] is very competent and hardworking. He and his staff really did a good job. We were able to pick that up and take the next logical steps."

Karl Schuler (DMTS, 1522), who did mechanical analysis and worked closely with Paul on the explosives, says, "We revisited most of what the Navy did. We'd ask ourselves whether there was any possibility that the Navy people might have overlooked anything. And in most cases, the answer was no — we might as well go on to something else. Even when it wasn't clear from written reports, we could call up whoever did the work and make sure that they had taken everything into account. Nearly always, they had."

"They eliminated the blind alleys for us," says Paul. "That was a big service."

The Sandians needed not only information, but also materials, points out Dennis Mitchell (2513), a member of the explosives-studies team:

"We have lists of what we requested, and it all got here — things such as ignitors and propellants used in the Iowa guns, samples from the projectile's rotating band, fire-fighting foam, powder-bag material, a bore-cleaning brush. They responded quickly in every case."

Karl also notes the speed with which the Navy reacted to Paul's half-scale ignition experiments. "We became aware of the possibility of impact-produced ignition about the end of the first week in May," he says. "By the middle of the next week, Navy people were here and were ready to start designing their own test apparatus. By the third week, they had a several-ton fixture built up. By the time Paul and I got there the fourth week in May, they had already done 16 tests."

Dick Schwoebel's (2500) testimony to the Senate Armed Services Committee sums up the Sandians' feeling: "Our interactions with the [Navy] technical team have been open and candid. They've helped us in every possible way."

**(Continued from Page One)****Iowa Explosion**

wrong or incomplete.

But he soon received confirmation, first from full news reports and then directly from Paul and Karl, who had been present at the Navy tests that afternoon. "It was almost like fiction.

"It was dramatic. And it couldn't have come at a more crucial time — just before our testimony."

The next day, before senators, reporters, and television cameras of CNN and C-SPAN, Dick methodically presented the results of the Sandia analysis. The cause of the explosion had not been conclusively determined, he said, but a plausible scenario that could result in accidental explosion had been both identified and demonstrated.

The scenario involved a high-speed "overram" of bags of propellants into the 16-inch gun barrel, pushing them far enough and fast enough that they crushed up against the rear of the projectile. If the second propellant bag's so-called trim layer — where varying numbers of explosive pellets are added on their sides at the front of each bag to bring it up to the exact weight wanted — contained fewer than normal numbers of the pellets, the resulting pressure could have crushed them and initiated an explosion. (Normal is 15 to 65 pellets.)

Dick showed a videotape of one of the experiments at a Sandia explosives test facility simulating such a condition on a smaller scale. A series of explosions ensued. This was just one of about 450 such impact tests carried out at Bldg. 9930 in the Coyote Canyon Test Complex. Many resulted in explosions (see "Explosives Experiments").

**No Unique Chemicals**

The explosives impact tests, carried out by Paul Cooper and colleagues, and the mechanical analysis, by Karl Schuler and colleagues, showing that the extent of the overram was 3 inches farther than the Navy had established (see "Overram Became Pivotal Datum"), came in parallel with examinations by another Sandia subgroup. This

chemical analysis group, led by Jim Borders, looked for any evidence of foreign material that might confirm the hypothesis that a chemical ignitor had been used to set off the explosion (see "Chemical Analysis Team").

The analyses found no unique chemicals or constituents indicating the presence of such an ignitor and found that constituents said to be indicators (calcium, chlorine, and glycols) were in fact widely present in other gun turrets on the *Iowa* and on two other battleships, the *New Jersey* and *Wisconsin*. A few possible metal fibers that might be steel wool were found, but their source couldn't be determined. As a result of the chemical studies, Sandia "could neither prove nor disprove the presence of a chemical ignitor proposed by the USN."

"The cause of the explosion was not conclusively demonstrated," said Dick, in concluding his testimony. "However, an important factor may have been the increase in impact sensitivity of a powder bag with a reduced number of pellets in its trim layer. Our half-scale experiments indicate that reducing the number of these pellets lying next to the powder pouch increases impact sensitivity enough that an explosion could have been caused by an overram at a higher-than-normal speed.

"Our studies indicate that impact initiation depends on two key factors — the number of pellets in the trim layer, and the speed of the overram. However, these experiments must be extended to actual 16-inch gun conditions to establish the validity of this ignition mechanism."

**Recommendations Offered**

He went on to offer recommendations to add a mechanism to the guns to control the speed of the rammer, to change powder bag designs to adjust weight without the addition of trim-layer pellets, and to extend studies of propellant impact sensitivity.

**Statement by US Senator Jeff Bingaman**

"I am very proud of the key role that Sandia played in the *Iowa* investigation. At the hearing on May 25, Senator Nunn joked that, while he has often heard me brag about Sandia's expertise, he finally realized that I have been telling the truth all along. By the nature of Sandia's work, much of what you do goes unnoticed outside New Mexico. The investigation, and the presentation Dick Schwoebel and his team made at the hearing, have given Sandia some of the recognition it deserves. Sandia should be very proud."



DICK SCHWOEBEL

The senators then questioned Dick, Paul, and Karl at some length. Afterwards, Armed Services Chairman Sam Nunn said, "Sandia's alternative scenario of a high-speed overram of a powder bag with a reduced number of pellets in its trim layers is a plausible explanation, although more testing needs to be done . . . and certainly we cannot draw any definitive conclusions this morning.

"I think the Navy should conduct and continue to conduct serious exploration of the Sandia alter-

**"They kept hearing the name Sandia National Laboratories."**

native with the active participation of Sandia experts. . . . I think it is very important [to] keep Sandia involved as an independent and, I think, objective, analytical technical organization."

He turned to the Sandia witnesses and ended the hearing with these words: "Senator Bingaman's been bragging on your laboratory out there for a long time, and we know now that he's been telling us a great deal of truth there. We appreciate your being here."

Sandia almost didn't do the study. In early October 1989, the Armed Services Committee asked the GAO for assistance in assessing the *Iowa* investigation. The first request for Sandia to study the *Iowa* incident came in a letter from the GAO to Dick Schwoebel Oct. 26, 1989. The letter to Sandia was worded very broadly, and Dick and other Sandia managers didn't consider it appropriate for Sandia to get involved in all aspects of the *Iowa* matter.

So Dick wrote a letter saying Sandia didn't think it could assist in answering the broad questions about the Navy's scenario.

Then, on Nov. 22, Sandia President Al Narath received a letter from Senators Nunn, John Warner, and Jeff Bingaman, all members of the Armed Services Committee. This one was worded much more carefully, appropriately constraining the Sandia analysis to physical evidence. Al said yes.

**Why Sandia?**

Why was Sandia selected? Dick asked the GAO about that and was told that they checked with organizations like the National Academy of Sciences. "They kept hearing the name Sandia National Laboratories." The recommendation was based on Sandia's breadth and depth of technical capabilities, Dick believes.

VP Roger Hagengruber (9000) was assigned  
*(Continued on Next Page)*

**(Continued from Preceding Page)**

managerial oversight of the study, with Dick Schwoebel the technical lead and John Holovka (9123) project leader and Roger's deputy.

In a trip to Washington on other business Dec. 7, Dick met with the Navy technical support team. On the way there, he read the Navy's final technical report and began marking questions and making notes in the margin. About 10 days later, he, Mark Davis (1880), Paul Cooper, and Dennis Mitchell (2513) — who all became members of the study advisory group — visited the *Iowa*. "That [the visit] was very important," Dick recalls.

Then and throughout the study, Navy technical personnel gave Sandia full cooperation and support. The Sandia team toured the gun turrets from top to bottom (seven levels, a massiveness of scale that impressed everyone), witnessed the extraordinary effects of the explosion (bulkheads bowed out, I-beams bent), took swipe samples for materials analysis, and talked to some of the sailors, getting what Mark calls the "deck plate view."

**'Devil's Advocate' Davis**

It turned out to be one of Mark's tasks in the study to ask what he calls "all kinds of crazy questions," and propose and check out any alternative possibilities that might have played a role in the explosion (soda cans down the barrel, powder bags reversed, anything). For this, he's been named the study's "Devil's Advocate."

On the way back on the plane, Dick and the others sketched out what became the general structure of the study. There would be groups for chemical analysis, explosives studies, and mechanical modeling studies. Under each, they listed a half dozen or so key questions to be answered.

(A fault-tree analysis team was added later to help guide the other groups as they studied possible causes of the explosion. Although the fault tree included impact, friction, electrostatic discharge, electromagnetic radiation, and heat as possible mechanisms for the explosion, most of these were later ruled out. It proved impossible to quantify the probabilities for the less likely mechanisms, because little data existed and the Sandia study did not last long enough to develop new data.)

**Focusing Took Time**

The study got under way in earnest in January. It took some time before things came into focus.

"I think early on everyone recognized that there wasn't enough from what we had in hand to pin things down," says Dennis. "We knew we needed additional data. The question was what kind?"

The study began to seek other alternatives once it became clear that the chemical analysis had found no conclusive evidence of chemical ignitor material, that the chemicals the Navy thought suspicious were also a part of the normal maritime and maintenance environment in the turrets, and that the analysis of possible steel wool particles led to no definite conclusion.

Frictional effects were quickly eliminated as a possibility, as well as any problem with the age of the propellant or with the propellant stabilizer. (Some of the latter studies were done at the Pantex Plant in Amarillo, by employees of Mason & Hanger-Silas Mason Co., the DOE contractor there.)

As soon as powder bags from the *Iowa* showed up, Paul started small impact drop tests, first with single pellets. Eventually, he was able to find out that pellets would go off fairly easily at energies similar to those that could be found in a rammer situation. These led to the half-scale (8-inch) tests, such as the one eventually shown in the Senate testimony.

Karl analyzed the structural aspects of the gun environment, identifying the amount of rammer overram, but he and Paul also worked closely together in forming and demonstrating the whole overram-bag hypothesis.



FINAL REPORT, "Review of the *USS Iowa* Incident," was the 300-page product of many authors and production people. Two of those who worked on it (here shown boxing up the last of 450 copies) were editor Carmen Drebing (3151, left) and support-team leader Linda Vigil-Lopez (2500).

All this came together rather late. Key to the study's success as a team effort were the regular Friday afternoon meetings on the third floor of Bldg. 891. (Toward the end, a second weekly meeting was added.) About 20 members of the study team would come together and compare notes. Representatives from the Navy and GAO attended some of these meetings as well.

"We'd get together and talk about the results," recalls Dave Anderson (2510), leader of the explosives studies team. "As a result, we'd change directions, reinforce efforts, get new ideas. The meetings were interactive, stimulating, and lively. If we hadn't had those regular meetings, I don't think we'd have been as successful," he says. "The meetings enhanced the teamwork. Everybody caught the spirit."

The combinations of people "with different capabilities, backgrounds, specialties, and approaches working together to focus on a difficult

**"It was late before we actually felt it was an accident of the gun."**

special problem" created a kind of synergism that helped move the study forward, Dave says.

"It was at those joint meetings," Dennis recalls, "that the scenario really evolved."

The last two or three weeks of the study, by all accounts, were very intense. "I think it was late before we actually felt it was an accident of the gun," says Dennis. This couldn't be demonstrated conclusively, but the explosives tests had by now shown that such a thing could occur.

"The last month was extremely intense in terms of analyzing, discussing, viewing, questioning, graphing — trying to come to some sort of conclusion with confidence and deciding what we could and could not say," Dennis notes.

As the GAO's deadline approached, the executive summary went through draft after draft. Supporting materials had to be prepared. Things became increasingly hectic.

**Working All Night**

There was extra work for everyone. Everyone worked extra time, from the technical people to the secretaries, publication people, tech editors, and

printers. "Everybody pitched in, and burned the midnight oil when it was needed," says Dave Anderson.

Finally, as Dick Schwoebel reached the Albuquerque airport for the 5 a.m. flight May 24 that would take him to Washington for his Senate testimony the next morning, Mike Lanigan of Illustration and Design Communications Div. 3155 met him with the large display posters Dick and Jim Borders used to summarize all aspects of the Sandia study for the assembled senators. Mike and others had been at work all night, completing the posters at 4 a.m.

"People at the Labs worked extremely hard," says Dick. He and others repeatedly caution that Sandia didn't prove what happened on the *Iowa* — only demonstrated a plausible alternative scenario. But he says, "I think we touched on some important issues."

He has high praise for everyone involved. "I think the team did a superlative job, invaluable."

Since the study has gained wide publicity, Dick mentions an experience other participants have described as well. Other Sandians have been calling, sending notes, dropping by, and expressing their sense that this was something right and appropriate for Sandia to do. "They say, 'I'm really proud to be a Sandian,'" says Dick.

"It was a very good project," says Dennis. "Sandia has a big responsibility when it's asked to do things like this. It has implications way beyond your office. It's a humbling experience, and you have to take that responsibility seriously."

Despite his 28 years here, Dick Schwoebel nevertheless found himself surprised at "finding this variety of experts at Sandia" from widely separate parts of the laboratory, who quickly came together and worked effectively as a team on an urgent and nationally important problem. "That's just remarkable," Dick notes.

"Sandia is a remarkable place in the array of talents and capabilities. I'm sure we don't really understand the tremendous strengths and capabilities of this laboratory." ●KFrazier(3161)

(Editor's Note: A videotape of the C-SPAN coverage of the Sandia Senate testimony is available to Sandians in the tech library.)

**More About USS Iowa on Pages 10-15**

Not Necessarily a Detonator

## Chemical Analysis Team Showed Alternative Explanations Possible for Material Found in *USS Iowa* After Explosion

One central issue that the General Accounting Office (GAO) asked Sandia to investigate in connection with the *USS Iowa* incident was evidence of "foreign material" in the area of the gun that exploded prematurely. The underlying question: Could someone have used a detonating device to deliberately set off the nitrocellulose propellant before the gun breech was closed?

That question led to establishment of a chemical-analysis team, headed by Jim Borders, Supervisor of Materials Compatibility and Reliability Div. 1823. (The other members are named on page fourteen). "Besides the people making up this

**The team was looking for tiny chemical clues in residues or fragments from a violent explosion.**

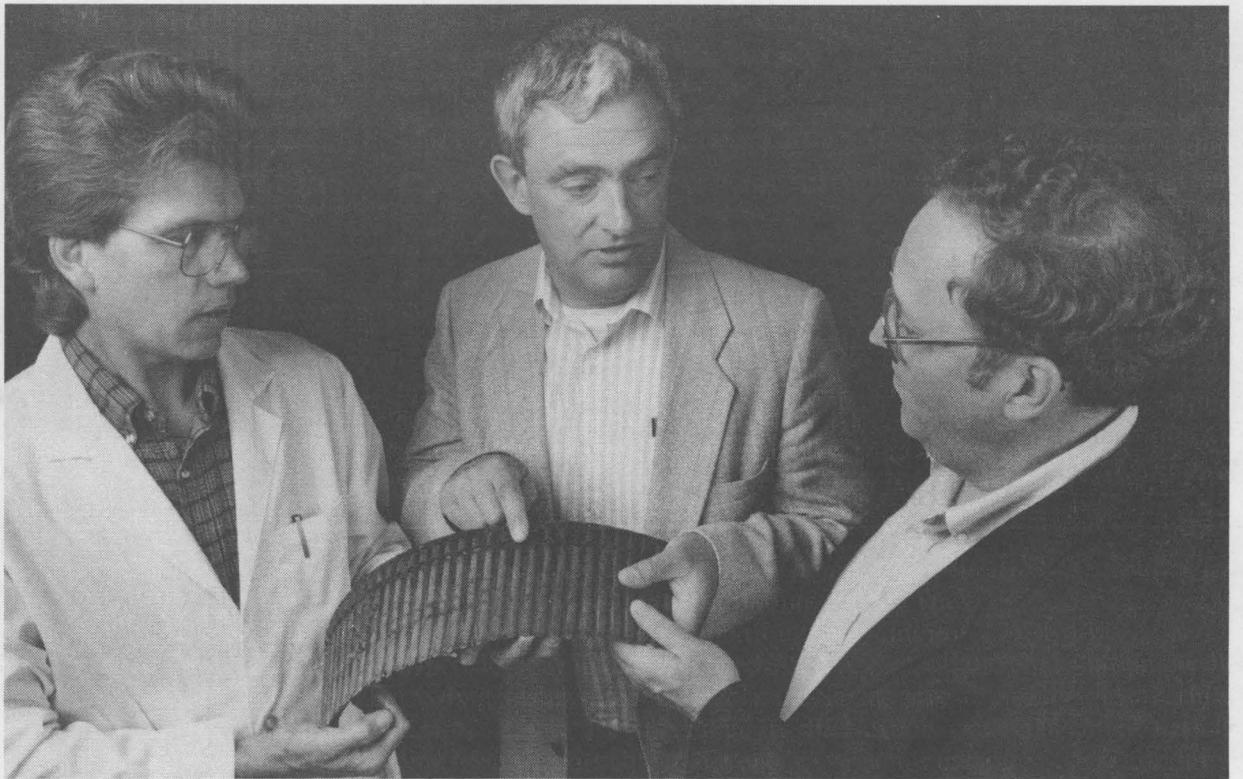
team," says Jim, "probably 10 or 15 more within [Materials and Environmental Sciences] Dept. 1820 were directly involved in the experimental work and analysis."

The team's assignment was not easy. They would be looking for tiny chemical clues in residues or fragments that had been subjected to a violent explosion. Not only that, fire fighting in the gun turret and the cleanup afterward had removed or contaminated most of the evidence.

Mark Davis (1880), the "Devil's Advocate" chartered with taking a broad view of the Sandia investigation, has an analogy: "Doing the analysis with little fragments from an environment such as this is like going out on a beach — one guy finds a grain of black sand and makes a big deal about it being black sand, another guy gets some white sand, or cream-colored sand and starts talking about that. Then there's so much contamination you can get — flyspecks, dandruff — that it's just awful. You have to do a lot of testing, and still there's no guarantee that you'll reach a conclusion."

### Not Quite Hopeless

The job might have appeared hopeless, but Navy investigators had recognized early that one area might preserve samples of material that were in the gun breech at the time of the explosion: a groove, called the "cannelure," in a copper-nickel



SECTION OF ROTATING BAND from a test-fired projectile is examined by (from left) Bill Chambers (1824), Jim Borders, and Jerry Nelson (both 1823). Jim is pointing to the slot formed when the cannellure closes as the projectile moves up the gun barrel.

band clamped around the projectile like a tight-fitting belt. This "rotating band" engages the rifling grooves of the gun barrel and makes the projectile spin when it's fired. Slightly overhanging the front of the cannellure is a solid ridge or fin that exceeds the interior diameter of the gun barrel. This ridge is forced down to form a gas-tight seal between the projectile and the gun as the projectile starts to move down the gun barrel. When the fin is forced down onto the cannellure, it creates a slot.

Inside that slot, the Navy investigators reasoned, would be material blown into the cannellure at the instant of the explosion and then protected from the effects of fire fighting, cleanup, and five weeks in the gun barrel before the projectile could be removed.

### No Pristine Samples

"The rotating band on a 16-inch shell is about 50 inches in circumference," says Jim. "After the Navy people started cutting open the cannellure, half the 50 inches was used in destruc-

tive testing at the Norfolk Naval Shipyard. Part of the remaining band was sent to an FBI lab, and the rest eventually to Crane Naval Support

**Calcium and chlorine were found in samples from several gun turrets, in concentrations comparable to the cannellure from the *Iowa*.**

Center in Indiana — that's where these shells are produced and where most of the Navy's analytical work was done.

"By the time Sandia came into the picture and received some pieces of the rotating band — totaling about 10 inches in length — it had all been opened," Jim continues. "So one point to be aware of right at the start is that we didn't have any pristine samples. Anything we got could have been contaminated at some point — while it was being handled, while it was stored, or what have you. Also, when the FBI investigators opened up their samples, they found that the inside of the cannellure was wet with a lubricant and cleaning fluid called Break-Free™, which had been used in trying to get the projectile out of the barrel and also is used around gun turrets for normal maintenance. You couldn't say that the cannellure formed a hermetically sealed enclosure."

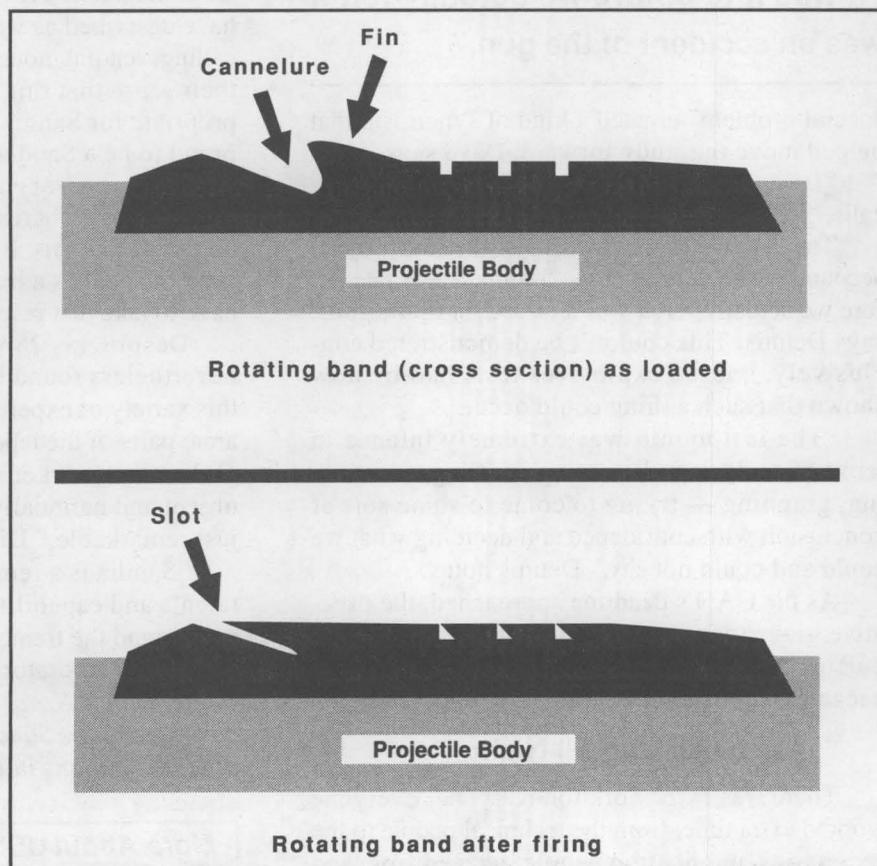
So one problem for the Sandia team was to determine the meaning of data from a source where so many variables were uncontrolled. Not only that, they had many possible lines of inquiry, and no way of knowing in advance what would be fruitful.

"Whenever any of us try to explain what we've been doing in this group," says Jim, "we get jumbled up, because there are so many different things to talk about." Nevertheless, he offers an account of the team's investigation, divided into three main analytical issues. "It's a simplified explanation," he warns, "but it does cover the basic points."

### Steel Wool Fibers

The first issue — which might be called two in one — is that fibers of what appeared to be steel (Continued on Next Page)

PROJECTILE CROSS SECTION shows how cannellure on rotating band closes to trap material in slot. View is of the same projectile at two points in the gun barrel: after loading, and after moving the first nine inches down the barrel when fired.



**Forceful Compression of Powder Bags****Overram Became Pivotal Datum In Iowa Investigation**

There's an odd fact about the 16-inch guns on a battleship such as the *USS Iowa*, points out Mark Davis (1880). They're almost exactly a scaleup of a .30-06 hunting rifle. The muzzle velocity is about the same, and the pressures inside are about the same.

But there the similarity ends. The battleship's guns have a range of more than 20 miles, and each projectile (weighing up to 2700 pounds) is fired by about 650 pounds of propellant.

Still another dissimilarity is important for understanding the sequence of events in a gun turret, and for understanding some of the evidence found in the *Iowa* turret. Unlike a hunter using a .30-06 round, which has bullet and powder in a single package, the battleship's gun crews first load the projectile, then several bags holding thumb-size pellets of propellant — nitrocellulose, sometimes

called "smokeless powder."

A crewman — the rammerman — uses a hydraulic rammer to shove the projectile into the gun breech at the rammer's maximum speed of almost 14 feet per second. Then, when six propellant bags (though there were only five in the *Iowa* incident) have been hoisted up by an elevator and

**"The only real, hard evidence not in dispute was the overramming."**

rolled onto a "spanning tray," the rammerman uses the rammer to push them along the tray into the gun, at only one or two feet per second, until the rearmost bag is just inside the breech. Normally, there is space between the base of the pro-

*(Continued on Page Twelve)*



**DISTORTED RAMMER LINKS** inside gouged spanner tray. Different-sized links — some 4.4 inches long and some 4.8 inches — left identifiable marks in the tray as the explosion blew them sideways and backwards. (US Navy photo)

**(Continued from Preceding Page)**

wool were found in the cannellure, and that they, as well as the inner surfaces of the cannellure, had calcium and chlorine on their surfaces. A detonating device consisting of steel wool, brake fluid, and calcium hypochlorite could leave evidence like this.

But was a detonating device the only explanation? To answer that question, members of the Sandia team — Paul Cooper (DMTS, 9333), Mark Davis, Dennis Mitchell (2513), and Dick Schwoebel (2500) — arranged to take swipe and magnetic samples from various locations in the gun turrets of the *Iowa* and two other battleships. (The samples were found to include steel-wool-like iron fibers.)

The Sandia investigators also searched their sample of the cannellure. "These fibers are really small," says Jim. "They're a few thousandths of an inch in diameter, and a few hundredths of an inch long. We had people looking with a microscope for a couple of days — boring work, but necessary." They found only a few fiber fragments, some of which were too embedded to remove. The Sandia analysis did, however, include some of the fibers that had been removed and kept at Crane.

The team found both calcium and chlorine in samples from all the turrets, in concentrations that were comparable with Sandia's analysis of the can-

**"We did not prove the Navy wrong. We did point to another possible scenario."**

nellure from the *Iowa* and with most of the data in the Navy reports.

"The one fiber that the Navy's analysis showed to have a significantly high value of calcium was one that appears in Navy photomicrographs to be encrusted with material," says Jim. "This fiber was actually sticking out of the closed cannellure. It's true that when we burned samples of steel wool in calcium hypochlorite, we found high values of calcium and fairly high values of chlorine on the steel wool. But except for this one crusted fiber, none of the steel-wool fibers from the *Iowa* had concentrations of calcium or chlorine that represented anything unusual in the background environment that we found in all the turrets." One possible source for calcium and chlorine is seawater; besides that, Break-Free™ contains calcium.

The presence of the steel wool itself raised questions of whether the fibers in the *Iowa* sample were the same as collected elsewhere. Navy reports say that the fibers from the projectile involved in the explosion are larger in diameter than

those found in other projectiles stored aboard the *Iowa* — which might point to a different source, presumably the steel wool in a detonator. The Sandia team, however, notes in its report that the fibers can vary in diameter along their length, so it's hard to arrive at a definitive measurement. Also, if the fibers in the cannellure were thrown there by the explosion or were already there, they would probably have been flattened, which would make them appear larger in diameter.

Conclusion on this issue: Sandia cannot say that the material samples — either the fibers themselves or the material on them — prove or disprove the presence of a detonator.

**Evidence of Plastic Bag?**

Another finding presented by Navy investigators as evidence of a detonator is a fragment of polyethylene terephthalate (PET), which in film form has the trade name Mylar™ and in fiber form is Dacron™. In addition, a microscopic fragment



**JIM BORDERS**

found in the cannellure, when analyzed by pyrolysis mass spectroscopy — a process of burning the sample and analyzing the resulting chemical species by mass spectroscopy — had the same chemical signature as a polyethylene-PET laminate. This laminate is used to package "Meals Ready to Eat" (MRE) field rations used in the

armed forces. Again, this could have been evidence for a chemical detonator packaged in the plastic bag from an MRE ration.

"We didn't find any PET or PE-PET laminate in the cannellure," says Jim, "though we did find PET in the swipe samples. So we really can't comment on whether the the PE-PET sample is evidence of an MRE bag. What we did find in the cannellure was a lot of polymeric material, plastics of all kinds. It's stuff that's used in more ways than you can think of — shirt buttons, eyeglass frames, ID badges, writing pens. We also found what's essentially Dacron™ in the brush that's used to clean the gun — there's a Dacron™ sock that goes over the brush. So that's a possible source of PET."

Conclusion once again: no proof or disproof of a detonator.

**Suspicious Glycols**

The third issue is the Navy's report of three glycols, two of which were considered to be significant foreign materials. "Glycols are organic chem-

ical species," explains Jim, "commonly found in antifreeze, but also present in brake fluid. They will burn, and in combination with calcium hypochlorite would have ignited."

In investigating the glycols, the Sandia investigators had to use data taken by the Navy, says Jim: "We weren't able to get enough organics out of the cannellure for identification — they had all volatilized during the months before our work started." The Sandia team tested known substances and compared the results to the Navy data.

**Glycols Don't Prove Detonator**

Of the three glycols, the Sandians agree with the Navy that one comes from a pen used to mark the samples for identification — although a Sandia

**"It's easy to take a source and find out what you're going to get from it, but the reverse ranges from difficult to impossible."**

analysis of Break-Free™ samples shows that it also contains this glycol. A second glycol is found in brake fluid, but also in Break-Free™, and this glycol was found in all three guns of the turret involved in the incident, not just the one where the explosion occurred.

The third "glycol," the Sandia investigators believe (on the basis of comparing Navy data with results on test samples analyzed at Sandia), is actually phenol, also a constituent of Break-Free™. Thus, all three of these organic materials could come from a source other than a chemical detonator.

For the third time: presence of a chemical detonator neither proved nor disproved.

**Sum of Parts**

Jim concludes with a reminder of how tricky an analysis this was, for both the Navy and Sandia: "We were all working with small samples of substances and trying to go backward to find out where they came from — and there could be a lot of different sources. It's easy to take a source and find out what you're going to get from it, but the reverse ranges from difficult to impossible."

The sum of the parts of the Sandia materials study, says Jim, is this: "We have shown that substances identified by the Navy as indicating a chemical ignition device can be explained by materials that are normally in the gun turret, or at least were present during some stage of the fire fighting and cleanup, and could have gotten into the cannellure. Very little is clear-cut, though. I want to emphasize that we did not prove the Navy wrong. What we did do is point to another possible scenario." ●CS



KARL SCHULER (DMTS, 1522) looks at a propellant bag of the type involved in the *Iowa* incident. The dark material is a wear-saving cover; the lighter, laced bag inside is the silk propellant bag.

(Continued from Page Eleven)

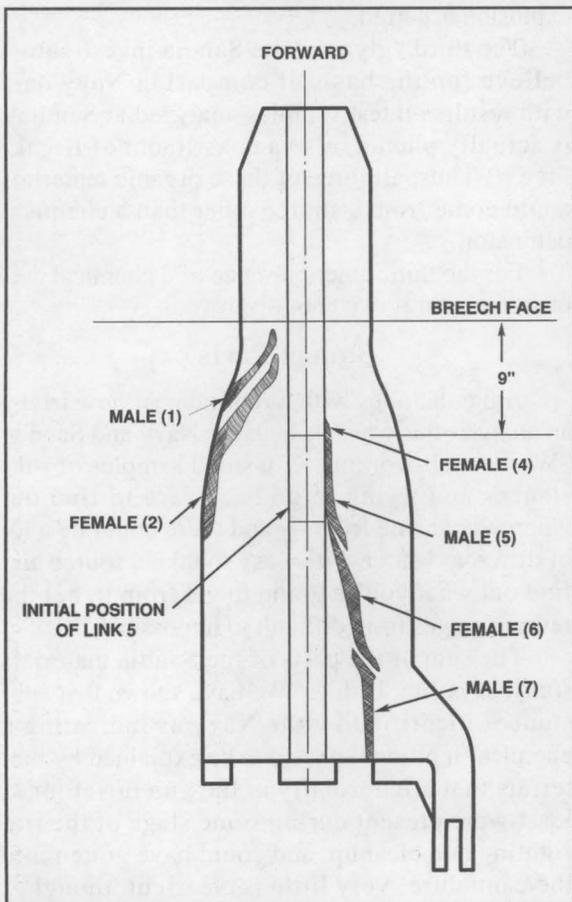
## Overram

jectile and the front of the first propellant bag.

But the *Iowa* incident obviously wasn't normal, points out Karl Schuler (DMTS, 1522), who did much of the mechanical analysis that went into Sandia's investigation.

### Powder Was Overrammed

"One of the crucial Navy findings is that the rammer head was too far into the breech," says Karl. "Their investigators used three observations to establish that an overram had occurred. One was the discoloration and distortion of the rammer chain." (The steel rammer chain — which pushes the rammer head into the breech — bends in only



SPANNER TRAY, in top view, showing location of gouges that allowed Karl to establish how far the rammer had pushed the propellant bags.

one direction, so that it can retract into a C-shaped housing.) "Second was a set of gouge marks on the spanning tray, which they felt were made by pieces of the rammer head blown out of the breech. Third, they believed the rammer head had to be against the back of the bags to provide tamping that would allow pressure to build up and force the projectile 44 inches down the gun barrel, where it was found after the incident."

Addressing those points in reverse order, Karl says that the need for a tamping effect doesn't establish where the rammer head was. Using gas-dynamic modeling, Mel Baer (DMTS, 1512) showed that a gap between the rammer head and the bags would not preclude an explosion producing the necessary blast pressure. (Mel's work did, however, corroborate the Navy's test findings that, to force the projectile 44 inches along the barrel, the most likely ignition point was between bags one and two — the first two bags behind the projectile.)

The marks on the spanning tray didn't add up, either. "The rammer head is bronze," explains Karl, "which has about the same hardness as the aluminum of the tray. I didn't see how bronze fragments could put such deep gouges into aluminum."

The condition of the rammer chain was good evidence, but not quite good enough. Navy investigators had noted which links were affected by the explosion, presuming that they had been exposed to hot gases and that the unaffected ones were protected by the housing. Measuring from the end of the housing, they concluded that the rammer head had been 21 inches into the gun.

"Certainly, discoloration and distortion of the chain provides a lower bound," says Karl. "So the gun was at least 21 inches overrammed. But it took

**"I didn't see how bronze fragments could put such deep gouges into aluminum."**

a certain amount of time — milliseconds, but still time — for the gases to come out of the breech and onto the chain. Observations and tests after the incident show that the rammer chain was pushed some distance back into the housing. How much of the chain could have been out of the housing, but pushed back before the gases could discolor it?"

### Matching Gouges to Links

For an answer, Karl looked harder at the spanning tray. Along its centerline is a shallow recess in which the rammer-chain links ride. Karl noted that the gouge marks were all at an angle to that recess, directed out of the tray and backwards. To him, it made sense that the gouges were caused by the steel links.

"I started taking links and trying to match them to gouge marks," says Karl. "There are two different kinds of links — male and female — with different baselengths. I started a process of saying, 'Okay, the link that made this mark must have been a female link. If I assume it was link number two, what does that say about which link made which mark?' It didn't take too long to reach a logical conclusion that certain links made certain marks. The next step was to note that the marks closest to the centerline of the tray were the best ones to use as an indicator of where the chain was initially, because they would have moved the least before leaving a gouge. In the end, we could say confidently where the chain was when the incident occurred."

### 'Kept Coming Back'

The overram became central to Sandia's investigation. Dave Anderson (2510), leader of the explosives-studies team, recalls, "Maybe halfway through the study, we began acknowledging to ourselves that the only real, hard evidence we collectively had — we and the Navy — that was not in dispute was the overramming. And we kept com-

ing back to that. That's the anomalous thing, that's the unusual thing, that's the abnormal thing. What does it mean? At practically every meeting, the question would come up — what does the overramming mean?"

The meaning gradually became clearer. Karl's conclusion doesn't appear too different from the Navy investigators' — 24 inches, by his analysis, to the 21 reported by the Navy. But there's a vital difference. A 21-inch overram would not have compressed the propellant bags against the rear of

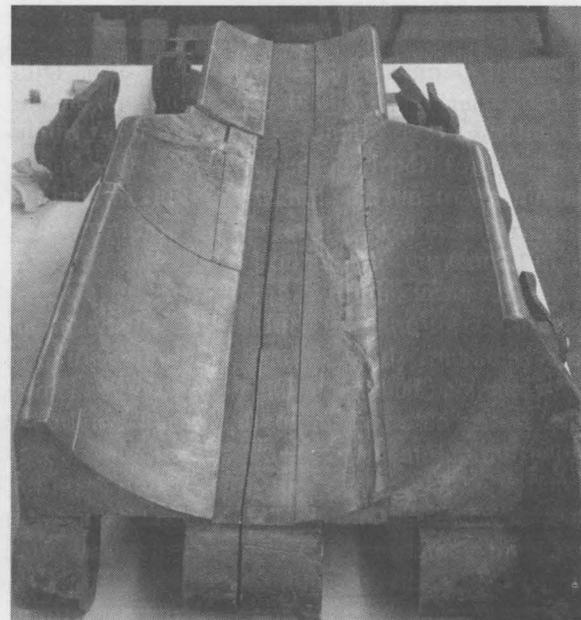
**"It didn't take too long to reach a logical conclusion that certain links made certain marks."**

the projectile. A 24-inch overram would. That set the scenario for an accidental ignition caused — somehow — by the compression.

Aware of the extent of the overram, the team began to conduct tests and analyses leading in several directions.

For instance, to confirm Karl's analysis, a computational model of the rammer chain and head was subjected to the forces predicted by gas-dynamic modeling. The results showed that the rammer would indeed have reacted to leave gouges of the type seen on the spanning tray.

Compression tests on propellant bags and individual pellets — performed by members of Development Testing 7500, primarily Rod May, Marlene Shields, and Larry Dorrell (all 7542) — provided



GOUGED SPANNER TRAY from *USS Iowa*. Tray is about 50 inches long. (US Navy photo)

data for computer modeling of the behavior of compressed propellant. For one phase of this work, modeling the effects of the rammer on propellant pellets, Ken Gwinn (1524) and Mel Baer performed about 50 hours of computation, mostly on a Cray.

The team needed to know how much force would have been exerted on the propellant. They were able to establish a lower bound. In the hydraulic system that drives the rammer, a relief valve opens at 800 pounds per square inch. At that pressure, according to Navy measurements, the drive is pushing with a 2800-pound force. So that's the maximum force a rammer can exert if it is stalled by propellant bags jammed against the base of the projectile.

### Slow or Fast Ram?

In parallel with the other work, Paul Cooper (DMTS, 9333) and his colleagues carried out a series of impact tests to establish ignition points for various arrangements of pellets — leading finally to tests by the Navy showing that the force of a high-speed overram *could* cause a premature explosion under certain circumstances (see "Explosives Experiments Led to Accident Theory").

Karl explains the significance of an overram at (Continued on Next Page)

## Explosives Experiments Led to Accident Theory



PAUL COOPER (DMTS, 9333) explains the half-scale test apparatus used for impact-ignition experiments. Small black cylinders near his left hand are propellant pellets, which are arranged on a large plastic cylinder that simulates the mechanical properties of more layers of pellets.

Key experiments supporting the possibility that the explosion of the *USS Iowa* gun was accidental were carried out at a Sandia explosive test site east of Area III (Bldg. 9930). The tests exposed a previously unsuspected sensitivity to impact of a layer of pellets in the bags of propellant used to fire the battleship's 16-inch guns.

These findings led, in mid-May, to related, full-scale tests by the Navy at the Naval Surface Warfare Center in Dahlgren, Va., resulting in an ignition of pellets in a test fixture the afternoon just before Sandia's Senate testimony. Sandians were involved in that test as well, and they are continuing to participate in further Navy tests now under way.

Paul Cooper, a DMTS in Sandia's Engineering Projects and Explosives Applications Div. 9333

### Sandia conducted about 450 impact tests to get statistics on the threshold of ignition.

and member of the study advisory committee, was a leading figure in the experiments here.

Although the tests ultimately led to an important discovery, it wasn't clear early in the study just how things should proceed, says Dennis Mitchell (2513), also a member of both the explosives studies team and the advisory group. "But Paul Cooper is a pretty clever experimentalist," Dennis says, "and he decided we ought to start doing some drop tests, to try to find out what the sensitivity of the pellets was.

"So as soon as the bags of 16-inch gun propellant Sandia had requested from the Navy showed up, Paul began small-scale drop tests with pellets to look at impact sensitivity and get go/no-go indications of energies necessary for initiation."

"We built a series of small fixtures simulating the impact in a gun," says Paul. "These were steel cylinders where you could place various arrangements of propellant pellets and black powder, with the appropriate silk pouches, and so forth (see "How Battleship Guns Fire"). You would place a steel ram representing the base of the bullet on that, and then drop weights on it.

"We felt these represented minimum impact conditions."

Paul and his colleagues looked at all manner of configurations and carried out enough tests of each to get good statistics on the threshold of initiation (ignition). The idea in these kinds of tests is to create conditions where an explosion might occur, then repeat the tests often enough to be able to assess the probabilities of the same explosion occurring under less severe conditions.

"We found," says Paul, "that the most sensitive configuration — when we could get things to go [explode] with the least impact energy — was the normal loading, where the front or trim-layer end of one bag is up against the black powder pouch of the bag in front of it. That configuration is the way the gun is supposed to be loaded."

### Impact Test Fixtures

Four different drop-weight impact test fixtures were built for the explosives experiments. Paul be-  
(Continued on Page Fourteen)

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high speed: "The force would be greater," he says, "if the rammer were moving faster than the standard one to two feet per second. In that case, when the powder bags hit the projectile, the kinetic energy of the rear bags would cause a higher transient force in the front bags. We can't say for sure how fast the rammer was moving, but we have modeled transient forces for rammer speeds up to 14 feet per second."

Ken Gwinn says, "Modeling shows that a rammer speed of at least six feet per second would compress the propellant bags to the amount required by a 24-inch overram. We're planning more experiments to check this finding."

At least one thing about the *Iowa* turret after the blast also points to a high-speed overram. Before each round is fired, the propellant comes up in a "powder car" on a hoist. Once the top door to the hoist is open, a mechanical interlock prevents the car from being lowered. That's a safety precaution, to keep fire on the top level from spreading downward via the hoist.

The rammerman closes the door, then begins ramming the propellant at low speed. As soon as the door is closed, another crewman begins lowering the powder car. If the ram is slow, the powder car will be some distance down the hoist before the propellant is in the gun. In the *Iowa* turret, the door was closed, but the powder car was still at the top. The inference: A high-speed overram did not give the powder-hoist operator time to begin lowering the powder car before the explosion.

Even if this scenario is correct, it answers only the "how" of the incident, not the "why." Why an overram, especially a high-speed overram? The answer may have something to do with an undefined problem reported from the turret by phone. At this point, a firm answer seems irretrievable. As the inquiry continues, however, investigators now know — due in no small measure to the additional three inches of overram discovered by Karl Schuler — that there is more than one credible cause to take into account. ●CS

## How Battleship Guns Fire

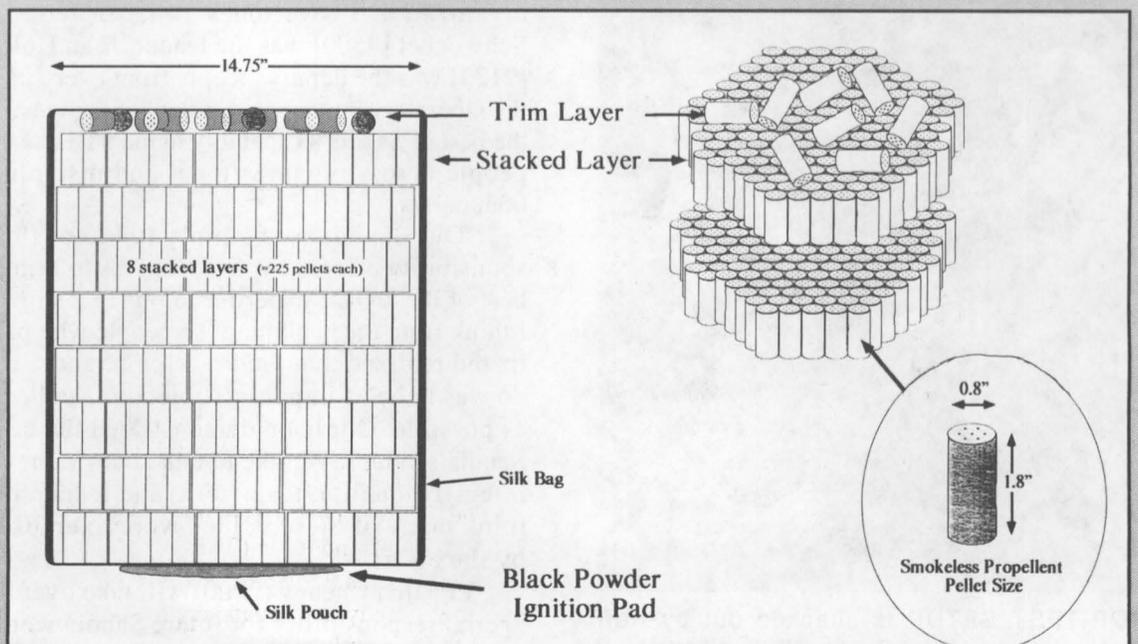
The bags of propellant used in battleship 16-inch guns are about 15 inches across and consist of some 1800 propellant pellets neatly arranged parallel to each other in eight stacked layers. Each pellet is a cylinder of solid nitrocellulose about three-quarters of an inch in diameter and two inches long.

To bring the bag up to the specified weight — 93.4 pounds on the *USS Iowa* — a final trim layer is added. These are additional pellets that lie on top, on their sides, perpendicular to the stacked propellant pellets. The cloth cover is then stitched closed. The number of pellets in this trim layer typically ranges from 15 to 65, according to recent Navy examinations. At the rear of each bag a pouch of black powder is attached.

In a 16-inch gun, after the 2700-pound pro-

jectile is rammed into the barrel by the mechanical rammer at high speed (about 14 feet per second), six bags of propellant are rammed into it by the same means, although much more slowly, one to two feet per second. The pouch of black powder at the aft end of each bag is immediately adjacent to the trim-layer pellets at the forward end of the next bag. Black powder is added because it is much easier to ignite than the solid pellets.

In firing the gun, an electrical signal ignites a primer cartridge of black powder inserted in the breech mechanism. This then ignites the powder in the pouch of the rearmost bag, which ignites its propellant pellets. The ignition quickly spreads to the forward bags, firing the projectile out the barrel.



POWDER BAG of the type being used on the *USS Iowa* when a 16-inch gun detonated prematurely.

*(Continued from Page Thirteen)*

## Explosives Experiments

gan with single pellets, lying on their side in a small rectangular chamber. He then scaled up to cylindrical chambers with inside diameters of 2½ inches, 4¾ inches, and then 8 inches. In these cylindrical chambers, he could simulate the trim layer by adding various numbers of pellets sideways atop other, stacked pellets.

Altogether, some 450 impact tests were conducted, Paul says. He credits Sandians Rod Owenby and Jerry Stofleth (both 9333) and contractors Gilbert Gonzales and Keith Kurowski with extraordinary contributions in conducting this huge number of tests, through evenings and weekends. "These guys made a herculean effort.

"We found that the sensitivity of the system was such that it was easier to ignite, or took less energy to ignite, as the number of trim-layer pellets decreased," says Paul. "So if you had fewer and fewer trim pellets at that interface, it was easier and easier to ignite."

This was a key finding.

"Based on that, and on all the test results, we predicted that if you had something like 5 or 10 or 15 pellets on that layer, between the first and second bag, and if the gun were overrammed, and overrammed at high speed, then there was a very high probability of getting ignition."

Or, as Karl Schuler (DMTS, 1522) describes the situation: "Too far, too fast, too few."

It was one of these explosions in the test set up near Area III that was shown in Sandia's Senate testimony.

What might happen in the full-scale situation in a 16-inch gun is this: A compressive high-speed overram fractures the trim-layer pellets, which are more vulnerable because they are few in number and are on their sides. When they fracture, they give off burning particles. Those burning particles

shoot through the silk bag and ignite the black powder pouch on the rear of the bag immediately ahead. That black powder pouch then rapidly propagates the ignition through the rest of the system. That was the idea that came out of these studies, and the scenario described in Sandia's report to the Senate and the GAO and, in early May, to the Navy.

### Series of Navy Tests

Uncertain how these test results related to full-size 16-inch-diameter gun conditions, the Navy quickly set up a series of tests at Dahlgren, essentially repeating the tests but with five full bags of

**"There was a loud blast. It blew the fixture apart. There was a tremendous cloud of smoke and yellow flame."**

propellant in a 16-inch-diameter cylinder, to make things much closer to the real gun condition.

The Navy's quick response was impressive, says Karl, who worked closely with Paul in these studies. "We became aware of the possibility of impact-produced ignition about the end of the first week in May. By the middle of the next week, Navy people were here and were ready to start designing their own test apparatus. By the third week, they had a several-ton fixture built up. By the time Paul and I got there the fourth week in May, they had already done 16 tests."

"Karl and I were there for the last two tests in that series," adds Paul. That was on May 24. At what Sandia and the Navy agreed to be the most sensitive interface, between bags one and two, the Navy test team had placed five trim-layer pellets.

The drop provided an approximate 14-foot-

per-second impact velocity. This roughly matches the highest rammer impact velocity possible in a 16-inch gun.

### 'It Was Close'

"They had five pellets, clustered right in the center," recalls Karl. "They dropped it, and it didn't go off." They then took the bags apart. "On that bag [bag two], all five pellets were crushed. One of the pellets actually looked like it had shot out some hot little particles. But they hadn't gotten to the black powder layer [on the next bag]. Paul thought it was close.

"I got to worrying that the way the pellets were clustered in the center we might not be giving them every opportunity to react, so I thought on the next test maybe we should spread the pellets out a bit. The Captain [Capt. Joseph Miceli, USN, director of the Navy technical investigation team] was more than happy to let me do that.

"So they unstacked the test setup. I moved the five pellets around in the bag to spread them out a little bit, over about a six-inch-diameter area, and then they restacked it and we dropped the bags. And it went off."

Technically it was a fire, not an explosion. "But there was a loud blast," says Karl. "It blew the fixture apart. There was a tremendous cloud of smoke and yellow flame.

"There was dead silence in the bunker. Then someone uttered an expletive.

"We all admired the Captain's response," says Karl. "Within minutes, he was having a meeting to talk about safety issues. Then he very quickly got on the telephone to recommend that an order be issued to have the battleships cease fire."

The recommendation was quickly accepted and acted upon. In addition, the Secretary of the Navy immediately reopened the *USS Iowa* investigation. ●KFrazier(3161)

## Hagengruber: Iowa Study Team 'Demonstrated Best of Sandia's Capability'

*Roger Hagengruber, Vice-President for Exploratory Systems 9000, had responsibility for managerial oversight of the Sandia study. The LAB NEWS asked for his comments.*

"This was an exceptional Sandia effort. There was never a question about which organization should take responsibility about it. There was only a question of who were the individuals to participate to get the project going in a hurry. Nobody worried about whether they came from 1000 or 7000 or 9000 or 5000 or 2000. We just basically got people together and went after it. I think that's a good example that our values at the laboratory really are very instinctive.

"It was a multi-organizational effort with no organizational overtones whatsoever. Dick Schwoebel [2500] was the leader, John Holovka [9123] was the deputy, people from every part of the laboratory participated. I think it demonstrated the best of Sandia's capability to marshal a team of people across organizational and disciplinary boundaries.

"Our agenda was simply to honor the responsibility offered by the Congress to bring the best of the DOE's expertise to this investigation. I think from the beginning the people who participated realized that the best thing Sandia could do was to be as impartial, objective, and expert as possible. Our team demonstrated the best of Sandia's values. We like to talk about values like integrity, quality, teamwork, and leadership. I think many of these values were exemplified by the effort."

VP Glen Cheney (2000) will take over managerial responsibility for future Sandia work related to the *Iowa* incident. A list of the members of the advisory group and team members, as listed in Sandia's report to the GAO, follows:

### Advisory Group

Richard Schwoebel (2500), Project Leader  
John Holovka (9123), Project Manager  
Mark Davis (1880)  
Paul Cooper (DMTS, 9333)  
Dennis Mitchell (2513)

### Project Teams

#### Chemical Analysis

James Borders (1823), Leader  
Suzanne Weissman (1824)  
William Chambers (1824)  
Samuel Myers (1112)  
William Wampler (1112)  
Gerald Nelson (1823)  
David Tallant (1821)  
Barney Doyle (1111)

#### Explosives Studies

David Anderson (2510), Leader  
Dennis Mitchell (2513)  
Paul Cooper (DMTS, 9333)  
Steven Harris (2513)  
Thomas Massis (2515)  
Marvin Morris (7553)

#### Modeling

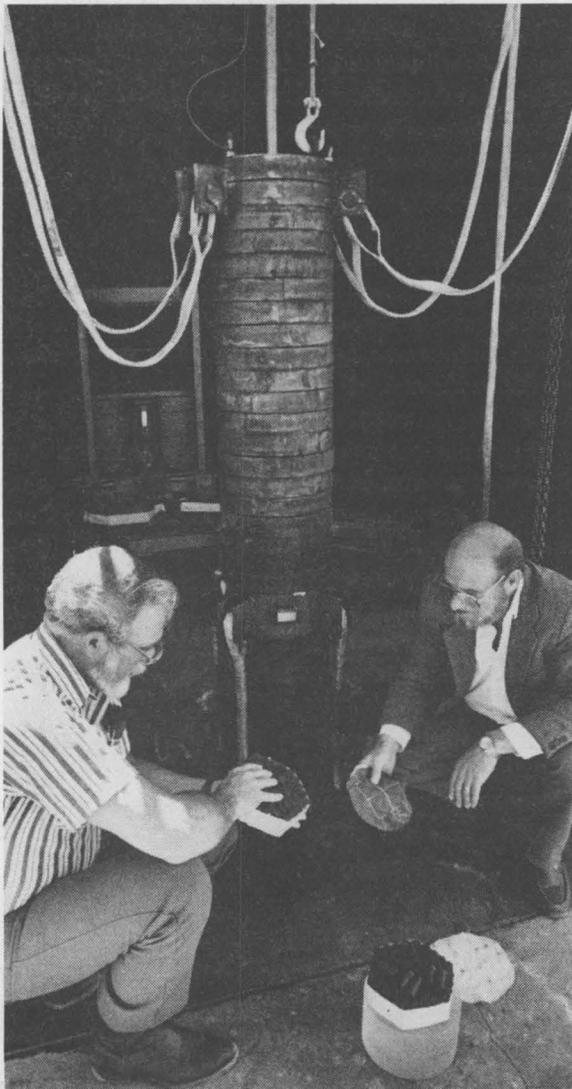
Karl Schuler (DMTS, 1522), Leader  
Melvin Baer (DMTS, 1512)  
Kenneth Gwinn (1524)  
Kathleen Diegert (DMTS, 7223)

#### Fault-Tree Analysis

Arthur Payne (6412), Leader  
Steven Harris (2513)

#### Support

Linda Vigil-Lopez (2500), Leader  
Judy Jewell (2500)  
Waylon Ferguson (142)  
Marty Noland (3151)  
Carmen Drebing (3151)



DROP-TEST SETUP is checked out by Karl Schuler (left) and Paul Cooper. Cylindrical stack behind them is formed by weights that determine energy of impact.

**From Executive Summary**

# Major Findings and Recommendations of Sandia's Iowa Report

The following is excerpted from the seven-page Executive Summary of Sandia's report to the GAO on the Iowa incident. Sandians wishing to read the complete Executive Summary can obtain a copy by calling the LAB NEWS on 4-7841. The entire report is available in the Technical Library.

This report describes work by Sandia National Laboratories (SNL) relevant to three aspects of the explosion that occurred in the center gun room of Turret 2 of the USS Iowa on April 19, 1989, killing 47 crewmen. Our studies began in December 1989 with initial contacts and information exchange with the United States Navy (USN). Technical work began in January 1990 and continued to May 18, 1990. The essential results of our study are as follows:

(1) We could neither prove nor disprove the presence of a chemical ignitor proposed by the USN. The interpretation of evidence for a chemical ignitor is complicated by the fact that some chemical constituents of such an ignitor are found throughout 16-in. gun turrets, not only on the USS Iowa, but also the USS Wisconsin and the USS New Jersey. Forms of these constituents are either commonly used in the turrets or are a part of the maritime environment. Steel wool was another component of the proposed ignitor. We found iron fibers in the rotating band that could be steel wool, but we were unable to clearly identify a source of fibers of their diameter. We believe evidence for the presence of a chemical ignitor is inconclusive.

(2) Our analyses indicate that the propellant stabilizer was within acceptable limits. We also found only a very remote possibility that this propellant could be initiated in the breach by friction, electrostatic discharge, or electromagnetic radiation. Similarly, we conclude there is only a very remote possibility the black powder could have been initiated in the breach by any of these mechanisms. Ether/air combustion cannot be achieved because minimum necessary concentrations are precluded. Even if the minimum concentrations are achieved and combustion occurs, our analyses show that the propellant cannot be ignited. These findings are in general agreement with those of the USN.

(3) We confirmed that the powder bags were overrammed against the projectile and determined that the extent of the overram was approximately 3 in. greater than that established by the USN. Our analyses indicate that the bag charges were under a compressive load of at least 2800 pounds at the time of the explosion. There may have been even higher transient forces due to dynamic loading resulting from a greater-than-normal ram speed. While the rammer is capable of a speed of 14 ft/s, we could only establish that the rammer speed was at least 2 ft/s.

(4) The cause of the explosion was not conclusively determined. However, an important factor may have been the increase in impact sensitivity of a powder bag with a reduced number of pellets in its trim layer. (The trim layer is an incomplete layer of pellets lying on their sides in the front of the bag and just behind the black powder pouch on the next bag.) Our half-scale experi-

ments indicate that reducing the number of these pellets lying next to the powder pouch increases impact sensitivity enough that an explosion could have been caused by an overram at a higher-than-normal speed. Our studies indicate that impact initiation depends on two key factors: the number of pellets in the trim layer, and the speed of the overram. However, these experiments must be extended to actual 16-in. gun conditions to establish the validity of this ignition mechanism.

### Recommendations

Based on our studies of the explosion in the gun turret of the USS Iowa, we recommend the following:

(1) A mechanism should be added to these guns to control the speed of the rammer and the placement of the powder bags.

(2) A new bag charge design should be developed in which the weight of the propellant can be adjusted without the use of a trim layer of pellets. Such a design would be much more robust and less sensitive to impact.

(3) Studies of propellant-impact sensitivity should be broadly extended and include both commonly used propellants, D846 and D839. The objective of such studies should be to fully define the safe limits of pellet configuration, bag compression, rammer speed, and other relevant 16-in. gun and turret operations.

NOTE: It has been assumed in these Recommendations that the 8-in. experiments will be extended to full-scale studies.

## Welcome

**Albuquerque** — Mary Bobbe (21-1), Thomas Faturos (7821), Gus Galves (122), Beverly Ortiz (2622), Paul Raglin (9342), Cynthia Restrepo (21-1), Amy Sharp (7824), Vincent Tidwell (6315); **Other New Mexico** — Jeffrey Anastasio (2857), Susan Howarth (6344), Carol Meincke (7821).

**Elsewhere:** **Arizona** — Bruce Dodd (1842), William Escapule (9144); **California** — Mark Phillips (1845); **Georgia** — Timothy Scofield (2564); **Mississippi** — Craig Parr (5171); **Nebraska** — Brian Geery (5127); **New York** — Walter Worobey (7411); **South Carolina** — Charles Vanecek (2545); **Texas** — Garret Okamoto (2174); **Utah** — Gregory Newman (6231); **Washington** — Phillip Pohl (6416); **Wisconsin** — Jon Martens (1144).

## Retiree Deaths

William Young (79) .....April 2  
 Donald Beatson (72) .....April 5  
 William Hess (78) .....April 13  
 Estill Wood (72) .....April 16  
 Benny Anaya (79) .....April 22  
 William Edwards (72) .....April 25  
 Allen Buchanan (72) .....April 30  
 Daniel Sasmore (68) .....May 1  
 Willis Bisenius (84) .....May 5  
 Molly Raisen (68) (SLFCU) .....May 5  
 John Robert Johnson (71) .....May 9  
 Francis Statzula (67) .....May 20  
 Watson Snyder (72) .....May 22



## feed back

*Q. The new Sandia history book is very well done, and everyone who worked on the book should be commended. Because the first ten years of Labs history are so interesting, I'm looking forward to future volumes detailing the next 30 years. When will those later years be documented?*

*A. Thanks for your positive response to the publication of Sandia National Laboratories: The Postwar Decade. This effort required five years' time of two full-time Sandians. Included in that time frame was the initial development of Labs archives to ensure our collective corporate memory, the documentation of which will continue. At this time, there are no plans to begin another history publication for at least a year.*

Herb Pitts — 3100

## Recent Patents To Sandians

Terry Guilinger (1841): Electrodeposition of Amorphous Ternary Nickel-Chromium-Phosphorus Alloy.

Bob Graham (1153), Stephen Kuehn (2543), Richard Precit (2533), and Mike Rogers (752): Lithium Niobate Explosion Monitor.

Francesco Lupinetti (former Sandian): UHF FM Receiver Having Improved Frequency Stability and Low RFI Emission.

Morton Lieberman (9123): Bonfire-Safe Low-Voltage Detonator.

Tommy Teague (5265): Blank Fire Configuration for Automatic Pistol.



**WHOO'S THERE?** — Luckily our photographer has a telephoto lens, to keep from getting too close to this mama Great Horned Owl as she watches over two young chicks. Yes, there are two — one is a little camera shy and is hidden behind its more intrepid sibling on the left. The feathered family has been residing near the top of Sandia's Solar Tower for the past months, although owls have been using the nesting site for several years, says Roy Tucker (6215). Roy has sort of become the official owl-watcher at Sandia's Solar Thermal Test Facility. (Photo by Mark Poulsen, 3162)

### Grinnell-Style Glasnost



"Not your average communist party" is how Grinnell College T-shirts describe the social gathering that welcomed eight Soviet students to the Iowa campus.

Wall Street Journal

# Take Note

Celebrate 100 years of Japanese culture in New Mexico by attending Omatsuri, a Japanese Festival, June 17 at Minato Square (10721 Montgomery NE) from 11 a.m. to 6 p.m. Admission is free. Omatsuri features food, Japanese-American folk arts, music, taiko drums, traditional and folk dances, Japanese swords, ikebana, bonsai, and martial arts demonstrations. Sandians involved in the festival include Randolph Shibata (3723), Steve Casalnuovo (2531), Davis Begay (7813), Wade Ishimoto (5214), Jackie Morimoto (7537), and Russell Mikawa (2142).

### Financial Seminar

Equitable Financial Companies will hold a financial seminar Monday, June 18, at the Coronado Club, Conquistador Rm., from 5 to 6 p.m. Topics include annuities, insurance, and retirement distribution options. Contact Jim Freese on 888-9700 for information.

Sandia Laboratory Federal Credit Union will present a College Fair on Saturday, June 23, from 10 a.m. to 1 p.m. at the Credit Union Center (Juan Tabo & Comanche NE). Representatives from New Mexico colleges and universities will provide information and answer questions about admission requirements and costs, and Credit Union staff will be available with information about savings programs, student loans, and other ways to finance higher education. The fair is free to SLFCU members.

The Cultural Diversity Colloquia Series (3511) is sponsoring Henry Gradillas, former principal of Garfield High School in Los Angeles, on Thursday, June 21, at the Technology Transfer Center (Bldg. 825) from 1 to 2 p.m. Title of the presentation is "High Expectations for Increased Student Achievement." Garfield High is where the story of Jaime Escalante was portrayed in the movie "Stand and Deliver."

\*\*\*

Valley High School Class of 1970 will hold its 20-year reunion July 13-15. For information, contact Mary Gallegos on 271-0061 or Great Reunions on 821-0038.

West Mesa High School Class of 1970 will hold its 20-year reunion July 20-21. For information, contact Gilbert Gallegos on 271-0061 or Great Reunions on 821-0038.

\*\*\*

KNME Channel 5 (PBS) will air the Metropolitan Opera production of Richard Wagner's complete "Der Ring des Nibelungen" on four consecutive evenings beginning June 18. The four operas in the cycle are "Das Rheingold" June 18, followed by "Die Walküre" June 19, "Siegfried" June 20, and "Götterdämmerung" completing the cycle June 21.

\*\*\*

The Council of Albuquerque Garden Clubs sponsors Tuesday evening classes at the Albuquerque Garden Center (10120 Lomas NE) at 7 p.m. Upcoming classes include "Patio Gardening" on June 19, instructed by Lynn Doxon, horticulture specialist with the Bernalillo County Extension

Office. On June 26, "All About Irises" will be sponsored by the Iris Guild, the Iris Society, and the Aril Society. Iris care will be discussed and Median irises will be sold. Classes are \$5, payable at the door. Reservations are not required. For information about these and upcoming classes, contact Linda McBride on 296-6020.

## feed miback

*Q. How can equal employment opportunity and affirmative action be implemented simultaneously? Affirmative action, by definition, is taking action to advance certain employees based on their minority status; this is not equal employment opportunity. All reasonable people support equal employment opportunities for equally qualified individuals, but affirmative action policies are causing serious employee morale problems. The prevailing attitude I see among "nonminority" employees is one of resignation, i.e., "Why should I work hard to get ahead when a minority will be hired and advanced before a nonminority, regardless of qualifications, abilities, and level of effort?"*

A. Your question is a thoughtful one and raises a serious issue: the perception that Sandia hires or advances female and minority persons who are less qualified than their nonminority male peers. This is not now, nor ever has been, Sandia's practice. We have made extra efforts to recruit and hire highly qualified women and minorities; in fact, women and minorities hired during the last ten years come from the same schools and have the same degree levels, fields of study, and grade point averages as their nonminority male peers. Sandia continually attempts to assure that all employees, including women and minorities, have opportunities to develop to their full potential — including advancement and promotion. The idea that women and minorities need not be highly qualified and that they are advanced or promoted "regardless of qualifications, abilities, and level of effort" is not correct. Those promoted into supervision and management have the same kind of experience and performance records as their nonminority male peers.

Though Sandia has made progress in achieving greater representation of women and minorities in its work force, the process has been gradual and has been based on the merit of people who have joined the Labs. The following stats show our gradual-but-steady progress: In 1984, 95.5 percent of Sandia's MTS management (Division Supervisor to President) was nonminority men; today, 90 percent of MTS management is nonminority men. In 1984, 16 percent of MTS staff was female and minority; today, the number is 20 percent.

In the 1990s and the next century, America's work force will become increasingly diverse. From 1988 to 2000, about two-thirds of all new workers in the US work force will be female and minority. It is in the best self-interest of the US, the nation's businesses, and, certainly, Sandia to help ensure that all new workers are well qualified (a basic goal of Sandia's educational outreach efforts) and that all employees, including women and minorities, are welcomed, challenged with meaningful work, and advanced to their full potential.

Ralph Bonner — 3500

SANDIA SUMMER EMPLOYEES — some 200 to 250 strong, mostly high school and college students — arrived at the Labs last week to start their temporary work assignments. Here, summer hires Lisa Sparks (6321, center) and Byron Newberry (6428) get the lowdown on Sandia from Shannon Lytle (3531) at a get-acquainted reception for summer employees at the Coronado Club.



A TEAM from Sandia and Albuquerque Microelectronics Operation/Allied Signal recently received a Sandia Award for Excellence in recognition of their troubleshooting work on the SA2998, a nonvolatile memory unit used in the Trident II. Within three months, the team identified causes of manufacturing problems and implemented solutions to correct them. Holding their individual award certificates are team members (from left) Jose Rodriguez (2144), Ron McClintock (AMO), Jeanne Green (2173), Warren Lewis (AMO), and Robert Nasby (2144). Not pictured is team member Sarah Everist (2144).

### Sympathy

To Phyllis White (5122) on the death of her mother in Albuquerque, June 6.



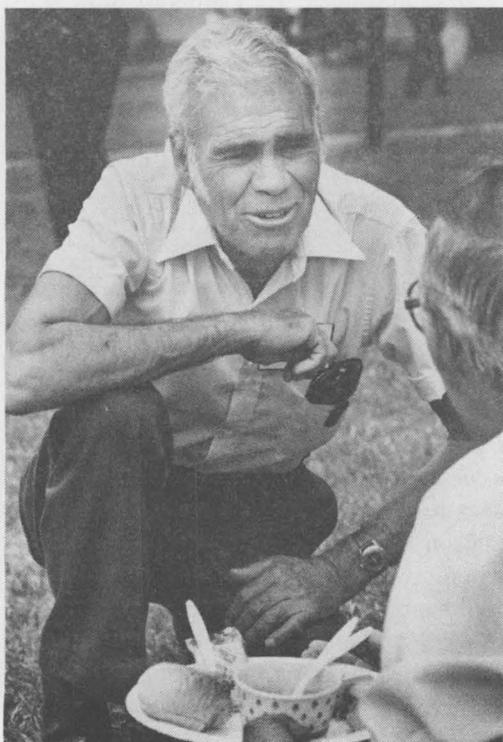
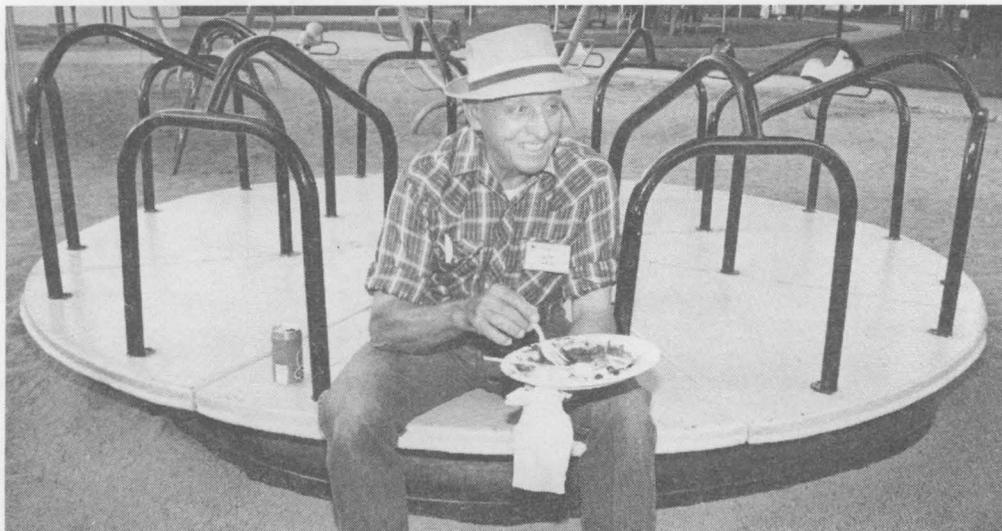


*Annual Rite of Spring*

# Retirees Gather For Picnic 1800 Strong

The Coronado Club was once again the site for the annual retiree picnic, held this year on May 24. The gathering gives retired Sandians and their spouses the opportunity to renew old friendships, down some mighty good grub, and — if so inclined — kick up their heels.

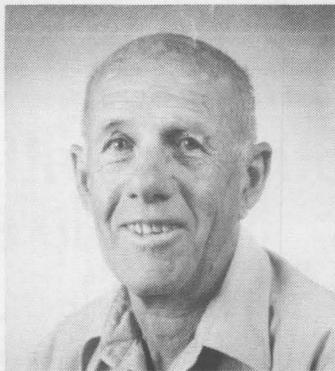
Photos by Randy Montoya & Mark Poulsen (3162)



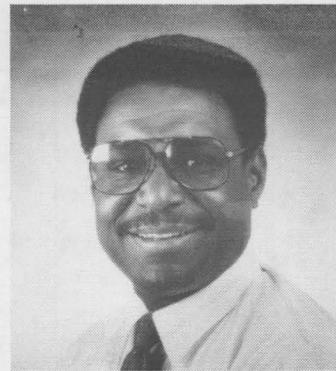
# MILEPOSTS

## LAB NEWS

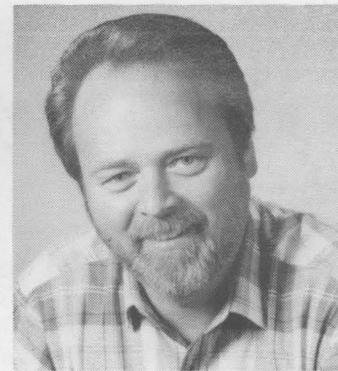
June 1990



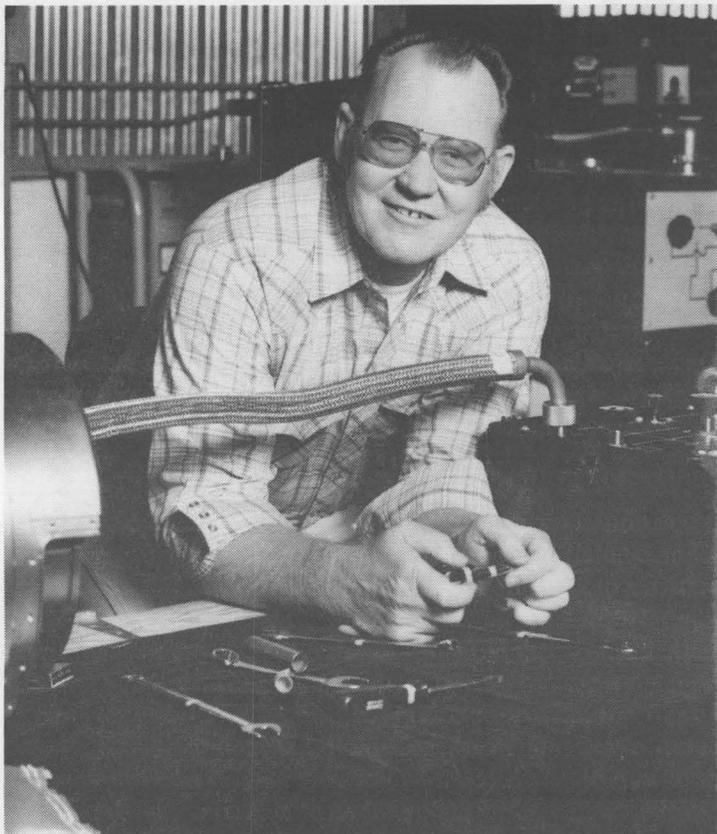
Delmar Gronseth  
(7811) 30



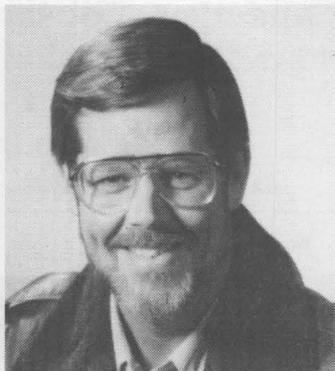
Art Hardeman  
(3734) 25



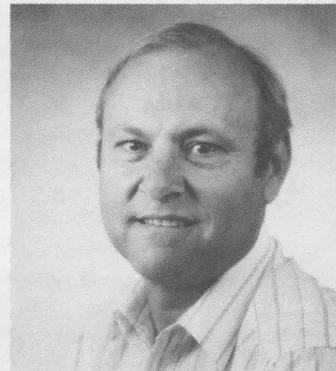
Ken Hencken  
(8362) 20



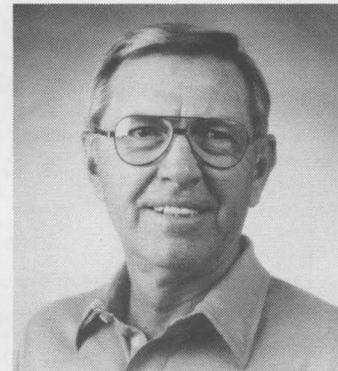
John Tootle  
(8283) 25



Woody Green  
(8283) 25



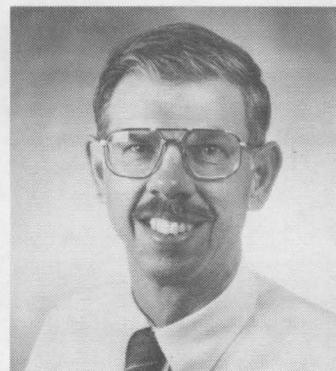
John Brane  
(2832) 30



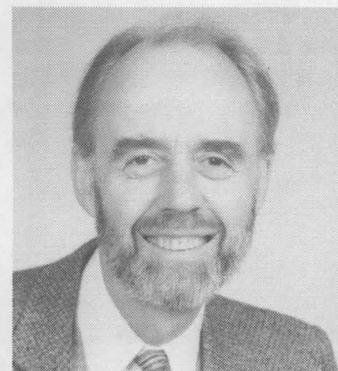
Leroy Brace  
(2526) 30



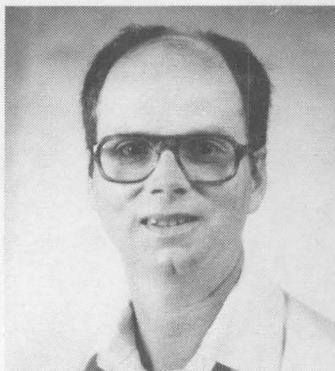
Roberta Chinn  
(2626) 20



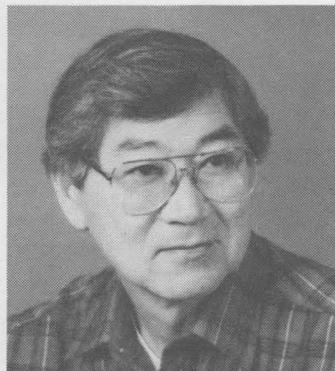
David Ryerson  
(5144) 25



Bob May  
(8512) 30



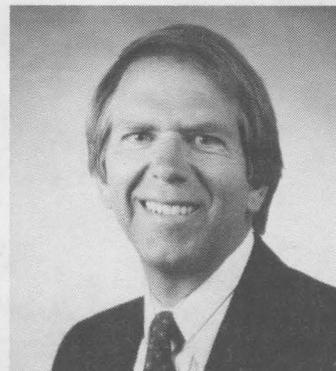
Gary Phipps  
(7556) 20



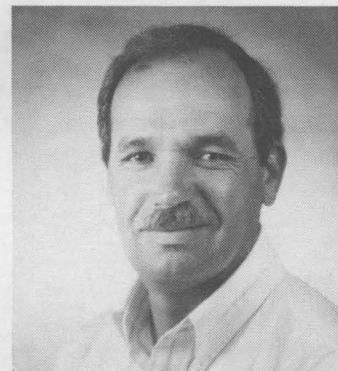
George Hirota  
(8271) 30



David Caskey  
(5248) 25



Wayne Sundberg  
(1552) 25



Don Lobitz  
(1522) 20

## feed back

*Q. In the interest of safety, can Sandia come up with a remedy for the traffic jam that occurs almost every afternoon on "H" St. between Bldgs. 802 and 809? Three tripper buses park on the south side of the street headed east, while four buses park on the north side headed west. Many vans, pickups, and go-carts park in the area overnight, and their drivers walk out Gate 1. Is this an example of using company vehicles for personal use? On the other hand, if the vehicles are parked in the area legitimately, could Sandia provide designated parking places elsewhere and post signs ("No Parking in This Area Between 4 p.m. and 8 a.m.")?*

*A.* As a bus rider who waits at the stop south of Bldg. 802, I've seen the situation you describe. In the past, I've suspected that some of the vehicles were parked there so the driver wouldn't have to walk as far to his or her personal car in the outside parking lot. However, I have reported license numbers to the Transportation Division, and it found each time that there was a valid reason for the vehicle to be parked overnight near

Gate 1. Even so, there may still be some vehicle-use abuse.

We have considered "No Parking After 4 p.m." signs. However, as a part of our concern for the appearance of the tech area, we are trying to minimize the number of signs and painted curbs. Also, if no-parking signs are to be taken seriously, someone needs to ticket offenders — but all available Security personnel are busy at quitting time.

There is adequate off-street parking northeast of Bldg. 802 at 4:30 p.m., and people should consider using that area as an alternative at that time of day.

Ward Hunnicutt — 7800

*Q. What's the possibility of having a supply of caffeine-free soft drinks in Sandia vending machines? I've been advised by my doctor to severely limit my intake of caffeine, but have been unable to find any caffeine-free drinks in vending machines.*

*A.* Service America currently stocks caffeine-free soft drinks (Pepsi and Diet Pepsi) in many

Sandia vending machines. They are very slow sellers and, therefore, are added by request only. If your building's vending machines don't offer caffeine-free soft drinks, you can have them added to the machines by calling Service America's operations manager, Steve Scott (344-1626), or Linda Stefoin in Benefits (4-7433).

Ralph Bonner — 3500

*Q. I was almost run over just inside Gate 10 by a contractor who evidently feels that vehicles have the right-of-way inside the Tech Area. Because of heavy pedestrian traffic between Bldgs. 820 and 821, there's a definite health and safety problem in that area. Can anything be done to alleviate the hazard?*

*A.* As a result of your Feedback question, the Traffic Liaison Committee has decided to install a pedestrian crosswalk between Bldgs. 820 and 821. Radar surveillance will also be increased on 9th St., north of Gate 10. Thanks for expressing your concern and bringing this to our attention.

Jim Martin — 3400

## 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**

80386 AT CLONE, 16MHZ, 4.5MB RAM, 20MB HD, monochrome display, Intel motherboard, \$1400. Ray, 294-7720.

UPRIGHT FREEZER, Wards, 17 cu. ft., \$125. Thompson, 293-8390.

LOVE SEAT, willow, w/cushion, \$150. Tremi, 292-9219.

SEARS VACUUM, 2 yrs. old, auto height adjustment & cord rewind, \$90; short-wave radio kit, \$150; slide projector, \$20. Thomas, 268-1532.

DISHWASHER, Frigidaire, under-counter, new seals, rebuilt motor, needs door seal and touch-up, \$25; 2 recliners, \$5/ea. Foster, 299-6240.

SCHWINN EXERCYCLE, XR7, \$100. Caskey, 296-1696.

WEIMARANER, male, 2 yrs. old, needs strong handler and large yard for exercising, \$250. Coe, 266-6579.

TWIN-SIZE HIDE-A-BED, \$75; 5-piece dinette set, round table, \$75. Coulter, 275-2183.

LABRADOR RETRIEVER PUPPIES, 6 wks. old, have shots, 3 chocolates, \$65/ea.; 8 blacks, \$45/ea. Kolb, 299-3403.

YOUTH SAILBOARD, 9'6", 130L Mirage 90, w/3M sail, mast, boom, 2 center boards, \$150; wet suit, size 12 jr., \$45. Weirick, 281-1462.

SIMMONS BABY CRIB, w/matching dressing table, spindle-type; Sealy Posturepedic mattress w/sheets; rattan double headboard. Chavez, 836-2719.

GUITARS: '87 Ovation, electric/acoustic, \$325; Suzuki inlaid 12-string, \$125; Goya Vintage 12-string, \$60; each w/original case. Dybwad, 296-9047.

TWIN-SIZE BED, complete, bookcase headboard, \$50; student desk and chair, wood, \$25. Mauldin, 293-3763.

APPLE II+, monitor, printer, 2 drives, software, \$325; metal executive desk and chair, \$60. McCoach, 298-5960.

GAS GRILL, Broilmaster, redwood shelves, rotisserie, spare burner, valve, requires post for fixed installation, \$40. Lambert, 344-9012.

WHEELBARROW, heavy-duty, 6 cu. ft., \$25. Shane, 294-4920.

AT-COMPATIBLE 80286, 640K RAM, 32M hard drive, HD floppy, monochrome VGA, monitor, printer, software, books, manuals, \$1225. Smith, 293-8773.

EXERCISE EQUIPMENT: Sears exercise cycle, weighted wheel w/ergometric measure, \$100; Octagym-eight, \$40. McClafflin, 292-2852.

RUGER MODEL 14, .223-cal., \$300; Winchester model 50 12-gauge, full choke, \$250. Greene, 299-4163.

TWO ROUND-TRIP AIRLINE TICKETS, Albuquerque to San Diego, leave June 30, return July 4, \$90/ea. OBO. Richards, 296-2272.

NATIONAL GEOGRAPHIC MAGAZINES, 1960-1976, free if you take all. Fisher, 298-0526.

TELEVISIONS: Sears 17", J. C. Penney 19", solid-state color, \$100/ea.; Heathkit oscilloscope, \$25. Mowry, 299-2526.

MICROWAVE OVEN, GE, \$50; white colonial dresser, \$50; coffee table, \$15; 2 bar stools, \$10/ea. Burke, 292-5328.

CAMPER SHELL & CARPET KIT, for Toyota, Datsun, or Nissan short-bed pickups, brown, \$350 OBO. Jones, 828-1529.

JACQUELINE ROCHESTER ACRYLIC PAINTING, "Southwest Spring," on canvas, dip tick, appraised at \$2500, sell for \$1800. Rodgers, 275-0669.

GARAGE SALE: vintage Vose piano, \$500; woman's Columbia bicycle, \$40; Minolta lenses, filters, bag, \$60; June 16-17, 2612 Virginia NE. Alexander, 291-8028.

GARAGE SALE: heaters, fans, radio, TV, skis, tools, crafts, clothing, recliner, misc. electrical & household, June 16-17, 7548 Lantern NE. Tedesco, 888-1068.

QUEEN-SIZE WATER BED, semi-waveless mattress, heater, \$40 OBO. Rodacy, 293-2668.

IBM PC, 640K RAM, 32MB hard drive, monochrome monitor w/color adapter, software, extras, \$700. Hilts, 275-1758.

TRAVEL TRAILER, 14', '72 Aristocrat, self-contained, AC/DC, \$1400; matching couch, chair, & ottoman, mahogany velour, \$175. Greer, 281-4688.

PLAN FILE, Planhold, rolled map/drawing storage w/108 tubes 2-1/8" square by 36", \$80. Pasterczyk, 255-2066.

WILSON/PROFILE TENNIS RACQUET, \$150; Dexter bowling shoes, W-6-1/2, \$25; Nordica ski boots, W-6-1/2, \$50; Nike/Air Pegasus, W-7, \$45. Ayers, 291-8216.

DOG WARMING PAD, used for outside doghouse or birthing puppies, used 2 months, cost \$75, make offer. Jones, 899-0642.

REFRIGERATED AIR CONDITIONER, \$75 OBO; Nash skateboard, \$15 OBO. O'Toole, 828-9260.

CANON AE-1 PROGRAM 35mm CAMERA, w/flash, lenses, bag; infant car seat, stroller, car booster seat, infant girl's clothing. Morrison, 299-4757.

NORTHFACE MOUNTAIN TENT, \$100; ultrasonic humidifier, \$25. Kramer, 294-0488.

ENCYCLOPEDIA, 25-volume, 1967, \$20; Olds. station wagon drive shaft, \$10; alternator, \$6; rims, \$10; wheels, \$10. Carter, 293-6750.

PGA CAMERON GOLF (9) CLUBS, 2-PW & SW, used 4 times, \$225. Stang, 256-7793.

HALLMAN CHEST PROTECTOR, w/arms, \$50; leather motorcycle jacket, new, size 42, \$100. Turner, 281-4264.

WEIDER INTERNATIONAL WEIGHTS, 110Kq, w/bar & collars, \$125. Burford, 865-8486.

WURLITZER ELECTRONIC PIANO, w/sustaining pedal, vol.-vib. control, 64 keys, \$75. Dieter, 268-3849.

SPEAKERS, EPI model T/E 5II, \$100; equalizer, ADC model SS100, 10 bands, \$75. Herther, 298-4823.

TAPPAN ELECTRIC RANGE, 30", 2 ovens, gold, \$50; white double kitchen sink, w/faucet, \$35; new swivel rocker, \$80. Hines, 821-8592.

CAMPER SHELL, for long wide-bed '81 Chev. truck, \$150 OBO. See, 864-7854.

TORO LAWN MOWER, self-propelled, new rear grass bag, \$70 OBO. Nation, 298-5605 after 5.

BROWNING BAR 7mm MAG., never fired, \$475; Winchester model 70, 300 Win. mag., w/Redfield scope, \$425; queen-size sofa sleeper, \$75. Habbit, 293-7216.

FURNITURE: queen-size headboard, \$15; chair, dark wood/Naugahyde, \$40; end table, \$25; table lamp, \$20; cocktail table, \$10. Dippold, 821-5750.

FRIGIDAIRE ELECTRIC RANGE, white, self-cleaning, \$100; Sony 7" reel-to-reel, \$100; Yashica, 50mm & 135mm lenses, \$45. Barnhart, 292-4186.

TRIPLE DRESSER, solid maple, \$185;

aluminum storm door, 32" x 80", \$10; carpet, brown & gold, 9' x 11', \$10; brass statue lamp, \$8. Trump, 299-5162.

EVAPORATIVE COOLER, Champion, 2800 cfm, window mount, \$110; burglar alarm, w/motion sensor, \$120; 2 maple swivel bar stools, \$30/ea. Fuersbach, 281-2978.

TRADITIONAL COUCH, 90", light beige background w/brocade print, \$100. Janik, 293-2420.

FOUR GM 5-HOLE, 15" WHEELS, w/caps; 2 P-235 Michelins; 2 camper-mount mirrors. Garcia, 299-7803.

CRIB, playpen, double stroller, car seat, high chair, calculator w/printer, wicker étagère, country-log coffee/end table. Levan, 293-0079.

CELLO, full-sized Schroeder, w/case, \$1850; two 50-gal. drums, \$5/ea. Trellue, 292-7369.

ESTATE SALE: furniture, appliances, linens, kitchenware, books, fabrics, art supplies & frames, classical/opera LPs, clothing, June 16-17. Joseph, 299-6989.

CURTIS AIR COMPRESSOR, 5-hp, 208V, 80-gal. tank, 2-stage, commercial quality, \$1000; Kelco sandblast-unit work space, 36" W x 36" D x 30" H, cost \$2800, sell for \$1400. Snidow, 298-6163.

**TRANSPORTATION**

'85 NISSAN 300ZX TURBO, T-tops, 2 alarm systems, AM/FM cassette, AT, 33K miles, red, still under warranty, \$9500. Lemmon, 822-9617.

'89 HONDA ACCORD LX, 17K miles, AT, PW, AC, AM/FM cassette stereo, \$12,900. Snidow, 298-0321.

'64 PONTIAC BONNEVILLE, AT, AC, PS, PB, tilt, \$350 OBO. Foster, 299-6240.

'65 TOYOTA LAND CRUISER, may be seen at 1728 Prospect NW, \$1800 firm, as is. Garcia, 344-0784 or 877-1840.

'85-1/2 PORSCHE 944, black, 74K miles, loaded, \$12,800. Senglaub, 281-8697.

14' RED & WHITE RUNABOUT, 65-hp Mercury, \$1500 OBO. Stromberg, 255-6131.

'77 LINCOLN CONTINENTAL MARK V, 2-dr., 650 CID, loaded, new radials, \$2300 OBO. Harrell, 281-4532 evenings/weekend.

'67 FORD GALAXIE 500, AT, PB, PS, AC, trailer hitch, 390 V-8, \$800 OBO. Outka, 298-5707.

BICYCLES: Junior Racer, 17" frame, 600 rims, alloy components, \$175; BMX Redline, blue, \$75. Weirick, 281-1462.

'75 ALFA ROMEO SPIDER, 55K miles, white w/maroon interior, garaged, passed emissions test, \$4600. Martel, 293-1892.

'84 FORD RANGER XLT, w/Admiral camper, 96K miles, original owner, \$4500 negotiable. Babcock, 881-3563.

GIRL'S 20" BIKE, \$125. Mauldin, 293-3763.

BMX BICYCLE, Redline Professional Freestyle, cost \$380, sell for \$290 OBO. Schauer, 865-9581.

'86 CHRYSLER LeBARON TURBO, 2.2L engine, FWD, PB, PS, PW, cruise, \$3100; '67 MGB/GT, 1800cc, complete, restorable, \$1800. McClafflin, 292-2852.

MOTORCYCLES: 30-mph experimental electric and '60 Cushman Eagle parts, free to good home. Horine, 266-4534.

'83 PLYMOUTH HORIZON, 4-dr., AM/FM cassette, 75K miles, original owners, \$1500 OBO. McDonald, 294-9576.

YAMAHA RADIAN, 600cc, 1K miles, helmets, cover, \$2500. Crenshaw, 296-8948.

'76 OLDS. CUTLASS, 4-dr., AT, PS, AC, new alt., battery, muffler, shocks, & tires, \$2095. Saviteer, 296-3750.

SPORTSMAN BOAT, 23', two 140-hp Chev. engines, OMC outdrive, refinished hull, storage cover, travel cover, tandem-axle trailer, \$10,000 or make offer. Hindi, 884-1110 days or 292-3393 after 6.

'76 DATSUN B210, 4-dr., silver, new

upholstery, 138K miles, \$900 OBO. Vittitoe, 883-5077 or 299-9298.

'79 AMC CONCORD, PS, PB, AC, 4-spd., 252 CID, 6-cyl., 92.5K miles, \$500. Fitak, 281-2748.

'79 FORD ECONOLINE CARGO VAN, manual transmission, AC, captain's chairs; '83 Ford Escort, hatchback, 5-spd., AC, 12K miles on new engine. Jennings, 268-8789.

'89 FORD ESCORT GT, sport model, 25K miles, PS, cruise, tilt, cassette, AC, 5-spd., \$7900. Benton, 877-0311 or 877-2473 after 5.

'85 GEORGIE BOY MOTORHOME, 28', 8K miles, \$29,000 book value, make offer; '80 Plymouth Horizon. Bukaty, 345-4691.

'87 TOYOTA PICKUP, white, 4-spd., \$4100 OBO. Rodgers, 275-0669.

'57 CHEV., \$895; VW dual-port engine, rebuilt, complete, \$650. Jones, 247-3455.

'84 FORD BRONCO II, 4-WD, V-6, 36K miles on engine, rebuilt AT, AC, stereo, \$5500 OBO. Lambert, 293-8825.

MAN'S BICYCLE, 25" Trek, 12-spd. tour racing, Reynolds 501 frame, \$300. Pasterczyk, 255-2066.

'84 NISSAN STANZA, 4-dr. hatchback, 5-spd., PS, AC, AM/FM stereo cassette, 58K miles, 25-mpg in town, \$3250. Vine, 293-0940.

'87 YFM200 FOUR-WHEELER, electric start, reverse, shaft drive, \$1650; '88 specialized Stump Jumper camp mountain bike, \$450. Pryor, 294-6980.

MOUNTAIN BIKE, Jamis 20", \$75. Turner, 281-4264.

'81 CHEV. EL CAMINO, 6-cyl., tan & white shell, AC, PS, PB, \$2700. Avila, 823-2339.

'73 CHEV. CAPRICE ESTATE WAGON, 92K miles, \$1200. Wintersberger, 294-1289.

'77 CAMARO, 350 V-8, AT, AC, AM/FM tape, tan vinyl top, book list at \$1400, sell for \$995 OBO. Stang, 256-7793.

BICYCLES: girl's 24" single-spd., \$25; man's 27" Motobecane 10-spd., 25" frame, \$35. Esherick, 299-8393.

'82 YAMAHA VIRAGO X-V 920, extras included, \$1300 OBO. Archuleta, 821-5405.

BOY'S & GIRL'S SCHWINN BICYCLES, \$70 and \$90. Kramer, 294-0488.

GIRL'S 10-SPD. BIKE, 24", \$35. O'Toole, 828-9260.

STARCRRAFT BOAT, 18-1/2", 140-hp I/O motor, closed cooling, trailer, \$9000; pickup/camper, 4-WD, 4-spd., AC, PS, PB, radio, \$6000. Dillon, 877-7628.

'82 KAWASAKI 440 LTD. MOTORCYCLE, belt drive, 7.9K miles, original owner, \$750 OBO. Manzanares, 292-6709.

MAN'S BICYCLE, 3-spd., Royce Union, \$35. Dieter, 268-3849.

'85 VW VANAGON, white, tan interior, AC, 7-passenger, 68K miles, \$5250. Kenefic, 256-9017.

'77 SUZUKI RM 250 DIRT BIKE, not running, \$75. Habbit, 293-7216.

'85 FORD F-150, AT, PS, PB, AC, 83K miles, 300 CID, 6-cyl., new tires & brakes, \$4700 OBO. Nickerson, 888-4159.

'88 BOUNDER CLASS-A MOTORHOME, Model 33W, w/extras. French, 298-9292.

TWO CHRYSLER NEW YORKERS: '78, for parts, '76, recent overhaul, red-leather interior, new tires, \$15,000/both. Smith, 384-5182.

**REAL ESTATE**

TIMESHARE, Week 39 at Pinecliff Village in Ruidoso, \$2500 firm. Whitehead, 292-1604.

3-BDR. HOME, 2 baths, FP, paneling, garage, sprinklers, dishwasher, refrigerator, washer/dryer, Central & Juan Tabo area, \$58,000. Coulter, 275-2183.

4-BDR. HOME, 1950 sq. ft., 1-3/4 baths, Tramway/Indian School area, landscaped, extras, \$99,900. Harrington, 294-6368.

DOUBLE-WIDE MOBILE HOME, 1977, 24' x 64', Fashion Manor in Coronado Village, \$27,500, negotiable terms. Avila, 823-2339.

2 ACRES, w/14' x 60' mobile home, fenced, utilities included, Quail Hollow Rd., 20 miles from Sandia, \$7000 down, \$34,000. Marquez, 831-3088.

70 ACRES, 4300-sq.-ft. lodge, 1/7 interest in sub-chapter "S", 8 miles from Rio Costilla at 9000 ft., \$32,000. Ruggles, 256-9563.

2-BDR. MOBILE HOME, 2 baths, 1983 All American, 14' x 70', all appliances, Four Hills Park. Lambert, 294-4188.

2-ACRE DEVELOPED LOT, near Tome, fertile bottom land, zoning covenants, horses allowed. Aronson, 898-8893.

**WANTED**

SCHEMATICS or any information for '40s-'50s-vintage radios, specifically Philco model 610. Williams, 296-2785.

FEMALE ROOMMATE to share 3-bdr. house w/2 other women, near Coors & I-40, approx. \$250/mo. Dickenman, 892-9561.

FEMALE ROOMMATE, nonsmoker, to share 2-bdr. house near base, \$250/mo., includes utilities. Ashby, 265-4816.

HELP WANTED for long-term home landscaping project, including sprinklers, railroad tie cutting, sod work. Joe, 897-2485.

WOODEN PATIO OR LAWN FURNITURE; luggage, 2-suiters, soft type. Underhill, 294-5774.

SERVICE MANUAL for '86 Olds. Cutlass Cruiser station wagon. Mowry, 299-2526.

3-D GLASSES for Sega Master System, good condition only. Bukaty, 345-4691.

VERTICAL-SHAFT TILLER with bad motor, have own motor. Greer, 281-4688.

ELECTRIC GUITAR, older Gibson hollow-body. O'Toole, 828-9260.

BABYSITTER, in my home, during school year, 2 boys, Juan Tabo & Comanche area, your children welcome. Nation, 298-5605.

WOMAN'S 1-SPD. BICYCLE, prefer one w/fenders, in good condition. Whipple, 281-9285.

BOOKS: "Strong's Concordance"; "Interlinear Greek/English NT," w/Textus Receptus or similar Greek text; "Vine's Expository Dictionary of NT Words." Levan, 293-0079.

ROOMMATE to share 2-bdr. house, Indian School and Pennsylvania area, \$225/mo. plus utilities. Golden, 299-1274 leave message.

**WORK WANTED**

HOUSE-CLEANING SERVICES, by experienced college student, references available upon request. Adams, 299-1274 leave message.

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

**LOST AND FOUND**

WATCH FOUND, in GSA vehicle, identify. Martinez, 766-2303.

BRACELET LOST, 14k gold herringbone, lost about May 30. Puissant, 821-2447.

BICYCLE LOST, please return, 20 yrs. of Tech Area transportation, faded-blue, balloon tires, girl's Schwinn, disappeared near Bldg. 823. Aronson, 898-8893.

**SHARE-A-RIDE**

VANPOOL RIDERS NEEDED, full & part-time seats are immediately available from Santa Fe to KAFB and Sandia Labs. Hawthorne, 471-0448.



**Coronado Club Activities****Blackjack Buffs & Roulette Revelers Cavort in the Casino**

**CALLING ALL CLOSET GAMBLERS** — Tonight's your night to shine. Casino Night, starting at 7 p.m., promises nonstop fun with all kinds of games of chance: slot machines, blackjack, craps, roulette. For \$10/person, you receive \$1500 in chips and the opportunity to win some great prizes to be awarded at evening's end. While the fugitives from Glitz Gulch are doing their thing inside, there's plenty going on outside as well: a BBQ chow line on the patio (6-9) and stompin' under the stars, courtesy of Back at the Ranch (7-11).

**ATTENTION, KIDS AGES 8 TO 16:** Tomorrow night, June 16, the pool/patio area is reserved exclusively for your use from 6 to 10 p.m. Join a bunch of fun-loving people at the Swing & Swim Hop. Pool hours are extended to 8, and a DJ will be on hand to play all your favorite tunes. Admis-

sion is free for those who have pool passes, \$1 for children of C-Club members without pool passes, and \$2 for guests.

**ANOTHER BRUNCH BARGAIN** is set for Sunday, June 24, from 10 a.m. to 2 p.m. It's the best deal in town; all that fabulous food's available for \$5.95/adults and \$2.50/children under 12.

**A PARADE OF PAMPERED PAPAS** is what you'll see in the pool/patio area Sunday, June 17, as families fete fathers at the annual Father's Day barbecue party from 11 a.m. to 6 p.m. A magnificent BBQ spread, available from noon to 5, features all sorts of papa-pleasin' food — grilled T-bone steaks, BBQ ribs and sandwiches, hamburgers, hot dogs, and all the trimmings. Enjoy a swim in the new pool or relax under a shade tree

while you listen to c/w tunes by Trio Grande (2-6). Free pool/patio admission for members and their immediate families; \$3/person for guests.

**THE STAGE FROM DOWN SOUTH** brings the ever-popular Isleta Poor Boys back to town next Friday night, June 22. They'll provide some outstanding sagebrush-shuffle music from 8 p.m. to midnight. Beforehand, chow down on either prime rib or halibut (both \$7.95). Dinner reservations recommended (265-6791).

**T-BIRD CARD SHARKS** get together again for fun and games June 28, starting at 10 a.m. Join the crowd for all kinds of card games and convivial conversation. Jim McCutcheon also plans to lead the group through a rousing chorus of "We're Gonna Beat the Vegas Dealers Blues."

**Events Calendar**

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

**June 15 & 17** — June Music Festival: The Emerson String Quartet, program features works by Haydn, Shostakovich, Beethoven, Mozart, Bartok, and Schumann; 8:15 p.m. Fri., 4 p.m. Sun.; Woodward Hall, 888-1842.

**June 15-July 15** — "Ain't Misbehavin'," revue featuring the blues, jazz, and ragtime music of Fats Waller; 8 p.m. Fri.-Sat., 6 p.m. Sun. (no performances July 6-8); Vortex Theatre, 247-8600.

**June 15-Aug. 5** — Exhibit: "From the Land of Dragons," collection of rare fossils, mostly from China; 9 a.m.-6 p.m. daily, New Mexico Museum of Natural History, 841-8837.

**June 15-Oct. 14** — "Georgia O'Keeffe and the Stieglitz Circle," exhibition examining the group of artists (including O'Keeffe) who were affiliated with Alfred Stieglitz, the photographer, gallery owner, and champion of early 20th Century avant-garde art; 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.

**June 16** — Summerfest '90: Juneteenth celebration, ethnic food, arts & crafts, dances; 5-10 p.m., Civic Plaza, 768-4575.

**June 21** — "Gypsy and Her Dancers," dance, mime, karate, and lambada demonstration; 7 p.m., free, South Broadway Cultural Center, 848-1320.

**June 22-24** — 29th Annual New Mexico Arts and Crafts Fair: featuring arts & crafts by more than 720 artists and craftspeople; continuous live entertainment, children's activities, special exhibits, & refreshments (preview night June 21, reservations required); 10 a.m.-10 p.m. Fri.-Sat., 10 a.m.-6 p.m. Sun.; NM State Fairgrounds, 884-9043.

**June 22-July 1** — "James and the Giant Peach," new adaptation of the Roald Dahl classic fantasy, presented by Theatre-in-the-Making's Youth Performance Workshop; 8 p.m. Thurs.-Fri., 2 p.m. Sat.-Sun.; Center-Stage (3211 Central NE), 260-0331.

**June 23** — Summerfest '90: Polish and Carpathian Night, ethnic food, arts & crafts, & dances; 5-10 p.m., Civic Plaza, 768-4575.

**June 24** — Opening: "Asi Es la Vida," juried exhibition of student art works, sponsored by the Tamarind Institute and Albuquerque Public Schools; 9 a.m.-5 p.m. Tues.-Sun., Albuquerque Museum, 242-4600.

**June 24** — Tony Quinones Music Workshop, featuring guests Harold Littlebird and Cipriano Vigil; 1-3 p.m., South Broadway Cultural Center, 848-1320.

**June 29** — "Bienvenido, Don Goyito," La Compañía presentation of story about a very traditional abuelo from rural Mora County who moves to Albuquerque and meets head-on with the modern and upbeat lifestyles of his daughter and granddaughter; 8 p.m., South Broadway Cultural Center, 848-1320.

**June 29** — UNM Dance Program: "Visiting Artists Potpourri Concert," dance performance in conjunction with the 15th Annual Bill Evans Summer Institute of Dance; 8 p.m., Keller Hall, 277-4402.

**Fun & Games**

**Bowling** — Winners of the Four-Game No-Tap Tournament held at Holiday Bowl April 21-22 were Wayne (7412) and Thelma Yoshimoto with a 1549 combined handicap series. Second went to Ron (2314) and Helen "Charlie" Husa with a 1537 combined handicap series. This was the last tournament for the 1989/90 season.

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**Flag Football** — The Sandia Football Association is holding a meeting at 5 p.m. on Wednesday, June 20, at the Coronado Club, Conquistador Rm. Anyone interested in forming a team or playing on one should attend. If you are unable to attend, call Ed James (5166) on 265-4015 or Jim Zipay (9212) on 266-2348 for information.

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**Skiing** — Sandians have had a prominent role in the Sandia Peak Ski Patrol, the all-volun-

teer outfit that skis and patrols at Sandia Peak. Patroller Paul Souder (DMTS, 7231) now reports that many of those Sandians, having retired from the Labs, have also retired from the patrol. "We need people for next season and we have to start their training this summer," says Paul. If you're interested, and a passable skier, call Paul on 281-3121.

**Congratulations**

To Lisa Mondy (1511) and Joel Miller (6452), a daughter, Elizabeth Lianne Miller, May 23.

To Monica and Howard (5219) Kimberly, twins, Eric Russel and Sara Ashley, May 25.

To Tammy and Russell (3426) Mickey, twins, Colton Scott and Brandon Lee, May 30.



PHIL APODACA (7556, third from right) served as 1989-90 president of the Industrial Photographers of the Southwest and received a plaque recognizing his service at the recent annual IPSW meeting. Here, he poses with other Sandia photographers who took home a bevy of prizes from the IPSW photo show held in conjunction with the meeting: (from left), Louis Archuleta, Russell Smith (both 3154), Bill Suderman, Diana Helgesen, Phil, Leroy Perea (all 7556), and Walt Dickenman (3154). Diana's photo, "In the Beginning," took best-of-show honors.